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An Analysis of Consumers' Knowledge and Perceptions in Relation to Genetically Engineered (GE) Cotton: Marketing & Utility

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An Analysis of Consumers' Knowledge and Perceptions in Relation to Genetically Engineered (GE) Cotton: Marketing & Utility

by

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Dedication

In dedication to my family who have encouraged me, my professors who had supported me, and the consumers that make the business of marketing and product development an ever fascinating field. Thank you.

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Abstract

An Analysis of Consumers' Knowledge and Perceptions in Relation to Genetically Engineered (GE) Cotton

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Abstract: Cotton makes up a majority of the world's fiber market, with genetically engineered (GE) cotton the current staple of the US agricultural landscape. With GE cotton's overall acceptance for US farmers and manufacturers, it is of concern that the majority of literature concerning GE crops primarily compares negative attitudes towards GE *food* crops in stricter economies such as the European Union. Due to the inadequate literature regarding both the market advantages and consumer perceptions of GE cotton specifically, this study was conceived to provide marketers with a baseline analysis of the factors that affect US consumers' current attitudes (knowledge, risk perceptions, etc.) regarding GE cotton. Multiple regression analyses were used for our models which measured purchase intentions towards GE cotton and perceived risks of GE cotton based on both intrinsic and extrinsic factors. Paired and single *t*-tests were performed to predict the current positioning of GE cotton as a marketable alternative to organic and conventional cotton, and to determine which institutions consumer's trust most for information on the risks and benefits of GE cotton. Our studies showed that while knowledge of

cotton and agriculture is low, GE cotton was regarded more positively than conventional cotton with the potential to improve in consumer's opinions. According to our findings, by efficiently communicating the benefits of GE cotton through trusted channels of communication (i.e. scientists, consumer organizations, the media), particularly addressing ethical concerns, policy regulation, and how the product is useful to the consumer individually, GE cotton could become a comparative market alternative to organic, at a greater available supply.

Table of Contents

List of Tables

List of Figures

Chapter 1: Introduction

Fibers are a high-demand commodity in today's ever populating world, and likewise, biotechnology, a growing field in itself, has stepped into this industry as well. Due in part to this partnership, this paper examines the consumer's awareness and attitudes towards the process of and end products produced through genetic engineering (GE). Specifically, this study examines perceptions when applied towards GE cotton rather than the well-documented topic of genetically altered foods. We justify this approach with three major points. The first is that a number of other studies have speculated this same connection between consumer "awareness" and attitudes towards GE products, even though most of these concentrated on its application in foods (Font, 2009). Secondly, it is justified by the fact that there is a bare amount of research found to focus on specific product categories, which is inadequate at best and potentially hazardous to market growth on all levels (Economist, 2004). And finally, as a result of said deficiencies in research, the concept of risk from the invaluable consumer's perspective is also negligibly addressed as well, again as relates to non-food produce (Gaskell, et al., 2004). These lacks are perhaps most felt when considering the diminished amount of research directed at the consumer's vs. the producer's perspective on textile crops, in particular (Puduri, Govindasamy, Lang, & Onyango, 2005). Given the prominence of cotton fibers through trade, cultivation, and research (ISU & AgMRC, 2011), and also given its status as the most widespread non-food GM crop (Economist, 2004), the subject of GE cotton could naturally be seen as an internationally

relevant focus of research. The US specifically is particularly invested in cotton futures as one of the leading producers of cotton, and especially GE cotton, world-wide.

Using the idea of a sliding scale, this study seeks to measure the consumer's perception of risk for GE cotton in relation to the two major classes known to the market, organic and conventional. According to Moschini's demand framework (Moschini, Bulut, & Cembalo, 2005), genetically-modified, organic and conventional products are differentiated by consumers, at least in relation to food. We would evaluate, therefore, whether this distinction might extend towards fibers as a potentially lower risk, high demand product category. Investigation into this field is deemed critical since research into crop improvement, including fiber quality, yield, and safety, has grown so rapidly in response to world demand, specialized product applications, and the consumer's 'need to know'. Today, the average consumer is much more concerned about product value and choice in today's economic climes. What adds weight to the issue is the highly controversial position of genetic sciences across several nationalities and industries (Bruhn C. M., 2003; Kuzma, Najmaie, & Larson, 2009) at the same time as experts have noted a sharp decline in the US textile industry and many natural fibers' market share over the past decade (FAO, 2009; Tencalla, 2005; ISU & AgMRC, 2011). When focused on product categories typically known for their 'common' status (i.e. fibers-to-clothing), industry-specific research could be the key to enlightenment and new opportunities within the B2C market.

From this reasoning, we conceived of this current study to determine where genetically engineered cotton fibers might rate between organic and conventional cotton in a more adaptive, national market such as the US. Despite the controversy surrounding the technology behind GE crops, we will attempt to support Frewer's findings that perceptions are more variable when

applied to specific applications or product categories (Frewer, Howard, & Howard, 1997). With our results, we hope to provide an initial resource of quantitative data upon which textile professionals can base their marketing and product development decisions, farmers can empirical weigh the benefits of GE cotton adoption, and regulatory-based economies can reopen the debate on GE crop utility and benefits. We also hope with this research, to encourage further investigation on how genetically engineered products are currently perceived across several other product categories and countries as a way to improve the acceptance of biotechnology in less documented industries. In order to accomplish these goals, or even conceive of possible hypotheses, we must first, clearly set the parameters of our study.

Study Parameters

Definition of Genetic Engineering

Before discussing the literature and general characteristics of GE cotton, it is important to identify the parameters of what we define as genetic engineering for the purposes of this study. For this research, our working definition of genetic engineering is contained within two functional parameters: 1. that products identified as genetically engineered are not lab-created into infinitum (for example, a cut of meat cloned to its end product, minus the full creation of a functional animal). And 2. This study will not term organisms or by-products produced from traditional, selective breeding practices in its identification of genetically engineered technology. This distinction must be made as it is through biotechnology or the technology of genetic engineering that we have such GE crop varieties as that of GE cotton. Instead, genetic

engineering, at its simplest form, will be defined as "the direct human manipulation of an organism's genetic material in a way that does not occur under natural conditions" (The European Parliament & the Council of the European Union, 2001). In short, GE is the specific genre of biotechnology that has led to the creation of "GE" seeds and, further, crops. And while "natural" is often a subject of argument to both the intrinsic and extrinsic qualities of ethics (Verhoog, 2003), the significant factor in all genetic engineering is that it is always heritable, making the changes in the affected organism permanent.

Secondly, GM is a common term found in our literature to describe applications of GE technology, most typically referring to crops. To minimize confusion, this study will refer exclusively to "GE cotton"- another term for our topic that is a more direct derivative of its scientific origin- in both our original survey and the body of this work, outside of direct quotes. Following these specifications, the bulk of related research found up to this point merely examines attitudes on genetic engineering in general or as related to certain plant- and animal-based foods (Puduri, Govindasamy, Lang, & Onyango, 2005; Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). To date, there were no resources that gave particular focus on attitudes towards the fiber applications of the technology. This focus on technology vs. application is seen as a disservice for the cotton industry, which is considered "the single most important textile fiber in the world" (ISU & AgMRC, 2011). With the trends of high-tech solutions, sustainable agriculture and marketing initiatives (Cotton Inc., 2007), GE cotton was a natural choice as a specific product of biotech research on which to focus our consumer study.

Agricultural Crop: Fiber vs. Food

Genetic-modification has been a common practice in farming over several centuries, going by the term "breeding" to instill desired traits in both crops and animals (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). During the1980s, modified crops were increasingly created through the technological revolution of gene insertion, a morally debatable method of acquisition, and one which has brought into account the importance of consumer attitudes and awareness on crop utility (Kershen, 2010). Since then, awareness, a combination of both knowledge and communication between the scientific community or industry and the lay consumer (Gaskell, et al., 2004; Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006) and attitudes, which can be described as the common position one takes given specific topics, have maintained a controversial and highly fluctuating line. Roberts *et al* (2006) also support that GE crops- and foods especially- have come to bear the brunt of this discourse due to their higher perceived risk by consumers, which is often motivated by a simple lack of communication and insufficient information. Today, the United States of America is one of a growing number of countries known as both leaders in international trade markets and as serious adopters of biotechnology in their agricultural sector, from produce to fiber crops (NAAS, USDA, & ASB, 2010). Given the global importance of cotton and the disparity in acceptance of GE crops and animals (ISU & AgMRC, 2011; Coghlan, 2006), we believe that research aimed at this specific product, GE cotton, is much needed in today's ever more global market.

Cotton itself is technically defined as both a fiber and food crop, due to cotton seed oil being commonly used in cooking products such as margarines and vegetable oils, even though it is often perceived as a non-food crop (Economist, 2004; ISU & AgMRC, 2011). So far, the

majority of literature that has emerged since the first commercial sale of genetically engineered produce in the 1990s has focused primarily on food applications (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Frewer, Howard, & Shepherd, 1995; Puduri, Govindasamy, Lang, & Onyango, 2005). GE cotton deserves similar levels of study due in part to the fact that much of the US economy depends on its cotton industry. According to statistics released by the US Department of Agriculture (NAAS, USDA, & ASB, 2010), 5.7 of the total 10.7 million acreage of US Upland cotton was produce in a single state, Texas, and 93% of all were of GE varieties. Essentially, this exemplifies how widely GE cotton has already been accepted, knowingly or unknowingly, by US and international consumers (Economist, 2004). The ability of the US market to truly promote GE cotton as at least comparative to organic or conventionally-grown cotton is severely limited without an honest evaluation of GE fiber positioning. Since the natural fiber industry has sought to make cotton an international brand through numerous campaigns, this oversight is even more puzzling. Our study would, therefore, act as the first step towards an understanding of consumer attitudes towards GE cotton and the constructs believed to significantly affect these outlooks. We will determine consumer awareness of the technology behind GE cotton and its common factors of concern. And, finally, provide quantitative data for the cotton industry as to where GE cotton may rate in-between organic and conventional as a marketable alternative, based on current attitudes and risk perceptions of US consumers.

As far as previous literature aides, we did discover several studies concerning genetic modification of plants, animals, and, overall, food. Yet only two articles were found to directly examine the advancement of genetic engineering in currently available apparel applications, these revolving around cotton fibers specifically (Economist, 2004; Puduri, Govindasamy, Lang,

& Onyango, 2005). In the US, cotton holds the title of being the major fiber crop and the fourth largest agricultural crop, with approximately 10.9 million acres dedicated to its cultivation as of 2010 (NAAS, USDA, & ASB, 2010). Of these top four however, it is telling that three crops, corn, soybeans, and cotton, also use biotechnology or genetically-engineered (GE) varieties in their overall statistics (2010). This places cotton on par with the growth of concern for GE produce in its pervasiveness in today's market.

What makes GE cotton the more unique is how it has, so far, gone largely unnoticed by anti-GE groups (Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). It is speculated that this is due to cotton not typically being considered a food crop, and therefore of lower risk and focus in the typical, international controversy surrounding genetic engineering (Economist, 2004). Whatever its method of avoidance, GE cotton itself has already been very well dispersed into the textiles market- a fact that has been seemingly kept down-played since its beginnings- as it is currently produced in great volume within a limited number of countries worldwide (Font, 2009). Cotton can also claim the classification as 'food' due to its crop nature and food by-products (ex. cotton seed oil), though this too has often gone under the radar (Economist, 2004), even among typically more environmentally-sensitive European consumers. A further look into the disparity in opinions on the topic of GE technology and between different nationalities will be examined at length later in this paper.

Research Objectives

O1: To analyze the relationship between US consumers' knowledge and their perceptions of risk regarding GE technology as applied to specific, non-food agricultural crops (i.e. GE cotton).

O2: To confirm and segregate who are the most likely adopters of GE cotton products based on consumers' intrinsic attributes, extrinsic attributes, and demographics.

O3: To investigate to what degree our study's factors affect consumers' preferences and attitudes towards GE cotton.

O4: To make an initial argument that GE cotton could be perceived as a positive compromise 'in-between' the conventional cotton and organic cotton markets in the U.S.

O5: To explore the need by industry to correctly communicate consumer relevant information, not simply scientific knowledge, in order to reduce perceived risks for consumers.

Chapter 2: World Cotton Industry

National Perceptions and Consumption

From our literature, perceptions of different cotton types have been found to vary to some extent, based on the demographic population tested, factors compared, and the social and ethical values of respondents (OECD, 2008). Particularly, Puduri includes the demographic factors of consumers' affiliations under what is defined as value attributes, and which can include their moral, political and social leanings (Puduri, Govindasamy, Lang, & Onyango, 2005). These values, which have been broken into both demographic indicators (2005) and intrinsic attributes such as consumers' social and ethical values (Frewer & Shepherd, 1995b) for the purposes of this research, were some of the most relevant determinates across all literature. We also see that the more information that is acquired about GE-created products through trusted sources, the more positively consumers view the benefits and risks associated with such goods, given certain application (Ronteltap, Trijp, Renes, & Frewer, 2007; Frewer, Howard, & Shepherd, 1995). This communication is seen to be especially true among American consumers (Frewer, Howard, & Shepherd, 1995; Bruhn, 2003), yet pose the highest restrictions on continents such in Africa and Europe, whose people typically have lowered trust in government entities (Reuters, 2010; Font, 2009).

United States of America

The U.S. cotton industry itself has a very long and varied history, as just about any generational, cotton farmer can attest. The first cotton to be grown for hundreds of years was in-fact, what we now label as organic cotton, as it was produced without the use of chemical pesticides and fertilizers, and was much more labor-intensive to harvest to best results (Klara, 2010). Yet around the turn of the century, the demand for more physically perfect textiles and at higher yields became overwhelming (Rieple & Singh, 2010) as the growth of man-made fabrics began to take strides into the market. What followed was what Wilkins (2001) refers to as the Chemical Revolution, and was a response that would affect consumers and producers into the current day. Beginning in the 1950s, chemicals were developed that initially seemed much preferable as they staved off such pests as the bollworm and cutworm, which had led to severe problem in areas of farming worldwide (OTA, 2011). Chemically enhanced fertilizers were soon developed to work synchronously with chemical pesticides to help plants fight off crop killing diseases and rot that could severely reduce yield. It was not until the 1980s, however, that laws began to make limitations on the use of these chemicals and a changed consciousness began to grow about potential, harmful effects, to both humans and the environment, through such heavy use of these alternatives (Rieple & Singh, 2010; OTA, 2011).

Since then, the science of crop development has moved into the realm of technology over tradition with the first genetically-modified produce distributed in 1994 (Kuzma, Najmaie, & Larson, 2009). As of 2004, the US is one of the limited number of producers of GE crops, all of whom collectively accounted for 96% of world cultivation. Throughout these advancements, the US government has acted as the major oversight system for US genetically engineered organism

(GEO) development for the past three decades. Three major, federal agencies- the EPA[1], FDA[2], and USDA[3]- have regulated the development and distribution of these products (Kuzma, Najmaie, & Larson, 2009). These bodies work separately and in tandem to pass national regulations on what may or may not be produced in the US. Unlike many other nations, the US do not enforce a strict code for labeling of 'advanced' products, GE or otherwise. Since such restrictions have been determined to decrease the benefit of producing GE crops in European countries due to the costs of segregation and labeling (Lassoued & Giannakas, 2010; Moschini, Bulut, & Cembalo, 2005), it is speculated that GE is and will continue to be a more economical choice in the more market-driven economies. American consumers are, for the most part, not willing to pay significantly more to avoid gene-altered foods (Font, 2009), nor to acquire organic products (Cotton Inc., 2007). As this stance could show implications across several other product categories, especially in the fiber and textiles market, a further look into the effect of pricing is essential. As we will discuss later in this paper, price concerns and how the consumer measures the value of GE products has cross-national bearing (OECD, 2008; Puduri, Govindasamy, Lang, & Onyango, 2005). Such issues can have long-term effects on both the purchase behavior by consumers, as well as the continued applications of GE technology in agriculture.

[1] US Environmental Protection Agency

[2] US Food and Drug Administration

[3] US Department of Agriculture

Europe

Valuation and social issues are the main distinctions we see between the US and European consumer. While organic and non-engineered foods steadily command a premium in purchasing patterns among the countries of the European Union, such regulations and prohibitions are uncommon among American consumers (UCSD & Aroian Lab, 2011). Though the agri-food industry is *the* leading industrial sector in Europe (Tencalla, 2005), technical innovation has continued to be a slow process in one of largest markets in the world. As an illustration: in relation to crop-to-plate utility, it was found that 58% of Europeans are opposed to GEOs (Reuters, 2010), and that maize was the exclusive biotech crop allowed up until 2007 in most European countries (Font, 2009). Given the staled state of biotech crops across most of Europe into today, it is irony that, in 2003, the then Minister for Education and Research of Germany, Edelgard Bulmahn, was quoted as being highly optimistic about its growth.

> "Biotechnology is one of the most innovative fields of the 21st century. We expect that, from now to 2020, biotechnological methods will be involved in about half of all important innovations." (Tencalla, 2005)

Extensive regulations on GE crop introduction, labeling, and production in the European market may be just one of the reasons behind this stand-off (The European Parliament & the Council of the European Union, 2001; Lassoued & Giannakas, 2010), while government skepticism and low consumer knowledge could also be factors behind genetic engineering's repulsion by its consumers (Tencalla, 2005). Europe's recalcitrance towards biotechnology,

particularly in its agricultural sector, has meant that countries such as China, Canada, and the United States, who have continued to innovate in both their conventional and GE crops, are quickly leaving EU behind as a market competitor (2005). Still, though Australia and most European countries maintain a higher vigilance on the GEO food they consume, a great deal of thought is rarely given to common place products such as one's clothes, tobacco, or even writing paper (Economist, 2004). This again illustrates the potential in the fiber industry that has so far been ignored. With little direct opposition to GE fiber applications, unlike food whose risk is well conceived, industry professionals and scientist have the opportunity to positively shape openness to application of GE cotton, even in more closed markets (Tencalla, 2005). What works against this progress are the distinct, labeling regimes adopted by the EU, international importers that perpetuates the all-or-nothing position that "agricultural biotechnology creates risks that are unique and different from conventional/organic agricultural products" (Kershen, 2010).

GE cotton can and is being gradually, openly accepted for use in everyday products, however. According to Frewer *et al* (1995), this continued growth is dependent on whether, in future, information is delivered through trusted paths of communication, and by relating information through appropriate and positive social contexts. The point that scientific knowledge is insufficient to determine outcome and perception of new products if "political, economic, and societal factors" are not also taken into the equation (Tencalla, 2005) mirrors our own objectives. This study will support the position that consumer's attitudes and acceptance of GEOs are influenced by multiple factors, as well as the *specific* application's perceived risks and benefits (Frewer, Howard, & Shepherd, 1995) .

Other Nationalities

Besides the historical leader in cotton production, India, China has become a force in recent years, partly due to its booming industrial economy, rising domestic consumption, and recent trade agreements. Between 2001 and 2003, China's cotton industry enjoyed an average increase of 2.5% in production, with GE cotton making up a portion of this account in more recent years (ABARE, March 2006; Figure 1.4). Bt cotton is most commonly used by farmers of the Yangzhe and Yellow River areas as bollworm is a persistent pest for these regions of the China's agricultural belt. Yet the cheaper, conventional cottons are typically used by farmers in regions where this isn't a major concern (ABARE, March 2006). The US has also been a major source of cotton since 2000 (approximately 58% of imports) to meet Chinas rising, domestic demand. This argues that genetically modified fibers are not a large concern, at least for the typical Chinese consumer, though it remains a concern for China as an exporter themselves. As China is becoming a major supplier of textile and apparel goods to Europe, North America, and many other international markets, the concern grows about the sustainability of their cotton industry given the more negative view of GMP (genetically-modified products) some of these patrons hold (Lemaux, 2009; ABARE, March 2006).

Despite some concerns, other countries have begun to at least consider GE cotton for their own fields, due in part to the success rates in the US and Asian markets, even under more difficult climates. Australia has entering into the biotech agricultural market, after following in the footsteps of the EU in limiting their biotech innovation for the past several years (Font,

2009). African smallholders have also begun to test small areas for Bt cotton growth, the most commonly known type of GE cotton (Eicher, Maredia, & Idah, 2006). Although their venture has been less successful to date due to institutional disadvantages, not the actual cotton production capabilities, several African countries have instigated government biosafety regulations and restrictions on gene-crops over the last few years (Reuters, 2010). These regulations were initially a "spillover" of many European concerns on safety and institutional ethics (Eicher, Maredia, & Idah, 2006), yet today are being utilized as a way of standardizing and controlling production and its effects with the potential of expanding GE farming in several countries (Kumwenda, 2011).

As of 2010, the only countries outside of the US to have not instigated a labeling regime for GE products in some form consist primarily of the major producers of said crops, including Argentina and Canada (Lassoued & Giannakas, 2010). This significantly affects the reach within each market, but is not a 'deal breaker' in any sense. As we discuss, cotton has the admirable trait of being a low-risk crop since it is typically not known for its use as a food additive (Economist, 2004) and is ever a high demand good for apparel applications (ISU & AgMRC, 2011). It is only through evaluation of how consumers, not just professionals, rate the different categories of cotton within the overall cotton market that a true understanding of GE cotton's future potential and research requirements will become evident.

Chapter 3: Cotton Classifications

Organic Cotton

Organic cotton, as noted previously, is what one might reasonably label cotton produced before the 1920s (Rieple & Singh, 2010). Organic cotton defines the method of cultivation in which no chemical fertilizers, pesticides or synthetic plant-food additives are used on a farmer's crop. The demand for this type of 'cleaner' cotton reemerged in the 1980s after several new regulations had been placed on the use of chemicals in crop cultivation (2010). The 1990s opened a period of green fashion, prompting a number of major companies such as Levi and Walmart to introduce organic lines of clothing and home goods into the early 2000s (International Trade Centre, 2010; Klara, 2010). The trend has become much more subtle with today's profit-conscious retailers, and many of these exclusive lines have since gone defunct (Zissu, 2011). However, the term 'organic' is still imbued with a much more positive perception in the minds of consumers over conventional cotton. This general perception has strongly influenced the market as, since 2001, the organic cotton industry has shown an annual growth of 40% (Klara, 2010). Despite this increase, organic cotton remains a niche market, making up only 2.3% of the $188 billion in US apparel sales (2010). Demand, like for all types of cotton, consistently outruns production capabilities. With the high labor, water consumption, and amount of resources involved in producing organic cotton, as well as its lower yields as compared to conventionally-raised crops, large, commercial farmers simply don't see the profit in conversion (Harkin, 2007) Though these facts are fairly common from the production side of

the market, there is still a severe disparity between what the consumer also understands. The average consumer, whether a past purchaser of organic or not, has been found to have no more than a vague understanding of the actual process of what makes a product organic (Rieple & Singh, 2010).

Organic certification for most products is typically dependent on individual regulatory bodies or producers, as well as the specific country of origin (Lassoued & Giannakas, 2010; Rieple & Singh, 2010). For cotton, the process is even less clear as many retailers use eco terms such as "organic" more as a marketing tool vs. an industry distinction (Cotton Inc., 2007; Zissu, 2011; Harkin, 2007). The presence of the Global Organic Textile Seal (GOTS) is considered the ultimate standard of recognition for organic products worldwide, as it also allows the product to be traced from field to store (Klara, 2010). Yet the cost of meeting the required standards for this certification often outweigh the benefit of certifying goods through ones local or national system, especially for the US and other, less stringent markets. Klara (2010) goes on to caution that international fashion retailers, such as Levi Strauss and Adidas, must balance the fluctuating premiums on just the actual organic cotton yarn (typically around 20%) with both potential profit and consumers' perceived added value of the final good, in order to remain competitive. Given the multitude of labeling regulations per export destination, this seal is not only unnecessary from a marketing point of view- especially for the fast turn-around of fashion products-, but also impractical in maintaining profitability (Klara, 2010). What both Janssen and Rieple do note, however, is that consumer attitudes towards relevant topics- cost, utility, health and environmental effects most prominently- largely influence their consumption behavior (Janssen, Heida, & Hamm, 2009; Rieple & Singh, 2010). If a garment is made of organic cotton, but its

price outweighs the intent of the purchase or the perceived value from its fibers, there is no market. This applies, naturally, to conventional cotton and our focus, GE cotton, just as well. What is significant in such evaluations is the fact that all such decisions are subjective per consumer and product. The primary determinants of said attitudes include the three constructs we intend to build upon in this study: intrinsic attributes, extrinsic attributes, and demographic indicators (Font, 2009; OECD, 2008; Puduri, Govindasamy, Lang, & Onyango, 2005; Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). These we will be the three driving classifiers as we conduct our research, and will be discussed at length later in our paper.

Conventional Cotton

For lack of a better term, perhaps, products that are not produced through organic or lab-altered means are considered 'conventionally-raised' crops. Cotton Incorporated (2007) explains conventional cotton, from an industry standpoint, as still dependent on non-modified seeds which are not as resistant to adverse weather, pest, and planting conditions as GE cotton. For farmers, this means that the major way of feeding and protecting their cotton crops is still accomplished by the heavy use of chemical-based and humanly harmful pesticides and fertilizers (OTA, 2011). It also means that strictly conventional cotton, which makes up less than 5% of US cotton acreage given or organic and GE cotton statistics, is much more variable in yield per season.

Conventional cotton is estimated to be the recipient of over 25% of all chemical pesticides and fertilizers produced world-wide (Zissu, 2011; Harkin, 2007). This trend originated in the early decades of the 20th Century, as cotton sought to keep up with the

challenge of synthetic fibers' meteoric rise (Rieple & Singh, 2010). Sustainability is, perhaps, most relevant for this particular type of cotton as many consumers have shown a preference for organic since the 1990s, even with its higher premium per yarn (Klara, 2010). To keep up with the sustainable movement, many manufacturers have begun incorporating one or more eco-friendly stages into the process of cotton production and manufacturing (Cotton Inc., 2007; Klara, 2010). While not enough to qualify products as organic, these steps do create added value for both the consumer and the company's equity with consumers (Zissu, 2011). Such goods are typically known as low-input or quality-enhanced products and, under European standards, also require certain labeling criteria be met (Lassoued & Giannakas, 2010; Janssen, Heida, & Hamm, 2009).

Low-input/ Quality-enhanced

As a social response to the ethical outcry of the '90s and early '00s, several companies began realigning themselves directly with organic or fair trade labor practices (International Trade Centre, 2010). As the organic market itself is not yet up to providing enough cotton to fill world, nor even the majority of major retailers', demand, this has not yet become a global norm. Instead, a more sustainable practice of individually improving certain steps in mill processing began to grow (Janssen, Heida, & Hamm, 2009). Former, conventional producers are increasingly adding better practices to one or more aspects of their product's processing trail. Many of these steps mimic practices used to certify organic status, hence the term "low-input products" in reference to these products. This type of sub-category label has, perhaps the most

resonance in the organic-driven markets of Germany, and smaller niche segments of the world's population (2009). One of the major organizations behind this change is known as the Better Cotton Initiative, which has worked to reduce a third of the amount of chemical and water consumption for cotton produced in India and Pakistan (Zissu, 2011).

The concept of improvement in total offering is where much of the idea for this study originates. Before, even if products were labeled as organic vs. conventional, the difference in the amount of chemicals actually used in making, say, a t-shirt, was negligible (Rieple & Singh, 2010). This was due to the amount of heavy chemical processing and traditional dyeing methods used, which had not been changed within the mills themselves (2010; Everman, 2009; Klara, 2010). Because of their relative improvement over conventional methods, low-input products could, reasonably be expected to fill the place of 'in-between' the organic and conventional positioning. However, our defense in this case, and further, why GE is the chosen medium for the future concept of balance in the natural fiber market, is due to national market, the dispersal of these safer practices, and how the consumer perceives value.

Addressing the first point, Germany, the location of Janssen's research, requires that low-input produce (again, this does not specify fiber crops, only foods) be labeled and marketed as a separate entity from the traditional choices of conventional and organic (Janssen, Heida, & Hamm, 2009). This is typically not observed as a requirement nor strategy within the US market outside of a way for companies to brand themselves as environmentally conscious (Zissu, 2011; Klara, 2010). Secondly, quality-enhancement is now taking place for products made not only through conventional means, but also for organic and GE cotton (Moschini, Bulut, & Cembalo, 2005). Both are accepted into the market with little fanfare, as in the case of fashion, marketers

have to be careful "to [not] push the concept [of green as the main factor that determines quality]…. It still has to be about the fashion of the garment" (Zissu, 2011). This brings us to our final defense, perceived value. Consumers' concept of value is a subjective idea, meaning that retailers must treat the ecological aspect in marketing as creating added value for both the product and company image, while not neglecting the essentials of fit, fashion, and utility (Zissu, 2011). Quality-enhancing practices are therefore considered important consideration of improved sustainability and eco-friendliness of all types of cotton we will cover in our study. It is simply its lack of distinction in the final product, at least under the umbrella of the US marketplace and application outside of specifically food crops, which lead to our discounting it in favor of the more segregated class known as GE cotton.

GE Cotton

Genetically-engineered (GE) cotton is the type of cotton we wish to evaluate as a possible compromise between organic and conventional cotton. GE cotton, based on supporting literature, shares many of the benefits and few of their combined disadvantages making its position between the two a natural placement (ISU & AgMRC, 2011; International Trade Centre, 2010). As introduction, GE cotton has many incarnations, from cotton engineered to be herbicide tolerant, that which resists certain pests, or the varieties which incorporate both qualities into their genetic make-up (NAAS, USDA, & ASB, 2010). Today, the first and most commonly known of this family is known as Insect-resistant (Bt) Cotton. Bt cotton is the genetically-modified variant this study will focus on, with some mention of Stacked gene

varieties' characteristics. Stacked gene crops are those that have been engineered to include the combined genes for Insect- and Herbicide-resistance (Ht) (NAAS, USDA, & ASB, 2010; Wossink & Denaux, 2006). This variety typically still includes the Bt gene to achieve its pest-resistance, but has, in recent years, exceeded Bt in cultivation in the US by nearly four times according to average planted acreage (2010). Because of this, we intend to include many of its characteristics in our measurement of consumer awareness and attitudes as we compile our data and survey questions.

Bt or *Bacillus thuringiensis* actually has a rather long history outside of the genetic additive it is known for today. The bacteria was actually first discovered during a silkworm crisis in 1901, and eventually tested as a pesticide for crops in 1920 (UCSD & Aroian Lab, 2011). It was not until the 1980s however, that earnest study into Bt research on a genetic level began, at the same time as environmentalists and farmers became aware of the increased tolerance to the traditional synthetic pesticides. Bt itself is considered an 'organic' pesticide itself (i.e. one found naturally in the environment), and was likely deemed a fitting if limited alternative (UCSD & Aroian Lab, 2011). This fact has been rather lost to the media at large today as genetically enhanced products seem to carry much the same stigma as 'synthetic' or 'artificial', enhancing risk concerns with their usage. What is also significant is the parallel shift towards organic in both farming practices and as a biotech alternative at this time, to meet that overall conductor, demand (Rieple & Singh, 2010).

Bt Cotton was introduced to the market in 1996 after a year of heavy losses for US cotton farmers due to pests such as the cotton bollworm (UCSD & Aroian Lab, 2011). Since then, 23 countries worldwide have begun to produce GE varieties in their agricultural sector (Font, 2009),

with the US retaining its lead as the highest volume producer of the fiber (NAAS, USDA, & ASB, 2010; ISU & AgMRC, 2011). The expansion is significant, though research has still shown several concerns that are repeatedly exemplified by participants. These include social, ethical and moral quandaries, including anticipated health hazards, sustainability (environmental) concerns, lack of accessibility, and trust in regulatory bodies (Puduri, Govindasamy, Lang, & Onyango, 2005; Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001; Frewer, Howard, & Shepherd, 1995). Health and sustainability are both issues that will be more completely discussed later, from the consumer's perspective as we move into our section on Consumer Perceptions. Scientifically, however, the main issues of harmfulness to both human handlers and the earth have been cleared by the US Environmental Protection Agency (EPA), a regulatory organization appointed by the US government (UCSD & Aroian Lab, 2011; Kuzma, Najmaie, & Larson, 2009). According to the EPA, Bt was exempted from "food residue tolerances, groundwater restrictions, endangered species labeling and special review requirements… [as Bt] has no known effect on wildlife such as mammals, birds, and fish" (2011). That tests were run on the bacteria over several years and completed by a prominent American, consumer-focused agency, implies that the risk that might be associated with these issues would be negligible if shared with the populace. As Americans typically have higher faith in government entities than GE-opposed countries such as the member states of the European Union, delivery of professional assurances would, if not bring positive feelings toward the product, would act as a calm for risk uncertainty (Ronteltap, Trijp, Renes, & Frewer, 2007; Font, 2009; Frewer, Howard, & Shepherd, 1995). Marketers would

naturally work to reduce or minimize most risks associated with new products so that a negative opinion does not form before all features can be communicated.

In regards to the final two issues, accessibility and trust, there is a combination of a legal and missionary aspect in their discussion. Most notably, pro-GE advocates argue that genetic engineering of food crops will help 'feed the world' (Lemaux, 2009). At the same time, anti-GE lobbyists proclaim the cost of obtaining GE seedlings ensures that the technology remains in the hands of the powerful (Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). Monsanto and Syngenta, as the major producers of all genetically altered seed, have felt this, perhaps, the most heavily (Glover, 2010). While the "Precautionary Viewpoint" stems mostly from the cost of genetically engineered seeds inhibiting smaller farmers from being able to afford the premium cost of seeds (Glover, 2010). A separate study on stacked gene cotton noted that the higher cost of GE seeds negated the positive environmental efficacy found over conventional or strictly Ht varieties (Wossink & Denaux, 2006). The results showed an increase of 8-13% in environmental efficacy from reduced pesticide use and herbicide tolerance, a number that could be communicated as a significant advantage for farmers if price were no longer a disproportion weight (2006).

According to recent news, however, the argument about price, at least from the farmer's side, may not be an especial hindrance for long. A major change in suppliers may be the future, as well as an end to the debate of "the privileged few" with the news that Chinese company, Biocentury Transgene's Bt cotton is seeking to expand into greater Asian markets (Jia, 2011). Jia remarks that Biocentury has "a combination of locally developed genetically engineered crop varieties, cut-rate seeds and low patent licensing fees, wrapped up in China's poor intellectual

property (IP) protection", to acknowledge for its success so far. With Biocentury Transgene's seeds selling at nearly half the cost of Monsantos, even if their total sales are still far behind that of Monsanto, it has chosen a careful position as opening biotech crops into other, less developed countries (2011). The real story behind this is, if Biocentury does become successful outside of China, the slightly higher cost for small-share farmers could then be alleviated, and therefore translate to consumers as a price-conscious alternative over both conventional and organic. The argument from conservatives would also be immaterial that such technology was not equally available to poorer countries and cultivators (Glover, 2010). These, amongst other points of contention, we will discuss in further depth later in this paper. For now, in order to best to evaluate GE cotton's positioning and the consumer's understanding of said products, we turn to the Theory of Risk to validate the methods we will use for our research study.

Chapter 4: Consumer Perceptions

Theory

Based on our literature, Risk Theory was determined to be the driver of both attitudes and perceptions, especially for the consumer. Risk is first separated into two phenomenons: the Theories of Risk Uncertainty and Perceived Risk. Risk Uncertainty relates directly to knowledge, as the concept is essentially caused by a lack of knowledge, either of product risks or benefits, and is typically due to incorrect, insufficient, or ambiguous modes of communication (Ronteltap, Trijp, Renes, & Frewer, 2007). Based upon the Risk Communication Model used by Roberts *et al* (2006), perceived risk, instead, "assumes that scientists and the general public view risk differently". As we will speak to later in the difference between science knowledge and values (refer to Model #2's seven independent factors), the level of trust a consumer may have in the distributors of information about technological development can directly affect their attitudes and concerns for products that are or are not endorsed by their "trusted sources". Based on a study by Cvetkovich & Lofstedt (Gaskell, et al., 2004), we know that there is a widely held assumption among professionals that it is due to the consumer's lack of trust in both scientists and regulators that the public would challenge developments such as GE cotton. Though Gaskell based his work in London which, we have reviewed, has a much more stringent view of GE hazards and government ethics, that trust is prominent in both determining perceived risk and lowering risk uncertainty has been witnessed in our other primary literatures, from Roberts to Ronteltap to Font (Font, 2009; Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006;

Ronteltap, Trijp, Renes, & Frewer, 2007). As such, we much first examine the US consumer's awareness of biotechnology or genetically engineered crops, and finally, the processes and risks associated with our three categories of cotton and how these affect the consumer perceptions of each other.

Genetic Engineering: Process and Products

Consumer Awareness of and Attitudes Towards GE Agricultural Crops

Knowledge, an integral aspect of "awareness" in this study, is of particular interest in a consumer-focused study. Again, awareness, for our study, is defined as both knowledge and the communication of information from industry to consumer (Gaskell, et al., 2004; Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006) Both elements are especially significant given the general, vague understanding of what genetic engineering is, including its processes, applications, and associated risks as concluded by several, international surveys (Eicher, Maredia, & Idah, 2006). The US is no exception, as previously noted. Americans were found to have a lower level of understanding and even concern about the issues surrounding genetic engineering, with only 39% of participants claiming to have read or heard at least 'some' about biotechnology (Bruhn C. M., 2003). It is important to note that these statistics don't, in any way, make a focus on the US consumer dubious. Instead, it supports our understanding that by learning what factors affect both attitudes and risk perceptions, the market position of GE cotton on a national, and eventually international, scale can be more accurately assessed and improved

through trusted modes of communication (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Gaskell, et al., 2004; Font, 2009; Tencalla, 2005).

Sustainability is also a growing concern, with knowledge being, again, a common point. According to AMP, over half of Americans factor sustainability into their purchase decisions, with 1 out of 10 counting 'green-ness' as the number one influence in their brand purchases (Klara, 2010). Yet this population can also be said to have only has a limited understanding of what products are truly sustainable, or even what the many terms used to market eco-friendly apparel truly means (Cotton Inc., 2007; Everman, 2009). US consumer as "environmentally aware", industry professionals insist that the new consumer must be made "environmentally intelligent" in order to distinguish true sustainability from the seeming catch-all term of organic (Harkin, 2007). GE crops could be classified as very sustainable if the issues of health, cost, and environmental impact are any measurement. In other words, the reduction in the use of pesticides would reduce health risk to workers, un-used pesticides would return to the farmer and mill increased profits through lowered cleaning needs, and the environment would absorb and disperse less harmful chemicals such as the synthetic fertilizers commonly used (Harkin, 2007). As indicated in our section for national perceptions, both the trend for eco-conscious goods is not exclusive to any one country. Yet with this issue comes the question of how much information is too much? How much does the average consumer want to know about GE or biotechnology? And how much does higher awareness of the technology affect attitudes and perceptions of the specific product, GE cotton (Frewer, Howard, & Shepherd, 1995)?

Location, as part of demographics, has been shown to have almost as significant an effect on perception as any factor we have so far discussed. Whatever its scale, national or global, location has been shown to shape consumers' attitudes towards products and especially technology, hence the argument of no 'global consumer' in marketing of GE products (Bal, Samanci, & Bozkurt, 2007; Bruhn C. M., 2003). Bruhn, for instance, insists that US consumers are the most likely to adopt distinct stances in their attitudes about GE technology, yet change said attitudes if given sufficient information and incentive to support new processes. This is in direct opposition to the more rigid, general depiction of the European consumer (Bruhn C. M., 2003; Bruhn C. M., 2007). Yet Font notes that even within such a broad category are exceptions, as the less European countries of less Nordic descent- such as Spain and Portugal- are known to have a more positive attitude towards GE foods and, by extension, all GE crops (Font, 2009). Partly, these cultural distinctions are speculated as due to differing economic and government policy, which effect consumer trust and understanding of GE technology, as well as proven costs and advantages (Tencalla, 2005; Font, 2009).

Cotton: Types and Processes

Consumer Knowledge of Cotton Types: Organic, Conventional, and GE

As mentioned previously, knowledge on what makes goods of one category or another- organic vs. GE, conventional vs. organic, etc. - is generally lacking in the average consumer's mind. Janssen and company *(Janssen, Heida, & Hamm, 2009)* assert that many consumers have even held the belief that they have purchased organic items before, only to be proven mistaken.

The level of ignorance is seen to vary mainly depending on societal norms *(Gaskell, Bauer, Durant, & Allum, 1999)* and along demographic lines *(Puduri, Govindasamy, Lang, & Onyango, 2005; Saher, Linderman, & Hursti, 2006).* Yet consistencies remain that, whatever the composition, price, fit, style and color are the primary factors that determine whether a customer purchases a garment *(Cotton Inc., 2007)*. More and more, the apparel industry has come to realize this, especially in the organic cotton market *(Klara, 2010)*.

In a market context, cotton has been limited not only by the turn towards synthetics fibers and ethanol-producing crops such as corn, but a severe lack of choice. Because of a lack of information, the average consumer basically is aware of one of two choices, either conventional or organic (Cotton Inc., 2007), with novelties such as Pima Cotton (which can be produced both organically and conventionally) as more of a distinction in length of fiber over positive/negative sustainable alternatives (NAAS, USDA, & ASB, 2010). According to a survey conducted by Cotton Incorporated's Lifestyle Monitor, over 60% of consumers identified the retail environment as their main source of information on the environmental footprints of their purchases (Cotton Inc., 2007). And yet, in Cotton Incorporated's Consumer Environmental Survey of 2006, 40% of respondents admitted to having no idea what terms such as "sustainable agriculture" and "renewable" meant (2007). Significantly, it is these descriptors, among others, that are common go-to words used by eco-promoting retailers.

We can draw ties between this uncertainty and lack of information to explain, in part, why there has been a 12% decrease since 2000 in the number of consumers that find environmental friendliness as major considerations in their apparel shopping behavior (Cotton Inc., 2007). The increased number of companies that have begun Better Cotton Initiatives,

including big name Levi's Jeans Co., is also expected to be a causal factor (Zissu, 2011; Cotton Inc., 2007). The Better Cotton Initiative (BCI) is a nonprofit program taken up by several large retailers to improve eco-impact in their cotton processing through water reduction, reduced chemical use, and better labor practices (2007; 2011). While the benefits of the BCI are encouraging for consumers to purchase cotton apparel over synthetics, it does not make a distinction between improvements in the actual process of processing conventional vs. genetically engineered cotton (Cotton Inc., 2007). This, we feel, is a mistake by the cotton industry. The benefits of GE, combined with its price competitiveness and the greener processing methods described above, could make a compelling marketing campaign aimed at today's consumers.

Surprisingly though, the actual process may not be the major determinate of preference. We take this uncertainty from Janssen *et al (2009)* as well, where individual aspects, as for low-input products, were seen as more important than the full process of organic farming. In their case, this meant that abandonment of the use of GE technologies, pesticides and antibiotics was superior. However, when looking at the significance of this factor across nationalities, the results could be expected to change due to both intrinsic and extrinsic attributes that naturally vary across national borders *(Frewer, Howard, & Shepherd, 1995).* In the US, could GE be seen as a compromise, similar to Germany's low-input products, since the manipulation is with the seed, versus the grown plant? Could, as Moschini *et al (2005)* put forward, the fact that GE cotton does not require segregation from conventional cotton in processing (lowering cost) be sold as an economic benefit for manufacturers? That less pesticides- and therefore cleaning-would typically be required in its cultivation, without the premium price that may defer some

customers from organic be seen as advantageous enough if communicated well and correctly to the consumer *(Cotton Inc., 2007)*? To answer these questions and so determine the full picture for our three types of cotton, our analysis is essential, but is only a first step. As multiple studies have reinforced, the more awareness consumers have about the benefits of a product, the more they are influenced to act in a more positive way towards its adoption *(Font, 2009; Frewer, Howard, & Shepherd, 1995).* Therefore, it must be accounted, that all of the associated "consumers" of GE cotton, from farmers to mills to shoppers, be studied so that a truly global 'map' can be developed. This, we believe, would help in both customization of communications and in attitude building across markets about GE cotton, but also, other GE applications.

Risk Perception of Cotton Types

The first obstacle to any study involving consumers, and especially dealing with as divisive a topic as genetic engineering, is separating fact from supposition. As Parrott discusses, there are several misconceptions about what benefits and risks are by-products of even the discussion of genetic modification (Parrott, 2010). Though Parrott mainly looks at the reactions to genetically-modified maize, he and other sources cite many common concerns to be widespread among consumers about biotechnology and its specific processes. These include intrinsic elements such as naturalness, environmental and long-term health benefits, consumer choice and policy regulation, trust, and the subjective cost/benefit measure which includes product usefulness (Verhoog, 2003; Lemaux, 2009; Ronteltap, Trijp, Renes, & Frewer, 2007;

Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). Specifically, trust and the combined factors of choice and policy regulation are noted as the most difficult factors to influence in consumers according to a study on consumer acceptance of tech-based food innovations (Ronteltap, Trijp, Renes, & Frewer, 2007).

> "Trust in risk regulators and managers plays an important role in public risk perceptions and has been found to be hard to acquire and easy to lose."
> (Ronteltap, Trijp, Renes, & Frewer, 2007)

Relating again to one of our fixture topics, awareness, we note that the cotton industry would have to take care in both how and by whom communication is transmitted on the potential benefits and risks associated with the uses for GE cotton. It is widely assumed that a lack of trust in government, industry and private entities (i.e. scientists, independent regulators) leads to a great deal of the rebellion against such technological innovations (Gaskell, et al., 2004). And though trust is seen to be currently higher for Americans in their government oversight agencies and 'expert' professionals (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Kuzma, Najmaie, & Larson, 2009), US cotton professionals could potentially use this national confidence to break through the obstacles of commonly GE-resistant or developing markets such as the EU and parts of Africa (Glover, 2010; Reuters, 2010).

Coming back to the original factors, these seven issues were found to have the most over-arching relevance to the use of the technology in fiber production, or indeed any current or proposed application of genomic technology. They are also, in addition to the efficient

communication of information, the main determinants of how both farmers and consumers measure perceived risk (Ronteltap, Trijp, Renes, & Frewer, 2007). In our review, we will quickly examine the cost/ benefits of the three types of cotton we will use for our study, with mention of Risk Theory. An understanding of risk as perceived by the customer is the key influence in changing or simply identifying consumers' aversions or optimism towards genetically-modified products. As Font paraphrases, "risk perceptions have more impact on choice than benefits" (Font, 2009). However, it is only later in our proposed research paper will we expound upon the main three constructs that contribute to these attitudes, as well as how Risk forms the basis of our research model.

Though we have previously, and in brief, spoken of the dissimilarities between the US and EU product labeling regimes, the US and the European Union are unquestionably each other's major trading partners (Lemaux, 2009). Although the US and Turkey hold the record as leaders in organic cotton (OTA, 2011), yet it is European nations such as Germany and their catalog shopping system, whose demand has truly propelled the organics industry from niche to mainstream since the early1990s (International Trade Centre, 2010). Organic cotton is known for several advantages as it is typically associated with sustainability and fair labor practices (Harkin, 2007). Its constant market gains make it attractive to manufacturers with its very exclusiveness leading to organic cotton being regarded as an attractive 'luxury' staple (International Trade Centre, 2010). A premium or up-pricing is also generally attached to products containing even a percentage of organic fibers (minimum of 3-5%), though the blending with conventional fiber can keep manufacturer costs down (2010; Klara, 2010). Yet with all of

these benefits, organic does not typically hold up to some of the quality markers of the conventional or GE cotton crops.

Organic cotton is typically made of shorter staple fibers, which brands like Loomstate believe makes it both harder and more costly to spin into yarn (Zissu, 2011). It also has as a tendency to stretch and to create a 'fuzzy' surface after a few washings, according to designer Rogan Gregory (2011). This could be seen as a definite cost for consumers as both decrease the perceived value of a garment, not only with the higher initial cost of up to 50% at retail (Cotton Inc., 2007), but also with the less stable fibers making the product less durable over time (Zissu, 2011). The fact that organic cotton is also grown at only approximately 0.1% of global cotton production as compared to conventional and genetically engineered cotton, makes its position as cotton's main, market-driver even more limited (International Trade Centre, 2010; Cotton Inc., 2007). This is generally attributed to the cost incurred from higher water consumption, land, and labor required for organic cotton production (Harkin, 2007; Cotton Inc., 2007).

Not only is the cost of cultivating organic cotton high during the care and management stage, but the time invested in land preparation is also a consideration. Harkin's article (2007), published in the Financial Times, asserts that converting arable land to organically certifiable, requires at least three years. Indeed, the main other type of cotton readily recognized by consumers outside of organic cotton is Pima cotton. Pima, for example, also has a distinct advantage in comparison to certifiably organic cotton. While also commanding a higher cost due to specific crop management and environmental conditions, is known for its extra-long staple (ELS) fibers (International Trade Centre, 2010), which is typically associated with higher durability and ease of spinning. It also comprises a full 3% of the world's cotton production in

recent years (International Trade Centre, 2010), and, as of 2010, accounted for 209,000 of the 10,909,000 acres of cotton planted in the US alone (NAAS, USDA, & ASB, 2010). Because of these statistics, farmers' willingness to increase their organic output is naturally seen as un-compelling. This is especially so given that technologically-increased production instead of additional planted acreage has become the norm for the cotton industry since the 1950s (International Trade Centre, 2010). Figure 1 (below), which has been adapted from those found from the International Cotton Advisory Committee or ICAC (2010), illustrates this timeline of both production and cultivated land.

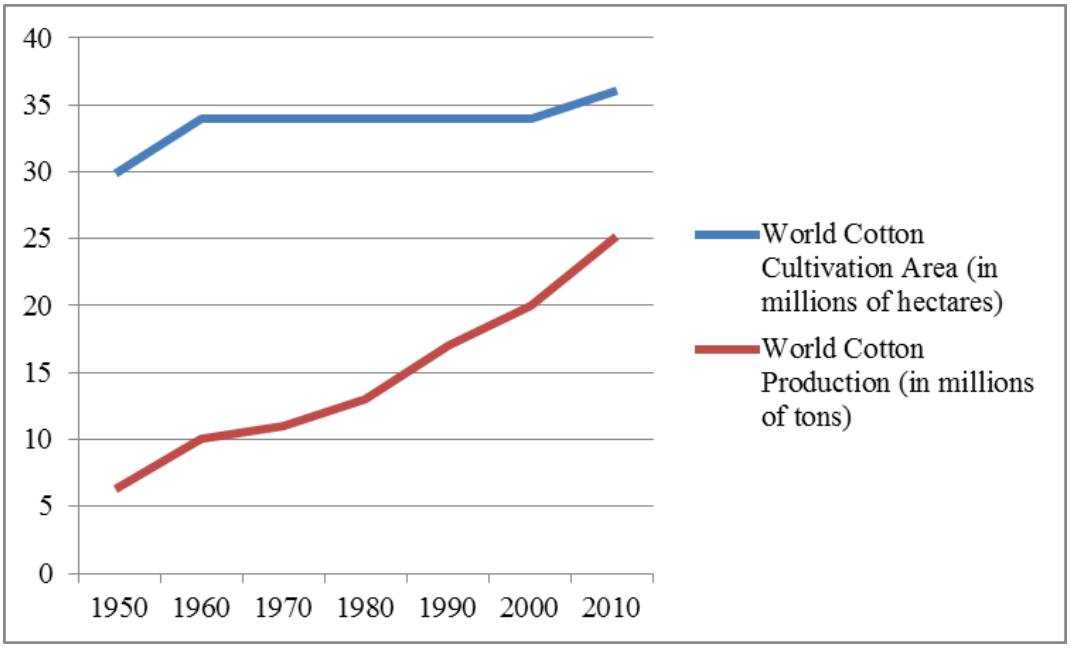

Figure 1: Representation of World Cotton Production & Cultivation Area (International Trade Centre, 2010)

Based on these literatures, it is reasonable to agree with Harkin (2007) that many of the issues mentioned simply add to the debate on how sustainable organic cotton really is, making

the balance of what is 'best' no longer concrete. Besides these challenges, the fact remain that the majority of demand for organic cotton fibers is still lead by persons with a higher knowledge of and/or concern for ecological consciousness (Rieple & Singh, 2010). Surprisingly, this population is skewed towards the lower income bracket in the US over any other economic group (OECD, 2008), which may have continued ramifications on the profitability of organic expansion at home and abroad. While the number of people concerned with 'cleaner' products is growing, the average consumer still believes it the responsibility of the retailer or government agency to extol the benefits of a product to increase demand and awareness (Klara, 2010). In the end, the value and preference for organic cotton products may be strongly affected by its economic or price factor. Its associated risks, including its perceived benefits (Font, 2009) will also depend on participants' demographic and intrinsic attributes.

Conversely, conventional and GE cotton do not have these added costs nor major production limitations. Though cotton has recently been quoted at $1+, its highest cost per pound in decades (Southwest Farm Press, 2010), the only significant marketing encompassing these both conventional and GE production has been that of Cotton Incorporated, a non-profit which promotes the cotton market as a whole. Additionally, except in parts of the EU where a premium is added to assure a product is non-GE, the cost of Bt cotton has fallen by .8¢ per pound as production volume has risen (UCSD & Aroian Lab, 2011). The total risk to the consumer of the use of conventional cotton is only apparent given their level of awareness about the process of production. Again, we stress that awareness is not only knowledge but communication of information. If the negative effects on health due to the level of pesticides used and the significant improvements that have come about due to the Better Cotton Initiative's

efforts are not shared with consumers for them to form an informed opinion, perceived risks would naturally share a negative relationship with purchase intentions

Many direct concerns over cost throughout the production cycle are now less prevalent- or at least not as risky due to voluntary environmental standards adopted by several international companies (Cotton Inc., 2007). It is still important, however, to distinguish between no perceived risk and an actual lack of risk. If the consumer is not aware of the specific issues involved, they may only see the benefits of a lower cost, more durable item as compared to a similar organic item. This is, perhaps, one of the most evident reasons behind the inclusion of awareness as a required measure in diagnosing our responses. Though cost could be argued as high from a scientific standpoint, there may be little perception of risk to validate a negative attitude to the product by the average consumer.

GE cotton, however, may not be perceived as risky by simply the methods by which they are created. Its origins have also been fairly well-villainized by several environmental organizations and even farmers (Coghlan, 2006). To its list of charges are, most prominently, its unnaturalness and its possible contamination of organic and conventional cotton crops; the fear that such crops will lead to Bt-resistant pests and weeds, again affecting bio-diversity of said crops; and that, depending on circumstances and GE seed provider, quality can be inconsistent (Parrott, 2010; Glover, 2010; Moschini, Bulut, & Cembalo, 2005). Though public perception is ever changing, the amount of risk or reluctance associated with GE products often differs depending on the application required of said products (Economist, 2004). Fear of GE crops, even those that are not directly related to food such as GE cotton, is a possibility. As one of our

few articles that remarks to some degree on non-food GE agricultural products attests, "[though] one may think the fear of non-food [GE] crops quite irrational,… if lots of consumers do fear them, the most cynical farmer may be entirely rational not to plant them" (2004). It goes on to remark that leaders against biotechnology will often take an all-or-nothing stance; that if one incarnation is considered risky, the entirety should be banned.

This may indeed be a concern for producers if opening up communication about GE cotton as a marketing strategy does go forward on an international scale. The subjective norm, as it is called, shows a positive correlation with the attitudes of peers, whereby if the masses approve, intention and one's individual attitudes are also affected more positively (Ronteltap, Trijp, Renes, & Frewer, 2007). The norm could also relate to not just a community, but a nation or between countries as our global connectedness expands. Yet, generalizing that these concerns will naturally produce the same results when applied to GE cotton is premature reasoning. There has, so far, been little research to back up or argue the negative consequences of engineered fibers specifically, which is necessary for those in the cotton industry to make informed and beneficial decisions. This absence is, of course, one of the drivers of our study.

One of the up-sides is that there is also very little information that reaches the average consumer, whatever their national affiliation, as to the distinction between conventional and GE cotton in their textile purchases (Cotton Inc., 2007; Economist, 2004). As psychological studies have found, given contradicting information, respondents will typically fall back on previous opinions and attitudes in order to make a 'safe' decision (Harkin, 2007). This could be of great benefit in pushing forward GE cotton. Genetically-engineered foods, after all, raise the most

concerns and fears in consumers, not the application of the same technology in medical applications or apparel, both common end uses for cotton fibers (Chen & Rafan, 2009; Frewer, Howard, & Shepherd, 1995; Puduri, Govindasamy, Lang, & Onyango, 2005). What this means is that a lower risk, real or imagined, would be associated with these goods in the consumer's mind, a window in which marketers can communicate efficient and positive information (Cotton Inc., 2007) after first accurately gauging the target population's current perceptions.

Following the above arguments and based upon our literature, we can hypothesize that social and ethical aspects (categorized as intrinsic attributes here), while important to GE as a whole, may be considered of similar importance as its economic as when applied to GE cotton explicitly (OECD, 2008; Puduri, Govindasamy, Lang, & Onyango, 2005). We hope to show that GE cotton's benefits and current understandings will outweigh its costs significantly enough that it may be considered horizontally integrated between conventional and organic cotton to the majority of our research participants (Lassoued & Giannakas, 2010; Moschini, Bulut, & Cembalo, 2005). To support this hypothesis, we turn to Roberts *et al* (2006), which are based upon a Risk Communication Model that marketers must ascribe to should GE cotton hope to become a distinct brand. Roberts found, for both the Discerning Supporter and Promoting Viewpoint, that experts evaluated the potential environmental benefits of GE crops as at least neutral in outweighing any possible risk (2006). These benefits include the ability to thrive under harsh and variable conditions, to self-protect against both pests and diseases, and to potentially feed, vaccinate, *and* clothe a rising population (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). In the meantime a steadily lowering price tag and rising competition in worldwide seed suppliers are strong benefits for continued growth in the number of producers

(Jia, 2011; Glover, 2010). This growth can only aid in opening markets to be more receptive to uses and cultivation of GM cotton by national partners. The rise in production would most affect price and accessibility, and ensure an unavoidable diffusion throughout the available, international cotton market.

Chapter 5: Hypothesis Development

Modeling

In regards to research structure, much of our reference literature was found to use Q Methodology (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001), a more qualitative method of data collection. Q methodology, according to Roberts' sources (2006), actually evolved from factor analytic theory and has the benefit that it does not rely exclusively on facts, nor are its results greatly affected by strict compliance to instructions. Instead, it is used as a subjective measure of opinion, most often for consumer-focused studies such as in marketing. Though some aspects of these studies will be adapted from works by Font, Moschini, Gaskell, and Janssen, which focus on risk perception and market positioning between organic and conventional foods, these will act primarily as guides (Font, 2009; Janssen, Heida, & Hamm, 2009; Moschini, Bulut, & Cembalo, 2005; Gaskell, et al., 2004). Roberts (2006) and Font (2009) especially will be instrumental in forming our positioning questionnaire on cotton fibers, and in demographic information collection. Their and others' contribution to our survey structuring will be included under the Instruments portion of our paper.

What lead to this research was in part the common thread found across various studies, the idea of risk. This was most notable in Roberts's study on dietetic professionals' attitudes, Gaskell's study on the misperception of risk, and Font's thesis on choice, attitudes and acceptance (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Gaskell, et al., 2004; Font,

2009). Though GE cotton and its end uses are not typically associated with the high personal risk evident in strictly food crops (Economist, 2004), Risk Theory is relevant for any marketable good. Though of our literature, much study was done in countries having ingrained segregation rules governing their organic and GE-derived products (Gaskell, Bauer, Durant, & Allum, 1999; Janssen, Heida, & Hamm, 2009; Lassoued & Giannakas, 2010; Moschini, Bulut, & Cembalo, 2005), the factors found to most significantly influence risk across populations were shown as applicable to our US population. These factors, as previously stated, include different types of knowledge, environmental issues, price consciousness, social consumerism, and ethical concerns for the construct of intrinsic attributes. Communication, trust, policy regulation, and usefulness were the relevant factors found to describe the extrinsic attributes determining risk associated with GE cotton. And finally, demographic indicators, of which gender, level of education, and purchasing power are the most common, yet affective factors in determining risk. However, for our study, we support the addition of less typical demographic markers, including location, religious frequency, and political affiliation as based on Puduri and Saher (Puduri, Govindasamy, Lang, & Onyango, 2005; Saher, Linderman, & Hursti, 2006) . All three constructs are expected to play key roles in determining what precipitates consumers' perceptions and choices in purchasing and their general preferences, making the evaluations of risk in relation to all three of our above constructs, significant.

Moschini *et al* (2005) also had relevant ideas which we've chosen to adapt in our own research. In their work, a broad, analytical view of the segregation of organic, conventional and genetically-engineered foods, the categories on which our own research revolves, is adopted. He and his colleagues examined the direct effects of consumer resistance and strict product

regulations by the European Union which, again, typifies a very negative disposition towards GE products, from animal to plant. Of significance is that their demand framework indicated which type of cotton- from organic to conventional, low impact to genetically modified- have horizontal or vertical differentiation in how they are 'rated' by consumers (Moschini, Bulut, & Cembalo, 2005). In their findings, GEO and non-GE products garnered the vertical position, meaning that one or the other was considered 'better' per customer versus 'an alternative' (2005). It would be a substantial boon for our study if we could provide our first piece of evidence that research into specific product categories changes both what is the most effective method of communication and the perception of value for genetically engineered goods. To do this, we would be tasked with finding enough supporting evidence to determine whether Moschini's classification holds true or is rebuked in the lower-risk product category of cotton fibers and their major applications (2005).

Typically, our literature tries to quantify the reception or acceptance of GE- again, usually relating to food applications- came up with three groupings for its participants. Roberts's study, for example, denotes Precautionary, Promoting, and Discerning Supporter as their attitude classifications, with Wilkins concurring but for the insert of Cautiously Supportive in place of Discerning Supporter (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006; Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). Likewise, Gaskell *et al*. (1999), from a much earlier publication, cites the positions of those of supporter, risk-tolerant supporter, and opponents in his examination of the reception of GE foods in the US and the EU. Unlike most studies, however, they look at specific applications of GE technology and consumer responses to those uses. Since GE food and GE crops are evaluated separately by both European and US

consumers, it is better for marketers themselves to study the perceived values and risk perception associated with each group specifically (Gaskell, Bauer, Durant, & Allum, 1999). Naturally, we cannot assume that the results of this study might be the same if run today given the speed of communications and the changed political and economic landscapes. As models by Ronteltap *et al* (2007), Gaskell and partners (1999), and Font (2009) examine Risk Perception and Uncertainty, we judge that this basic method is sound in garnering the response data we hope for through our original research.

Our intention is to use a modified version of Font (2009), Robert's (2006), and Gaskell's (1999) models to reflect perceived risk. To exemplify, we anticipate that the three grouping categories that consumers generally fall into in their preferences will hold true, yet these risk groups will be fractured based on our end use in comparison to general or food application of GE. This also due to the fact that our scale would measure the relationship of attitudes between three types of cotton, not exclusively consumers' perceptions and knowledge of genetically-engineered (GE) cotton. Figure 3 is a linear scale meant to illustrate the basic understanding of GE cotton's positioning we wish to decipher from our final data.

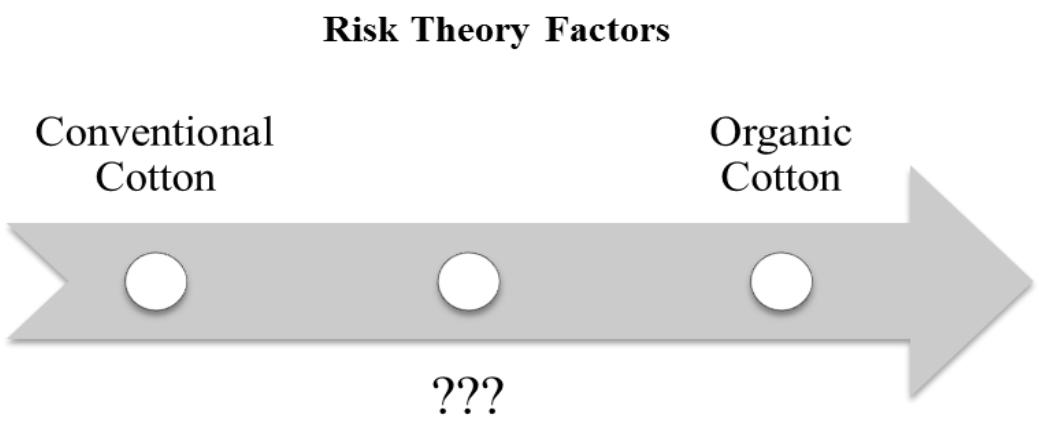

Figure 2: Anticipated market positioning of GE cotton based on Attitudes

Model Significance

For this study, we have developed two primary models based on available current literature. The broader significance of our study lies in its ripple-effect for future research. With this research, we hope to determine where GE cotton fibers might rank between organic and conventional cotton in a more adaptive, international market such as the US. For our first model, the question we ask is whether the overt marketing of GE cotton as a consumer choice would be a positive and potentially profitable step for the US cotton industry, much as organic cotton has become. We do this by determining purchase intention (PI) towards GE cotton given our previously applied factors such as ethical concerns, usefulness, etc.. With our results, we hope to provide one of the first studies of quantitative data as to consumer attitudes and PI

towards GE cotton based on knowledge of several different concepts and measures of previous perceptions.

With our second and third models, we hope to support awareness and consideration of the factors that affect the perceived risk of GE cotton. This information can relate to textile retailers in shaping their marketing and product development decisions, farmers who can more empirical weigh the benefits of GE cotton adoption, and regulatory-based economies as encouragement for them to reopen the debate on GE crop utility and benefits. This would not only aid in more efficient use resources for all involved in the cotton industry, but potentially form the template for investigation of other specific GE products and applications with an as yet unidentified audience or positioning.

Model #1: Purchase Intentions towards GE Cotton

Our first model for this study examines the relationship between knowledge, risks, and attitudes, in correlation with Purchase Intentions (PI). At the center of this model are the consumers' approaches towards genetic engineering in general, and more specifically, towards GE cotton alone. The approach is further broken down into two elements, perceived benefits and perceived risks, which are the main drivers of this study. In this model, we take an original approach, not only due to the fact that such a model has not been applied specifically outside of GE food crops, but also due the fact that we seek to evaluate the quantitative factors involved in the consumers' approach to genetic engineering and their potential purchase intention towards GE cotton.

Knowledge of Agriculture

Knowledge, based on our literature, has been found to be the predominant driver of consumer attitudes, perceptions, and choice (Font, 2009; Puduri, Govindasamy, Lang, & Onyango, 2005; Hallman, Hebden, Cuite, Aquino, & Lang, 2004). This has been reflected in both national and restricted populations, from Hallman's (2004) national survey of American consumers and GE Foods to Bal's examination of GE by University students (Bal, Samanci, & Bozkurt, 2007). Knowledge of agriculture, for instance, is not a determinate of attitude, yet concern with it has been shown to be strong in consumers. In Font (2009), participants indicated great concern about the effects of agriculture on the environment. And across various organizations, the call for sustainability and 'green' practices have continued to hold precedence for both the US government and independent, non-industrial organizations (Cotton Inc., 2007; MAKING THE ECO-MOVEMENT MATTER, 2011). Given the speed at which genetically engineered foods and crops are dominating the market (NAAS, USDA, & ASB, 2010), these consumer concerns cannot be taken lightly. From studies on a market-by-market basis (Janssen, Heida, & Hamm, 2009) to consideration of experts' viewpoints as taken from a Land-grant University (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006), knowledge of the general issues and changes to agriculture have been found to show a correlation with respondents' knowledge of genetic engineering, a growing aspect in agricultural production. As such, we support that knowledge of GE will show dependent upon consumers' knowledge of agriculture.

H1: Knowledge of agriculture will show a positive relationship with consumers' knowledge of GE.

Knowledge of Genetic Engineering (GE)

According to Font (Font, 2009) and Gaskell (Gaskell, et al., 2004), science or knowledge of science and technology is a significant factor of interest in measuring attitudes and, eventually, risks associated with genetically-modified or engineered products. Previous literature by both Ronteltap (2007) and Frewer *et al* (1995) promote that more knowledge can lead to a more positive reception of new products and technological innovations. If the consumer feels knowledgeable about a product or technology, this indicates that they may have a *lower* level of uncertainty (*see*: Risk Uncertainty), which can promote avoidance (Ronteltap, Trijp, Renes, & Frewer, 2007; Font, 2009). It can also indicate that, having heard more about something, that they are more likely to have greater knowledge of its benefits to them, not only real or imagined risks. The problems arise from the fact that knowledge is not often recognized as transmittable through more than the facts-only approach of science; it is, in fact, a combination of facts and values (Wilkins, Kraak, Pelletier, McCullum, & Uusitalo, 2001). Because of this lack of consideration, communication on risks to the average consumer can be stuttered and create a negative or indifferent perception of GE technology (Gaskell, et al., 2004). What we understand from these complementary points leads us to the following hypotheses.

H2: Knowledge of GE will have a positive relationship with consumers' perceived benefits of GE.

H3: Knowledge of GE will have a negative relationship with consumers' perceived risks of GE.

Approach Towards Science and Technology

Our second independent construct is the consumers' Approach towards Science and Technology. As stated above, science and technology have been found to be of relevance by both Font and Gaskell in their studies on risk and consumer attitudes (Font, 2009; Gaskell, et al., 2004). Font (2009) concluded that "Meta-attitudes such as science in general and the environment have some impact on consumer perception of risk and benefits associated with [GE technology]". Though Font's thesis most distinctly used this particular variable in their data collection (Font, 2009), several others, including Puduri, Saher, and Gaskell note that without knowledge, the consumer will have a heightened perceived risk due to uncertainty (Puduri, Govindasamy, Lang, & Onyango, 2005; Saher, Linderman, & Hursti, 2006; Gaskell, et al., 2004). Combined with Wilkins' argument (2001), we can generalize that consumers' approach towards science and technology will be based upon both known facts or objective knowledge and personal values (i.e. subjective knowledge) (Font, 2009). It would, therefore, directly affect perceptions of benefits and risks associated with the specific science of genetic engineering.

H4: Consumers' approach towards science and technology will have a positive relationship with consumers' perceived benefits of GE.

H5: Consumers' approach towards science and technology will have a negative relationship with consumers' perceived risks of GE.

Perceived Benefits of Genetically Engineered (GE) Cotton

As attitudes are naturally of a trickle-down nature, it is common sense, as well as proven, that the benefits perceived for GE technology will directly affect the perceived benefits of products made with said technology (Font, 2009). For European consumers, given the negative connotations that are associated with GE, one would assume that GE cotton would also be a largely avoided product… but not so (Economist, 2004). Due, perhaps, to the less direct effect on the individual in, for example, clothing, versus food, a consumable necessity, consumers would be more likely to judge GE fibers as beneficial, even with limited knowledge (2004; Frewer, Howard, & Howard, 1997). This is especially likely in the American market, where knowledge of GE and engagement with new technologies is already low, given that the US agricultural system is not set up to distinguish between GE and traditional cotton at this time (Knight, 2009). Gamble (2000) points out that, if a consumer generally understands that genetic engineering is supposed to provide some benefits for them, if benefits for a specific application of GE are not immediately recognizable and beneficial to the consumer- versus, perhaps, the manufacturer- the consumer will maintain the lower perceived risk for the technology, as well as a similar level of risk for the product of GE technology. This leads us to hypothesize the following statements.

H6: Consumers' perceived benefits of GE will have a positive relationship with consumers' perceived benefits of GE cotton.

H7: Consumers' perceived benefits of GE will have a negative relationship with consumers' perceived risks of GE cotton

Perceived Risks of Genetically Engineered (GE) Cotton

As with perceived benefits of GE cotton, the perceived risks of the overall technology have been shown to directly affect both the benefits and risks associated with its specific applications (Frewer & Shepherd, 1995b). Roberts *et al* (2006) argue that risk, even for specific applications of biotechnology, is often motivated by a simple lack of communication and insufficient information. A prime example of this, though in the alternate direction, is that of GE foods. Over the past few years, European consumers, having witnessed a number of food scares, making any inroads into the potential acceptance of GE technology stagnant, if not impossible (Reuters, 2010). Because of the risks associated with the altered foods, a negative perception was concreted in the minds of EU consumers on the general technology (2010). If, however, consumers had noted a positive effect from GE foods, this would have reflected upwards on GE technology, whether or not the consumer had held a negative opinion of GE previously (Frewer, Howard, & Shepherd, 1995). Given these linear relationships, we can conclude the following.

H8: Perceived risks of GE will have a negative relationship with consumers' perceived benefits of GE cotton.

H9: Perceived risks of GE will have a positive relationship with consumers' perceived risks of GE cotton.

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Attitudes Towards GE cotton

Throughout most of our literatures, it is a recurring point that the actual use of GE is not the most controversial issue but its specific applications (Frewer & Shepherd, 1995b). By this, we encompass the field of genetic engineering as it relates to animals, plants, and humans to produce medicines, foods, and fibers. These are not mutually exclusive in any sense as, for example, certain medicines can be created through the modification of plants and animals, and plants, naturally, can be considered both a fiber and food crop. It has been found that consumers rate plant-based genetic engineering with a more positive attitude than others, particularly if applied towards medical or non-food uses (Puduri, Govindasamy, Lang, & Onyango, 2005; Bal, Samanci, & Bozkurt, 2007; Frewer, Howard, & Howard, 1997), while GE food typically breed more risk. As we will discuss further under Model #2, this simply confirms the tendency of consumers, with the same level of knowledge, to weigh the positive usefulness or benefit of specific end use, against their more negative, general attitude towards GE technology (Frewer, Howard, & Shepherd, 1995). Yet most of our studies are, again, only considering the applications of food vs. medicine (Frewer & Shepherd, 1995b), as comparison of attitudes towards fiber crops have yet to be directly studied. Therefore, for our study, we will test whether the same tendency might be observed in shaping attitudes towards GE cotton. To this, we will also determine consumers' Attitudes towards GE Foods, another plant-based technology, to measure whether Attitude towards each specific industry could be similarly inferred from the publics perceived benefits and risks for GE technology in general. Our hypotheses are then:

H10: Perceived benefits of GE cotton will have a positive relationship with consumers' attitudes towards GE cotton.

H11: Perceived risks of GE cotton will have a negative relationship with consumers' attitudes towards GE cotton.

Purchase Intentions (PI) Towards GE cotton

There is a great deal of literature available which examines purchase intention as it is commonly studied by marketers. As our goal for this study is to look at how GE cotton might be marketed as an alternative to the common types of cotton that are already distinguished on the market (Janssen, Heida, & Hamm, 2009), a measure of purchase intention was deemed appropriate as the final dependent variable for our primary model. Because GE cotton is not differentiated in the US, as it has been the staple of US cotton cultivation for over a decade (International Trade Centre, 2010), behavior was not the main concern for this study. This is because of works by Follows & Jobber (2000), which explains Purchase Intention as that which directly ties together attitudes and behavior based on the Theory of Planned Behavior. In other words, if attitudes are negative, the intentions towards purchasing that product would then also be negative. Given the highly controversial position of genetic sciences across several nationalities and industries (Bruhn C. M., 2003; Kuzma, Najmaie, & Larson, 2009), any simple miscalculation in target receptiveness, particularly individuals' attitudes specifically towards GE cotton, could lead to unexpected effects on purchase intention.

H12: Attitude towards GE cotton will have a positive relationship with consumers' purchase intentions towards GE cotton.

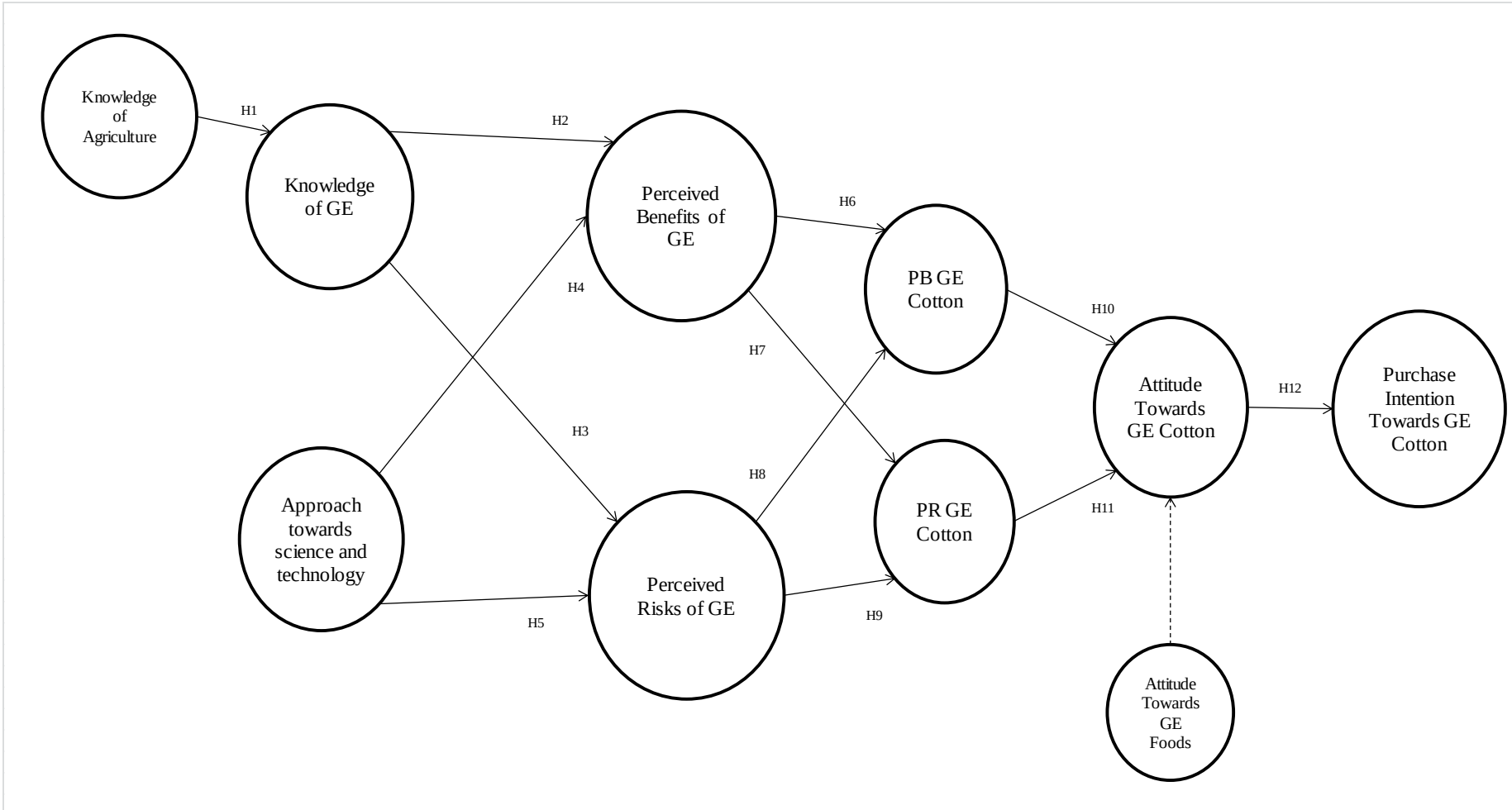

Figure 3: Graphic Representation of Model #1

Model #2: Perceived Risks of GE Cotton

As we mentioned previously, we have found little literature related specifically to GE cotton. The majority of our findings have concentrated on GE foods and how risk, knowledge, and perceptions are involved in its cultivation across several countries (Eicher, Maredia, & Idah, 2006; Gaskell, Bauer, Durant, & Allum, 1999; Janssen, Heida, & Hamm, 2009). To overcome this lack, we have had to extract and adapt relevant concerns of consumers towards food that can also apply towards our focus, GE cotton. We can also assume that while the fact-based, positive impact of genetically-altered products are important, the factors that may affect our understanding can play, perhaps, an even greater part in determining risk and gain from all levels of GE consumers (Lemaux, 2009).

Intrinsic Attributes

Intrinsic and extrinsic attributes, two of the three construct to be examined in this model, would encompass both known and suggested risks and are defined as the ethics, public concerns, and attitudes of the consumer (Frewer, Howard, & Shepherd, 1995). Intrinsic attributes are known as "sensory variables" and are based more on the informations and moral concerns that help inform a person's attitudes about specific innovations, goods and services (Verhoog, 2003). This includes the amount of knowledge each individual may have regarding a specific topic, as well as the additional considerations of price, social responsibility, and both ethical and

environmental values. These last we have translated into the factors of price consciousness, social consumerism, ethical concerns, and environmental issues.

Knowledge of GE cotton

Puduri *et al* (2005), in their study on consumer acceptance of genetically engineered foods, drew parallels between knowledge of GE and a greater positive attitude towards its many applications. From this, we hypothesize that the opposite would also be true, that knowledge of a specific end use of biotechnology, GE cotton, will decrease the perceived risk GE cotton to both the consumer and professionals. In this case, unlike for our other types of knowledge, we rely on only the scientific knowledge that consumers perceive they have in regards to GE cotton. As this is also what most marketers and industry professionals rely on exclusively in order to promote their products, we will test the effectiveness of this purely scientific approach in brief, as compared to consumer studies that state a combination of subjective and objective knowledge as key in acceptance and risk perceptions. From this, we developed the following hypothesis.

H13: Knowledge of GE cotton will have a negative effect on perceived risks of GE cotton.

Price Consciousness

Next, we turn to cost as the more tangible incarnation of risk. Price or the economic valuation of a product is the key motivating factor in apparel purchase decisions according to 81% of Americans, results which corroborate the recorded disinclination of US consumers to pay significantly more for enhanced products (Cotton Inc., 2007; Zissu, 2011). This is also based on

per household consumer behavior in relation to environmentally conscious purchases, which specifically defines the traditional economic variables as price, income, and socio-economic characteristics (OECD, 2008). From the farmer's standpoint, price is relative to GE cotton's contestably higher yields and an average reduction of $45 per acre of pesticide use as of a 1998 survey (Glover, 2010; UCSD & Aroian Lab, 2011). Both advantages would help farmers meet the high-demand, environmentally-conscious markets in the US and abroad, while keeping cost at the retail level at least more stable for the potential consumer. And from a retail perspective, we would infer that, *if* GE cotton was recognized as both cheaper and environmentally friendly, the majority of the US population would indicate a preference towards GE cotton products. This is based on Moschini (2005), as through his study, price was indicated as the major segregator for 25% of EU consumers, and that, due to their indifference to the technology, they are likely to consume GE food if the price is in any degree lower. Since knowledge on many of the advantages of GE cotton such as price are well known in the US's unsegregated cotton market, however, technology is expected to be perceived as more costly to the consumer. Due to this projection, we can hypothesize the following.

H15: Price consciousness will have a positive effect on perceived risks of GE cotton.

Social Consumerism

Social Consumerism, a term that is generally mentioned in relation to social media, was adapted from a study conducted by Minton & Rose, and based on the ideal of Antil & Bennett's original construct describing environmentally friendly consumer behavior (Minton & Rose,

1997). Antil (1984) and Antil & Bennett's (1979) development of the concept known as SRCB or Socially Responsible Consumption Behavior, was modified to our brief descriptor. This was due to our intention of gauging what consumers believe is the societal norm in regards to environmental concerns, and the effect this may have on their individual risk perceptions regarding eco-awareness. In an article on public concerns regarding the process of GE and its applications (Frewer, Howard, & Howard, 1997), the authors point out that societal norms or expectations can positively affect both individual responses and attitudes towards a new technology. And, as we will discuss for our factor of Environmental Issues, those having higher concerns for the environment will generally report greater risk to nature with as yet, unsure technology. This leads us to our final hypothesis regarding Social Consumerism:

H15: Social consumerism will have a positive effect on perceived risks of GE cotton.

Ethical Concerns

One of the main factors found to be mentioned across both nationalities and application is that of ethical concerns. As the "health and safety" variable of our intrinsic attributes (Kuzma, Najmaie, & Larson, 2009), debate over this issue often includes questions of naturalness, divine right, moral obligation, and scientific dependence on trait breeding (Verhoog, 2003; Tencalla, 2005; Frewer & Shepherd, 1995b). In other concerns, the focus tends to revolve around less theologically-driven issues such as health- in humans and animals- and the environment (Lemaux, 2009; Bruhn C. M., 2007; Bal, Samanci, & Bozkurt, 2007). GE cotton is known for its benefits to farmers as to improved crop yield, disease and pest resistance (Eicher, Maredia, &

Idah, 2006), It is accepted by manufacturers due to its lower cost and, due to its ability to grow in less ideal climes, its availability to meet the world's growing demand (Glover, 2010; UCSD & Aroian Lab, 2011). But to the consumer, it is the process of genetic exchange, from organism to plant, or in other cases, from plant to animal and so on, that breeds the suspicion of important ethical standards being ignored in pursuit of science (Frewer & Shepherd, 1995b; Knight, 2009). That the average consumer is not aware of the tests that have been conducted to rule out many of the expected, long-term repercussions of GE crops, only encourages the expectation of risk with GE technology (Wossink & Denaux, 2006; Coghlan, 2006). Given that those with more concerns will typically perceive greater risk in the unknown quality of such a controversial topic as gene technology (Gaskell, et al., 2004), we can speculate the following relationship will be observed.

H16: Ethical concerns will have a positive effect on perceived risks of GE cotton.

Environmental Issues

Environment impact has become one of the major considerations for manufacturers since the 1990s (International Trade Centre, 2010), with more than 50% of Americans found to factor sustainability into their purchase decisions (Klara, 2010). This shift was precipitated by consumer concerns regarding the hazards associated with chemical-based dyes and solvents used in textile processing, as well as a growth in the eco-friendly movement (2010; Everman, 2009; Klara, 2010). Today, eco-concerns have shifted more towards the long-term impacts of GE technology, such as contamination from the release of GEOs into the environment, human,

animal, and nature-related health risks, and the proven benefits versus risks associated with GE cultivation (Font, 2009; Lemaux, 2009; Gaskell, et al., 2004). As Follows & Jobber (2000) explain, consumers will now often measure the consequences of their purchase decisions based on the public versus the individual. Yet risk remains high, particularly for genetically engineered crops. Particularly since, unlike Janssen's target population (2009), American consumers are not willing to pay significantly more for product that may pose fewer risks to the environment (Font, 2009). GE cotton, as typically priced within the same range as that of conventional cotton while also shown to have several benefits for the environment, would then be expected to be the ideal remedy to assuage perceived environmental threats and economic uncertainty (Wossink & Denaux, 2006; Southwest Farm Press, 2010). Yet, again, due to the inefficiency of the industry to communicate the safety and benefits of GE technology, for, example, GE cotton, consumers with higher concerns for the environment will naturally perceive greater risk in an unknown science (Coghlan, 2006). This leads us to the following hypothesis.

H17: Environmental issues will have a positive effect on perceived risks of GE cotton.

Extrinsic Attributes

Extrinsic attributes, contrary to intrinsic attributes as discussed above, are typically considered the social values that define consumer attitudes. Unlike intrinsic, extrinsic focuses on the consequences of the technology vs. preventative arguments. Both are associated with specific applications adapted from Verhoog's research on the perceived naturalness of

genetically engineered animals, and Frewer's study on the acceptance of GE food (Verhoog, 2003; Frewer, Howard, & Shepherd, 1995). For this construct, we have adopted four factors which are believed to hold significant influence on the perceived risks of GE cotton, or indeed, many other technological innovations. These factors are policy regulation, usefulness, communication, and trust. Given the goal of each variable's questions, however, even as their dependent is shared, the independent variables of communication and trust will be separately calculated under our third Model. This allows for the calculation of what institutes are believed to be important for the effective fulfillment of each factor, and will be discussed at further length in the results section of this paper.

Policy Regulation

Policy regulation was determined to be an important factor in determining risk for several reasons. The first lies in the fact that choice, in combination with trust, were noted as two of the most difficult factors to influence in consumers (Ronteltap, Trijp, Renes, & Frewer, 2007). Font (2009) also advocates that, in addition to trust, regulation is one of the main determinants of consumer acceptance of new technology, whereby "substantial uncertainty constrains new technology development". Because regulation can be viewed as either giving consumers a choice or taking it away (Bruhn C. M., 2003; Glover, 2010), the question of an actual need for a working oversight system for the targeted population, is key (Kuzma, Najmaie, & Larson, 2009). The main factor to consider in this argument is that the US, unlike countries under the European Union, so far does not have a labeling regime that mandates the labeling of genetically engineered crops (Lassoued & Giannakas, 2010). Instead, consumers place their trust in the

three government-set agencies assigned to regulate GEOs for the US agricultural industry, which are the EPA, FDA, and USDA (Kuzma, Najmaie, & Larson, 2009). Further concern with risk is minimal past these oversight systems given that, if regulation of the technology is seen as adequate or higher, the public assumes that hazardous outcomes (i.e. risk) of GE technology have been assessed and controlled by the appropriate agencies (Frewer & Shepherd, 1995b). Added to their general lack of scientific knowledge on GE technology, study of the US consumer offers a blank slate upon which to gauge the importance and perceptions of such government-set regulations and agencies in a free, developed market (Tencalla, 2005). And to accomplish this, we have developed the following theory.

H18: Policy regulation will show a negative relationship with perceived risks of GE cotton.

Usefulness

Finally, the factor of usefulness comes to us primarily from Gaskell's study on the Misperception of Risk (Gaskell, et al., 2004). Here, he utilized the Euro barometer survey to determine perceptions of Riskiness and Usefulness in relation to each other. In his findings, he notes that the pairing of usefulness (useful/ not useful) with riskiness (risky/not risky) resulted in two relevant groupings, "Relaxed" and "Tradeoff", which showed a positive encouragement for GE foods when it was deemed useful, whether risk was perceived or not (Gaskell, et al., 2004). Frewer and Font support that a consumers' belief in the usefulness of a new technology can positively impact their attitudes and acceptance of the product (Font, 2009; Frewer, Howard, &

Shepherd, 1995). Even for applications that they view otherwise as negative or risky, if applied towards a specific goal, many consumers indicate acceptance (Frewer, Howard, & Shepherd, 1995), somewhat in the attitude of "for the greater good". Given that GE cotton is a broadly used fiber with a variety of uses, even outside of the common thought, clothing, we anticipate the following results from our data.

H19: Usefulness will have a negative effect on perceived risks of with GE cotton

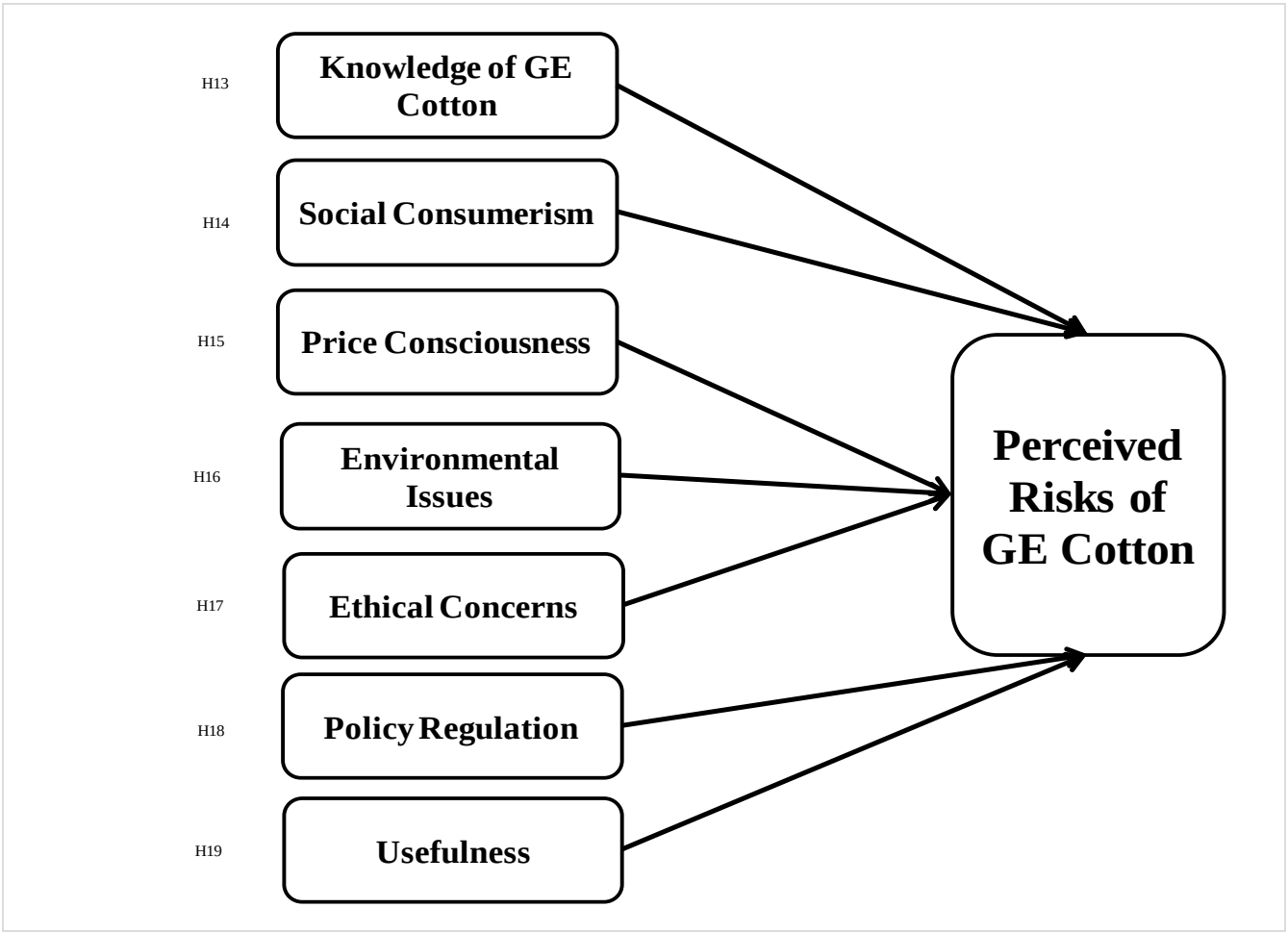

Figure 4: Graphic Representation of Model #2

Model #3: Perceived Risks- Communication & Trust

Communication

Continuing from the previous promotion of knowledge and dispersal of information, we look at communication as an equally significant factor. As discussed in Model #1, knowledge is key to the formation of the lay consumers' attitudes, perceived risks, and benefits of new technology (Font, 2009; Gaskell, et al., 2004; Ronteltap, Trijp, Renes, & Frewer, 2007). Ronteltap *et al* (2007) and Frewer *et al* (1995) promote that more knowledge can lead to a more positive reception of new products and technological innovations. Essentially, what the consumer perceives as the costs and benefits of a product or technology reflect not only the individual consumer's "tradeoff" between the need and economic risks associated a with product based upon their knowledge and level of trust (Gaskell, et al., 2004; Ronteltap, Trijp, Renes, & Frewer, 2007). It also demonstrates their valuation system, which, as indicated under ethical concerns, social consciousness, and usefulness, can shift acceptance of new technology even if general opinion is negative. If consumers place value in information they receive from one source and not another, that method of communication and information dispersal is, naturally, going to be more effective for both marketers and with consumers. And, based on Klara (2010), the average US consumer believes it to not be their responsibility to investigate the benefits of a product. Instead, they trust certain organizations to, from government to retailers to environmental groups, to lead a thoughtful and well-rounded dialogue on the benefits and consequences new products.

While Europe tends to associate more talk about an issue or product as cause for higher concern, the US generally encourages more information, on both benefits and risks associated with a new technology before making a decision (Gaskell, Bauer, Durant, & Allum, 1999). And since, according to Font (2009), the US is one country most likely to be swayed positively given more facts about an innovation, greater knowledge can be inferred as perhaps more important when marketing to the American consumers. Roberts *et al*, in their Risk Communication model, particularly support that communication is key to perceived risks of GE crops, but must be tailored to address individuals' "characterization and perceived "tolerability" of the risk" (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). What we can infer from this information in regards to communication is the following hypothesis.

H20: Communication will have a negative effect on perceived risks of GE cotton.

Trust

As presented by Gamble (2000), and as mentioned in the above defense of communication, trust is an important issue in shaping consumer preferences and risk perceptions. Michael Seigrist, for the Office of Science and Technology Policy (Kuzma, Najmaie, & Larson, 2009), found that "perceived benefits and risks are affected by trust, and that both influence public acceptance of biotechnology". According to Font's (2009) study of consumers in Spain, the most trustworthy channels of communication are consumer organizations, environmental groups, and scientist. Similarly, a work by Gaskell *et al* pointed out that Europeans also similar patterns in regards to trusted organizations for GE information, while also cautioning that trust in

government and industry for these countries is typically very low (Font, 2009; Tencalla, 2005). Although these rankings are, overall, expected to carry over into the US population, two points stood out as unaddressed.

The first was that, in Spain, environmental groups were shown to have a greater effect on perceived risk than benefits (Font, 2009); essentially, individuals accept risk presented by these interest groups more readily or as equaling more weighted, than benefits communicated by government and industry. Americans, however, were found to typically exhibit a more positive attitude towards GE technology in a 2004 study by Traill *et al*, as well as slightly more trusting in government than their European counterparts (2009). This extends at least to controversial studies that, like our own, ask how confident consumers are that different agencies and institutions are doing a good job in regulating this technology (Kuzma, Najmaie, & Larson, 2009). Due to the fact that we could find only limited literature on institutions that were most trusted for information and management of GE technology amongst the broader US population (2009), it was felt that to re-apply this measure to our US population would provide a more concrete measure and ranking of trust as applied specifically to cotton versus food crops. The results would explain whether greater trust could lead to, if not a complete lack of risk, at least significant risk abatement. From this theory, we have developed the following hypothesis.

H21: Trust will show a negative relationship with perceived risks of GE cotton.

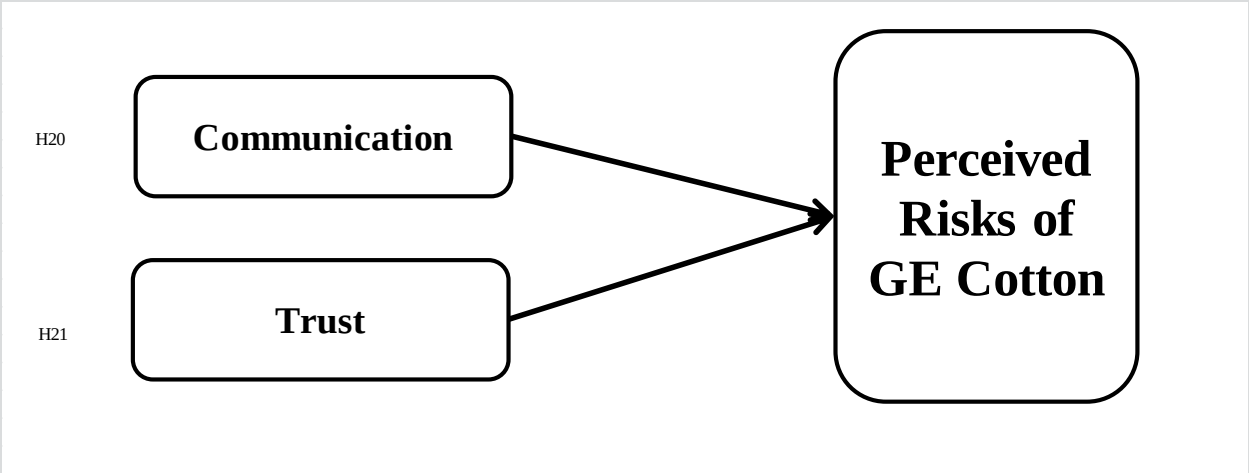

Figure 5: Graphic Representation of Model #3

Demographic Indicators

Demographic indicators are also some of the main components we wish to measure in relation to the perceived risks of GE cotton. Several of our literatures, and most of those that directly related to a type of cotton, noted pronounced distinctions between gender, socio-economic status, and affiliations as affecting attitudes (Cotton Inc., 2007; Puduri, Govindasamy, Lang, & Onyango, 2005; OECD, 2008). Ronteltap (2007) goes so far as to expound that the additional variables of race, nationality, and familiarity are also significant in innovation acceptance. For our study, not all of these identifiers will be considered significant enough to merit specific notice. However, we will examine the identifiers of gender, location, education, political affiliation, and religious frequency for significance due to their potential and unique

contributions to the future implications for our research. Below, we will discuss the primary literature we found to support our focus on each of these aspects.

Gender

Both Bruhn and Puduri noticed a slight dissimilarity between women and men sampled, and their openness to new technology (Bruhn C. M., 2007; Puduri, Govindasamy, Lang, & Onyango, 2005). Their findings were that women, the young, and the less educated (typically GED level or below) are typically less inclined to support genetic engineering (Puduri, Govindasamy, Lang, & Onyango, 2005). Though communication has been shown to make a greater difference in level of acceptance whether testing a European or American consumer (Bruhn C. M., 2003), the responses differentiated by gender is something that should be taken into account as it is typically women that either make or have a strong influence on purchase behavior within a household (Cotton Inc., 2007; OECD, 2008). Gaskell *et al* also noted that women were typically 'less interested, knowledgeable, and supportive of science and technology' (Gaskell, et al., 2004). They are, however, deemed nearly twice as likely to search out more eco-friendly clothing according to data collected on an article by Cotton Inc. (2007) as Figure 6 (below). While this usually translates to organic in the current market, this information could be significant for marketers if GE cotton, or indeed other GE products, do become a 'pushed' alternative in future (2007).

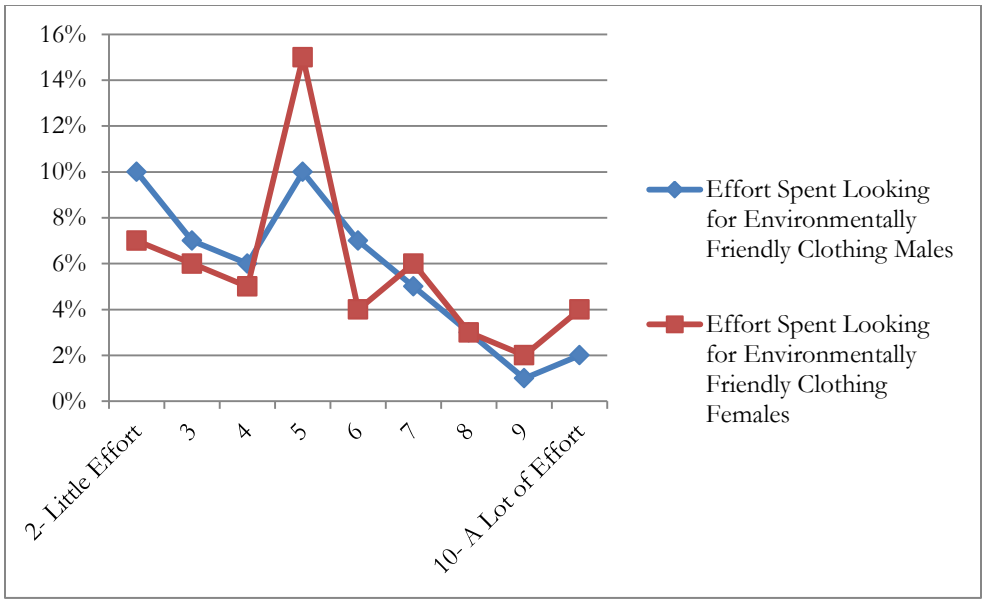

Figure 6: Gender breakdown of average time spent in search for environmentally-friendly clothing (Cotton Inc., 2007)

Education

As noted previously, plant-based genetic modification is preferred over animal-based in US consumers (Bruhn C. M., 2003; Puduri, Govindasamy, Lang, & Onyango, 2005) which lends itself towards GE cotton growth. To break this down into market segments, however, Puduri found that over half of respondents supported plant-based genetic modification from all age brackets, yet men, older individuals (age 35-54 years old), and all participants with a higher level of education were shown to be more inclined towards approval of all types of GE technology (Puduri, Govindasamy, Lang, & Onyango, 2005). This was supported by Traill *et al* (Font, 2009) in their findings that higher education has a positive relationship with the acceptance and belief in the benefits of GE technology, while the converse or less educated perceive higher risks.

Political Affiliations & Religious Frequency

Value attributes, as mentioned previously with our review of world-wide cotton perceptions, was described as what determines acceptance among US consumers (Puduri, Govindasamy, Lang, & Onyango, 2005). Here, the authors outlined value attributes as including advanced demographic alignments such as political leanings and church service attendance (2005). Because of the wide range of lifestyles we will use in our sample, many of whom would not be related through a church per se due to alternate or absent religious beliefs, we will modify this last to "religious frequency". By this, we would still get a picture of how involved subjects are in their religion based on their frequency or attendance at services, yet this will allow our questions to apply to the national vs. niche audience. Both political leanings and religious frequency would, of course, be the more optional of our demographic queries, but would indicate how these element shape ethical and social values as we spoke of in our intrinsic and extrinsic constructs (Puduri, Govindasamy, Lang, & Onyango, 2005; Frewer, Howard, & Howard, 1997). These in turn can affect all aspects, from attitudes, risk perception, and adoption of GE cotton or many other innovative technologies.

Purchasing Power

A significant note of comparison for our study on these three types of cotton are findings by the Hartman Group which concluded that the consumer segment with the highest propensity to purchase organics also had a higher than average number of households with income under

$25,000" (OECD, 2008). This illustrates a different perspective, based on the rationale of higher education, which one generally equates with a greater income, as being more open to GE technology (Puduri, Govindasamy, Lang, & Onyango, 2005). Women are also important for this factor as they are typically the primary shopper for the family across several nationalities, and are seen to have a higher willingness to pay a premium on sustainable products (OECD, 2008).

Location

Our last demographic identifier, location, was conceived based the international range of our literature, from Germany to Spain (Janssen, Heida, & Hamm, 2009; Font, 2009), Africa to Asia (Eicher, Maredia, & Idah, 2006; ABARE, March 2006; Chen & Rafan, 2009), and, of course, the US (Gaskell, Bauer, Durant, & Allum, 1999). As the economies of each location varied, from more agricultural to urban landscapes as with Font (2009), it was considered a point of interest to evaluate whether such variance could be significant in the more diverse economy of the US, where agriculture and industry are dispersed across our tested population. The results, if significant, might be expected to have an effect on knowledge of GE cotton, knowledge of agriculture, and attitudes towards both GE (technology, general) and GE cotton.

Chapter 6: Methodology

Data Collection

Participants

Survey participants were gathered through a respected marketing research company and an online survey was used to collect all study data. As the main criteria was that participants be above 18 years of age and a US resident, regardless of other common demographic factors, a random sample of U.S. consumers were invited to participate in the survey via email. The invitation letter, sent via email, explained the purpose of the study, assured confidentiality of informations provided by respondents, and directed them to a website on which to complete the survey by clicking on the survey's URL. Reminder emails were sent to potential participants to encourage study participation as the intended sample of participants had to include a minimum of five hundred examples of usable data. This number was chosen in order to provide a significant national sample of US consumers, and to ensure validity to survey results.

Sample

As the goal of this survey was to take a representative sample of the US population, participation was exclusive to US residents to fairly reflect the population as of Census 2010 (Government of the United States of America, 2011) regarding ethnicity, gender, and age. According to the 2008 population estimated gender breakdown, we anticipated our sample

breakdown to include approximately even numbers of women vs. male participants above the age of 18 years old (Government of the United States of America, 2008). Ethnicity was also estimated to fall within the results of the 2010 Census with White or European-American holding the majority at 64% and Native Hawaiian or Other Pacific Islander as the minority of 0.2% (Government of the United States of America, 2011). As ethnicity was not a largely significant factor in this study, however, a general representation from all groups was measured as sufficient for analysis.

Measures

The actual survey utilized a seven-point Likert scale structure, taken after Roberts' questionnaire and grading rubric for studying Risk Communication (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). Additionally, works by Frewer, Font, and Flynn & Goldsmith, among others, were used as sources of questions and survey formatting (Font, 2009; Goldsmith & Flynn, 1999; Frewer, Howard, & Shepherd, 1995; Frewer & Shepherd, 1995b). Though Likert scales are most often used in qualitative studies, we chose to adopt this method due to its ability to combine both subjective and objective questions using pre-set statements (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). It was also commonly used in measuring many of our constructs, from Purchase Intention to Risk Perception. Our incarnation followed a modified scale of Roberts *et al*. (2006) who configured all statements/questions to a rating scale from -3 to +3, with -3 being "Strongly Disagree" or its negative equivalent, "0" described as "Neutral", and +3 representing "Strongly Agree" or a positive equivalent. Our

scale, instead, exactly follows our Likert point scale, with 1, 4, and 7 being the reflective values to Roberts' own study. This system provided the range and variation intended to illustrate how GE cotton rates between the two major methods of cotton cultivation, organic and conventional. The two applications of GE technology, as a food or fiber crop, were also evaluated separately thanks in part to this measurement scale and survey structure. As illustrated in our literature, whether food, medical, or textile products, it was felt important to retain the distinction between GE applications to best evaluate consumers' true attitudes and intentions given each category (Economist, 2004; Chen & Rafan, 2009; Frewer, Howard, & Shepherd, 1995; Moschini, Bulut, & Cembalo, 2005). Frewer *et al*. (1995) especially noted that the perceived need or benefit of a specific application of GE technology (i.e. product) weighs significantly against the negative perception consumers may have of the general technology.

Data Analysis

All data was collected and analyzed using a combination of factor analysis, t-tests, and multiple regression analysis, as was used in related, comparative literature (Janssen, Heida, & Hamm, 2009). The decision to use this method of analysis also stemmed from the fact that our study evaluated the relationships between multiple factors. Reliability, though proven in the industry-approved literatures our variables were taken from, were again verified as a fit for our models, and was determined based on the Cronbach α of each factor included in our survey (refer to Appendix B). Significance was tested with factor analysis of all questions according to their groupings. And finally, positioning for all types of cotton, and consumers' trust and

communication preferences, divided by relevant industry (ex. Government, scientists, etc.), were calculated using the standard t-test method of calculating means.

Instruments

The creation of our actual survey depended largely on previous studies, whether directly related to genetic engineering or relevant consumer issues. Due to our goals of measuring both pre-knowledge and attitudes towards GE technology and its applications (refer to p47) and a post-evaluation of knowledge and attitudes towards GE cotton specifically, our survey was composed of two main sections which closely correspond to our two test constructs, purchase intention towards GE cotton and perceived risks of GE cotton. The two halves were delineated by a list of general definitions of the three types of cotton we wish to compare as well as the request that after said point, participants consider GE cotton alone when rating each statement. These statements were as follows:

Conventional cotton can be defined as cotton that has not been genetically modified and which generally requires the use of chemical pesticides and fertilizers to produce a successful crop. "Conventional" is the term commonly used to describe non-organic crops (Cotton Inc., 2007; Organic Trade Association, 2011).
Organic Cotton describes the type of cotton produced without the use of chemical fertilizers and pesticides. This can impact both the amount of labor and consumption of resources required to produce a successful crop (Rieple & Singh, 2010; Harkin, 2007).
Genetically engineered or GE cotton (sometimes referred to as genetically modified or GM cotton) is cotton that has been genetically engineered to grow in less ideal conditions. Its primary characteristic is a reduced amount of the common chemical pesticides and fertilizers required to produce a successful crop (NAAS, USDA, & ASB, 2010; Wossink & Denaux, 2006;

Cotton Inc., 2007).

For our survey, we also chose to describe all applications of genetic engineering, from food to fiber crops as "genetically engineered (GE)" instead of the term most commonly used in our literature on cotton varieties, specifically, GM or genetically modified. This was done to create consistent terminology for survey participants and to non-expressly define what technology we attempt to gain their responses regarding. To ensure that the shift was not a significant issue for those that were more familiar with the term GM, the alternate name was available in the definition for GE cotton preceding the second half of our survey on which GE cotton becomes the direct topic. In the following section, we will identify the constructs to be examined and the questions used to measure each.

Survey Development

The survey began by determining participants' Approach to Science and Technology. The two statements used to measure this variable are drawn directly from Font's study on consumers' choice, attitudes, and acceptance of genetically engineered (GE) foods (Font, 2009). Like Font, these questions were be evaluated using a Likert method, but were modified to reflect our format of 7-point versus Font's 5-point scale.

Approach towards science and technology	I am interested in science and technology.
	I feel well informed about science and technology

Our next set of statements measured participants' knowledge of agriculture and knowledge of genetic engineering (GE). The three questions under each heading are reflections of each other and have been adapted only to the purpose of reflecting each type of knowledge to be examined. All three statements were taken from Flynn & Goldsmith's study on subjective knowledge in fashion, a rather fitting parallel (Goldsmith & Flynn, 1999).

Knowledge of agriculture	When it comes to agriculture, I really don't know a lot.
	Compared to most other people, I know less about agriculture.
	I feel very knowledgeable about agriculture.
Knowledge of genetic engineering (GE)	When it comes to genetic engineering (GE), I really don't know a lot.
	Compared to most other people, I know less about genetic engineering (GE).
	I feel very knowledgeable about genetic engineering (GE).

The following chart for knowledge of genetic engineering (GE) differed in its final three questions. The statement of "I feel well informed about genetically engineered (GE) food", has been modified from Font's statements on science and technology (Font, 2009) and, likewise, follows the typical Likert scale from "Strongly Disagree" to "Strongly Agree" as response

options. However, the following statements were adapted from Hallman's study on Americans and their knowledge of genetically-modified foods (Hallman, Hebden, Cuite, Aquino, & Lang, 2004). Because his study was set up as a multiple choice questionnaire, these two statements were adapted from a similar question. A bilateral set of responses- "Never", "Some", and "A lot"- were applied to the matrix of choices. These three statements were added so as to provide a distinction between participant's general knowledge of GE, their specific understanding of GE food, the subject of most of our reviewed literature, and GE cotton, the under-represented application we focus on through this research.

Knowledge of genetic engineering (GE)	I feel well informed about genetically engineered (GE) food.
	I have heard or read about genetically engineered (GE) foods.
	I have heard or read about genetically engineered (GE) cotton.

Knowledge of the types of cotton, our next variable, drew its single independent statement from Flynn & Goldsmith as to what participants know of cotton in general (Goldsmith & Flynn, 1999). Following this are three statements adapted from Font's construct of Approach to the Environment ("I feel well informed…"). These were used to gauge participants' self-perceived knowledge of each of the three types of cotton we examine as comparisons for this study (Font, 2009).

Knowledge of the types of cotton	When it comes to the different types of cotton available (ex. organic, conventional, and genetically engineered (GE)), I really don't know a lot.
	I feel well informed about organic cotton.
	I feel well informed about genetically engineered (GE) cotton.
	I feel well informed about conventional cotton.

Both set of questions measuring consumers' approach towards genetic engineering and approach towards GE cotton (i.e. the perceived benefits and risks towards each) were, for the majority, reflective of each other as all four statements used to measure perceived risk and two from perceived benefits are either lightly modified or original to Font and Roberts (Font, 2009; Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). The only diversion lies in the first two statements for each constructs benefits section. For Genetic Engineering, the first two benefits were again drawn from Font with a slight grammar revision to reflect 'sustainable crops' versus the previous assertion towards "healthier foods" (Font, 2009). However, in the identical section under GE cotton, only one question was drawn from Font, even though here the originating question differed from the previous section's statements. The second question which relates to price was drawn, instead, from Moschini (2005) as he examined price as one of the factors that make the segregation of organic, conventional, and genetically modified foods a worthwhile venture in the EU. Again, due to the original format, this question was adapted to fit our 7-point Likert scale.

Perceived benefits of GE	Genetic engineering (GE) has contributed to an increase in the quality of life.
	The technology of genetic engineering (GE) will lead to more sustainable agricultural crops.
	Genetically engineered (GE) crops are necessary to assure an adequate supply of agricultural products for a growing human population.
	Genetically engineered (GE)crops reduce the need for fertilizers, irrigation, and pesticides.
Perceived risks of GE	I am worried that engineering pesticidal properties into agricultural crops will lead to more rapid resistance to pesticides.
	I believe the risks of genetic engineering (GE) to human health are largely unknown.
	Growing genetically engineered (GE) crops will be harmful to the environment.
	I'm worried that the use of genetically engineered (GE) crops in agriculture will lead to further loss of biodiversity in our food and agriculture systems.

Perceived benefits of GE cotton	Genetically engineered (GE) cotton is ecologically-friendly.
	The cost of products made with genetically engineered (GE) cotton is less expensive.
	Genetically engineered (GE) cotton is necessary to assure an adequate supply of textiles for a growing human population.
	Genetically engineered (GE) cotton reduces need for fertilizers, irrigation, and pesticides.
Perceieved risks of GE cotton	I believe the risks of genetically engineered (GE) cotton to human health are largely unknown.
	I am worried that engineering pesticidal properties into cotton crops will lead to more rapid resistance to pesticides.
	Growing genetically engineered (GE) cotton will be harmful to the environment.
	I'm worried that the use of genetically engineered (GE) cotton crops in agriculture will lead to further loss of biodiversity in our agriculture systems.

Our next factor was that of environmental issues, a very important aspect of today's consumer market. As this sector acted as an evaluation of consumers' personal opinions towards the issues and main institutions involved in environmental responsibility, we borrowed our first two statements from a similar conference presentation, which attempted to measure socially responsible consumption behavior (Antil & Bennet, 1979). Our final question is again modified from Font's Approach towards the Environment construct (Font, 2009).

Environmental Issues	I feel angry and frustrated when I think of the ways industries are polluting the environment.
	I feel sorry that the government does not do more to help control pollution of the environment.
	I am interested in sustainability and the "Going Green" movement.

The three statements used to measure price consciousness were drawn from Huff & Alden (1998). Completed during this 1990s, they completed a three-country evaluation of customer response to sales promotions in developing markets. Their questionnaire was ideally relevant for our study, requiring no modification as the results could be expanded to test a developed market such as the United States.

Price Consciousness	I usually buy consumer products when they are on sale.
	I buy the lowest price brand that will suit my needs.
	When it comes to choosing most consumer products, I rely heavily on price.

Our next section, social consumerism, took all four of its measures from Minton & Rose (1997) which was, as mentioned previously, taken from Antil and Bennett's (1979) SRCB theory. All four statements were taken directly from their source, but for the first and final statements to which a mild restriction and a reverse adaptation respectively have been used to modify them to their current forms.

Social Consumerism	Environmental issues are overrated.
	The environment is one of the most important issues facing the world today.
	Consumers should be interested in the environmental consequences of the products they purchase.
	Environmental issues are of concern to me.

Purchase intention towards GE cotton garnered the majority of its questions from Bruner & Hensel's guide to marketing scales (Bruner & Hensel, 1996). To measure this variable, four modified statements from Bruner & Hensel were used, and one, the second in the corresponding insert, from Font's construct of Consumer Intentions as both measures represent similar data (Bruner & Hensel, 1996; Font, 2009).

Purchase Intention	I would be willing to buy products containing genetically engineered (GE) cotton.
	I would buy genetically engineered (GE) cotton if it were grown in a more environmentally friendly way.
	I would be willing to buy clothing containing genetically engineered (GE) cotton.
	I would be willing to buy home textiles (ex. sheets, upholstery) containing genetically engineered (GE) cotton.
	I would be willing to buy baby clothes containing genetically engineered (GE) cotton.

Attitudes towards cotton and GE food are again drawn from Bruner & Hensel's examples of bilateral measurement scales (Bruner & Hensel, 1996). In this case, all questions were given five value scales including bad/good, not interesting/interesting, negative/positive, not worthwhile/worthwhile, and expensive/inexpensive. These were measured using our 7-point format with each set having a "neutral" option, as with all statements for our survey, which corresponds to the number 4 on the 1-7 grid. Attitudes towards cotton was the only construct of the two that required modification. Instead of a general evaluation of cotton, statements were made to differentiate between the three types of cotton of interest. This was sued as a way to evaluate the possible market position of GE cotton between conventional and organic cottons, and was loosely based on Moschini and partners' segregation analysis (Moschini, Bulut, & Cembalo, 2005).

Attitudes towards GE food	Genetically engineered (GE) food is…

Attitudes towards cotton	Products made from organic cotton are…
	Products made from genetically engineered (GE) cotton are…
	Products made from conventional cotton are…

The factor of ethical concerns, which was used in our evaluation of GE cotton specifically, derived its definition and title from Frewer's (1995b) study, which also utilized the 7-point Likert scaling. Though Frewer studies the attitudes on ethics between applications of GE for medicine and food applications, our construct was actually built upon the concerns found among four of our resources. These included Font's thesis, Gaskell's work on moral acceptability, a common part of ethics, and Verhoog's issue of "naturalness" in GE applications and public concern for the ethically and morally correct action (Font, 2009; Verhoog, 2003; Gaskell, et al., 2004). To this end, three of our questions were derived from Font, who examines "Attitudes Towards GM Foods" from a social values point of view, with only the last directly taken from Frewer's questionnaire.

Ethical Concerns	To what extent do you agree that use of modern genetic engineering (GE) in the production of cotton, for example to increase production, reduce environmental impact, and/or reduce labor costs, is morally acceptable for society?
	Although some benefits are associated with genetically engineered (GE) crops, these are morally wrong.
	Although some benefits are associated with genetically engineered (GE) crops, these are unnatural.
	The genetic engineering of plants for food production purposes should be controlled by legislation for ethical reasons.

Policy regulation adapted two statements, one concerning federal government and the other on the need for labeling, from Roberts *et al* (2006) to create four of the questions used in this portion of our study. These were adapted to reflect government regulations, of which there are few for US crops, whether food or fiber. These acted as points of opinion based on each consumer's attitude and current knowledge of such policy. Only one of our five statements was derived from Font and modified to relate directly to the regulatory agencies involved in US crop oversight versus the European Union (Font, 2009). All were adapted, as need, to fit the statement format we continued for our survey.

Policy Regulation	The federal government needn't spend much taxpayer money on developing regulatory policies related to genetically engineered (GE) cotton crops and products because the industry (including farmers, manufacturers, and retailers) will use them responsibly.
	The federal government needn't spend much taxpayer money on developing regulatory policies related to genetically engineered (GE) cotton crops and products because the scientists and research companies will use them responsibly.
	I believe that government regulation agencies such as the Environmental Protection Agency (EPA) and Food and Drug Administration (FDA) are doing a good job for society.
	I don't think that there is any need for textile manufacturers to identify genetically engineered (GE) cotton content on product labels.
	I don't think that there is any need for food manufacturers to identify genetically engineered (GE) cotton content on product labels.

Usefulness or need was shown to have a significant, negative effect on perceived risk for GE applications in both Gaskell and Frewer's bodies of work (Gaskell, et al., 2004; Frewer, Howard, & Shepherd, 1995). For this factor, we reviewed studies by Font, Roberts, and Frewer in selecting relevant queries. From Frewer (1995), we adopted our first and last questions in order to measure consumers' perception of usefulness on a personal and industry-wide level. From Font's construct of "Attitudes Towards GM Foods", and with minor modification to express the purpose behind GE technology for cotton production, we incorporated only one, our second, question (Font, 2009). And finally, of Roberts, we adapted the remaining statement to identify GE cotton and measure consumers' response given a specific use and, again, purpose, towards its creation.

Usefulness	To what extent do you believe genetically engineered (GE) cotton would be useful to you?
	To what extent do you agree that use of modern genetic engineering in the production of cotton, for example to increase production, reduce environmental impact, and/or reduce labor costs, is useful for society?
	Genetically engineered (GE) cotton is most useful in industrial textiles to meet the needs of a growing human population.
	Genetically engineered (GE) cotton would be useful for the industry (including farmers, manufacturers, retailers).

The following section, communication, was taken from Roberts' study on the Risk Communication Model (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006). As Roberts *et al* also utilized Likert measures in their data collection, the main changes implemented for the three statements chosen were to modify the statements to reflect GE cotton and related modes of communication. The third statement, however, was more broadly transformed through the addition of seven major outlets through which the average consumer receives information on technological innovations such as GE crops (Font, 2009). These seven institutions were adapted from Font (2009) which determined the trust Spanish consumers had in each organization to provide reliable information about genetic engineering in food production (Font, 2009). Though somewhat modified in to simplify reference for survey participants, the only direct modification was the extracting of these seven of the nine institutions Font lists due to their direct tie to GE cotton and the American consumer. Despite this, survey participants were still asked to answer each on a "Strongly Disagree/Strongly Agree" scale as with Roberts *et al* (2006).

Communication	I think that there is a need for retailers to identify genetically engineered (GE) cotton on product labels.
	Consumers have the right to know if the products they buy contain genetically engineered (GE) cotton regardless of whether or not such products pose any known risk to human or environmental health.
	To lead a thoughtful dialogue and critical thinking related to the social, environmental, economic, ethical, and technical aspects of genetically engineered (GE) cotton in the market, should be the role of:
	Government (ex. FDA, EPA)
	Scientists
	Consumer Organizations (ex. Cotton Inc.)
	Retailers (ex. Levi, Banana Republic)
	Environmental Groups
	Manufacturers
	Public/ Media (ex. News, Web)

Our final factor in measuring extrinsic attributes was that of trust. For this, Font's questionnaire was utilized almost exclusively, although several resources, from Frewer to Gaskell, were found to support this factor as well (Frewer, Howard, & Shepherd, 1995; Font, 2009; Gaskell, et al., 2004; Puduri, Govindasamy, Lang, & Onyango, 2005). All four questions have been modified to fit the statement form we applied throughout our survey. Yet again, with the final one, as with the factor of communication, we used a combination of Roberts' (2006) statement on trust and Font's (2009) non-dependent ranking of trusted institutions to obtain specific consumer data on source trustworthiness. It was also decided that adding the term "impartial" to this final statement would best reflect Americans' tendency in receiving information on both risks *and* benefits of new technology in the media, unlike in many countries (Font, 2009).

Trust	Corporations doing research on genetically engineered (GE) cotton are doing a good job for society.
	Scientists across the industry doing research on genetically engineered (GE) cotton are doing a good job for society.
	The US government doing research on genetically engineered (GE) cotton is doing a good job for society.
	To provide reliable, impartial information about genetic engineering in genetically engineered (GE) cotton production, I would trust:
	Government (ex. FDA, EPA)
	Scientists
	Consumer Organizations (ex. Cotton Inc.)
	Retailers (ex. Levi, Banana Republic)
	Environmental Groups
	Manufacturers
	Public/ Media (ex. News, Web)

Demographic Indicators

For our survey, common demographics such as gender, age, and income were recorded along with four less common classifiers. As discussed under our section "Demographic Indicators", these included the identifiers of location, education, political affiliation, religious frequency, and purchasing power. Although, gender was expected to have the greatest impact on consumers' perceived risk associated with GE cotton, these additional definitions were expected to show a direct correlation with perceived Risks of GE cotton. Of these, the first was location, which was used to measure whether subjects were exposed to a more urban or rural community. This was expected to affect both agricultural understanding and evaluation of importance for

certain factors. Education, political affiliation and religious frequency were classifiers found in Puduri and Saher's studies as a divisive characteristic for respondents (Puduri, Govindasamy, Lang, & Onyango, 2005; Saher, Linderman, & Hursti, 2006). In the use of these for our study on GE cotton, the inclusion of these identifiers helped determine consumers' general approach to GE products, particularly through the scope of individual ethical concerns. Finally, questions regarding participants' purchasing power in regards to textiles were anticipated as potentially relating to the variables of environmental issues and social consumerism to show preference and purchase patterns for survey participants.

Chapter 7: Results

Descriptive Analysis

Our survey produced a total of 572 specimens of usable data which met and slightly exceeded our minimum of 500 to ensure external validity. The specific characteristics of our respondents were collected into Appendix A of this paper. From this data, participants were found to be predominantly married with at least one child (under age 18) in the house. The average participant was between the ages of 36 and 55, with a household income between $50,000 and $99,999 per year and a purchasing power of up to $99 per month specifically for clothing and other textile goods. As far as education, 268, or approximately half of respondents, indicated completion of a four-year Bachelor's degree or higher. Ethnicity was found to be comparable to the 2010 US Census (Government of the United States of America, 2011) in that "White or European-American" held the majority at 485 respondents, with "Black or African-American" (32) and "Latino or Hispanic American" (21) as the major minorities. Gender was also in line with expectations with approximately half male (265), half female (293) responders to our demographic query, with females again shown as the primary shopper per household.

As mentioned under our "Measures" section, all variables were checked for reliability (refer to Appendix B), even though our constructs were adopted from previously validated studies. All variables were found to show good to excellent reliability for our models, measured by a Cronbach's $\alpha \geq 0.75$ or higher. Based on multiple regression, this study was able to prove the significance of knowledge and attitudes on purchase intentions towards GE cotton, as well as

the impact of our seven intrinsic and extrinsic attributes on the perceived risks of GE cotton. Finally, through mean comparisons and paired *t*-testing, we determined GE cotton's potential market position, as well as institutions American consumers prefer in regards to the spreading of information regarding GE cotton. The following sections include the corresponding data tables and figures from our analyses and short discussions on whether results met or denied our previous hypotheses.

Hypothesis Testing

Model #1

Results

For Model #1, hypotheses H1-H12 were analyzed through multiple regression, and the results recorded in Table 1 (below). The Variance Inflation Factors (VIF) for this model were noted, and suggested no multi-collinearity of either independent or dependent variables. Based on the results recorded in Table 1, knowledge of agriculture shows a highly significant, positive relationship with knowledge of GE (β= 0.588, p< .001). This then supports H1 of this study.

The second evaluation for this model measured the independent variables- knowledge of GE and approach towards science and technology- against the dependent variable of perceived benefits of GE. Although both variables showed a positive relationship with the dependent, knowledge of GE showed only minimal significance (β=0.094, p= 0.049), while approach towards science and technology showed a highly significant contribution to the perceived benefits of GE (β= 0.292, p< 0.001). Based on these results, we support both H2 and H4.

In Table 1, both knowledge of GE and approach towards science and technology were found to have a negative relationship with perceived risks of GE. Knowledge of GE, however, did not show a significant effect on the dependent (β=-0.036, $p \geq 0.05$), indicating that knowledge plays a significant role in the promotion of benefits with the public and not for risks. Approach towards science and technology, however, was significant at $p < 0.01$ (β=-0.154). From these results, we support H5, but must reject H3.

Next, perceived benefits of GE and perceived risks of GE were found to have highly significant contributions to the perceived benefits of GE cotton ($p < 0.001$). Perceived benefits of GE was shown to share a positive relationship with perceived benefits of GE cotton (β=0.601) as both are similar measures. Perceived risks of GE was shown to have a negative relationship with the dependent (β=-0.143), as expected. From these results, we can support H6 and H8.

For the dependent variable perceived risks of GE cotton, perceived benefits of GE showed a negative, significant relationship (β=-0.098, $p < 0.01$). The other independent variable measured for this dependent, perceived risks of GE, in contrast, had a highly significant, positive relationship with perceived risks of GE cotton (β=0.738, $p < 0.001$). Based on these analyses, we support H7 and H9.

Both of the independent variables, perceived benefits of GE cotton and perceived risks of GE cotton, were shown to have a highly significant relationship with the dependent variable of attitudes towards GE cotton ($p < 0.001$). However, while perceived benefits of GE cotton indicated a positive relationship with the dependent variable (β=0.610), perceived risks of GE

cotton had a negative effect on attitude towards GE cotton (β=-0.199). As such, we can support the corresponding hypotheses of H10 and H11.

As the final measure for Model #1, attitude towards GE cotton was found to be highly significant, as well as positively related to the dependent variable purchase intentions towards GE cotton (β=0.751, p< 0.001). From this data, we can support the hypothesis H12. In summary, we found that eleven out of our initial twelve hypotheses were accepted based on our model. Only the independent variable knowledge of GE was rejected as insignificant or not contributive to that of perceived risks at p= 0.472.

Although not the results expected based on background literature and our target population, the rejection of H3 can be explained in part by Puduri's findings that those that cited greater knowledge of technology were often more likely to hold a favorable view of GE applications (Puduri, Govindasamy, Lang, & Onyango, 2005). In other words, what was communicated to these participants can be expected to be more benefits than risks of such technology. Conversely, those with less knowledge of GE would fall into the pattern of anticipating risk due to a lack of either positive or negative information regards GE technology or products (Gaskell, et al., 2004). Further studies would therefore do well to indicate the relationship between only knowledge of GE and the perceived benefits of GE in determining consumer attitudes towards specific applications of GE technology (i.e. GE products).

Model #1: Purchase Intentions towards GE Cotton						
Hypotheses	**Variables**		**ß (beta)[4]**	**Model Adjusted R^2**	***F*-Statistic (df)**	**Model *P*-value**
	Dependent	**Independent**				
	Knowledge of GE Technology					
H1		Knowledge of Agriculture	0.588***	0.345	284.66 (1, 538)	$p < 0.001$
	Perceived Benefits of GE					
H2		Knowledge of GE	0.094 *	0.119	37.60 (2, 538)	$p < 0.001$
H4		Approach Towards Science & Technology	0.292 ***			
	Perceived Risks of GE					
H3		Knowledge of GE	-0.036 NS	0.027	8.58 (2, 538)	$p < 0.001$
H5		Approach Towards Science & Technology	-0.154 **			
	Perceived Benefits of GE Cotton					
H6		Perceived Benefits of GE	0.601 ***	0.475	248.59 (2, 549)	$p < 0.001$
H8		Perceived Risks of GE	-0.143 ***			
	Perceived Risks of GE Cotton					
H7		Perceived Benefits of GE	-0.098 **	0.631	468.85 (2, 546)	$p < 0.001$
H9		Perceived Risks of GE	0.738 ***			
	Attitude Towards GE Cotton					
H10		Perceived Benefits of GE Cotton	0.610 ***	0.539	308.03 (2, 524)	$p < 0.001$
H11		Perceived Risks of GE Cotton	-0.199 ***			
	Purchase Intention Towards GE Cotton					
H12		Attitude Towards GE Cotton	0.751 ***	0.563	691.48 (1, 534)	$p < 0.001$

Table 1: Model #1 Regression Analysis Results[4]

[4] ***= $p < 0.001$, **= $p < 0.01$, *= $p < 0.05$, NS= $p \geq 0.05$

Model #2

Results

Our second model tested hypotheses H13-H19, again utilizing multiple regression analysis. VIF was also examined, with no multi-collinearity observed. Based on our data outcomes, as collected into Table 2, price consciousness was shown to be minimally significant, as well as have a positive relationship, with the singular dependent variable for this model, perceived risks of GE cotton (β=0.065, p< 0.05). Based on these results, we support H14.

Knowledge of GE cotton, however, shared a negative relationship and was shown to be insufficiently correlated to Model #2's dependent variable of perceived risks of GE cotton (β=-0.003, $p\geq$ 0.05). Social consumerism, while determined as sharing a positive relationship with the dependent variable at β=0.085, was also non-significant in relation to said variable at $p\geq$ 0.05. Based on these findings, we then reject H13 and H15.

Both ethical concerns and environmental issues were evaluated as having a positive relationship with perceived risks of GE cotton with betas of β=0.410 and β=0.102 respectively. In significance, however, ethical concerns was found to be highly significant (p< 0.001), while environmental issues were shown to be only minimally significant the dependent variable at p< 0.05. H16 and H17 can, therefore, be accepted.

Table 2 shows that policy regulation and usefulness have identical relationships with the dependent variable of perceived risks of GE cotton. Usefulness was found to be highly significant with a negative relationship (β=-0.292, p< 0.001), while policy regulation, at

marginally less significant, also showed a negative relationship with the dependent variable (β=-0.117, p= 0.001). From these findings, we can support both H18 and H19.

Model #2: Perceived Risks of GE Cotton						
Hypotheses	**Variables**		**ß (beta)**	**Model Adjusted R^2**	***F*-Statistic (df)**	**Model *P*-value**
	Dependent	**Independent**				
	Perceived Risks of GE Cotton					
H13		Knowledge of GE Cotton	-0.003 ^{NS}	0.561	95.895 (7, 512)	$p < 0.001$
H14		Price Consciousness	0.065 *			
H15		Social Consumerism	0.085 ^{NS}			
H16		Ethical Concerns	0.410 ***			
H17		Environmental Issues	0.102 *			
H18		Policy Regulation	-0.117 **			
H19		Usefulness	-0.003 ***			

Table 2: Model #2 Multiple Regression Results

Social consumerism, while non-significant for this model, did indicate an interesting contrast between our population and previous literatures' observations. Essentially, the rejection of this hypothesis lends support to the concept that the individual's valuation of a product (as illustrated with the results for variable environmental issues) would be slightly more important in determining risk before purchasing than the societal norms or group values that have been previously indicated (Frewer, Howard, & Howard, 1997). When targeting the American consumer, this is both an interesting and potentially useful finding for marketers to take into

consideration, particularly regarding advancing technology and the flood of new products that have and will be introduced onto the market based on these sciences.

In regards to knowledge of GE cotton, as in Table 1, we observed that knowledge was not a significant factor in determining risk, but would have more effect on perceived benefits. Coghlan (2006) confirms that the public, over all, has a minimal concept of genetic engineering. Nor, based on Figure 7, do they have a very confident knowledge of cotton agriculture in general, whatever their location or general demographic profile. This is not alleviated by the fact that some of the most active communicators on innovations are those with a negative attitude towards the technology, such as anti-GE interest groups (Economist, 2004). As discussed, risks touted by such groups are often valued as stronger than the benefits communicated by institutions that consumer feels should have a lesser role in communicating credible information on this specific topic (Font, 2009).

In order to shift the impact of knowledge on purchase decisions for GE cotton, marketers would benefit from the data found for our third model, which highlights consumer's trust and avenues of communication regarding GE cotton specifically. By recognizing how consumers assign credibility to different sources of information, industry professionals can pre-emptively avoid the negative attitudes individuals may have for GE technology by communicating the benefits of GE cotton (a specific product) more efficiently. . By recognizing how consumers assign credibility to different sources of information, industry professionals can pre-emptively avoid the negative attitudes individuals may have for GE technology by communicating the benefits of GE cotton (a specific product) more efficiently.

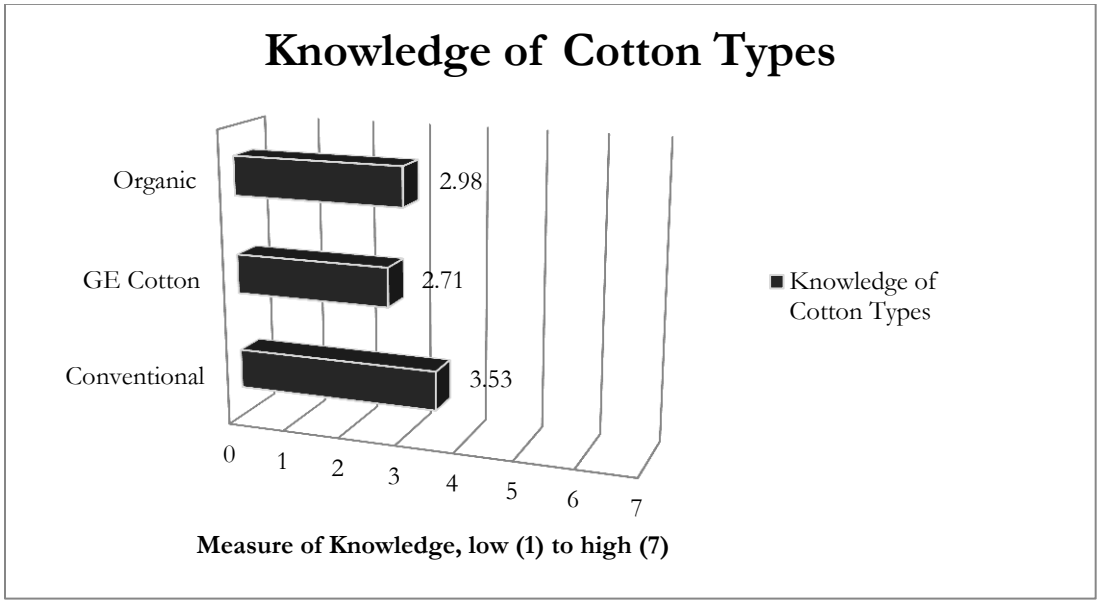

Figure 7: Factor Analysis- Consumers' Level of Knowledge for Types of Cotton

Model #3

Justification

The third model for our research also examined the effects of consumer trust and communication roles on the perceived risks of GE cotton. However, these two factors were not measured in Model #2 since these included two separate measures or analysis. The first objective was to measure the direct relationship between the independent variable and dependent variable using multiple regression, as with our previous models. Secondly, however, we intended to evaluate how consumers, on average, rate separate institutions in regards to both their responsibility and information dispersal on the topic of GE cotton. This last required only a

comparison of means, but was integral to describe the full impact of both communication and trust on risk and, ultimately, purchase intentions towards GE cotton (*see*: Figure 3).

Results

Multiple Regression: Communication & Trust

Multiple regression analysis was used for the initial measurement of the independent variables, communication and trust. The results were based on the questions included in both constructs which followed the standard statement-format (and continued 7-point Likert scale) utilized throughout our survey. And, as before, VIF was determined and accepted to not show significant multi-collinearity.

In Table 4, communication was found to have a highly significant, positive relationship with the perceived risks of GE cotton (β=0.496, p< 0.001). Trust was also shown to be highly significant for perceived risks of GE, though, here, the relationship was shown to be negative (β=-0.302, p< 0.001). While we support H21 in regards to Trust, we reject H20 (communication) due to the observed variables being positively rather than negatively related, as was expected. This relationship was, however, in line with one previous assertion regarding EU consumers, that higher media coverage raises expectations that there is more reason for public concern (Gaskell, Bauer, Durant, & Allum, 1999). Unlike Gaskell's population and the media, the data found in Table 3 seems to points towards the American consumer taking a similar position with communication in general, whatever its source.

Model #3: Perceived Risks of GE Cotton- Communication & Trust						
Hypotheses	**Variables**		**ß (beta)**	**Model Adjusted R^2**	***F*-Statistic (df)**	**Model *P*-value**
	Dependent	**Independent**				
	Perceived Risks of GE Cotton					
H20		Communication	0.496 ***	0.387	173.7 (2, 546)	$p < 0.001$
H21		Trust	-0.302 ***			

Table 3: Model #3 Multiple Regression Results

Mean Comparisons: Communication & Trust

Despite rejection of H20, our measure to identify what institutions consumers believed to be both trustworthy and responsible for dispersing information regarding GE cotton (Font, 2009), retained its significance for this study. For this section, the average response of survey participants was calculated per each of the seven institutions we extracted from Font's (2009) evaluation of trust regarding GE foods. Study participants' ratings of trust and communication were compared in order to gauge the interrelatedness of US consumers' trust and who they perceive has the responsibility of communicating both thoughtful and comprehensive information on GE cotton. The results were illustrated in Figure 8 (below).

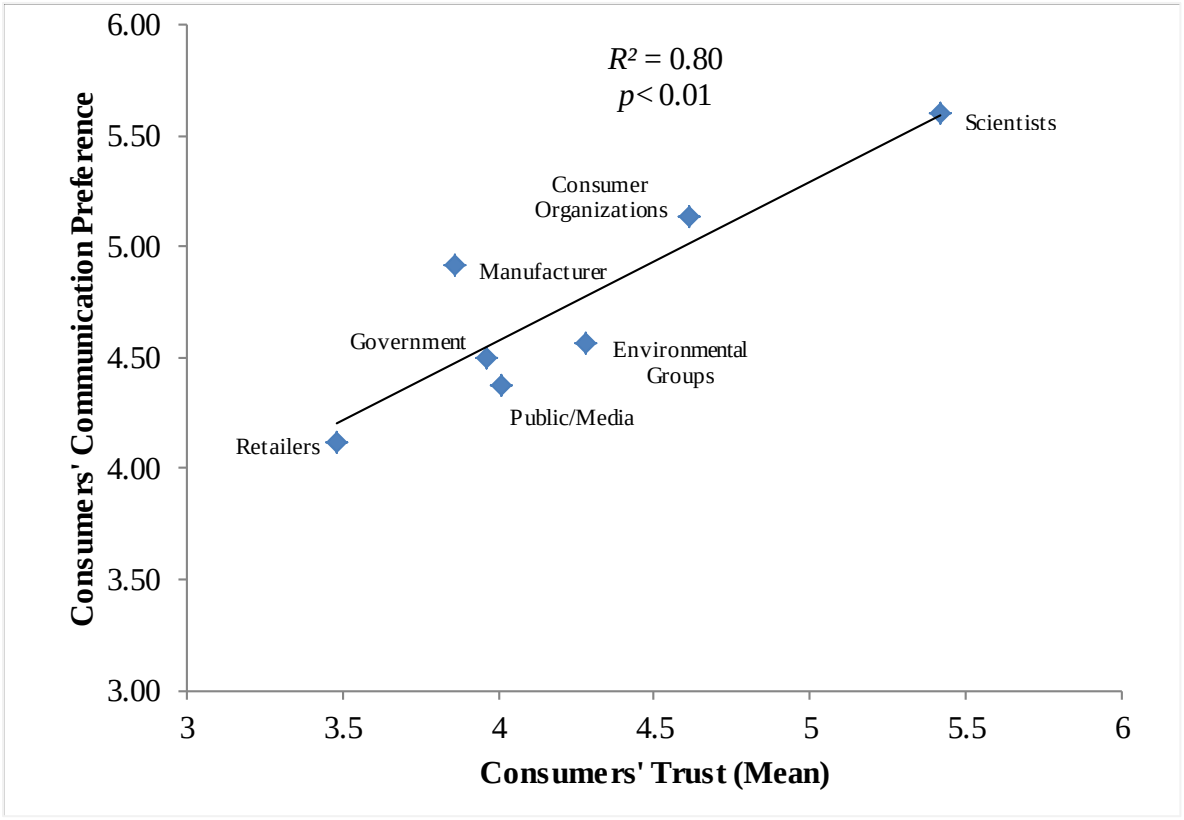

Figure 8: GE Cotton Information Preference- Communication and Trust

The means for both communication and trust were found to have a positive correlation of $R^2 = 80$, with a p-value of $p < 0.01$. For four of the seven institutions- scientists, consumer organizations, government, and retailers- we found both trust and communication to have identical positions as to consumers' preference. The remaining organizations, however, including environmental groups, manufacturers, and the media, were shown as nearly contradictory in consumer ratings in the consumers' levels of trust versus communication assignments. Actual mean values for both factors account for this imbalance, and were found to differ consistently, and more positively, when evaluating communication.

The results for the above mean comparisons were in line with European studies in that scientists and consumer organizations were rated as largely responsible for communication on a genetically engineered product (GE cotton), and that consumers place the greatest levels of trust in these two institutions. Slightly against EU populations, however, was the fact that retailers were graded as lowest in both trust and communication by US consumers. This also contradicted an article from Cotton Inc.'s (2007), which put forward that 60% of US consumers gather the majority of their information from the retail environment, at least in relation to products' environmental impact. Although both trust and communication were rated of equal preference, at the lowest level, marketers can infer that information received from a retailer is less likely to significantly shape a consumer's attitude towards GE cotton long-term.

Also unexpected was the rating of manufacturers as third most preferred as to who consumers believe the role of communicating about products belonged to, yet their trust in manufacturer's to provide impartial information was more than 50% less. From these results, marketers can infer that, for those organizations to which information about GE technology is not a primary role, the consumer tends to place higher trust with the potential reasoning that this increases their impartiality on both the benefits and risks associated with GE. Further studies, however, would be needed to either confirm or debunk this theory.

To further illustrate the differences found across international populations, the below graph was created. Figure 9 represents the rating of our seven organizations based on trust, comparing Font's (2009) findings in relation to GE food production to our population's ratings concerning GE cotton. Though here mean values are not available to compare, nor is the focus identical (GE food vs. GE cotton), it is important to note how trust was shown to differ per

application and population. The Spanish consumer was found to be more in line with the level of trust observed in our study for environmental groups, manufacturers, and the media, the three organizations with whom communication most differed (*see*: Figure 8). Trust was also shown as lower for government, yet significantly higher for retailers, which illustrates the most striking difference between European and US consumers' market structure.

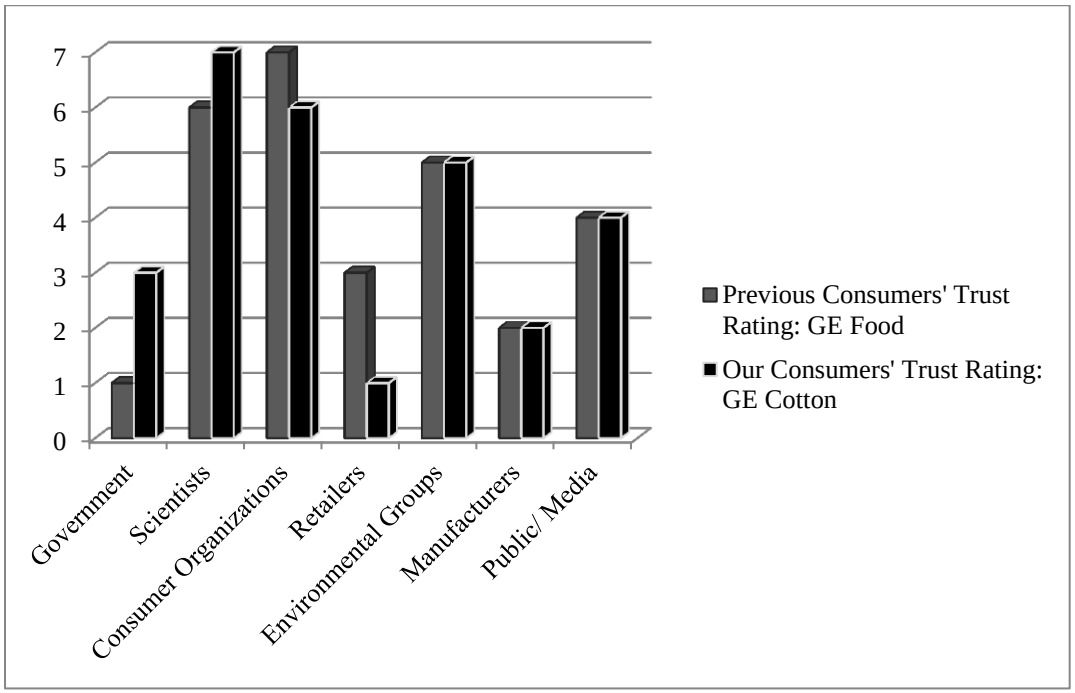

Figure 9: Comparison of Previous Trust for GE Food vs. Current Trust for GE cotton

Demographics

As represented in Table 4, of the five demographic characteristics expected to show some impact on risk, only gender was found to make a significant contribution to the dependent factor

perceived risks of GE cotton. Of our respondents, gender varied less than two percent from the most recent US Census results at 47.5% male and 52.5% women respondents. All other variables did not meet results found in background literatures (Puduri, Govindasamy, Lang, & Onyango, 2005; Saher, Linderman, & Hursti, 2006), including those of education, political affiliation, and religious frequency. Location was also one of the factors we hoped would show a relationship with consumers' perceived risks of GE cotton. That those from rural parts of the country might indicate a more positive disposition towards GE cotton was found to be irrelevant since our sample was made up of nearly even numbers of participants from urban (population < 99,000) to rural (population > 99,000), with similar responses from both.

Demographic Variables: Factor Analysis					
Variables		**ß (beta)**	**Model Adjusted R^2**	***F*-Statistic (df)**	**Model *P*-value**
Dependent	**Independent**				
Perceived Risks of GE Cotton					
	Gender	0.199 ***	0.046	6.1 (5, 528)	$p < 0.001$
	Education	-0.075 ^{NS}			
	Location	-0.017 ^{NS}			
	Political Affiliation	0.008 ^{NS}			
	Religious Frequency	-0.062 ^{NS}			

Table 4: Demographic Identifiers- Multiple Regression Analysis

GE Cotton Positioning

Results

As one of the main objectives for this study, the evaluation of attitudes towards conventional, organic, and GE cotton was conducted using standard, paired t-tests which were paired by respondent. The results were then summarized into Table 5. The findings were that, as anticipated, attitudes towards GE cotton were slightly more positive than attitudes towards conventional cotton, though the difference was not statistically significant. At the same time, attitudes towards organic cotton were significantly higher than both conventional and GE cotton. Our previous chart (Figure 1) on GE cotton positioning was accordingly updated to reflect these results (Figure 10).

Cotton Types: Paired Comparison				
	Mean Value	**Mean Difference**	***t*-value**	**Sig. (2-tailed)**
Organic Cotton	5.13	0.25	3.54	p< 0.001
GE Cotton	4.89			
GE Cotton	4.89	0.11	1.44	0.15 ^{NS}
Conventional Cotton	4.78			
Organic Cotton	5.15	0.36	5.32	p< 0.001
Conventional Cotton	4.79			

Table 5: Cotton Attitudes- Paired T-test by respondent

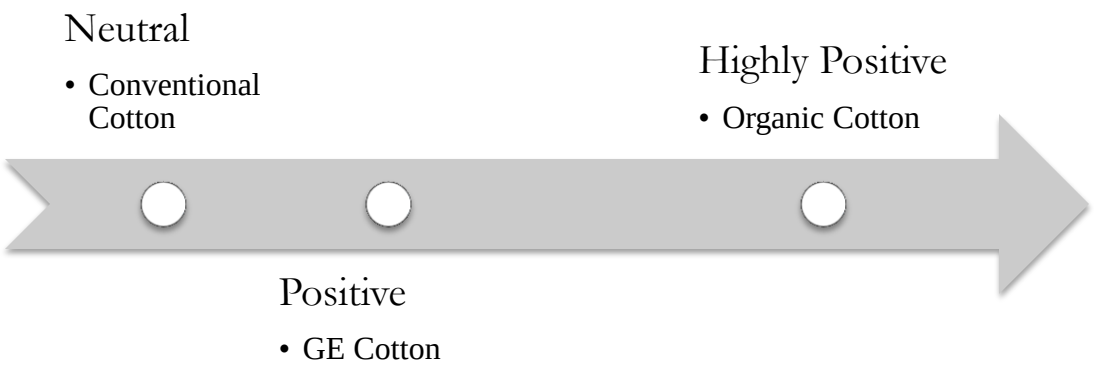

Figure 10: Attitude Towards GE cotton- Accepted Market Positioning

Chapter 8: Summary

Discussion

This study was developed in order to study the relationships and potential concerning products made from genetically-engineered (GE) cotton from the perspective of a non-segregated, international market. Specifically, the goals of this research were, for one, to evaluate the relationships between US consumers' knowledge and perceptions of GE cotton, and determine the impact of our intrinsic and extrinsic attributes- price consciousness, social consumerism, ethical concerns, environmental issues, policy regulation, usefulness, communication, and trust- on perceived risk for GE cotton and, by extension, other specific applications of GE technology. Finally, we also hoped to develop support as to whether GE cotton could be marketed as a viable compromise between the traditional conventional and niche market of organic cotton by illustrating how industry might incorporate consumers' subjective valuation into communication and adoption strategies for GE products. Our results support all hypotheses, with the exceptions of H3, H13, H15, and partially, H20.

Based on the outcomes from our survey, we found that, of the concept of awareness, knowledge, while significant, was of less importance in the formation of consumers' attitudes than the modes of information dispersal, which includes both the variables of trust and communication. Knowledge was indicated as being significant in regards to perceived benefits rather than perceived risks of GE cotton, and, in particular, knowledge of GE. We also conclude that, outside of the above, risks associated with GE cotton are most affected by the factors of

usefulness, ethical concerns, and policy regulation. These results underlined one of our main arguments, that consumers' subjective understanding or valuations are of significantly close weight in attitude and risk perception as the purely scientific knowledge typically communicated for new products (Roberts, Strubble, McCulum-Gomez, & Wilkins, 2006).

Both the risks and benefits associated with GE technology found to have a direct impact on those for GE cotton. But, additionally, through comparison of the means in responses regarding attitudes towards GE cotton and foods weren't found to differ significantly among US consumers (both had averages of approximately "Neutral" based on our 7-point scale of "Strongly Disagree" to "Strongly Agree"), unlike in other, international markets. Although not one of the major purposes for this study, this was an interesting parallel for many reasons. From this we can suspect that, while the level of perceived risk may be different for each specific application of GE technology, attitude and subsequent purchase intentions towards the final end use may be determined by an identical model. This then validates our methodology and framework as appropriate if applied to a number of other specific categories of GE production.

Finally, in regards to GE cotton positioning, our results suggest that, though American consumers show the least knowledge of it, GE was positioned as anticipated, at a nearly median point between conventional and organic cotton based on consumers' attitudes towards each type of cotton. Although consumers still typically polarize cotton by organic vs. non-organic, GE cotton was found to have a slight advantage over attitudes towards conventional cotton. This suggests that while, as Moschini *et al* (2005) attested, the relationship between organics, low-input products (in the case, GE cotton), and conventional is a vertical one, attitudes towards GE cotton have the potential to improve. This can occur if the parallels to and advantages over the

leader, organic cotton, are communicated to consumers, taking into account each factor we have found to be of significance to consumers' perceived risk (and, by extension, attitudes) towards GE cotton. This would then increase purchase intentions toward GE cotton if the industry does decide to market GE as comparable alternative than organics.

Future Implications

Much of our justification for this research was based on the theory that the potential to expand the natural fibers market is, as yet, untapped given the scientific community's neglect of consumer input and subjective value cues. With our models and through such extended comparisons, we hope to encourage interest from the textile community and biotech companies to create research that brings more focus to GE cotton as a viable market solution. Further, we hope that this same approach can be applied in the study of other specific GE applications. These works could be used to individually measure innovative products' reception in other major economies with a lower need for company trial and error. By factoring in the subjective cues we've proven, both intrinsic and extrinsic, marketers could anticipate a product's potential to a useful degree based on consumers' current risk perceptions, attitudes, trusted avenues of communication, and purchase intentions. We support that, in order to compete in tomorrow's changing, international market, it is imperative that new ways of communication be examined. Keeping a focus on the end-use in science and profit-based industries, as well as encouraging positive, relevant awareness between industry and the consumer, is the first step towards improving market opportunities in all aspects of the businesses of GE, cotton, and change.

Appendix A

	Sample Characteristics	Respondents	Percentage
Gender	Male	265	47.5%
	Female	293	52.5%
Marital Status	Single, never married	102	18.3%
	Married	335	60.0%
	Separated	9	1.6%
	Divorced	64	11.5%
	Widowed	33	5.9%
	Other	15	2.7%
Age	Between 18-25	14	2.6%
	Between 26-35	87	16.0%
	Between 36-45	84	15.4%
	Between 46-55	124	22.8%
	Between 56-65	106	19.4%
	Over 65	130	23.9%
Education	Less than High School	2	0.4%
	High School or GED	85	15.3%
	Some college	142	25.5%
	2 Year Associate's or Trade School Degree	60	10.8%
	4 Year Bachelor's Degree	144	25.9%
	Master's Degree	100	18.0%
	Doctoral Degree	14	2.5%
	Other	10	1.8%
Income	Less than $10,000	17	3.1%
	$10,000 to 24,999	70	12.6%
	$25,000 to $49,999	130	23.4%
	$50,000 to $74,999	118	21.3%
	$75,000 to $99,999	98	17.7%
	$100,000 to $149,999	96	17.3%
	$150,000 to $199,999	17	3.1%
	$200,000 to $249,000	4	0.7%
	$250,000 and Over	5	0.9%
Ethnicity	White	484	85.5%
	Black	32	5.7%
	Hispanic	21	3.7%
	Asian	9	1.6%
	Indian	10	1.8%
	Hawaiian	1	0.2%
	Multi-racial	9	1.6%
Location	Urban > 99,999 population	289	52.4%
	Rural < 99,999 population	263	47.6%
Primary Shoppers	Males, yes Prime Shopper	186	33.5%
	Males, no Prime Shopper	78	14.1%
	Females, yes Prime Shopper	281	50.6%
	Females, no Prime Shopper	10	1.8%
Political Affiliation	Liberals	99	17.7%
	Centrists	63	11.3%
	Conservatives	186	33.3%
	No Affiliation	210	37.6%
Religious Frequency	Worship Frequently	174	31.1%
	Worship Occassionally	183	32.7%
	No Worship	202	36.1%

Appendix B

Reliability: Primary Research Model		
	Cronbach's alpha (α)	Level of Reliability
Knowledge of Agriculture	0.767	Good
Knowledge of GE	0.805	Good
Approach Towards Science and Technology	0.847	Good
Perceived Benefit of GE	0.863	Good
Perceived Risk of GE	0.837	Good
Perceived Benefit of GE Cotton	0.767	Good
Perceived Risk of GE Cotton	0.853	Good
Attitude Towards GE Cotton	0.953	Excellent
Purchase Intention Towards GE Cotton	0.968	Excellent

Reliability: Mediating Factors		
	Cronbach's alpha (α)	Level of Reliability
Ethical Concerns	0.804	Good
Environmental Issues	0.858	Good
Price Consciousness	0.804	Good
Social Consciousness	0.908	Excellent
Communication	0.873	Good
Trust	0.8	Good
Policy Regulation	0.766	Good
Usefulness	0.921	Excellent

Reliability: Additional Constructs		
	Cronbach's alpha (α)	Level of Reliability
Attitude Towards Conventional Cotton	0.917	Excellent
Attitude Towards Organic Cotton	0.918	Excellent
Attitude Towards GE Food	0.851	Good

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