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DEPARTMENT OF FOOD SCIENCE

# USING NON-HYPOTHETICAL EXPERIMENTAL AUCTIONS TO MEASURE CONSUMER VALUATION OF GENETICALLY MODIFIED FOOD PRODUCTS

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# ABSTRACT

As genetically modified foods become increasingly common in the U.S. food supply without required package labeling, consumers are forming attitudes about GMOs from information presented by the food industry, government agencies, and third-party interest groups. An important issue within the controversy of GMOs is how available information may affect consumers' willingness to purchase these food products in the market. Previous studies have measured consumer acceptance of GM foods in a non-hypothetical experimental auction setting with varying degrees of success. This study attempts to fill a gap in the current literature by eliciting consumer willingness-to-pay (WTP) bids for non-GMO corn tortilla chips through a series of $5^{th}$-price, non-hypothetical experimental auctions and introducing five different types of information shock across different sessions. In small auction groups with adults, we were able to show that non-hypothetical experimental auctions can elicit significant differences in consumer WTP for real food products. Introducing information that appeals to an example of a changed viewpoint, trusted authority, and societal usefulness significantly increased average participant bids while an appeal to the precautionary principle significantly decreased average participant bids. The results also showed that group size is critical to determining the significance of effects and that the auction mechanism may be easily biased.

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# Chapter 1

# Introduction

Consumer valuation of specific food attributes is highly sought information for food producers and processors, and may have important implications for policy makers as well. Without accurate market feedback, as many as 95% of new products eventually fail each year (as cited in Phillips & Hallman, 2013). Traditional methods of measuring consumer preferences include surveys, taste panels, and focus groups. Auction mechanisms are unique in that they use real money and real goods to replicate point-of-purchase decisions made by consumers encountering food products in retail stores (Hayes, Shogren, Fox, & Kliebenstein, 1996). The advantage of non-hypothetical experimental auctions as a market research tool is that they create incentive compatible environments, minimizing the risk of over/understatement of valuation when real money is on the line (Lusk, Alexander, & Rousu, 2007).

Non-hypothetical experimental auctions are easily tailored to fit the objective of the research; there are a variety of auction mechanisms, valuation measures, and general procedures to choose from among the available economic literature. Hayes et al. (1996) suggested the inclusion of information shocks – introducing new information halfway through the bidding cycles – to measure consumer change in willingness-to-pay and to infer the effects of the information itself. Since then, several studies have investigated the effects of different types of information about biotechnology on consumer acceptance of genetically modified (GM) food (Lusk, Daniel, Mark, & Lusk, 2001; Huffman, Shogren, Rousu, & Tegene, 2003; Jaeger, Lusk, House, Valli, Moore, Morrow, & Traill, 2004).

Genetic modification is one of the relatively new agricultural technologies that consumers have considerable reservations towards. Teisl et al. (2003) states that health and environmental risks are often mentioned as key concerns held by consumers about the use of GM technologies. Despite these concerns and others, the FDA maintains that US food labels are not required to carry information about GM content unless the genetic modification significantly alters the properties of the food (as cited in Roe & Teisl, 2007). Without explicit food label information, consumers seek out other information sources to interpret this new technology and try to understand its implications. The consideration of new information may lead to greater acceptance or aversion of genetically modified foods. Highly variable, the outcome depends on factors such as the credibility of the source, the information conveyed, and the individual weighing of risks versus benefits (Phillip & Hallman, 2013).

The purpose of this study was to determine the influence of various information shocks on perceived consumer value of genetically modified foods in a non-hypothetical experimental auction setting. Corn tortilla chips were chosen because the majority of corn products are assumed to be genetically modified, they are a popular snack food among Americans, and consumption of this product is feasible in a lab setting.

# Chapter 2

# Review of Literature

### 2.1 Background on Organic and Genetically Modified Food

Since the era of the Green Revolution, the divide between organic and industrial agricultural has grown in complexity and contentiousness. Differences in farming techniques are now central to far-reaching political issues. With social, ethical, ecological, and economic considerations in mind, people often perceive food choice as a means to express values and lifestyles. These significant implications stem from the fundamental differences between organic and conventionally grown food.

#### 2.1.1. Organic Food

The National Organic Program (NOP) is the organization within the United States Department of Agriculture (USDA) responsible for developing and regulating standards for organic agricultural products. In order for crops to be considered organic, the following practices are forbidden: irradiation, sewage sludge, synthetic fertilizers, prohibited pesticides, and genetically modified organisms. The USDA and its 100 affiliated certifying agencies around the world conduct annual audits on farms and processing facilities that aspire to represent their products as organic. On-site inspections do not have to be announced but do require at least five percent of certified organic products to be tested for residues of prohibited substances. If a certifying agent finds an organic operation out of compliance with the USDA’s standards, then the operation may be subject to financial penalties up to $11,000 per violation, and/or suspension of its organic certificate. The business may no longer sell, label or represent its product as organic (USDA Agriculture Marketing Service, 2014).

Such regulations indicate the USDA's awareness that consumers purchase organic products with trust in their organic integrity. The organic label is subsequently an essential tool for consumers to identify USDA certified products. Overall, products containing less than 95% organic ingredients may not use the USDA organic seal. Specifically, the USDA NOP outlines its labeling standards as a system of four tiers. The highest level of organic – raw agricultural commodities labeled as "100 percent certified organic" – must have all ingredients and processing aids certified, with the certifying agency listed on the information panel. The differentiation begins with products labeled as "organic" which allows up to five percent of ingredients to be non-organic. Products "made with organic" ingredients may not use the USDA organic seal or represent the finished product as organic; however, the "made with" category still requires products to contain at least 70 percent certified organic material. The lowest level of organic products – which includes multi-ingredient agricultural products that contain less than 70 percent certified organic content – may only list certified organic ingredients as an organic percentage in the ingredient list. No other organic claims are permitted (USDA Agriculture Marketing Service, 2014). To summarize, the USDA seal is a convenient way for consumers to trust that a product contains at least 95% certified organic ingredients.

Figure 1 shows an increase in U.S. organic food sales from an estimated $11 billion in 2004 to $28 billion in 2012, despite the economic recession (Greene, 2013). This is especially significant given that organic food products are often sold at a premium. Van Loo, Caputo, Nayga Jr, Meullenet, & Ricke (2011) found that consumers were willing to pay a 3.5% premium for an organic meat product with a USDA certified organic label (i.e. $3.545/lb vs. $3.424/lb); habitual buyers were willing to pay a 44% premium. Turco (2002) and other studies have found premium ranges of 10-100% depending on the country, organic product category, and socio-demographic factors (gender, age, income, and education) (as cited in Van Loo et al., 2011). The appeal of organic products is explained by the USDA: organics rely on renewable resources, support local communities, build soil and water quality, promote environmental stewardship, and enhance biodiversity, benefitting all agriculture (USDA Agriculture Marketing Service, 2014). There exists a large and growing population of consumers willing to pay the higher price for organic food products in support of these causes and other commonly believed benefits (e.g. nutrition, health).

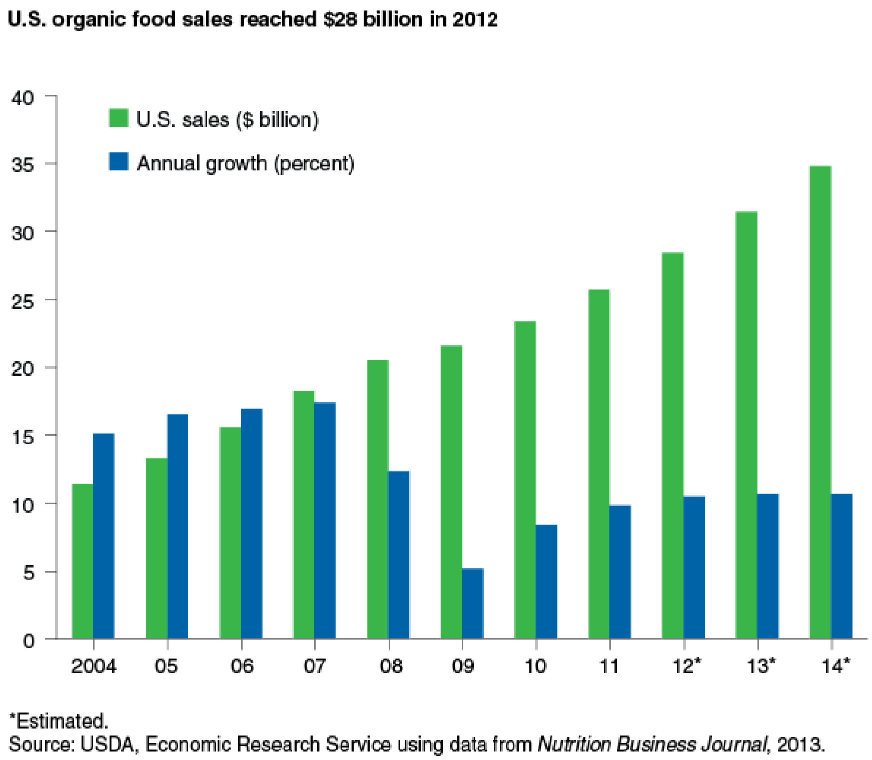



**Figure 1. U.S. organic food sales and annual growth. Sourced from USDA, Economic Research Service.**

### 2.1.2. Genetically Modified (GM) Food

The World Health Organization (WHO) defines GMOs as organisms whose DNA has been altered in a way that does not occur naturally. Individual genes are selected to be transferred from one organism to another, including non-related species. The technology used to create

GMOs may be known as “modern biotechnology”, “gene technology”, “recombinant DNA technology” or “genetic engineering”. In agriculture, genetically engineered plants are used to grow GM food crops. The initial purpose of utilizing the technology was to improve crop protection by genetically imparting insect resistance, virus resistance, and herbicide tolerance. Since the commercial introduction of genetic engineering in 1986, GM foods continue to be developed and marketed for additional benefits including lower prices, longer shelf lives, and greater nutritional value (World Health Organization, 2002).

Though a relatively new technology, the USDA reports that 95% of the sugar beets, 93% of the soy, 94% of the cotton, and 88% of the corn produced in the United States are GM varieties (USDA Economic Research Service, 2013). Since GM varieties are often mixed with ordinary varieties during shipping and storage, Hallman (2012) estimates that 75% of processed foods on American grocery store shelves contain some GM ingredients (as cited in Phillips & Hallman, 2013). This likely explains why the USDA NOP does not consider the presence of GMO residues on an organic product to be a regulatory violation. Cross-contamination is nearly impossible to avoid, especially with processed foods, considering an overwhelming majority of staple crops are genetically modified. Many GM foods are products that are typically consumed daily (Costa-Font, Gil, & Traill, 2008).

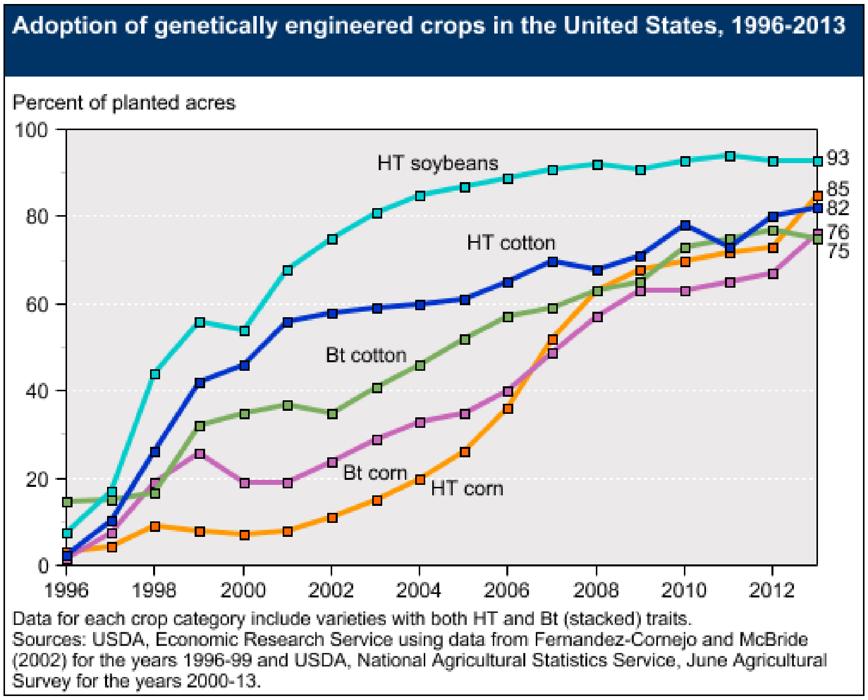



**Figure 2. Recent GE crop adoption in the U.S. Sourced from the USDA, Economic Research Service.**

The US Food and Drug Administration (FDA) upholds that there is no basis for concluding that bioengineered foods differ from other foods in any meaningful or uniform way, or present any different or greater safety concern than foods developed by traditional plant breeding. In response to public commentary, however, the FDA has since published guidelines for food manufacturers who wish to voluntarily label their products as containing, or not containing, GM ingredients. For example, the FDA encourages simple statements that disclose the use of biotechnology (e.g. “This product contains high oleic acid soybean oil from soybeans developed using biotechnology to decrease the amount of saturated fat”). In contrast, the FDA discourages the phrase “GMO free” without any context as it may be misleading to the public since all plant-based foods are the result of genetic modification achieved through selective breeding, crossbreeding, and other traditional agricultural practices. Due to the delicacy of accurate wording, the FDA and USDA believe that the practices and record keeping that substantiate the "certified organic" statement are sufficient to claim that a food was not produced using bioengineering (Food and Drug Administration, 2001).

Many consumer advocacy groups and some legislators disagree. A variety of policies have tried to initiate mandatory labeling of food containing genetically engineered ingredients at both the state and federal level. The Non-GMO Project claims there are currently 37 states that have drafted mandatory labeling bills. Of those 37 states, Connecticut became the first to successfully pass an amended bill through the House and Senate but the regulations will not go into effect until at least four other states enact similar laws – one of which must share a border with Connecticut (Strom 2013). Maine was the second state to pass a similar law and requirement in early January 2014 (Wilson 2014). At the federal level, the *Genetically Engineered Food Right-to-Know Act* has been introduced into the U.S. House of Representatives numerous times since 1999, most recently in 2013 as *H.R. 1699*. Powerful opposition from multinational corporations like Monsanto has repeatedly restricted most U.S. labeling policies through million dollar campaigns and threats of lawsuit, affirming the idea that the organic food movement is a common man’s cause against industrial agriculture.

## 2.2 Consumer Perceptions of GMOs

Genetically modified food is a relevant example of how technological developments challenge societies to comprehend and evaluate a new set of relationships. Such a development generates attractive benefits like cheaper production costs, enhanced food attributes, and increased crop durability. But these benefits may be realized at the price of gene transfer from GM crops to non-GM crops and wild species, as well as the potential generation of resistant insects and plants.  Consumers’ perceptions of potential benefits and costs shape market responses to the new technologies and eventually determine how widely the technology is adopted (Roe & Teisl, 2007). Unfortunately, there is a persistent lack of consensus in many parts of the world, highlighted by the ongoing debates between and within the European Union and the United States.

### 2.2.1. Europe and the United States

The European Union maintained a six-year de facto moratorium against the importation of GM food that ended in 2005. The rationale for the moratorium was largely based on regards for health and environmental concerns as well as the underlying protection of European agriculture (Costa-Font et al., 2008). The World Health Organization attributes the loss in consumer confidence due to a number of food scares that occurred in the second half of the 1990s that while unrelated to GM foods, certainly impacted discussions on safety and the validity of risk assessments (World Health Organization, 2002). When the moratorium was lifted in 2005, the Eurobarometer published a snapshot of European perceptions of GM foods which could be classified into three groups: 'optimistic' – 25%, 'pessimistic' – 58%, and 'undecided' – 17% (Gaskell, 2006, cited in Costa-Font et al., 2008). Interestingly, a 2010 Eurobarometer survey on food-related risks found that 66% of Europeans are worried about GMOs found in food and drink, which represents a +4 shift from the same question asked in 2005. Worry on this issue has increased significantly in 10 Member States since 2005, with Lithuania (81%; +18) showing the largest shift, followed by Portugal (67%; +13). The United Kingdom (48%; -6) is the only nation that shows a marked decline in the level of worry since 2005 (European Commission, 2010).

64 countries around the world mandate GM food labeling laws, including Russia, Australia, China, Brazil, South Africa, and the entire European Union (Center for Food Safety, 2012). Legislation varies between countries. The EU currently enforces a 1% minimum threshold for DNA or protein resulting from genetic modification, below which labeling is not required on

food products (Center for Food Safety, 2012; World Health Organization, 2002). In fact, it was the European Union's insistence upon labeling GM foods that spurred the United States to file suit against the EU to lift its moratorium (Knight, 2003, cited in Roe & Tiesl, 2007). With only voluntary GM labeling regulations in place, US agricultural products will require either the virtual elimination of GM ingredients or the strict adherence to other nations' labeling standards if they are to be imported. It has been argued that American food manufacturers would benefit from labeling legislation by helping them better compete in the global marketplace (Phillips & Hallman, 2013).

The following factors have been raised as possible explanations for why American and European acceptance of GM foods differs to such an extreme: the influence of the press, trust in regulatory procedures, and knowledge of biology and genetics (Gaskell et al., 1999, cited in O'Fallon, Gursoy, & Swanger, 2007). First, there may be a greater quantity of media coverage regarding technological controversies of GM foods in Europe – certainly highlighted by new legal precedents regarding labeling and importation. Second, individuals in the US may have a significantly higher level of trust in US regulators (e.g. USDA, FDA). As previously mentioned, European trust in regulatory officials has been substantially weakened by recent "food scares" (World Health Organization, 2002) possibly in tandem with historical memories of famine and corruption. Finally, Gaskell (1999) suggests that Europeans are more knowledgeable regarding the processes taken to develop GM foods than Americans, resulting in more threatening images of food biotechnology (as cited in O'Fallon et al., 2007). These "threatening images" may instead stem from a desire to preserve European tradition and countryside; alternatively, Americans may be more accustomed to the landscape of industrial agriculture (e.g. John Deere, westward expansion, the Homestead Act of 1862, the Morrill-Land-Grant-Acts, etc.).

### 2.2.2. Attitudes and Risks

The process by which individuals acquire knowledge about GM foods is not straightforward. Information is communicated with varying degrees of power, often evaluated by consumers in terms of reliability, objectivity, and prior beliefs (Costa-Font et al., 2008; Roe & Teisl, 2007). Consequently, trust in the source of information is of critical importance. These interrelated elements must be taken into account when deciphering consumer attitudes about GM foods. Communication about GM content in foods (i.e. food labels) has been a relevant topic of research (Noussair, Robin, & Ruffieux, 2002; O'Fallon et al., 2007; Phillips & Hallman, 2013; Roe & Tiesl, 2007).

Some studies have empirically shown a direct and positive relationship between an increasing knowledge of GM technology and an increasing support to GM applications (see review in Costa-Font et al., 2008). In contrast, others have demonstrated that simply conveying factual information about the risks and benefits of genetic modification is unlikely to result in consumer acceptance (Frewer et al., 2004). Costa-Font et al., (2008) makes an important distinction between objective knowledge, which has been defined as the "real" knowledge people have about GM food, and subjective knowledge, which refers to what consumers believe they know about GM food. For example, a House et al. (2004) study revealed that objective knowledge seems to be less related to acceptance than subjective knowledge; Lusk et al. (2004) found that individuals with higher levels of subjective knowledge were less influenced by new information about GM foods (as cited in Costa-Font et al., 2008). This finding is further illustrated in Frewer et al., (1998). A heightened level of subjective knowledge resulted in a polarizing effect for British consumers who were presented with persuasive messages about GM foods: consumers with initially negative attitudes became even more negative, and consumers with initially positive attitudes became even more positive (as cited in Frewer et al., 2004).

Social trust refers to people's willingness to rely on experts and institutions in the management of risks and technologies (Frewer et al., 2004). Consumers are often more willing to believe the opinion of experts who appear to hold similar values to themselves. Consequently, to increase consumers' knowledge, it is important that the information received by consumers is not only believable, but credible. Many studies have revealed that consumer organizations, environmental groups, and scientists are considered to be more trustworthy on matters relating to GM food than the biotech industry and government – a troubling finding given that US and UK consumers consider government a main actor regarding GM technology control. Nevertheless, an important trust divergence exists among Europeans and Americans, as Americans rely on the FDA more so than Europeans on EU regulatory organizations (see discussion in Costa-Font et al., 2008).

Roe et al., (2007) found in a sample of 1898 US consumers that label claims certified by the FDA are, in general, viewed as most credible and adequate, and products with FDA certified claims are perceived to have fewer long-term health problems. It is noteworthy to mention that this study included labels from seven different "messengers" (e.g. unidentified, three federal agencies, a health organization, a consumer organization and an independent GM certifying organization). A nuance to this finding is that when the GM claim was expanded to include the reason for the genetic modification, respondents' purchase intent tended to be higher even for products with no certifying agency than products that merely stated that content was genetically modified (Roe et al., 2007). The study suggests that substantial information may be even more important for US consumer trust than the source of information. In stark contrast, a similar labeling study using 16,078 Europeans found that 73% of the sample was less likely to purchase a food product with a label indicating the existence of a GM ingredient; the individuals who are more likely to purchase a GM food believed it was unnecessary to include complete information pertaining to the use of GM organisms on the package of food products (O'Fallon et al., 2007).

With all of these differences in mind, there are some fundamental perceptions of GM foods and general philosophies about life which transcend geographic boundaries. Studies conducted by Bredahl (2001), Traill et al. (2004), and Gaskell et al. (2003) refer to both European and US consumers with regard to GM food and find that consumers can be classified as either "opposed" to biotech, entailing concern about nature as well as technology, or "optimistic" about biotech and more materialistic. Even so, consumers may be optimistic about the potential benefits of GM food and still express concerns about associated health, safety, and environmentally consequences (see review in Costa-Font et al., 2008). Problematically, Burger et al. (2001) found that differences in perceptions of risks and benefits associated with GM food exist between different countries and cultures, between different individuals within countries, and within different individuals at different times and within different contexts. As the formation of attitudes is inherently dependent on the motivation, ability, and opportunity to understand an issue in conjunction with an individual's pre-existing values and beliefs, it is no surprise then that empirical research has reported inconsistent findings about attitudes toward GM foods at both the individual and national level (O'Fallon et al., 2007).

## 2.3 Experimental Auctions

Attitude and risk are more than just theoretical concepts. They manifest in the economy, where both significantly drive consumer behavior. Economic research continually attempts to measure how consumers differ in purchasing decisions due to personal attitudes and perceived risks. Though surveys, focus groups, and hypothetical scenarios are historically employed with this goal in mind, none have shown to reflect the real-market as accurately as non-hypothetical experimental auctions (Hayes et al., 1996; Lusk et al., 2007; Sánez-Navajas, Campo, Sutan, Ballester, & Valentin, 2013).

### 2.3.1. Non-Hypothetical Experimental Auctions Defined

A non-hypothetical experimental auction uses real goods, real money and real purchasing decisions in order to elicit real market prices from consumers. The core reasoning of this method is that consumers will be as honest and accurate as possible when faced with tangible consequences for their actions (Combris, Bazoche, Giraud-Héraud, & Issanchou, 2009). Specifically, participants in a non-hypothetical experimental auction must evaluate a trade-off between endowed money and consumption of a good (Hayes et al., 1996). Preferences for a new product are most often determined by measuring bid prices to exchange an endowed, pre-existing substitute for a new good (Lusk et al., 2007). This paradigm is called willingness-to-pay (WTP). Such economic information is important not only for determining whether new products and product features enhance consumers' perceptions of value, but also for deciding whether or not to impart a premium (or discount) and/or initiate commercial production (Jaeger et al., 2004). Non-hypothetical experimental auctions are best suited for an objective, reproducible setting in which participants are given plenty of opportunity to learn from winning bids. Consumers will then realize that revealing their true preferences is the dominant strategy of the auction (Shogren, Fox, Hayes, & Kliebenstein, 1994).

Hayes et al. (1996) claims that the superiority of non-hypothetical experimental auctions over other hypothetical methods is simply due to their realistic nature. Non-hypothetical methods are described as "incentive compatible" because it is in participants' best interest to reveal their maximum price. For example, if participants understate their valuation of a good, then they lose an opportunity to buy at a price they would have been satisfied with. Alternatively, over-bidding increases the risk of losing money they would have otherwise preferred to keep. This result is attributed to the assurance participants feel in knowing that the price is settled independently of their own maximum buying price (Combris et al., 2009). Comparatively, it is believed that participants often prematurely state a value for good in a focus group setting or survey, try to strategize against the group or please the interviewer, and allow one or two participants to successfully dominate the results (Hayes et al., 1996).

### 2.3.2. Comparing Methods

That is not to say that the results of experimental auctions are free from misrepresentation. In fact, skepticism about the exact accuracy of WTP measurements has led to the development of numerous experimental auction methods, all originating from Vickrey's second-price experimental auction. Vickrey (1961) noted a major flaw in traditional, highest-value, Dutch auctions: individual bidders are compelled to predict the behavior of their competitors in order to maximize their own expectations of winning. This process detracts from independent valuations of a good and often proves erroneous. Unless bidders are fairly homogenous and sophisticated enough to perform a general appraisal of the market, Dutch (or first-price) auctions will not accurately reveal preferences (Shogren et al., 1994). Therefore, the advantage of the Vickrey (or second-price) auction is that a general market appraisal becomes superfluous for individual bidders (Vickrey, 1961). In Vickrey's second-price auction, the highest bidder pays the second-highest bid price, so theoretically, there is nothing to be gained from strategic bidding (Hayes et al., 1996).

Still, some researchers have questioned whether the mechanism of Vickrey's second price auction can adequately engage low-value bidders who may believe they will never win (Shogren, Margolis, Koo, & List, 2001). The Becker-DeGroot-Marschak mechanism was designed to further promote individual, minimally influenced bids by determining the selling price from a randomized distribution selected by the experimenter (Becker, Degroot & Marschak, 1964). This distribution of prices typically ranges from zero to a price greater than the anticipated maximum WTP among bidders. In a BDM auction, any bidder who submits a bid greater than the selected selling price "wins" a unit of the good and pays an amount equal to the selling price (Noussair, Robin, & Ruffieux, 2004).

Shogren et al. (2001) proposed an auction methodology that combines elements of the BDM and second-price auction. In a random $n^{th}$ price auction, one of the bids is randomly chosen from all but the highest participants' bids and the n-1 highest bidders buy the product at a price equal to the $n^{th}$ bid (Shogren et al., 2001). Therefore, the randomness of BDM is still employed to engage all bidders, even off-margin (i.e. bidders whose value is far below or above the winning bid). By choosing a price from the submitted bids, however, the selling price is endogenous to the market and is thus equally analogous to the second-price auction mechanism.

One further attempt has been made to optimize the non-hypothetical experimental auction. After designing and comparing the $n^{th}$ price auction to the second-price auction, Shogren et al. (2001) concluded that "there might be an effective mix between the number of subjects (k) and the number of units of an auctioned good (n) that would engage both on-margin and off-margin bidders. Exploring this mix might help us better understand why auctions that are demand-revealing in theory can fail in practice." Indeed, though sound in theory, the random $n^{th}$ price auction may significantly affect the bids of low-value participants who are concerned about the probability of having to buy the auctioned product (Combris et al., 2009). In response, a $5^{th}$ price auction was designed, tested, and shown to equally incentivize low-, medium-, and high-value bidders (Lusk et al., 2007). Once the binding round is randomly determined, the four winning bidders pay the $5^{th}$ lowest bid amount to exchange their goods (Jaeger et al., 2004).

### 2.3.3. Nuances

Theoretically, all auction mechanisms should yield the same result considering it is always in the participants' best interest to submit bids equal to their true valuations of a good. However, behavioral tendencies and specific features of each auction may influence the way consumers participate (Combris et al., 2009; Lusk et al., 2007). For example, an individual may bid haphazardly to test the market out of curiosity or bid in attempt to impress (Lusk et al., 2007). With regards to the auction environment, training procedures, wording of instructions, distributing cash, displaying winning bids, and other factors should be considered (Noussair et al., 2004). Notably, Lusk & Shogren (2007) found that auctions for controversial goods like genetically modified foods inspire a highly skewed, bimodial distribution of values (as cited in Lusk et al., 2007). In fact, auctions that introduce novel, provocative goods like GM foods highlight three significant nuances to a standard experimental auction: WTP versus WTA (willingness-to-accept), repeated trials, and information shock.

As previously discussed, WTP measures the premium consumers are willing to pay to upgrade their endowed product. An important distinction arises with willingness-to-accept (WTA) in which a discount is measured based on the minimal amount of money consumers demand in compensation for a lesser product. With regards to GM food in experimental auctions, the premium participants are willing to pay to trade a GM food for a GM-free food is a measure of WTP. Alternatively, the compensation consumers must receive to exchange a GM-free food for a similar food made with GM ingredients is a measure of WTA. WTP is the more commonly used measure but WTA may be more appropriate depending on experimental objectives, especially with individuals who are particularly opposed to consuming GM food (Jaeger et al., 2004).

Repeated trials in non-hypothetical experimental auctions were introduced with Hayes et al. (1996) with products such as irradiated pork – analogous to GM food in that technology is applied to improve the product, though consumers express concerns. The auction called for twenty consecutive trials in order to give the experimental market ample time to stabilize bid prices (Hayes et al., 1996). It is important to note, however, that only one repetition was chosen as binding to safeguard against wealth-effects (i.e. changes in bids caused by winning an earlier trial) (Jaeger et al., 2004). Arguments in favor of repeated trials also maintain that subjects are better able to learn the auction procedure, understand the implications of bidding their true values, and benefit from market feedback (Bernard, 2005). Shogren et al. (1994) argues that this market signal may encourage strategic bidding but this has not been demonstrated to date.

Researchers may also choose to introduce information shock to further utilize repeated trials. A common practice is to conduct 5-10 trials, introduce new product information, and then conduct 5-10 more trials. For example, participants in an experimental auction with a GM food product may be informed that less pesticide was used to produce the product, thereby inferring an environmental benefit that would not have been otherwise conveyed. Changes in WTP/WTA after the information shock allow inferences to be made about the effect of information on consumer valuation of a good (Hayes et al., 1996; Jaeger et al., 2004). By incorporating these nuances, non-hypothetical experimental auctions present a viable methodology for measuring (changing) consumer perceptions of GMOs.

### 2.4 Non-Hypothetical Experimental Auctions with GMOs

Genetically modified food products have been commercially available for only twenty years; the Flavr Savr tomato was first available for retail sale in 1994. In 1996, Hayes et al. published the results of a novel auction process designed to replicate the decision-making processes consumers face with new food products in retail stores. The multitrial, non-hypothetical experimental auction was applied to milk from cows treated with bovine somatotropin (bST), pork from pigs treated with porcine somatotropin (pST), *Salmonella*-free chicken meat, and irradiated trichinella-free pork. With the continuous advancement of biotechnology, it is apparent that GM food products are now applicable goods to study consumer concerns about emerging technologies in food production with non-hypothetical experimental auctions. Indeed, three studies since Hayes et al.'s semiannual publication in 1996 have done just that with US consumers, serving as a foundation for the present research.

Lusk et al. (2001) investigated consumer WTP for corn chips made with non-GMO ingredients using first- and second-price auctions. Participants were endowed with one dollar and a one-ounce bag of corn chips identified as produced with GM corn. Seventy percent of participants were unwilling to upgrade to non-GM corn chips. The average bid to exchange a bag of GM corn chips for non-GM corn chips was $0.07/oz. Twenty percent of participants were willing to pay at least $0.25/oz. for the exchange and two percent offered bids as high as $0.50/oz. It is worth noting that the study was small and unrepresentative, only using students enrolled in two sections of a junior/senior-level agricultural economics class at Kansas State University for both treatments. Additionally, Lusk et al. (2001) references that GM corn and soybeans comprised less than 2% and 8%, respectively, of total planted crop acres in 1996, but grew correspondingly to 25% and 52% of planted acreage in 2000. This statistic has since increased to 88% and 93%, warranting future studies using experimental economics to quantify consumer WTP for non-GM food products (USDA Economic Research Service, 2013).

Huffman et al. (2003) noted some shortcomings of the Lusk et al. (2001) experimental auction and sought out to correct those by incorporating multiple products (i.e. vegetable oil, corn chips, and russet potatoes), $n^{th}$-price methodology, and a larger sample of adults in the U.S. The primary aim of the study was to identify the effects of GM food labels and different perspectives on genetic modification on consumers' WTP for food items that might be GM. By randomly assigning the sequence in which consumers bid on food products with/without GM labels and the type of third-party information consumers would receive, the experimental design yielded twelve treatments. The three types of information packets included collections of statements from an environmental group perspective, an industry perspective, and an independent third-party perspective. Multiple repeated trials were not used; instead, participants bid on the three unrelated food items twice, differing only in food label. Notably, the distinction in labels was deemed as either "standard-labeled" (i.e. no information about presence of absence of GM content) or "GM-labeled" (i.e. "This product is made using genetic modification (GM)"). Huffman et al. (2003) found about 60% of participants bid less for the GM-labeled version for at least one of the three products, with an average discount of approximately 14%. The study is silent on the effects of the information treatments, which may be why the authors suggest future research examining consumer reactions to specific GM food benefits (e.g. enhanced proteins, vitamins, micro-nutrient content, shelf-life).

Jaeger et al. (2004) conducted a series of experimental auctions with US consumers as part of a larger study to compare acceptance of genetically modified foods in the US, UK, and France. The primary objective of the study was to investigate the relative impact of different types of information shock on GM food valuation. 164 middle-aged, female participants were recruited from Lubbock, TX, Long Beach, CA, and Jacksonville, FL to represent a population of primary grocery shoppers across geographically diverse locations. Each participant was endowed with fifty dollars and participated in a non-hypothetical market training session with candy bars before the market for the GM cookies began. Participants were then endowed with a GM-free cookie and asked to bid the least amount of money they were willing-to-accept to exchange their non-GM cookie for one containing GM ingredients. WTA was selected over WTP due to concern about participants refusing to eat a GM food product, even if experimental procedure required them to do so; this was of particular concern for the UK and French cohorts. The auction proceeded through ten rounds of bidding with information shocks directed towards the potential benefits of biotechnology for the environment, personal health, food quality, and the developing world introduced after round five and before round six. A $5^{th}$ price auction mechanism was utilized to determine the winning bidders. The study found that health benefit and environmental benefit information shocks significantly changed WTA at -$0.12 and -$0.08, respectively; world benefit and food quality information shocks were not effective. Though the study may be more comprehensive than Lusk et al. (2001), it still allows opportunity to investigate WTP with other types of information shocks relevant to the contemporary political economic food environment.

# Chapter 3

## Aim of Study

The objective of this research is to assess the effects of different types of information shock on consumer willingness-to-pay for non-genetically modified corn tortilla chips. To date, only three published studies have investigated WTP/WTA for GM food products with non-hypothetical experimental auctions, the most recent being ten years ago. The presence of genetically modified ingredients in food production has drastically increased in tandem with increased consumer awareness. In order to improve the relevancy and power of these experiments, change in WTP will be measured with five treatments (information shocks) which vary in appeal (e.g. changed viewpoint, authority, modern progress, societal usefulness) and directionality (i.e. pro- vs. anti-GMO).

<u>Primary Aims</u>

*Aim 1*: To demonstrate the utility of non-hypothetical experimental auctions.

Hypothesis—The change in WTP will have statistical significance in at least one of the treatment groups, indicating that non-hypothetical experimental auctions are a viable tool to measure consumer behavior with food products.

*Aim 2*: To determine the influence of information appeals on perceived consumer value in a non-hypothetical experimental auction setting.

Hypothesis — Individuals will decrease their bid values for non-GMO corn chips after receiving the pro-GMO information shocks. Similarly, individuals will increase their bid values for non-GMO corn chips after reading the anti-GMO information shock.

# Chapter 4

# Materials and Methods

## 4.1 Selection of Auction Goods

Corn tortilla chips were selected as the auction good of interest for several reasons. First, genetically modified corn is a rapidly growing segment of GM food crops. Consumers are more likely to be familiar with the application of biotechnology with corn due to the media coverage on Monsanto's "Roundup Ready Corn" and Bt corn since 1996. Second, concerns about affiliation between bidders' values in repeated, experimental auction trials are minimized by using familiar goods (Lusk et al., 2001). Corn tortilla chips are a popular snack food, and as Cormick (2004) argues, some consumers may be less comfortable with GM food products they view as "natural" or "healthy" (e.g. fruits and vegetables) than on products such as snack foods or fried products (as cited in Phillips & Hallman, 2013). Third, the variety of corn chip products available on supermarket shelves made it relatively simple to find both a conventionally processed (assumed to be of GM corn ingredients) and organic (certified non-GMO) corn chip brand that had similar characteristics.

A sampling of local supermarkets' corn tortilla chip products were presented to the sensory laboratory group for informal evaluation. Yellow corn, white corn, round, restaurant-style, brand name, store-brand, organic, and conventional chips were tasted and compared to each other in order to agree upon a GM and non-GM corn tortilla chip product that were relatively similar in sensory characteristics. Snyder's Yellow Corn Tortilla Chips and Trader Joe's Organic Yellow Corn Tortilla Chip Rounds were selected from this group to be further evaluated by consumers in a Central Location Test (CLT).

The CLT was conducted in the Sensory Evaluation Center (SEC) at Penn State University with the assistance of Rachel Primrose. Participants ages 18-65 were recruited on the basis of willingness to eat corn tortilla chips. Each panelist was paid $5 and presented with a tray consisting of two plates with two of the same corn tortilla chips on each plate. The samples were labeled with three digit blind codes and counterbalanced to reduce carryover effects. Panelists were instructed to taste the first sample of corn tortilla chips and evaluate the product for overall liking, appearance liking, flavor liking, and texture liking on a 9-point hedonic scale (i.e. 9 = Like Extremely to 1 = Dislike Extremely). After rinsing with water, panelists evaluated the second sample of corn tortilla chips using the same parameters. All responses were collected using Compusense 5 software (Guelph, OH).

### 4.2 Auction Mechanism

For the auction, each subject was given a plastic bag of corn tortilla chips assumed to contain GM ingredients (i.e. Snyder's corn tortilla chips). Subjects then participated in a 5$^{th}$-price auction to bid on a plastic bag of corn tortilla chips that were similar in quantity and sensory characteristics, but were certified organic and thus GM-free (i.e. Trader Joe's corn tortilla chips). Willingness-to-pay (WTP) money to exchange GM-chips for non-GM chips was elicited. Brand names were not revealed to the participants at any time. The auction repeated for ten rounds, with new information (i.e. information shock) introduced after the fifth round and before the sixth. At the conclusion of the auction, the binding round was determined by a random number generator. The four highest bidders in the binding round won the auction and were required to pay the 5$^{th}$ highest bid amount and consume the non-GMO tortilla chips. All other participants were instructed to eat two of their endowed, conventional tortilla chips.

The design is primarily modeled from Jaeger et al.'s (2004) multinational study on measuring GM food acceptance through experimental auctions. The authors chose to implement a 5th-price value elicitation mechanism. After a review of the literature, different studies seem to select one value elicitation mechanism over another based upon preference and issue at hand. Jaeger et al. (2005) defends their use of the 5th-price auction as "theoretically incentive compatible and engages more participants than the second-price mechanism, while still being relatively simply to explain and administer." Because the current research investigates a very similar issue and the 5th-price auction was effective in Jaeger et al. (2005), the same value elicitation mechanism was chosen for the present study.

However, our design is notably altered from the Jaeger study in that consumer willingness-to-pay is measured instead of willingness-to-accept. After careful consideration, Jaeger et al. (2004) suggests that WTA was more appropriate due to European concerns of having to eat GM food products. The authors also argue that endowing participants with a non-GM food product and measuring the compensation demanded (i.e. WTA) "approximates the choice many US consumers currently face in the marketplace." Perhaps this was true at the time, but as of 2013, it is estimated that 88% of the corn produced in the U.S. is genetically modified (USDA Economic Research Service, 2013). This statistic implies that the majority of processed food products containing corn include GM-corn ingredients. Consequently, US consumers are faced with buying GM-corn tortilla chips unless they specifically seek out certified organic, non-GMO chips—often at a premium. Preferring to replicate a familiar marketplace scenario, WTP was measured instead of WTA.

Five different information shocks resulted in five different treatment groups for this experiment. In other words, all subjects within a particular auction session received the same information shock. Four of the information shocks were designed to provoke a decrease in WTP by appealing to an example of changed viewpoint (Treatment One), classic/trusted authority

(Treatment Two), modern progress (Treatment Three), and societal usefulness (Treatment Four). In contrast, one of the information shocks was designed to provoke an increase in WTP by appealing to a precautionary principle (Treatment Five). Treatment Five was included as a control in attempt to demonstrate the power of experimental auctions in case consumer attitudes could not be shaped by positive information. The primary objective of this experiment is to investigate which type(s) of information is/are most effective in increasing consumer acceptance of a GM-food product. Complete text for all information shocks is found in Appendix B.

## 4.3 Participant Recruitment

Subjects were recruited using the Sensory Evaluation Center's online participant scheduling system, SONA (SONA Systems, Tallinn, Estonia). A mass e-mail was sent to over 1,000 individuals inviting them to participate in an upcoming research study. The e-mail disclosed that participants would receive $2 for showing up on time and an additional $4 to buy food in an auction, and that the test would take approximately 60 minutes. A link to an online prescreener was provided; if an individual qualified, they would receive a passcode at the end of the survey. Individuals were directed to use the passcode to sign up for a timeslot.

The prescreener disqualified anyone who indicated they were under 18 or over 65 years of age. Individuals also had to have an active Penn State University ID and be willing to eat both genetically modified and organic corn tortilla chips. The most notable exclusion criterion was that individuals were disqualified if they indicated they were students or employees of the College of Agricultural Sciences. This was done to avoid biasing the sample toward individuals who might be biased towards genetically modified foods or biotechnology. About 30 seats were open for each experimental session for a total of 150 seats (i.e. five treatments/sessions). During the auctions, the numbers attending ranged from 12-19 per session.

## 4.4 Auction Protocol

Participants arrived at the Laboratory for Economics, Management, and Auctions (LEMA) within the Penn State Business Building at the time of their experimental auction session. The LEMA Lab provides a laboratory environment in which auctions can be conducted and controlled using a computer network. Our collaborator, James Fan, a graduate student in Supply Chain Management, programmed the auction protocol using the Zurich Toolbox for Readymade Economic Experiments (zTree). After reviewing the consent form, participants were instructed to sign into a computer using an assigned ID number. Each participant was given a packet of instructions and asked to follow along as the procedures were read out loud.

Prior to conducting the auction for the non-GMO corn tortilla chips, participants read a brief informational statement on genetic modification to ensure awareness. Participants then learned and practiced the experimental auction procedures by engaging in a non-hypothetical auction using $2.00 to bid on chocolate bars. Truthful bidding was explained and emphasized as the best strategy. No information shocks were included but the auction was repeated for three rounds to familiarize participants with the random binding-round and $5^{th}$-price mechanisms. The instructions were then repeated to explain the corn tortilla chip auction procedure with two new additions: there would be ten rounds of bidding and all participants must eat at least two of their acquired corn tortilla chips at the end of the session. The experimental auction proceeded as follows:

*Step 1.* Participants were given a free bag of conventionally processed (i.e. GM) corn tortilla chips. The zip top bag was transparent so that consumers could freely observe the contents inside without any labeling.

*Step 2.* Participants were shown an otherwise identical bag of organic (i.e. non-GM) corn tortilla chips that was up for auction.

*Step 3.* Participants entered the maximum amount they were willing to pay to exchange their GM-corn tortilla chips for the non-GM-corn tortilla chips on their computers.

*Step 4*. Once all bids were recorded, the computers ranked the bids from highest to lowest and displayed the four highest bids on all monitors. Participants were notified whether or not they were a winner for the round, along with the winning price (i.e. the fifth highest bid).

*Step 5.* Steps 1-4 were repeated for four additional rounds.

*Step 6.* The auction was interrupted at the end of the fifth round as new information displayed on each individual monitor. Participants received a printed copy of the vignette and followed along as it was read out loud by the auction moderator.

*Step 7.* Steps 1-4 were repeated for five additional rounds.

*Step 8*. At the completion of the tenth round, the results for all ten rounds were displayed on each individual monitor.

*Step 9*. The binding round (1-10) was determined using a random number generator in the front of the room. The four winning bidders from each auction group were then selected.

*Step 10*. All participants received monetary compensation (i.e. $6) minus the amount they had paid for winning the auction. All food good exchanges for chocolate bars and corn tortilla chips occurred at this time. Participants were required to eat at least two of their acquired corn tortilla chips before they left the session, ensuring this was a non-hypothetical auction.

A complete instruction set is available in Appendix A.

# Chapter 5

# Results

### 5.1 Sensory Evaluation

Trader Joe's Organic Yellow Corn Tortilla Chip Rounds scored significantly higher than Snyder's Yellow Corn Tortilla Chips in all categories of consumer liking (Table 1). Reponses from 66 consumers were analyzed by Compusense 5 using ANOVA paired with Tukey's HSD at a 5% significance level. Although the results are statistically significant, the differences in hedonic ratings for each category between the two tortilla chip samples were all within one unit on a 9-point hedonic scale. Additionally, all mean ratings were above 6 (i.e. like slightly) which suggests both brands of chips were acceptable even though the Trader Joe's brand consistently scored significantly higher. The results from the CLT support the choice of tortilla chips used in the experimental auctions – both chips were liked by consumers, and while the Trader Joe's organic tortilla chips (GM-free) were liked more, these were the chips auction participants would be bidding for as an upgrade from the Snyder's tortilla chips (GM-containing). (To be clear, the participants in the auction did not eat chips of either type until after the auction was complete).

**Table 1. Mean hedonic ratings for tortilla chips presented to panelists for sensory evaluation. Superscripts denote significance.**

| Sample | Overall Liking | Appearance Liking | Flavor Liking | Texture Liking |
|---|---|---|---|---|
| Trader Joe's Organic Yellow Corn Tortilla Chips (GM-free) | $7.06^{a}$ | $7.32^{a}$ | $7.15^{a}$ | $7.36^{a}$ |
| Snyder's Yellow Corn Tortilla Chips (GM-containing) | $6.45^{b}$ | $6.88^{b}$ | $6.39^{b}$ | $6.73^{b}$ |

### 5.2 Experimental Auctions—Unpooled Data

Table 2 illustrates the average willingness-to-pay bids for non-GM corn tortilla chips before and after each vignette was introduced to an auction group. Pre-information shock means were calculated from all bids in trials 1-5 per session whereas post-information shock means were calculated from all bids in trials 6-10; this is because the vignettes were introduced to all auction participants between trials 5 and 6. As a result of low attendance, some vignettes were shown in two groups (i.e. sessions) while others were only shown to one auction group. The low number of subjects in each group noticeably affected the standard error of the means as well as the significance of the results. Therefore, the mean percent change in WTP was calculated to further demonstrate the degree of monetary difference in bid offers.

The pre- and post-information shock means for bid offers in each session were compared with two-tailed, paired t-tests at a 5% significance level. An appeal to example of a changed viewpoint on GMOs significantly changed participants' WTP for non-GMO corn tortilla chips but only in one of the two auction groups. The p-value comparing the two means in the first session was marginal ($p = 0.0569$), although the effect size was relatively large (i.e. a relatively high percent change in WTP). An appeal to classic, or trusted, authority also demonstrates a significant effect on consumer bids, but this vignette was only shown to one auction group; similarly noted, an appeal to modern progress did not significantly affect the mean bid offers in one session. The appeal to societal usefulness showed significant results in one of the two auction groups. The number of subjects remained constant between the sessions which allows for direct comparison. While the percent change in WTP was higher in the first session (i.e. 60.1% vs. 46.5% in the second session), the second session had lower SEM values which is likely attributable to the significance of the session's difference in pre- and post-information shock bid offers (p = 0.045). An appeal to the precautionary principle did not show significant results in the unpooled data.

**Table 2. Average bid offers for each experimental auction group, before and after a vignette (i.e. information shock) was introduced, with standard error of the mean. The means were analyzed with paired t-tests at a 5% significance level; asterisks denote statistical significance.**

| Vignette | Session (n) | Pre-Information Shock Mean (SEM) | Post-Information Shock Mean (SEM) | p-value | Mean Percent Change in WTP (%) |
|---|---|---|---|---|---|
| Appeal to Example of Changed Viewpoint | First (9) | $0.1200 (0.0330) | $0.0844 (0.0337) | 0.0569 | 70.33 |
| | Second (10) | $0.0630 (0.0202) | $0.0070 (0.0060) | 0.0063* | 11.11 |
| Appeal to Classic/Trusted Authority | First (12) | $0.3258 (0.0710) | $0.1958 (0.0471) | 0.0161* | 60.10 |
| Appeal to Modern Progress | First (13) | $0.5492 (0.1992) | $0.2985 (0.0711) | 0.2291 | 54.35 |
| Appeal to Societal Usefulness | First (8) | $0.2975 (0.1846) | $0.1788 (0.0885) | 0.2946 | 60.10 |
| | Second (8) | $0.2850 (0.0793) | $0.1325 (0.0316) | 0.0450* | 46.49 |
| Appeal to Precautionary Principle (Control) | First (9) | $0.3467 (0.0937) | $0.5733 (0.1877) | 0.0784 | 165.4 |
| | Second (9) | $0.3544 (0.1532) | $0.4711 (0.2499) | 0.2783 | 132.9 |

Figure 3 represents the data as a line plot with WTP bid offers averaged within each auction trial periods (1-10). Each line corresponds to a different treatment/auction session. In both sessions for the appeal to an example of a changed viewpoint, the trend in bid offers continually decreases without a notable change in slope between the average bid values in trial 5 and trial 6. The same trend is observed for the appeal to authority. However, the difference between the average first and tenth bid offers for the first session of the appeal to changed viewpoint and for the appeal to authority is noticeably greater than the second session of the appeal to changed viewpoint – a possible explanation for the difference in significant results (Table 1). For the appeal to modern progress, it is observed that the market was initially volatile, leading to a great change in WTP between trial 5 and trial 6. However, the market was relatively stable afterwards and closed at a point similar to the average bid offer of trial 1. A similar trend is observed for both sessions of the appeal to the precautionary principle. None of these three sessions demonstrated statistical significance in Table 1 despite the immediate influence of information shock between trials 5 and 6 apparent in Figure 3. The trends for the appeal to societal usefulness look similar except for the surprising increase in WTP for session one immediately after the information shock. It is unclear why this occurred, but it likely contributes to the lack of statistical significance in results for this session (Table 1).

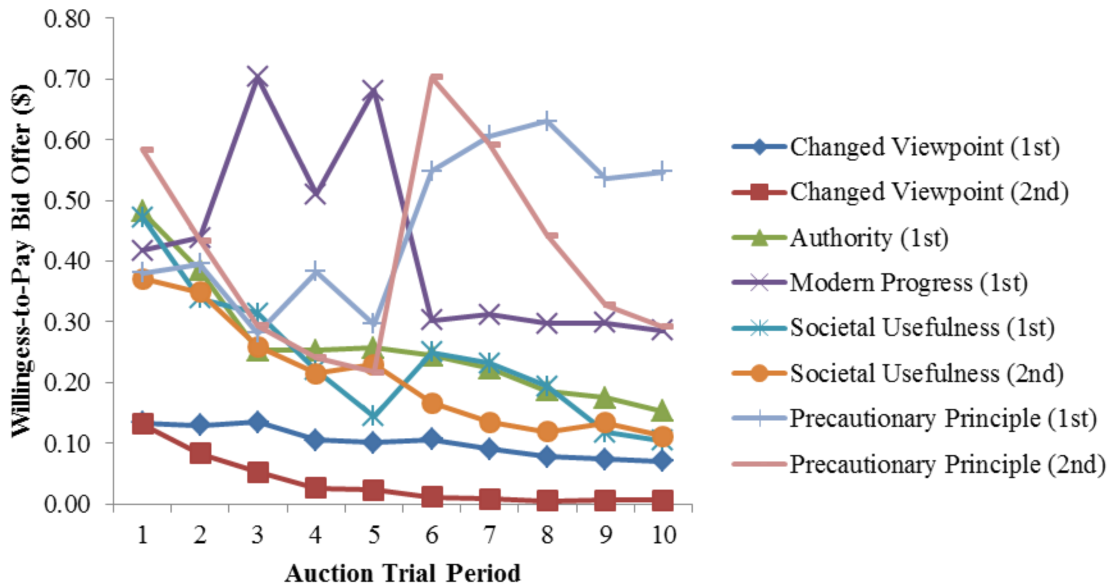



**Figure 3. Line plot of average WTP bid offers in each trial period for each auction session. Information shocks were introduced before trial 5 and after trial 6.**

## 5.3 Experimental Auction—Pooled Data

The original design of the non-hypothetical experimental auction sessions intended for split groups (n = 15) in order to thoroughly engage all participants and effectively create replicates. Due to the small number of participants that actually attended each session, the data was pooled and analyzed again. Table 3 shows that when two-tailed, paired t-tests are conducted on the pooled mean values before and after information shock, the change in WTP is significant with appeals to an example of a changed viewpoint, classic/trusted authority, societal usefulness, and the precautionary principle. The appeal of modern progress is the only vignette that remained ineffectual in changing consumer willingness-to-pay for non-GM corn tortilla chips.

**Table 3. Average bid offers for pooled groups, before and after a vignette (i.e. information shock) was introduced, with standard error of the mean. The means were analyzed with paired t-tests at a 5% significance level; asterisks denote statistical significance.**

| Vignette | N | Pre-Information Shock Mean (SEM) | Post-Information Shock Mean (SEM) | p-value | Mean Percent Change in WTP (%) |
|---|---|---|---|---|---|
| Appeal to Example of Changed Viewpoint | 19 | $0.0900 (0.0195) | $0.0437 (0.0437) | 0.0006* | 48.56 |
| Appeal to Classic/Trusted Authority | 12 | $0.3258 (0.0710) | $0.1958 (0.0471) | 0.0161* | 60.10 |
| Appeal to Modern Progress | 13 | $0.5492 (0.1992) | $0.2985 (0.0711) | 0.2291 | 54.35 |
| Appeal to Societal Usefulness | 16 | $0.2913 (0.0971) | $0.1556 (0.0458) | 0.0367* | 53.42 |
| Appeal to Precautionary Principle (Control) | 18 | $0.3506 (0.0871) | $0.5222 (0.521) | 0.0336* | 148.9 |

Figure 4 once again represents the data as a line plot with WTP bid offers pooled and averaged within each auction trial periods (1-10) and each vignette. The lines for the appeal to authority and modern progress are identical to those in Figure 3 as they were only presented to a single group. The trends in WTP bid offers for the appeal for changed viewpoint and the appeal to the precautionary principle did not notably change after the data was pooled. The pooled data trend for appeal to societal usefulness, however, displays a clear change from its unpooled trend in Figure 3. Figure 4 suggests a relatively stable market before and after information shock with a nearly consistent, gradual decline in WTP bid offers. Specifically, the immediate effect of information shock between trials 5 and 6 was negated when pooling the data for this treatment.

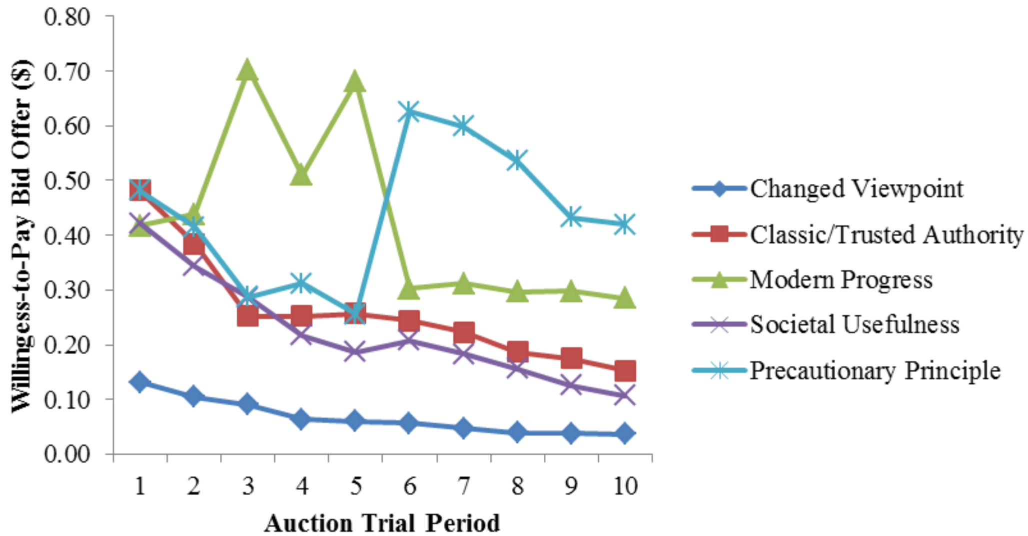



**Figure 4. Line plot of average WTP bid offers in each trial period for pooled auction sessions, where applicable. Information shocks were introduced before trial 5 and after trial 6.**

# Chapter 6

## Discussion

The results here suggest that introducing certain types of information pertaining to genetic modification in food can affect real consumer behavior in a non-hypothetical market. In all sessions, there was an overall decrease in the amount consumers were willing to pay for non-GM corn tortilla chips after receiving pro-GMO information; there was also an overall increase in the amount consumers were willing to pay when presented with anti-GMO information. However, Table 2 and Table 3 show that the significance of the change in WTP may not be dependent on the information alone since a change in market size was shown to affect statistical significance. In other words, the change in WTP may be comparable between and within sessions but the group size can substantially influence whether the observed change is statistically significant. Additionally, Figure 3 and Figure 4 also show that the immediate effect of information shock may be great but the market can stabilize again, perhaps due to a smaller body of influential consumers. At a minimum, it will be necessary for future studies to successfully recruit larger and more equal subject pools across all auction sessions.

It will also be important to obtain information about the demographics and prevailing attitudes of the participant within each market in order to deduce confounding variables. For time and simplicity reasons, subjects were considered for recruitment only if they stated no affiliation to the College of Agricultural Sciences, assuming that students, faculty and staff of the College may be inherently biased towards biotechnology. This exclusion criterion dramatically reduced the size of the available subject pool, and without additionally filtering for biases, most likely selected opinionated participants, regardless. Targeted recruitment or the inclusion of a survey before/after the auction trials may allow for conclusions for specific market niches about the effects of various types of information on GMOs. Additionally, the vignettes could be tailored to specific audiences based on demographic information and provide insight for more nuanced attitude-behavior correlations.

Aside from individual consumer biases, the auction mechanism may induce directional behavioral. Noussair (2004) reasoned that the direction of the bias may be sensitive to many aspects of the experimental design -- including the wording of instructions, training techniques, maximum and minimum possible bids, publicly revealing subjects' bids, and timing of cash payments. For example, the instruction packet for the present study describes GM-corn tortilla chips as 'conventional'. Whether or not they were previously aware of the prevalence of GM-corn in processed food products, participants were inclined to consider GM-corn tortilla chips as the standard (which is true in today's market, irrespective of prior knowledge) due to the wording of the instructions. Furthermore, the practice auction with chocolate bars appears to have primed the market in terms of what participants were initially willing to pay out of pocket. Table 4 displays the average bid offers for the Dove chocolate bar across all three practice trial rounds for all participants in each session, as well as the pre-information shock mean bid offers for Trader Joe's non-GMO corn tortilla chips. Comparing the two data sets with a Pearson's correlation in Figure 5 indicates a strong positive relationship between the mean bid in the practice auction and a pre-shock mean bid ($r = 0.82$) with statistical significance ($p = 0.014$). The anchoring and adjustment heuristic is well-documented in psychology literature but should be further researched to improve experimental auction methodology. Finally, other techniques of statistical analysis may be more appropriate for the present results. While we observed significance before and after information shock with paired t-tests, other statistical tests may be more robust against the prevalence of $0.00 bids and render more accurate conclusions.

**Table 4. Average bid offers across all practice auction trials (1-3) for a Dove chocolate bar and across all pre-information shock auction trials (1-5) for Trader Joe's non-GMO corn tortilla chips.**

| Vignette | Session (n) | Mean Dove Chocolate Bar Bids (All Trials, 1-3) | Mean Non-GMO Corn Chip Bids (Pre-Information Shock Trials, 1-5) |
|---|---|---|---|
| Appeal to Example of Changed Viewpoint | First (9) | $0.11 | $0.12 |
| | Second (10) | $0.11 | $0.06 |
| Appeal to Classic/Trusted Authority | First (12) | $0.49 | $0.33 |
| Appeal to Modern Progress | First (13) | $0.43 | $0.55 |
| Appeal to Societal Usefulness | First (8) | $0.28 | $0.30 |
| | Second (8) | $0.21 | $0.29 |
| Appeal to Precautionary Principle (Control) | First (9) | $0.39 | $0.35 |
| | Second (9) | $0.46 | $0.35 |

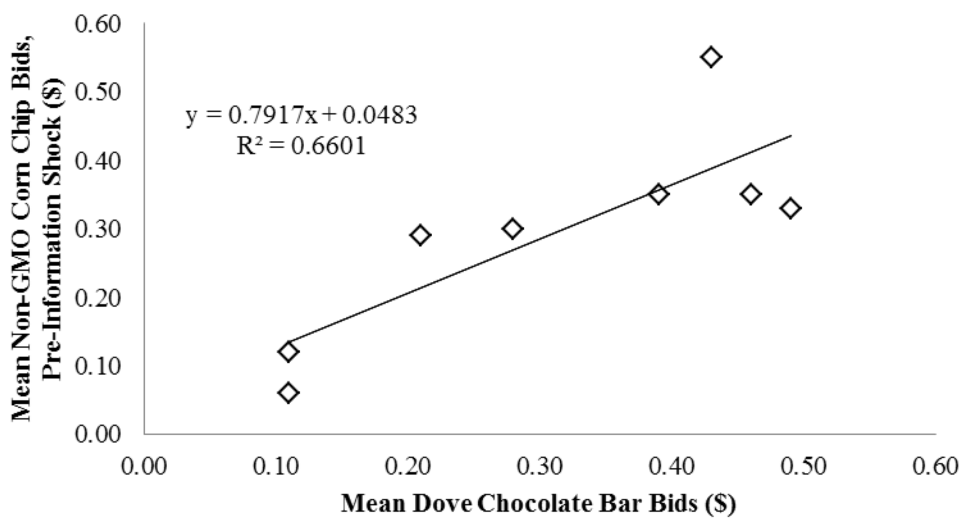



**Figure 5. Scatter plot of mean bids for all practice trials versus mean bids for non-GMO corn chips, pre-information shock trials 1-5. Linear regression with coefficient of determination is included.**

# Chapter 7

## Conclusion

Despite the setback of small sample sizes, present results suggest non-hypothetical experimental auctions have utility in eliciting consumer valuations of food products with/without GM-ingredients. On-going research in this field is recommended due to the changing agricultural and political climate surrounding GMOs in the U.S. food supply. Trying to determine simple answers to consumer attitudes and purchasing behavior with GM food products is a complex task. Non-hypothetical experimental auctions may be one of the better techniques for replicating the decision process undergone by consumers faced with food products in retail stores, but as we have demonstrated in this study, the accuracy of this replication is dependent on the consumer population (e.g. demographics, knowledge levels, pre-existing attitudes, etc.) and the nuances of auction methodology (e.g. instruction sets, information shocks, market feedback, etc.). As health-conscious consumers increasingly look for organic and non-GMO food labels, it will be of critical importance to provide guidance to the food industry on how to address concerns about GM-ingredients in food products. Future research directed towards understanding which appeals show significant changes in willingness-to-pay a premium for non-GM foods will have important implications for food policy and marketing.

# Appendix A

## Food Auction—Experimental Script

**Part A: Introduction**
Thank you for agreeing to participate in today's session. Please use your assigned ID number to log in to your computer station and to identify yourself during this research session. We use random numbers in order to ensure confidentiality. Before we begin, I want to emphasize that your participation in this session is completely voluntary. If you do not wish to participate in the experiment, please say so at any time. Non-participants will not be penalized in any way. I want to assure you that the information you provide will be kept strictly confidential and used only for the purposes of this research.

Please review the consent form at this time. In today's session, we are ultimately interested in your preferences for different types of foods, some of which are genetically modified. Before we begin, please follow along as I read a working definition of genetic modification:

*Genetic modification involves new methods that make it possible for scientists to create new plants and animals by taking parts of genes of one plant or animal and inserting them into the cells of another plant or animal. This is sometimes referred to as biotechnology or genetic engineering.*

I will now go through a set of instructions with you and will read from this script so that I am able to clearly convey the procedures. Importantly, from this point forward, I ask that there be no talking among participants. Are there any questions before we proceed?

In today's session, we are interested in your preferences for genetically modified foods. To determine how much these foods may be worth to you, we are going to conduct a series of auctions. It is important to know that we will be running two auctions at the same time. The computer will keep your bids organized and we will all be following the same procedures together.

First, let me say that I realize the procedure may be a bit confusing. We will conduct a candy bar auction <u>as practice</u> so that you will have a chance to learn how the experiment works. I will also provide an example that should help to further clarify any confusion you might have.

**Part B: Candy Bar Auction**
For agreeing to participate in this research session, we are giving each of you \$2.00 and one free Hershey's chocolate bar. The Hershey's bar is yours to keep, but please do not eat it just yet. I will now conduct an auction where you have the opportunity to exchange your Hershey's chocolate bar for a Dove chocolate bar. You may prefer to have a Dove bar rather than the Hershey's bar. Therefore, I'm interested in how much of the \$2.00 you are willing to spend in order to exchange your Hershey's bar for the Dove bar.

Let me explain how the auction will proceed:

Auction Procedures

1. First, you will use the computer to indicate the greatest amount of money you are willing to pay to exchange your Hershey's bar for the Dove bar. This is the amount of money you would pay me from your $2.00 so that you may have a Dove chocolate bar instead of a Hershey's bar.
   *Note: Your bids are private information and should not be shared with anyone.*

2. After you've finished submitting your bid, the system will rank all bids from highest to lowest.

3. In each auction, the four highest bids for the Dove bar will win. The individuals that submitted the four highest bids will *only pay the 5th highest bid amount* to trade their Hershey's bar for a Dove bar.

4. The four highest bids and the winning price in each auction (the 5th highest bid) will be electronically displayed to all bidders in that auction.

5. Everyone will start with their full $2.00 again as the auction is repeated for **two** additional rounds. This allows for different winners in each of the three rounds.

6. At the completion of the third round, I will randomly draw a number 1–3 to determine the binding round. *For example, if I randomly draw the number 3, then I will ignore outcomes in all other rounds and only focus on the winning bidders and price in round 3. Importantly, all rounds have an equally likely chance of being the winning round.*

7. Once the binding round has been determined, the four winning bidders from each auction will be recorded. At the end of the experiment, eight total winners (four from each auction) will come forward and will pay the 5$^{th}$ highest bid from their auction to trade their Hershey's chocolate bar for the Dove bar. All other participants will pay nothing but will only keep their Hershey's bar.

Important Notes

• You will only have the opportunity to win an auction for one candy bar. Because we randomly draw a binding round, you cannot win more than one candy bar. You will either complete the auction with one Dove bar OR one Hershey's bar, and some amount of money.

• The four winning bidders will actually pay from their two dollars to exchange their Hershey's bar for the Dove chocolate bar. This procedure is not hypothetical. You cannot bid more money than the $2.00 you've received for this part of the experiment.

• In the auction, the best strategy is to bid exactly what it is worth to you to trade your Hershey's bar for the Dove bar. Consider the following: if you bid less than it is worth to you to trade your Hershey's bar for a Dove bar, you may end up losing the auction even though you could have traded your Hershey's bar at a price you were actually willing to pay. Conversely, if you bid more than it is worth to you to trade your Hershey's bar for the Dove bar, you may end up having to trade your Hershey's bar at a price higher than you really wanted to. Thus, *your best strategy is to bid exactly what it is worth to you* to trade your Hershey's bar for the Dove bar.

• It is acceptable to bid $0.00 for the Dove bar in any round. This would mean that you are not willing to pay a premium for the Dove over the Hershey's bar.

• Importantly, we are interested in what it is worth to you to trade your Hershey's bar for the Dove bar. We are not interested in your total value of the Dove bar, only the amount of the exchange. In other words, what is the *premium* you would place on the Dove bar versus the Hershey's chocolate bar?

**Part C: Auction Example**
Suppose there were 10 people participating in an auction just like the one you are about to participate in. Suppose that these individuals participated in 3 auction rounds, as you will, and that the 2nd round was randomly selected to be binding. Now, suppose in round 2, Participant #1 bid $0.00 to exchange their Hershey's chocolate bar for the Dove bar, Participant #2 bid $0.03, Participant #3 bid $0.06, Participant #4 bid $0.09, Participant #5 bid $0.12, Participant #6 bid $0.15, Participant #7 bid $0.18, Participant #8 bid $0.21, Participant #9 bid $0.24, and Participant #10 bid $0.27 to exchange their Hershey's bar for the Dove bar. To further illustrate, the bids in round 2 were as follows:

| Participant # | #1 | #2 | #3 | #4 | #5 | #6 | **#7** | **#8** | **#9** | **#10** |
|---|---|---|---|---|---|---|---|---|---|---|
| Bid Amount | $0.00 | $0.03 | $0.06 | $0.09 | $0.12 | **$0.15** | $0.18 | $0.21 | $0.24 | $0.27 |

*Who would win the auction?*
Participants #10, #9, #8, and #7 would win the auction because they were the four highest bidders.

*How much would participants #10, #9, #8, and #7 pay to exchange their Hershey's bar for the Dove bar?*
They would pay the 5th highest bid amount, which was $0.15.

Thus, participants #10 through #7 would pay $0.15 and exchange their Hershey's bar for a Dove chocolate bar. Participants #1 through #6 would pay nothing but only take home the endowed Hershey's bar.

*Note: these dollar amounts were used for illustration only and should not in any way reflect what the candy bars may be worth to you.*

Do you have any questions before we begin the practice auction?

**Part D: Corn Tortilla Chip Auction**
Now that you have had the chance to learn how the auction will work, we are interested in your preferences for two types of corn chips.

For agreeing to participate in this research session, we are giving each of you an additional $4.00 and a free bag of tortilla chips. These chips are yours to keep. We also want you to know that these chips conventionally processed corn tortilla chips that were made with genetically modified (GM) ingredients.
Although you have been given these chips for free, we will give you the opportunity to participate in an auction to obtain a different type of tortilla chips, if you so desire. Here in the front of the

room are certified organic corn tortilla chips made with NO genetically modified ingredients (i.e. non-GMO). Other than differences I just described, the non-GMO chips are the same size, weight, and taste as the chips that you have been given.

We will now conduct an auction, where you will have the opportunity to exchange your conventional tortilla chips (GM chips) for tortilla chips made with NO genetically modified ingredients (GMO free chips). In a moment, you will be asked to indicate the greatest amount of money you are willing to pay using the $4.00 to exchange your tortilla chips for the non-GMO tortilla chips by entering bids on the computer. The procedures for this auction are exactly the same as the chocolate bar auctions, with one exception: *we require that all participants eat at least two of their chips at the end of the auction*.

To refresh your memory as to how the auction works, I will go through the instructions again:

1. First, you will use the computer to indicate the greatest amount of money you are willing to pay to exchange your endowed chips for the chips made with NO genetically modified ingredients. This is the amount of money you would pay me using the $4.00 so that you may eat certified non-GMO chips instead of conventional chips made with genetically modified ingredients.
   *Note: Your bids are private information and should not be shared with anyone.*

2. After you've finished submitting your bid, the system will rank all bids from highest to lowest.

3. The four highest bids in each auction will win the non-GMO tortilla chips. The individuals that submitted the four highest bids will *only pay the 5th highest bid amount* to exchange their conventional corn chips for the certified non-GMO corn chips.

4. The four highest bids and the winning price in each auction (the 5th highest bid) will be electronically displayed for all bidders in that auction to see.

5. We will then re-conduct the auction for **nine** additional rounds in which everyone bids with their full $4.00.

6. At the completion of the tenth round, I will randomly draw a number 1–10 to determine the binding round. *For example, if we randomly draw the number 3, then we will ignore outcomes in all other rounds and only focus on the winning bidders and price in round 3. Importantly, all rounds have an equally likely chance of being the winning round.*

7. Once the binding round has been determined, the four winning bidders from each auction will be recorded. At the completion of the experiment, the winners will come forward and pay the $5^{th}$ highest bid amount from their auction to exchange their corn tortilla chips for the certified non-GMO corn tortilla chips. All other participants will pay nothing **but will have to eat at least two of the conventional corn tortilla chips made with genetically modified ingredients that have been given to them**.

Important Notes

• You will only have the opportunity to win an auction for one bag of chips. Because we randomly draw a binding round, you cannot win more than one bag of chips from this auction.

• The winning bidders will actually pay money to exchange their conventional chips for non-GMO chips. *This procedure is not hypothetical*. You cannot bid more than the $4.00 you've received for participating in this corn tortilla chip auction.

• We will also expect every participant to eat at least two chips at the conclusion of the auction.

• In this auction, the best strategy is to bid exactly what it is worth to you to exchange your chips for the chips with NO genetically modified ingredients.

• It is acceptable to bid $0.00 in any round. This would mean that you are not willing to pay a premium for chips made with NO genetically modified ingredients.

• Importantly, we are interested in what it is worth to you to exchange your corn tortilla chips made with genetically modified ingredients for certified non-GMO chips.

Do you have any questions before we begin?

# Appendix B

## Vignettes

### Treatment One: Appeal to Example of Changed Viewpoint

In the '90s, British environmentalist Mark Lynas, was one of the founders of the anti-GMO movement. In early 2013, he publicly withdrew his past position on GMOs at the Oxford Farming Conference. Below are excerpts from this speech:

*I want to start with some apologies. For the record, here and upfront, I apologise for having spent several years ripping up GM crops. I am also sorry that I helped to start the anti-GM movement back in the mid 1990s, and that I thereby assisted in demonising an important technological option which can be used to benefit the environment…*

*...I don't know about you, but I've had enough. So my conclusion here today is very clear: the GM debate is over. It is finished. We no longer need to discuss whether or not it is safe – over a decade and a half with three trillion GM meals eaten there has never been a single substantiated case of harm. You are more likely to get hit by an asteroid than to get hurt by GM food. More to the point, people have died from choosing organic, but no-one has died from eating GM.*

*...As I did 10 years ago, Greenpeace and the Soil Association claim to be guided by consensus science, as on climate change. Yet on GM there is a rock-solid scientific consensus, backed by the American Association for the Advancement of Science, the Royal Society, health institutes and national science academies around the world.*

*Yet this inconvenient truth is ignored because it conflicts with their ideology...Farmers should be free to choose what kind of technologies they want to adopt. If you think the old ways are the best, that's fine. You have that right. What you don't have the right to do is to stand in the way of others who hope and strive for ways of doing things differently, and hopefully better. Farmers who understand the pressures of a growing population and a warming world. Who understand that yields per hectare are the most important environmental metric. And who understand that technology never stops developing, and that even the fridge and the humble potato were new and scary once.*

*So my message to the anti-GM lobby, from British aristocrats and celebrity chefs to the US foodies to the peasant groups of India is this. You are entitled to your views. But you must know by now that they are not supported by science. We are coming to a crunch point, and for the sake of both people and the planet, now is the time for you to get out of the way and let the rest of us get on with feeding the world sustainably.*

**Treatment Two: Appeal to Classic/Trusted Authority**

There is consensus among the world's leading health organizations and regulatory agencies that GMOs are safe:

**The American Medical Association**
*Chicago, USA*
"There is no scientific justification for special labeling of genetically modified foods. Bioengineered foods have been consumed for close to 20 years, and during that time, no overt consequences on human health have been reported and/or substantiated in the peer-reviewed literature."

**The National Academy of Sciences**
*Washington, USA*
"To date more than 98 million acres of genetically modified crops have been grown worldwide. No evidence of human health problems associated with the ingestion of these crops or resulting food products have been identified."

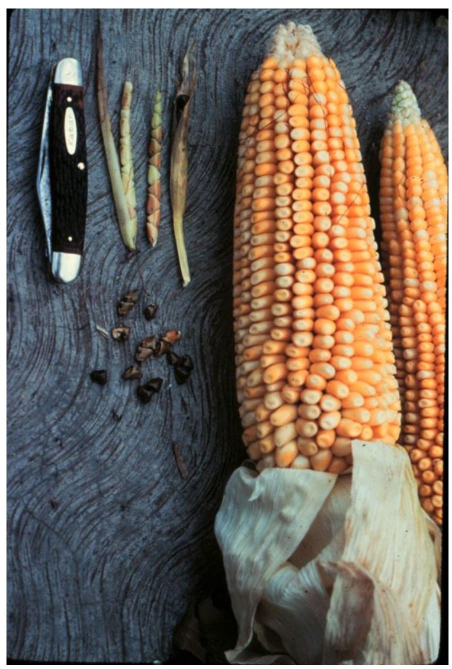
**The European Commission**
*Belgium*
"The main conclusion to be drawn from the efforts of more than 130 research projects, covering a period of more than 25 years of research, and involving more than 500 independent research groups, is that biotechnology, and in particular GMOs, are no more risky than conventional plant breeding technologies."

**World Health Organization (WHO)**
*Switzerland*
"No effects on human health have been shown as a result of the consumption of GM foods by the general population in the countries where they have been approved."

**Treatment Three: Appeal to Modern Progress**

The modification of food's genetics by humans is nothing new. This process began ~10,000 years ago when man started to cultivate wild varieties of grains like wheat, maize and barley. Seeds from the most desirable plants were sown in the next harvest, and through a process of artificial selection, important food crops transformed into their present forms.

As an example, recent research has shown maize (corn) evolved from a species of *teosinte* originally found in southwestern Mexico. The cob has expanded from less than 12 kernels in teosinte, to over 500 in maize. And through selection, the hard, stony covering protecting the fruit has been eliminated, leaving the kernels exposed. These and a number of other modifications have transformed maize, satisfying the nutritional needs of modern day humans and animals.



Although the modern plants that emerged over the last 10,000 years have been "genetically modified", this term has been reserved for plants using recombinant DNA technology, which first emerged in the 1970s. Instead of waiting for random mutations to provide desirable traits, the new technology allowed scientists to rapidly introduce useful genes directly into the genomes of various crops. GM crops are engineered to improve the quality of food products, as well as to increase yields and to lower costs of food production. On the horizon are GM crops that can grow in inhospitable corners of the earth, such as dry and salty environments, that don't naturally currently support food growth.

**Treatment Four: Appeal to Societal Usefulness**

The world's population is expected to grow from 6 billion today to about 8 billion by 2030. Feeding all of these people and reducing hunger will require advances in food production and distribution to enhance food supplies without damaging the environment. Agricultural biotechnology – specifically genetically-modified (GM) food crops – is one tool that holds great promise for alleviating hunger and poverty.

Today, one-fifth of the population in the developing world (800 million people) does not have sufficient food to meet human needs. Malnutrition plays a significant role in half the nearly 12 million deaths each year of Third World children under five. Growing enough staple crops – such as corn, rice, wheat, yams, and potatoes – without further expanding the amount of land that must be cultivated requires substantial increases in yields per acre. GM food crops have lived up to their promise of providing increased yields with lower pesticide use and at a lower cost to the consumer.

Genetic engineering also has the potential to provide much needed micronutrients (i.e., vitamins and minerals) to the malnourished of the world. One example is the recent development of GM rice that produces a vital precursor of vitamin A, dubbed "golden rice". Golden rice has the potential to mitigate hundreds of thousands of cases of blindness in the developing world, and yet it remains shelved due to public hesitation about GMOs.

**Treatment Five: Precautionary Principle (Control)**

The following statement was published online by Civil Eats:

*The safety of GMO crops for human consumption has not been adequately assured. Several studies from the National Academy of Sciences have affirmed that GMO crops have the potential to introduce new toxins or allergens into our food and environment. Yet, unlike the strict safety evaluations for approval of new drugs, there are no mandatory human clinical trials of GMO crops, no tests for carcinogenicity or harm to fetuses, no long-term testing for human health risks, no requirement for long-term testing on animals and limited testing for allergenicity. Some studies raise concerns that GMO foods may pose an allergen risk.*

*Supporters of GE in agriculture point to a multitude of potential benefits of engineered crops, including increased yield, tolerance of drought, reduced pesticide use, more efficient use of fertilizers, and the ability to produce drugs or other useful chemicals. However, analysis by the Union of Concerned Scientists shows that actual benefits have often fallen far short of expectations and that GE crops have the potential to cause a variety of environmental impacts, including the spread of "superweeds."*

*While the U.S. lacks a labeling requirement for GMOs, 61 other countries, including the European Union, Australia, New Zealand, Japan, Korea, Brazil and China, have adopted one. Polls show that consumers in this country demand transparency in the foods they buy and eat and overwhelmingly support labeling of GMO food...*

*Until a label is mandated, consumers who wish to avoid GMO foods can buy USDA certified organic, as the organic standards prohibit the use of GMO ingredients, products from the Non-GMO Project, or buy unprocessed foods such as fruits and vegetables and avoid packaged food, much of which contains GMO ingredients.*

Founded in January 2009, Civil Eats is a community resource of over 100 contributors who are active participants in the evolving food landscape from Capitol Hill to Main Street. The organization aims to "publish stories that shift the conversation around sustainable agriculture in an effort to build economically and socially just communities".

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# ACADEMIC VITA


## AMANDA HOFSTAEDTER

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### EMPLOYMENT HISTORY

**Undergraduate Research Assistant, Food Science Sensory Lab** – *University Park, PA*

August 2011 – Present

- Perform one-on-one testing sessions to collect data for a comprehensive study of chemesthetic and genetic differences
- Provide assistance with implementation of sensory evaluation and consumer tests, and data analysis using Compusense 5

**RDQ&I Intern in Beverages, Kraft Foods, Inc.** – *Tarrytown, NY*

May 2013- August 2013

- Leveraged cross-functional support in the design of a quantitative mainstream coffee consumer study
- Successfully managed the production of over 42kg of roasted and ground coffee within time limitations
- Collaborated with the sensory group to collect, analyze, and interpret data for topline recommendations

May 2012 – August 2012

- Assessed the feasibility of utilizing identified health and wellness ingredients in ready-to-drink beverages
- Developed fortification prototypes on the bench top and in the pilot plant with minimal supervision
- Conducted shelf life and stability assessment of prototypes – organoleptic and analytical

**Instructional Developer, ITS Training Services** – *University Park, PA*

May 2011 – May 2012

- Created online training modules, revised for accessibility, and proofed University quick start guides for official submission
- Developed proficiency in operating Microsoft Office 2007 and Adobe Software

### LEADERSHIP DEVELOPMENT

**Undergraduate Teaching Assistant, Food Science Department** – *University Park, PA*

January 2013 – December 2013

- Led instruction for junior-level food science laboratory course, Chemical Methods of Food Analysis
- Graded quizzes, lab reports, and exams for senior-level Technology & Science of Plant Foods
- Offered weekly office hours to assist students in their understanding of course materials

**Secretary, Food Science Club –** *University Park, PA*

August 2011 – May 2013

- Acted as a liaison between students, alumni, faculty and staff within the Food Science Department by promoting open communication through e-mail, weekly newsletters, and website maintenance
- Corresponded with professional organizations on behalf of club members for continued student outreach

**Vice President of Spring 2012 Pledge Class, Gamma Sigma Sigma** – *University Park, PA*

February 2012 – May 2012

- Demonstrated the values of service, friendship and equality as a pledge member of a non-exclusive, service sorority
- Solely responsible for organizing the efforts of the current pledge class and a partner service fraternity to plan a "Senior Prom for Senior Citizens" with a local retirement community

**Student Representative, Student Alcohol Advisory Committee** – *University Park, PA*

November 2010 – May 2012

- Convened with student and faculty leaders to strategically mitigate high-risk drinking on campus

## EDUCATION

**The Pennsylvania State University**
University Park, PA
***Schreyer Honors College***
*The College of Agricultural Sciences*
B.S. Food Science, May 2014

## HONORS AND AWARDS

**2011-2012, 2012-2013, 2013-2014 IFT Feeding Tomorrow Scholarship**
**2013 PSFIG Student Leadership Award**
**Winner of 2013 PSU Civic Engagement Public Speaking Contest**
**Philadelphia IFT Scholarship 2012, 2013**
**The Doylestown Rotary Scholarship 2010, 2011, 2012, 2013**
**Dean's List Fall 2010 – Fall 2013**
**3-A SSI 2011 Student Travel Scholarship Award**
**The President's Freshman Award, 2011**
**The Ronald McDonald House Charities Scholarship 2010**
**Bucks County Chamber of Commerce's Young Citizen Award 2009**

## CERTIFICATIONS

**RAMP Server/Seller** (2014-Present)
**HACCP** (2013-Present)
**CPR-AED** (2013-Present)
**Wilderness First Aid/SOLO** (2013-Present)
**ServSafe** (2010-Present)