THE SOCIAL CONSTRUCTION OF GENETICALLY ENGINEERED AGRICULTURE AND FOOD IN THE UNITED STATES (GEORGIA) AND NEW ZEALAND (CANTERBURY)

by

Tiffany Rinne

(Under the Direction of Bram Tucker)

ABSTRACT

Using a Social Construction of Technology Framework (SCOT), this dissertation looks at cross-cultural differences in cultural perceptions of genetically engineered food and crops (GE), between United States (US) and New Zealand (NZ) stakeholder groups [consumers, organic farmers, GE farmers (US), GE-amenable farmers (NZ)]. Multiple methodologies were utilized to gain a full and deep understanding of how GE technology is socially constructed within the US and NZ. Methodologies include cultural modeling of respondent discourse, media analysis of major newspapers and TV outlets utilized by participants, and analysis of historical literature as well as national identity and national branding literature. The US and NZ were chosen for comparison because both nations are economically dependent on their large agricultural sectors, yet their respective governments and general publics have responded with opposing positions to GE food and crops. GE technology is highly controversial. Proponents promote its potential to significantly increase global food production, improve food nutritional quality and decrease agrochemical use while opponents question its safety and morality. The research indicates that national identity and branding as well as cultural models of health and environment are important mediators of genetic engineering perceptions and partially account for GE's adoption in the US and non-adoption in New Zealand. The findings also suggest that foundational schema found in respondent cultural models of health and the environment may be influencing media interpretations of GE coverage with respondents choosing to ignore media frames, which do not align with their preexisting cultural schema. By gaining an understanding of the cultural elements influencing the GE debate, a greater understanding of the roots of international conflict over biotechnology are garnered and this dissertation concludes by offering insights on how to improve communication during public debates between US and NZ stakeholders regarding GE technology.

INDEX WORDS: Cultural modeling, Genetic engineering agricultural and food technology, Media analysis, National identity, National brandings, New Zealand

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B.S., Wake Forest University, 1999

A Dissertation Submitted to the Graduate Faculty of The University of Georgia in Partial Fulfillment of the Requirement for the Degree

DOCTOR OF PHILOSOPHY

ATHENS, GEORGIA

2008

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December 2008

Dedication

To my parents Larry and Carol Rinne and my fiancé David Maclagan for their unwavering support

Acknowledgments

This dissertation would not have been possible without the help and support of several different agencies and individuals. I would first like to thank Dr. Bram Tucker for stepping in to be my major advisor after my two previous advisors had left the university. His support and insights into this dissertation were invaluable. Second I would like to thank my two previous advisors Dr. Alexandra Brewis and Dr. Carolyn Ehardt for getting me starting along the path to a very fruitful dissertation research project. I would also like to thank the rest of my committee, Dr. Robert Rhoades and Dr. Susan Tanner for their support in the dissertation completion process. I would be remiss not to thank the Anthropology office staff for their help and support throughout my time at UGA. Labau, Margie, Jill and Lisa I truly appreciate all your help and kind words along the way.

A thank you goes to Associate Professor John Fairweather, at the Lincoln University Agribusiness & Economics Research Unit, for generously giving me his time and support while I was in New Zealand.

Thanks go to all the research participants in both the US and NZ who took the time to talk with me and share their insights regarding genetic engineering technology. This report would not have been possible without their participation and generosity.

I would like to thank all my friends and family who have been supportive of my research goals. Thanks go to Larry and Carol Rinne for supporting my desire to get a degree in Anthropology and to travel to a land far, far away, to my UGA friends, Meredith Welch-Devine, Eial Dujovny, Jim Siegel, Jen Schaffer, Beth Lovern, John Turck, Tammy Watkins, Caroline Weathers, Gregory Gullette, James Hurlburt, Sarah Hunt and the BEEDL lab for your friendship and generosity and to my fiancé David Maclagan for giving me peace, happiness and an endless supply of motivation to finish this dissertation.

Finally I would like to thank Fulbright New Zealand and the National Science Foundation for making it possible for me to go to New Zealand and complete my dissertation research.

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Chapter 1 - Introduction

"The 21st century has been dubbed the biotechnology century" (Eichelbaum 2001:342). Despite this proclamation, biotechnological advances, like genetically engineering in agriculture (GE) (also referred to as genetically modified organisms (GMOs or GM)), have proven to be internationally contentious. The FAO has defined biotechnology as "the use of biological processes or organisms for the production of materials and services of benefit to humankind" (Zaid et al. 1999:online). Genetic engineering in agriculture, which can involve interspecies gene transfers, deletion of genes, or modification of genes, poses ethical quandaries for many as it calls into question where species boundaries lie and what it means to be human. Not all of the world's cultures have welcomed this form of technology as it often conflicts with cultural and societal values. Genetic engineering is decidedly Western and modernist in orientation, having been developed primarily in Europe and the USA. However, not all Western developed countries have been amenable to the technology.

The goal of this dissertation is to try to understand why genetically engineered food and crop technology is so readily embraced in some industrialized nations (United States) while it evokes extreme concern and aversion in others (New Zealand). The United States and New Zealand were chosen for comparison because they are both developed, Western nations that share historical features of colonial settlement and landscape transformation (Crosby 1993). Both the United States (US) and New Zealand (NZ) are economically dependent on their large agricultural sectors, yet their respective governments and general publics have responded with opposing positions to GE food and crops.

To fully understand how the US and NZ differ with respect to GE technology, this dissertation has multiple foci and employs multiple methodologies. Foci include: technological and agricultural history, national identity, national branding, cultural models and the media. Each focal area had unique methodological requirements and examples of methodologies used during the course of research include discourse analysis, cultural consensus analysis and media framing methodology.

What is Genetic Engineering in Agriculture?

Biotechnology, in a variety of forms, has been around for centuries, used in the production of yogurt, cheese and beer as well as in animal husbandry and plant breeding (van den Bergh & Holley 2002). Recent biotechnology innovations allow scientists to select specific genes from one organism and introduce them into another to confer a desired trait. This technology can be used to produce new varieties of plants or animals more quickly than conventional breeding methods and to introduce traits not possible through traditional techniques. Crop varieties developed through genetic engineering were first introduced for commercial production in 1996 and are now planted commercially in twenty-three countries. GE crops, such as soybean, maize, cotton, and canola, are planted on more than 200 million acres worldwide (James 2004). Common grocery store foods and products that contain GE ingredients include milk, ketchup, bread, honey, beer, tomatoes, breakfast cereals, chips, candy, and gum (Uzogara 2000). The United States, Argentina, Canada, Brazil, China, Paraguay, India, and South Africa dominate the GE market and produce 99% of all GE crops (James 2004). US farmers are by far the largest producers of GE crops, producing 59% (by acreage) of all GE crops worldwide (James 2004). Despite increasing prevalence of GE agriculture worldwide, not all countries have jumped on the GE bandwagon, and places where it remains particularly contentious include New Zealand, Australia, Japan, and many of the EU nations (European Commission 1997, Gaskell et al. 1999, Hoban 1997, Macer et al. 1997, Zechendorf 1994).

Genetically engineered food and crop technology has novel characteristics not seen in other technological advances, meaning that both nations and lay people have little existing experience to draw on when assessing its value and risks. While GE technology has the potential to significantly increase global food production (Conway & Serageldin 2000, Pretty 2001, van den Bergh et al. 2002), its safety and morality are highly controversial (van den Bergh et al. 2002).

Proponents of the rapid implementation of GE technology point to its potentially beneficial effects on global health and the environment. To increase crop productivity, many current GE crops have genes for herbicide tolerance or pest and disease resistance. Additionally, many future crops are likely to have genes for improved texture, taste, appearance, and nutritional value (Altieri 1998, McHugen 2000, Uzogara 2001, van den Bergh, et al. 2002). By maximizing productivity per hectare and lessening inputs from pesticides and herbicides, GE crop technologies could significantly contribute to environmental conservation efforts. The National Center for Food and Agricultural Policy (NCFAP) found that the combined impact of genetically engineered crops led to a pesticide usage decrease of 69.7 million pounds in 2005 (Sankula 2006). Proponents claim GE crop production may be essential for addressing current famines and for guaranteeing sufficient food to feed future world populations (Conway & Serageldin 2000, Pretty 2001, van den Bergh et al. 2002). Without productivity gains in agriculture or a worldwide expansion of cropland, a global shortage of food in the future is forecast (Pimentel and Wilson 2005).

As proposed by Malthus's 1798 treatise entitled, "An Essay on the Principles of Population," the population, if unchecked, will increase at a geometric rate while food supply grows only at an arithmetic rate. Thus, the power of human population growth is so superior to the ability of the earth to produce food for humankind, that death from factors such as war and famine must result in order to re-establish a balance between population numbers and food supplies (Malthus 1798). According to Malthus, "the only true criterion of a real and permanent increase in the population of any country, is the increase of the means of subsistence" (Malthus 1798:530). GE technology is touted by its advocates as offering just such an opportunity.

Despite the potential benefits of GE technology, many consumers and environmental advocacy groups question the moral, environmental, and health consequences of GE use. GE crops and food are the most rejected form of biotechnological application (Wagner et al. 2001). Opponents use terms such as "Frankenstein food", "farmaggedon" and "genetic manipulation" to point to its unnaturalness and associated health and environmental dangers. Possible environmental dangers include gene transfer to wild varieties of plants or to soil bacteria, as well as increased insect resistance to the pesticides produced by GE crops (Ginzburg 1991, Pretty 2001, Uzogara 2000, van den Bergh et al. 2002). Regarding gene transfer, an example of potential harm that might result is the transfer of GE pesticide producing genes to wild plants thereby endangering insect populations, an integral component of the food chain. Possible health dangers include allergic reactions (e.g. fish genes inserted into vegetables), introduction of toxins, and antibiotic resistance of human intestinal bacteria (Koch 1999, McHugen 2000, Pretty 2001, van den Bergh et al. 2002). Opponents of GE have stated its benefits to be primarily economic and restricted to large multinational corporations with genetic code and biotech procedure patents (Krimsky & Wrubel 1996).

A History of Public Perceptions of GE in the United States and New Zealand

Since 1987, many public opinion surveys regarding GE agricultural and food technology have been conducted in the United States and New Zealand. Given the intense controversy generated during the recombinant DNA debate of the 1970s, industry and government policy makers could not ignore the public's concerns and preferences regarding genetic engineering technology being brought into agricultural fields and onto grocery store shelves. I will briefly review significant studies that were conducted in the US and New Zealand in order to highlight how the populations of each nation view the technology.

United States

A 1987 study conducted by the United States Office of Technology Assessment (OTA) indicated that two-thirds of the 1,273 Americans surveyed believed that genetic engineering would "make life better for all people". Only one-fourth of respondents felt that "humans should not meddle with nature". The OTA report also came to the conclusion that while the public expressed abstract concerns regarding genetic engineering, they approved of almost every aspect of its applications, both environmental and therapeutic and were willing to accept relatively high levels of risks to the environment in order to gain the benefits of the technology (OTA 1987).

Hoban and Kendall (1992) conducted a phone survey of 1,228 US respondents titled "Consumer Attitudes about the Use of Biotechnology in Agriculture and Food Production". The survey was commissioned by the United States Department of Agriculture and found that respondents were reasonably positive about biotechnology being used in the production of food, particularly plant applications (Hoban and Kendall 1992). The primary reason for US consumer support of the technology was the prospect of a lower price for food.

A 1998 paper by Hoban indicates that surveys he conducted in 1992, 1994, and 1998 all show just over 70% of Americans supporting the technology, with the highest level of support among highly educated men. Most Americans said they would buy new varieties of genetically engineered produce with better flavor or pest resistance properties. US respondents were primarily concerned with the taste of food and its price and not how the products were developed (Hoban 1998). By contrast, European consumers were more concerned about environmental, political and social impacts resulting from the technology (Hoban 1998). Hoban (1998:6) concluded that, “American consumers are optimistic about biotechnology. They will accept the products if they see a benefit to themselves or society; and if the price is right!”

While US citizens have by and large been more accepting of genetic engineering and biotechnology, surveys conducted by the International Food Information Council (IFIC) indicate that American support for biotechnology, GE agricultural technology in particular, is undergoing steady erosion. In 1997, 78% of Americans saw GE agriculture as beneficial. This fell to 75% in February 1999, then to 63% in October 1999, and finally to 59% in May 2000. Priest (2000) found similar results indicating an increased level of concern about GE agriculture and food among US Americans, although more than 50% of Americans were still positive about the technology. Despite this decline, Priest (2000:941) contends that, “people in the US continue to have faith that science and industry involved with biotechnology are working for the good of society.” Genetically engineered foods, although a concern for Americans, ranked the lowest on a four-point scale of concern compared to any other food-related concerns like antibiotic use in livestock, zoonotic diseases, bacterial contamination, pesticide contamination, and artificial preservatives (Priest 2000).

A 2006 study conducted by IFIC showed that a majority of Americans were still confident in the safety of the food supply in the United States and had little concern with respect to agricultural biotechnology. Only 3% of consumers expressed concerns about the safety of food biotechnology and only 1% said they would like to see information about genetically engineered products on food labels. The majority of consumers were either neutral or unsure about their opinions regarding food biotechnology. Of those who held an opinion, more than half were positively inclined towards the technology.

New Zealand

In 1990 a survey was conducted by the New Zealand Department of Scientific and Industrial Research (DSIR) to explore public attitudes towards biotechnology (Couch & Fink-Jensen 1990). The DSIR surveyed 2000 members of the public and their findings suggested that New Zealanders were supportive of biotechnology, in general, although only 9% of those surveys could explain what was meant by the word "biotechnology". While the survey indicated support for biotechnology in general, it also indicated that 50% of respondents were concerned about eating products with genetically modified ingredients.

In 1997, AGB McNair, a marketing research firm, working in conjunction with environmental groups such as Greenpeace, Soil and Health, and Friends of the Earth, conducted a poll of perceptions of genetically engineered foods (ERMA 2002). One thousand New Zealanders were telephoned. The major findings indicated that 43% of respondents worry a lot about eating genetically engineered foods with only 12% of those polled not being concerned about eating genetically engineered food.

A 1998-1999 study by HortResearch, a fruit science company, used focus groups, conjoint analysis and a telephone survey (n=1000 for the phone survey) to determine public awareness and understanding of biotechnology as it pertains to food. The study's findings indicated that New Zealanders were still making up their mind with respect to the benefits and risks of the technology and were considerably nervous about the unknown aspects of the technology with respect to health and environmental factors (ERMA 2002). Like the DSIR study, 50% of those polled indicated negativity towards genetic engineering in food production.

Similarly, the BRC Marketing and Social Research study for the Royal Commission on Genetic Modification (2001), based on telephone surveys of 1153 respondents, found that respondents saw more advantages in using genetic engineering in medicine, pest control and plant research and more disadvantages in using it for food production and in farm animals (Eichelbaum et al. 2001).

In 2001 the New Zealand Royal Commission launched a comprehensive investigation into GE technology. The Royal commission's final report recommended proceeding with caution with respect to genetic engineering and the door seemed to be opening to the technology in New Zealand. However, public opinion surveys conducted after the Royal Commission still indicate a high level of concern with respect to genetic engineering technology in agriculture with about 50% of those surveyed being either concerned or very concerned about the technology (Cook et al. 2004, Cook & Fairweather 2005). Many opponents of GE technology have joined/formed anti-GE activist groups such as GE Free New Zealand with some activist groups going as far as illegally burning field trials of genetically engineered crops to show their disapproval.

Understanding Technological Acceptance: The Social Construction of Technology Paradigm

Prior to the advent of Science and Technology Studies (STS), science was viewed as both asocial and positivistic (Edge 2001). Research on science and technology was primarily historical or philosophical in nature and treated science and technology as being embued with privilege and authority (Bowden 2001). With the introduction of the research paradigm – Sociology of Science Knowledge (SSK) – in the 1970's, a break was made from the view of science as privileged and asocial. SSK "argued for an empirical examination of the social bases of scientific knowledge" (Bowden 2001:71). Work in SSK crossed disciplinary boundaries and included thinkers and methodologies from sociology, anthropology, computer science studies, philosophy and history. The ethnographic method as employed by anthropologist Bruno Latour in his book *Laboratory Life* (with Steve Woolgar 1979) proved a particularly fruitful method for highlighting the social context of science. Building on SSK, the Social Construction of Technology (SCOT) paradigm was introduced in the late 1980s and extended the insights of SSK regarding the social construction of science to also include the social construction of technology. SCOT, developed by Bjiker and Pinch, contends that all explanations for the genesis, acceptance, and rejection of science and technology should be sought by looking at the social world as opposed to the natural world (Bijker 2001). By focusing upon both science and technology, SCOT brought two independent scholarly communities, those that study science and those that study technology, into closer communication (Bowden 2001).

The SCOT paradigm is comprised of five main conceptual elements. The first key concept of the paradigm is that technological development and adoption takes place in a "sociocultural and political milieu" (Klein and Kleinman 2002:30). SCOT contends that acceptance of a technology cannot be understood without first understanding the wider social atmosphere of the target culture. The second conceptual element of the SCOT paradigm is termed by Bijker and Pinch as "relevant social groups" (Pinch and Bijker 1987). Relevant social groups share "the same set of meanings, attached to a specific artifact" (Pinch and Bijker

1987:30). The social groups are seen as the agents "whose actions manifest the meanings they impart to artifacts" (Klein and Kleinman 2002:29). The third conceptual element—the technological frame—is a "shared cognitive frame that defines a relevant social group and constitutes members' common interpretation of an artifact" (Klein and Kleinman 2002:31). Interpretive flexibility is the fourth conceptual element and suggests that technological artifacts such as GE are the "product of intergroup negotiation" (Klein and Kleinman 2002:29). Technological development and adoption becomes a process in which different social groups with unique interpretations of a given technology, negotiate over what form the technology should take (Klein and Kleinman 2002). "Technological artifacts are sufficiently underdetermined to allow for multiple possible designs, so whatever the design that finally results from the process, it could have been different" (Klein and Kleinman 2002:29). Technological design ends not because the technology works from an objective standpoint but because social groups with a stake in the technology accept that it works sufficiently well for them (Klein and Kleinman 2002). The fifth and final conceptual element of SCOT is that of closure and stabilization. Technological design continues until it no longer poses a problem for all relevant social groups (Klein and Kleinman 2002). When this point has been reached, closure and technological stabilization is achieved (Klein and Kleinman 2002).

This dissertation research draws on and looks at a number of conceptual elements within the SCOT paradigm.

The Research Questions

Goal 1: To address SCOT conceptual element one—the role of social context in shaping GE adoption—the following three questions guided the research:

A) What is the history of agriculture, technology and GE policy in both the U.S. and New Zealand?

A historical analysis of agriculture, technology and GE policy in the US and New Zealand will provide a context for understanding differences between the two nations with regard to their stances on GE technology. History is an important social element in understanding human cognition and cultural meanings.

B) How have historically grounded factors like national identity and economic factors like national branding influenced perceptions of GE technology in the United States (US) and New Zealand (NZ)?

National identity and national branding have a cohesive effect on each nation's citizens by uniting them under a common cultural idiom or brand. New technologies like GE have the potential to either fortify or disrupt that cohesion, thus, influencing perceptions of said technology.

C) How has the media shaped cultural meanings given to GE technology in each country?

GE technology is a new and unique technological development. Most people do not have direct personal experience with the production of this technology and may not be aware that they are consuming GE products. A major source of public sentiment may be constructed from media representations. According to Hall (1982), the mass media is responsible for providing meanings to groups, practices and objects in the external world.

<u>Goal 2. To address the second and third conceptual elements of the SCOT paradigm, that of relevant social groups and the meanings/technological frames they apply to a given technology, the following two questions guided the research:</u>

A) How do the cultural meanings invoked by GE technology vary among stakeholder groups inter- and intra-culturally in the US and NZ?

Cognitive cultural modeling methodology was employed in this research to identify the meanings attached to GE technology and represent them pictorially. A particular focus in this study was cognitive differences in benefit and risk perceptions across multiple stakeholder groups (GE farmers, organic farmers, and consumers) within each country and between the same stakeholder groups across countries. GE farmers, organic farmers and consumers were chosen for analysis because each group has an important stake in the GE debate. The livelihood of GE farmers is partially based on the ability to use GE products. By contrast, members of the organic community have stood in public opposition to GE technology. The use of GE seeds is strictly prohibited by international and national organic accreditation agencies and there are mounting concerns within the organic farming community about gene transfer between GE crops and organic varieties. Contamination of organic crops with GE genes would cause organic farmers to lose organic accreditation and the price premiums normally obtained for organic food. Finally, consumers are important stakeholders in the GE debate as they will bear the costs of potential negative health and environmental repercussions as well as receive many of the benefits that might result from the technology.

B) How do the cultural meanings invoked by GE technology vary with the cultural meanings given to health and the environment?

When stakeholders assess whether to plant GE crops or consume GE food an understandings of the health and environmental ramifications of this technology may play a part. Research by economists has shown that consumers do consider these factors as part of a trade-off in assessing GE food attributes (Hu et al. 2004). This dissertation postulates that the meanings ascribed to health and the environment will influence those given to GE technology by these different stakeholder groups.

Goal 3. To help improve communication during the intergroup negotiation phase of technological adoption—a phase in which interpretive flexibility (SCOT concept four) may lead to ineffectual communication among stakeholder groups and may prohibit closure (SCOT concept five) from being reached.

A) During the deliberative process in which the meaning of technology is being socially shaped, what are likely points of both miscommunication and commonality among the stakeholder groups?

By employing multiple research methodologies, such as cultural modeling and analysis of national branding literature, to discern how GE technology has been socially constructed, researchers can highlight points of both disagreement and commonality of thought between stakeholder groups in the GE debate as well as areas in which affective communication during the deliberative process may be hampered by semantics.

Field Sites

The US stage of the interviewing process for the cognitive cultural modeling component of the research was conducted in both Northeast Georgia, home to a mid-size organic farming community, and Southwest Georgia, home to a large GE farming community. The New Zealand interview portion was conducted in the South Island province of Canterbury. The research areas in Georgia and Canterbury were selected because they have several key features in common:

1. Both areas contain active farming communities, including small and large scale producers, and are prime crop farming areas for local, national, and export production.

2. These areas either contain or are located near a major metropolitan city where regional crops are sold and eaten (i.e. Atlanta and Christchurch).
3. Historical features of colonial settlement and landscape transformation are shared, as similar populations of settlers/farmers emigrated from Europe (albeit 100 years earlier in Northeast Georgia) (Crosby 1993).
4. Significant academic/farming community outreach programs are present in both regions, in Canterbury through Lincoln University and in Georgia through the University of Georgia. Thus, in both contexts, there are mechanisms in place for two-way science-community flows of information about agricultural technology.
5. There is an overlap in the predominant crops grown in both areas. Both areas produce onions, sweet corn, peas, potatoes, and squash. In NZ, the only GE crop that has been allowed, although in a very limited context, is the onion. In Northeast Georgia, GE versions of sweet corn are widely grown as is GE cotton and soybean.

Research Design and Methodology

Goal 1:Questions A and B

The first goal of the dissertation was to look at the role social context plays in shaping technological acceptance. Social context in a variety of forms-agricultural/technological history, GE policy, national identity and nation branding-were focused upon. To accomplish this goal a comprehensive survey of available literature on these focal areas was completed. The information was then analyzed for important similarities and differences between the two nations that might influence each nations stance towards GE technology.

Goal 1: Question C

Question C was concerned with the role of media in shaping cultural meanings of GE. To address this question, GE media coverage in both the US and New Zealand was explored using framing theory and methodology. A frame is an organizing idea, which enables journalists and the general public to understand a given topic such as GE (Botelho 2004, Gamson & Modigliani 1989).

Newspaper and TV sources for analysis were chosen based on consumer participant responses to questions asking about their top news sources for GE information. Employing a methodological format set out by Botelho (2004), media frames, quotation sources and bias scores were collected and analyzed. Media data was analyzed for the presence of the following frames identified by Botelho (2004): discovery, economic implications, ethical issues, food and agricultural security issues, public accountability, globalization, environmental issues, health implications, labeling, public opinion, and moratorium. The information from the analysis of frames in US and NZ media sources was qualitatively compared with the frames present in the cultural models of consumer research participants. The objective of this comparison was to discern possible relationships between media framing of GE and the cultural meanings applied to GE by respondents.

Goal 2: Questions A and B

Cultural modeling theory and methodology were utilized to uncover cultural meanings associated with GE technology, health, and the environment. Applying cognitive anthropological approaches to the study of technological adoption is a relatively new endeavor and offers a unique opportunity to gain an empirical understanding of how people think about technologies like GE. Cultural models are models of knowledge and thought that are utilized by people to guide their behavior in everyday life. The models are comprised of schemas, which are experientially based mental structures that allow individuals to engage the world in straightforward and predictable ways (Blount 2002). Schemata are the constituent pieces that comprise meaning (Holland and Cole 1995) and can be discerned by researchers and constructed into visually represented models in order to elucidate shared knowledge and perceptions across groups.

Respondents were interviewed and cultural models of health, environment, and GE for each respondent stakeholder group were devised based on analysis of respondent discourse. In order to analyze the discourse obtained during semi-structured interviews, each interview text was imported into NVivo 7 and coded according to key words and phrases. It was then inductively analyzed for patterns, structure, and linkages of schemas. The cultural models demonstrate how each stakeholder group assigns meaning to GE technology, human health, and the environment.

As qualitative research has been criticized for lacking scientific rigor and reproducibility, quantitative research methodologies including free-listing, rank-ordering, likert scaling and risk scenario exercises were also employed to inform the cultural models. The quantitative measures taken during the course of this research contribute to cultural modeling by mathematically confirming and quantifying inter-group differences in model foundational components derived via schema analysis.

<u>Goal 3: Question A</u>

To meet Goal 3 concerning affective inter-group deliberation, each element of the SCOT framework employed during the course of this research—cultural modeling, historical analysis, national branding analysis, media framing—was analyzed for information about potential points of commonality and miscommunication between the stakeholder groups. This information was then used to make recommendations about how to improve communication among stakeholder groups should stakeholders enter into a debate/deliberation concerning GE.

Summary of Chapter Contents and Results

So far this chapter has highlighted the main foci of the dissertation and explored research design and methodology. To further set the stage for this dissertation, this section will outline the topics to be discussed in each chapters and review relevant results.

Chapter Two presents historical background information about the US and New Zealand that will be important for a full understanding of the research presented in subsequent chapters of the dissertation. Although a main focus of this dissertation is people's very specific cognitive cultural models of GE, that cognition is based, at least in part, in each society's history, thus, a larger picture of each nation and its people must be drawn.

Chapter Two begins with a brief overview of the governmental and economic systems of the US and New Zealand followed by a look at each nation's biogeographic and demographic profiles. Next, a historical review of technological and agricultural production in each nation is presented in order to highlight the historical context upon which each nation's stance towards GE technology developed. Finally, the history of GE policy in each nation is reviewed.

The historical review revealed several important points of similarity and difference between the US and NZ that should be kept in mind when assessing each nations stance on GE. Points of similarity include the presence of democratic governments, free-trade economic systems, large agricultural sectors and historical ties to Europe, Britain in particular. Arguably the two most important differences have to due with issues of size and international power. The US is a large nation from a geographic and economic standpoint and holds considerable power in the international community. New Zealand, on the other hand, is a small island nation with a small economy and limited international influence. A review of each nation's technological and agricultural history reveals another important difference between the two nations—the US is a technological innovator while NZ has historically been a technological adopter.

Chapter Three discusses the role of national identity and national branding in the shaping of GE perceptions in each nation. By understanding national identity, the connectedness of people in a common cultural idiom, and national branding, a shaper of international images, one can gain significant insight into a nation's people and the principles upon which their cultural lives are based.

A review of national identity and national branding literature indicates that both the United States and New Zealand's responses to genetic engineering technology make sense with respect to each country's national identity and nation branding. New Zealand has a national identity partially based on its unique and majestic landscapes and a national brand intimately tied to that identity. GE crop technology has become synonymous with pollution in much of the world and is therefore a direct threat both ideologically and economically to New Zealand identity and branding as a "clean green", "100% Pure" nation. By contrast, the image of genetic engineering as a pollutant is not as significant for the United States, which lacks an identity and branding associated with nature. Instead, an alternate image of genetic engineering as progressive and productive ties in nicely with US identity and branding as a technological powerhouse. Although placing the US and New Zealand on different poles of the genetic engineering debate, the national identity and national branding of both nations has allowed each significant economic success.

Chapter four introduces the reader to cognitive cultural modeling theory and methods utilized in Chapters five and six of the dissertation and presents results from the quantitative research components used to inform respondent cultural models. Cognitive cultural models are models of knowledge and thought that are utilized by people to guide their behavior in everyday life.

The information on social context presented in Chapters Two and Three and the review of cognitive cultural modeling theory and methodology discussed in Chapter four provide a firm basis for the exploration of cultural models surrounding health, environment and GE found in Chapters five and six. Health and environment models will be the focus of chapter five while GE will be focused upon in Chapter 6.

The cultural models uncovered during the course of research clearly show inter- and intra-cultural variation in cultural meanings of health, environment and GE technology. The research shows that those New Zealanders interviewed do, by and large, ascribe more negative attributes to GE technology than do US consumer respondents. Out of 32 NZ consumers interviewed, only 11 were in favor of the technology. Furthermore, those stakeholders open to GE technology (pro-GE consumers and GE amenable farmers) felt that either the technology was not currently needed in New Zealand (GE amenable farmers), it was currently a potential danger for New Zealand from an economic standpoint (Pro-GE NZ consumers, NZ GE amenable farmers), or that it could tarnish the nation's image (Pro-GE NZ consumers). Intra-culturally, the meanings ascribed to GE varied widely. Members of the organic communities at each field site location saw the technology as inherently risky and an affront to nature and their life philosophy of living in balance with nature. By contrast, respondents from the GE farming communities saw the technology as innovative and as necessary from a business perspective. Consumers in both

US and NZ field locations were less engaged with the GE debate compared to those in the organics and GE communities and were divided with respect to their stances on GE technology. Those consumers with a strong faith in science were more accepting of the technology while consumers highly concerned with chemicals in and on food often felt very negatively towards GE. They associated GE technology with agrichemicals, like pesticides and herbicides, and thus viewed it as a potential food pollutant.

In Chapter seven, GE media coverage in both the US and New Zealand is explored using framing theory and methodology. Research has indicated that consumers obtain knowledge about technologies like GE from the media (Hallman and Metcalf 1995, Hoban 1998, Botelho 2004). The media is a boundary setter for debates surrounding technologies as it frames media discussion in certain ways while omitting other viewpoints.

Chapter seven highlights similarities and differences between US and New Zealand media coverage with respect to the amount of overall coverage, the frames used in coverage, the sources cited and overall media bias. The results indicate that media coverage varied significantly between the two countries. Coverage in New Zealand was negatively biased and focused on public accountability and food and agricultural security. By contrast, coverage in the US was largely positively biased and focused on discovery.

Chapter eight qualitatively compares and contrasts the frames and biases present in US and New Zealand media sources with those present in the cognitive models of the consumer research participants in each nation. Although previous research has been done on the media's influence on public perceptions of GE technology, none has made a direct comparison of the coverage found in respondent's top media sources for GE information and respondents actual perceptions regarding the technology. Instead research relied on data from media analyses of the elite press and comparisons of that data with public perceptions surveys conducted by separate research groups. The research found within this chapter remedies that omission and takes a much sharper look at possible relationships between the media and public perceptions.

While the media analyses in Chapter 7 revealed reporting in the US and NZ to be biased for and against GE technology, respectively, the analyses also revealed that the media did present both pro and anti-GE perspectives. The research presented in Chapter eight indicates that prior existing foundational cognitive schema may influence which aspects of the news stories are integrated into respondent cognitive models. For example, Pro-GE consumers in the US and New Zealand utilized a "faith in science" schema as the foundation of their cultural models of GE. The data suggests that these respondents may be interpreting GE news stories based on this "faith in science" foundation, choosing to adopt information from media frames consistent with this schema into their cultural models of GE while ignoring other portrayals. Likewise, anti-GE consumers in the US and NZ had "health" and "environment" schema as foundations for their cultural GE models and may be adopting information from media frames that articulate well with their health and environment schema to the exclusion of other media frames.

In Chapter nine, I explore how employing a SCOT framework and utilizing multiple methodologies to understand how technology is socially constructed can play a role in improving communication in public debates surrounding GE. Each stakeholder group had unique cultural histories and unique cultural models concerning health, the environment and GE and thus come from very different perspectives when discussing GE technology. If stakeholder groups are to effectively communicate in a public debate regarding GE, each group must come to understand each of the other group's perspectives.

Chapter 2 - Historically Pertinent Background Information about the United States and New Zealand

The goal of this chapter is to provide pertinent background information about the United States and New Zealand that will set the stage for the exploration, in subsequent chapters, of the adoption and non-adoption of genetic engineering agricultural technology in each country. This chapter will begin by briefly highlighting similarities and differences between the US and NZ with respect to general country characteristics such as population (Table 4.1), biogeography and economics. This very generalized information serves merely to introduce the reader to the two nations of research interest, particularly to introduce the reader to New Zealand, a smaller and less well-known nation from an international perspective. Following this generalized overview, the history of technology, agriculture and GE policy in each nation will be explored in order to provide a context by which each nation's stance on GE agriculture technology can be understood.

US Biogeography

Situated in the western hemisphere, the US is the world's 3rd largest country by total land area behind Russia and Canada and by population after China and India (World Factbook 2007). Due to its expansiveness, the US is comprised of numerous geographical features and multiple climatic zones. The US is primarily temperate but places like Florida and Hawaii often experience weather conditions characteristic of the tropics while Alaska can experience arctic-type weather conditions and the Southwest is semiarid to desert (World Factbook 2007). Fauna and flora in the US is very diverse with many native species. Over 17,000 native plants, 400 mammals, 700 birds, 500 reptile and amphibians and 90,000 insects have been identified (National Biological Service, no date).

Table 2.1: General information regarding the US and New Zealand as well as the research sites (Georgia and Canterbury) in each nation

	United States	Georgia	New Zealand	Canterbury
National Capital	Washington, D.C.	---	Wellington	----
Largest City within the State or Province	---	Atlanta	---	Christchurch
Population Size (obtained from US Census Bureau, Statistics NZ)	303,350,000 (2008 estimate)	9,363,941 (2006 estimate)	4,252,000 (2007 estimate)	521,832 (2006 estimate)
Area	9,826,630 sq km	93,191 sq km	268,680 sq km	44,638 sq km
Population Density	31 people per sq. km (144th in the world)	54.59 people per sq. km	15 people per sq. km (193rd in the world)	10.75 people per sq. km
GDP total	13.543 trillion (1st in the world)	---	110.296 billion (58th in the world)	---
GDP per capita or Median Income	$43, 444 (4th in the world)	$43,217 (28th in the US)	$27, 220 (28th in the world	$23,500 (compared to 24,400 for all of NZ)
Human Development Index (HDI)*	0.951 (12th in the world	---	0.943 (19th in the world)	---
Independence from Britain	Declared-July 4, 1776 Recognized-September 3, 1783	---	Occurred gradually with a series of governmental and Royal proclamations. There is no single official date of independence.	---
Government	Federal, Presidential, Constitutional, Republic	---	Parliamentary Democracy and Constitutional Monarchy	---
Official Language	None at the federal level-English is the official language in 28 states	English	English and Maori	English and Maori
Ethnic Composition	Caucasions-79.96% African Americans-12.85% Asians-4.43% American Indian-0.97% Native Hawaiian and other Pacific Islander-0.18%	---	Caucasians-69.8% Maori-7.9% Asian-5.7% Pacific Islander-4.4% Other 0.5%	---

(Unless otherwise specified, the information presented within this table was obtained from the 2007 CIA World Factbook.)
*HDI is a standardized means of measuring well-being across the world. It takes into account life expectancy, literacy, education, standard of living and per capita GDP.

New Zealand Biogeography

New Zealand is in the southern hemisphere and is composed of two main islands and a number of smaller islands surrounding the shoreline. Its total land area is greater than that of Great Britain but smaller than that of Italy or Japan. The climate is temperate with temperatures rarely falling below zero or above 30 degrees Celsius. New Zealand is very unique from a biogeographic standpoint due to its long isolation from the rest of the world. Approximately 80% of the flora in New Zealand is endemic and descended from Gondwanan forms (Allan 1982). Before humans arrived, 80% of the land was forested. The three dominant forest types were the podocarp, kauri and southern beech forests. The remaining vegetation was tussock grassland. New Zealand has only 3 non-marine native mammals; all bat species. Despite a paucity of mammals, New Zealand forests once had a diverse range of endemic megafauna in the form of birds such as the Moa (*Dinomis robustus, Dinomis novaezelandiae*), a flightless 12 foot tall relative of the Australian Emu, and the Haast Eagle (*Harpagomis moorei*), the largest eagle to have ever lived (Tennyson & Martinson 2006). These endemic birds were easy targets for early human inhabitants, as they had no prior experience with serious predation. As a result, New Zealand suffered a high rate of extinction early on in its history of human occupation. Extinctions were the direct result of over-hunting as well as a result of the introduction of feral animals like stoats (*Mustela erminea*), and brush-tailed possums (*Trichosurus vulpecula*).

US Economics

According to the CIA World Factbook (online), "the US has the largest and most technologically powerful economy in the world." The size of the US in both population and land area, coupled with significant natural resources, a stable government, and high education standards has given the US the resources, both natural and intellectual, to be a significant international economic power-player (World Factbook 2007). The US has become a dominant force in global capitalism with high rates of consumption and production as well as importation and exportation. As of 2006, the US had the world's largest gross domestic product (13.21 trillion dollars) (World Factbook 2007). The US economy is highly diverse, has a high GDP growth rate, a low unemployment rate, and a high rate of both research and capital investment.

Large corporations have played an instrumental role in shaping the US economy through processes like mass production and through stock market trading. The US has been the world's top import nation while also being one of the top five export nations (World Factbook 2007). The primary exports of the US are capital goods like computers and telecommunications equipment (49%), consumer goods like automobiles and medicines (15%), industrial supplies (26.8%), and agricultural products (9.2%) (World Factbook 2007). The top imports are industrial supplies (32.9% with crude oil comprising 8.2% of the total), capital goods (30.4%), consumer goods (31.8%) and agricultural products (4.9%) (World Factbook 2007).

New Zealand Economics

The New Zealand economy is heavily dependent on trade of agricultural, horticultural, fishing and forestry products. Exports represent 24% of the total value of goods and services produced in the NZ economy, making NZ vulnerable to global economic slowdowns (World Factbook 2007). Tourism also plays a significant role in the economy, contributing roughly 9% to the nation's GDP (New Zealand Ministry of Tourism 2007).

Historically, New Zealanders have enjoyed a high standard of living based partially on an early trading relationship with Britain. High demand for New Zealand's narrow range of products (dairy, wool, meat) has led to sustained periods of economic success in the past. Prior to 1973, New Zealand economic success and living standards often rivaled those in Australia and

Western Europe (Wilson 2007). However, due to the nation's narrow economic base, New Zealand also experienced periods of severe economic crisis. Since 1984, the nation has undergone major macroeconomic restructuring transforming the formerly protectionist and highly regulated economy to one based on free-trade. The economic objectives of the current government are to continue to pursue free-trade agreements and build a "knowledge economy".

A Brief History of Technology in the United States

The term technology refers to knowledge and instruments used by humans in order to carry out the functions of everyday life (Friedel 2007). According to Pursell (1995:35) "the most important fact about the history of early American technology…is that the American Revolution and the Industrial Revolution happened at the same time." In the post-Revolutionary War period, leaders of the new United States sought to preserve the nation's freedom and continued prosperity via economic growth (Pursell 1995). Economic growth was to be achieved through the exploitation of the nations vast natural resources with the only limits being the appropriation and development of the technologies needed to use them and an adequately sized labor force (Pursell 1995, Marcus and Segal 1999).

> The nation's well-being and very survival depended on a powerful technological base. In the Euphoria of independence and of what seemed to be unimaginable resources to the west, the plan appeared to many to be without cost. The day when the resources might be used up, when the waste generated might begin to poison the environment, and when technological means would threaten to overwhelm social purpose could hardly be imagined (Pursell 1995:36).

During this post-war period, the US populace was seeking to distinguish itself from Great Britain and establish a national identity. Technology was embraced to "unify and homogenize America" (Marcus and Segal 1999:75).

Despite a growing population, the size of the labor force at the time of independence was insufficient to meet the needs of the new US economy. Fortunately, the Industrial Revolution, a revolution born in Great Britain, provided a technological solution to the nation's labor shortage as human workers could be replaced by machines. The problem then became acquiring the new machines for use in manufacturing and industry. At that time, the US was an importer of technology rather than an inventor.

Once transplanted to the United States, the Industrial Revolution began to take on a uniquely American flavor in an attempt to provide a common American material experience. The new American system of manufacture, as it came to be called, was based on the essential tenet of achieving uniform products through mechanization (Marcus and Segal 1999). Under the previous manufacturing system, skilled craftspeople oversaw the entire production process. Under the American system of manufacture, specialized machines were used to produce a large quantity of similar parts, a form of regularized production. Skilled and experienced workers were no longer needed as a semi-skilled labor force could produce the products that only experienced machinists could have previously produced. It was during this period that US factories came to the fore as places of large-scale production (Marcus and Segal 1999). Items such as bicycles, clocks and sewing machines are examples of items produced using this new system of manufacture. Coincident with the new American system of manufacture was a "demand for a common American material experience…consumers welcomed nationally distributed goods even as local manufacturers were destroyed" (Marcus and Segal 1999:78).

As the nation moved from the 19th century to the 20th century, "the way in which the nation dealt with natural resources and work, the government of cities, and even the generation of technological change itself became heavily infused with the methods, results, and spirit of the sciences" (Pursell 1995:203). This period was known as the Progressive Era, an era marked by social unrest as well as the proliferation of science. Progressives believed that science offered the assurance of national stability and order as it promised both efficiency and impartiality. The US had become a "culture of improvement," believing that "things could be done better" and thus continually sought advancement through technology (Friedel 2007:2). According to Pursell 1995, science was an effective substitute for politics.

By the 1920s the US was firmly entrenched in an age of high modernism with a machine aesthetic predominating (Pursell 1995). The rate of invention was increasing and mass production had been introduced by Henry Ford in 1913. Between 1915 and 1930, US government expenditures on science and research rose 323% (Wooddy 1934). Industrial research was considered an important national resource contributing to a high standard of living for the US populace (National Resource Planning Board 1940). Further, corporate investment in technological endeavors was made attractive by federal and state government's limited involvement in science and technology regulatory oversight (Marcus and Segal 1999).

During this period, the effects of science and technology were spilling over into other aspects of US culture. "The thread of technology ran throughout social relations" (Pursell 1995:230). During this technological golden age, there was agreement about the relationship between the public and science. This relationship was effectively summarized in the official motto of the 1933 Chicago World's Fair, "Science Finds—Industry Applies—Man Conforms."

Although the US government had been increasing expenditures on science and technology research throughout the early 1900s, US technology was largely the instrument of corporate as opposed to government policy until the advent of World War I. With World War I the need for a common defense "provided what the general welfare had failed to produce—a consensus that technology should be shaped and mobilized by the government to accomplish a great public purpose" (Pursell 1995:271). With the government's influence, unparalleled technological growth occurred during the war years and the post-war era. Transportation and communication infrastructures spread quickly as interstate highways became commonplace and television networks were introduced (Marcus and Segal 1999).

With its strong emphasis on technological development in the 19th and 20th centuries, the US had become a powerful technocracy. Technocracy is a late "version of the socio-technical myth of modernity…the belief that there is a given, positive causal relationship between technical progress and social welfare" (Hennen 1999:303). At the theoretical roots of modernity are "imperatives of change and progress, of rationality and purposeful action, of universal norms and the promise of a better life" (Misa et al. 2004:5). According to Hughes (1989) and highlighted in Misa et al. (2004), the US invented modern technology in the 1900s and inspired artists and architects in Europe to theorize the modern movement. Misa et al. (2004) contends that technology is the one true distinguishing feature of modernity. Technology was thought capable of solving problems associated with social injustices wrought by industrialization (Hennen 1999, Misa et al. 2004). Hennen (1999:303) calls this belief of technology as an unquestioned common good, the "religion of modernity" and asserts that this period of "late modernism" saw scientific/technical rationality reach the status of "principal mode of knowledge creation in society."

Since the 1960s the technology movement in the US has been marked with increasing controversy. To some US citizens technology remained a blessing and a source of infinite possibilities (Marcus and Segal 1999). For others it was a villain—a destroyer of personal fulfillment and expression (Marcus and Segal 1999). For many of those who vilified technology, technology became synonymous with the military-industrial complex. It was viewed as an unholy alliance between the US government, the military, and large-scale industry. The military-industrial complex had come to dominate life in the US by denying its citizens their personal freedoms (Marcus and Segal 1999). It was viewed as a juggernaut seeking power and profits for those fortunate enough to wield its power (ie. large corporations, government, the military) (Marcus and Segal 1999).

Books by Ralph Nader (1965), *Unsafe at Any Speed*, and Rachel Carson (1962), *Silent Spring*, exposed some dramatic failures of technology. In 1966 Lewis Mumford, a social critics, issued this criticism of technology:

> The Sacred Cow of the American Way of Live is overfed and bloated; that the daily milk she supplies is poisonous; that the pasturage this species requires wastes acres of land that could be used for more significant human purposes; and that the vast herds of sacred cows, allowed to roam everywhere, like their Hindu counterparts, are trampling down the vegetation, depleting wild life, and turning both urban and rural areas into a single smudgy wasteland (Mumford 1966:none).

Despite the controversy surrounding technology, the US populace did not adopt an anti-technology stance outright. Instead technologies came to be gauged by the public on a case-by-case basis. According to Marcus and Segal (1999), a majority of the contentiousness surrounding technology revolved around technologies like nuclear power and television, which were already familiar to the US populace. These technologies “bore the brunt of the technology as social question assault” and left “untouched the unfamiliar, such as technologies in development but not yet produced on a mass scale” (Marcus and Segal 1999:305). By the time unfamiliar technologies were introduced, companies had become much savvier at marketing the technologies to the US public so as not to spark controversy. Products, such as those derived from GE technology, were presented to the US public using terminology such as user-friendly and/or environmentally friendly (Marcus and Segal 1999).

A Brief History of Technology in New Zealand

A literature search reveals that relatively little has been written on New Zealand's technological history. According to historian Nigel Smith (2001:11), "the words 'industry' and 'heritage' do not readily trip off the lips of Kiwis and certainly not in the same sentence. Ours has been a predominantly agricultural society, not the southern hemispheres cradle of industrialization."

Science and technology were not heavily emphasized upon European colonization by either the government or the public of New Zealand. In fact, between 1838 and 1841, only one professional scientist worked in all of New Zealand and from 1941 to 1961, there were no professional scientists in New Zealand (Dick 1957). Several early settlers were of "sound intellectual training…[and] believed that the Colony should aspire to these heights" but these men were succeeded "by men whose greatest boast was their practicability and empiricism" (Dick 1957: 14). According to Dick (1957:12), "if the prospects of wealth from gold and coal had not become so entrancing towards the end of the fifties and in the early sixties, it is quite likely that New Zealand would have been spared the expense of employing scientists till about the turn of the century."

In 1867 the New Zealand Institute was established, now the Royal Society of New Zealand. The majority of research conducted by the institute was directed towards remedying agricultural problems and focused on natural history, systematics, geology, and the application of chemical analyses (Dick 1957). Industrial and technological problems were largely ignored. Beginning in the mid-1920's the need for an expanded research repertoire was becoming increasingly apparent. By this time, New Zealanders had "absorbed most of the available overseas technology and …were being faced with problems to which answers had not yet been found overseas” (Dick 1957:16). Thus it was in the mid-1930s and during the War years that research in fields other than those pertaining to agriculture received national support.

Although New Zealand is not one of the world’s biggest technological producers or innovators, several distinguished scientific or technological innovations can be attributed to New Zealanders. Kiwi Ernest Rutherford, a physicist, was the first man to split the atom. He additionally served as a mentor and teacher of scientific greats like Neils Bohr (structure of the atom, bohr effect, bohr model), J. Robert Oppenheimer (known as the father of the atomic bomb) and Hans Geiger (inventor of the geiger counter). Kiwi’s Bill Hamilton and John Britten invented the jetboat and Britten motorcycle, respectively. Hamilton’s jetboat could operate in only a few centimeters of water and could cruise at speeds up to 80 kph. Britten built the fastest four-stroke superbike in the 1990s and pioneered motorbike technology that is still being used today. Britten bikes set four world speed records for motorbikes and hold the outright speed record at Daytona. On a more controversial note, Richard Pearse is touted by New Zealand as being the first man to have taken a machine-powered flight. The actual date was unrecorded but eye-witness testimony contends that on 31 March 1903, eight months prior to the Wright brothers machine-powered flight in North Carolina, Kiwi Richard Pearse flew 50 feet in his version of a machine-powered plane.

As suggested in the above paragraph, New Zealand is the home of some great scientific and technological thinkers. However, New Zealand has not done a lot historically to foster creative people in their endeavors. Bridges and Downs (2000:7) contend, “while a popular conception of ourselves as a nation of innovators might be justified, the New Zealand environment certainly doesn’t beget a financially successful invention.” While governments like that of the US have programs to foster the development of science and technology, the New Zealand government largely does not (Bridges and Downs 2000).

Instead of a technological innovator, New Zealand has largely been a technological adopter (Dick 1957, World Factbook 2007). New Zealand's largest import commodity groups are machinery and equipment, vehicles and aircraft, petroleum, electronics, textiles and plastics (World Factbook 2007). These commodities are imported from Australia, China, the United States, Japan, Germany and Singapore (World Factbook 2007). By the 20^{th} century, the US had become a "culture of improvement," believing that "things could be done better." By contrast, the Kiwi's had adopted a "good enough" attitude and did not strive for large-scale technological innovation.

A Brief History of Post-Colonial United States Agriculture

In the 1800s, the occupation of 80% of the US populace was agriculture, which was accomplished largely by hand with limited use of horses and oxen for plowing and hauling. Between 1880 and 1910, the US farm population grew by 50% to 32.4 million people, a figure that was never exceeded (Pursell 1995). Between 1850 and 1890, the land area used for farming more than doubled and by 1910 it has tripled (Pursell 1995). Land clearing was one of the main tasks of farm improvement and absorbed a large amount of labor time until the 1900s.

With the US being a largely agricultural nation in the 1800s, market conditions favored technological innovation in farming. In 1837, only 20 patents were granted for agricultural inventions, by 1860, 507 were issued (Pursell 1995). As was the case with technology in general, uniformity was emphasized in agricultural technology (Marcus and Segal 1999). "Contemporaries advocated a new kind of farming—a machine-based agriculture, which mimicked machine-based manufacturing—to regularize farming (Marcus and Segal 1999: 97).

Major innovations were developed for areas of farming which were particularly exhaustive and time consuming such as threshing and harvesting. The newly developed agricultural implements fostered regularized-row cropping and created an agricultural system of nearly uniform production, a system, which was uniquely American at that point in time (Marcus and Segal 1999).

During the 19^{th} century, the productivity of farm labor increased significantly and the food one farm laborer could produce rose from feeding 4.1 persons in 1820 to feeding 7 persons in 1900 (Pursell 1995). By the 1900s farming had become increasingly mechanized with the introduction of combustion engines, steam and electricity. The industrial revolution had really and truly come to the US farmer by the 1930s with the advent of the all purpose gasoline tractor and rural electrification. Mechanization was at the root of a significant transformation of rural social structures in the US (Goodman et al. 1987). Agricultural labor employment dropped from 7.1 million to 3.3 million between 1950 and 1970 (USDA 1981). While technology helped to reduce farm labor costs, it proved a double-edged sword for farmers. Monopolies on storage and transportation cut farmers off from customers and channeled a bulk of farmer income to those companies that controlled mediating technologies such as railroad owners and refrigeration companies.

The post World War II era saw further increases in farm mechanization with the cotton and tomato pickers coming into general use. Cotton and tomato picking tractors were a means to cut farm costs and diminish the power and numbers of organized farm workers. Early picking machines performed poorly and led to the development of crops, which were designed to “fit” the machines. Tomatoes, for example, were bred to ripen at the same time and to have tougher, bruise resistant skins. Such breeding inadvertently removed much of the taste of the tomatoes, which was later added back in through the addition of salt and sugar during the processing phase of the tomato production (Pursell 1995). Similarly, corn was bred to have stronger roots and stalks so that picking machines could easily harvest the crop.

With increasing mechanization, the percentage of US farmers declined. By 1970, only 4.8 percent of the US populace were farmers (Pursell 1995). However, measured by output per worker, US agriculture had the highest rate of agricultural productivity in the world in the 1960s and 70s. While the number of farms decreased the size of farms grew (Goodmen et al. 1987). Expensive machines could harvest an extensive acreage of farmland, leading many farmers to consolidate into larger farm holdings. Between 1910 and 1987, the average farm size rose from 139 acres to 462 acres (Paarlberg 1980, Hallam 1993). As of 2007, the average US farm size was 449 acres (National Agricultural Statistics Service, no date). Despite productivity gains, those farmers that survived the period of farm consolidation were heavily invested in technology and consequently were forced to spend much of the money saved as a result of reduced labor costs on fuel and agrichemicals.

The US was one of the main leaders of the Green Revolution in agriculture. The term "Green Revolution" was first coined by William Gaud, the director of USAID. In reference to technology, in a 1968 conference for The Society for International Development he said, "These and other developments in the field of agriculture contain the makings of a new revolution." The technologies of the green revolution were applied both within the US and internationally. Many of the Green Revolution technologies were already in existence prior to the revolution but spread significantly in usage (Brown 1970). During this period agrichemical usage became a US agricultural production standard. US farmers used less than 10 million pounds of agrichemicals in 1953. By 1960, that amount had risen to 36 million pounds and by 1968, 79 million pounds of agrichemicals were used on US farmland (Marcus and Segal 1999). Irrigation projects increased as well, as did the application of synthetic nitrogen fertilizers (Brown 1970). The most significant novel technology to result from the Green Revolution was that of high-yielding seed varieties known as HYVs (Brown 1970). HYVs are genetically enhanced seed cultivars with characteristics such as increased growth rate, disease resistance or increased percentages of usable plant parts. HYVs are produced by cross-breeding two inbred plant lines, the result being a genetically homogenous genotype. The uniformity produced by having a genetically homogenous genotype makes HYVs ideally suited to mechanical crop care.

Following the Green Revolution in US agriculture was the biotechnology revolution, which built upon research in biochemistry and molecular genetics (Goodman et al. 1987). According to Goodman et al. (1987:103), "plant genetic engineering…heralds a new epoch in the industrial appropriation of agriculture" as it removes the species barrier to plant reproduction and makes accessible plant traits not necessarily found within a natural gene pool (Goodman et al. 1987:103, Shaw1984). Previously plant breeders had to rely on cross-breeding plants which could sexually mate with each other in order to confer desirable plant characteristics. With the introduction of these new industrial methods of achieving specific forms of genetic diversity, the development of crops with a host of favorable characteristics can be achieved in a more direct and precise manner.

A Brief History of Post-Colonial New Zealand Agriculture

Since colonization, New Zealand has been dependent on agriculture from an economic standpoint as the nation lacks important sources of wealth other than that resulting from farming (Evans 1969). New Zealand has only limited exploitable mineral resources. As a consequence, manufactured goods must be imported. Importation of manufactured goods is made possible by exportation of the nation's farm surplus (Evans 1969).

As in the United States, the first colonists to New Zealand were subsistence farmers. European style agriculture was first introduced to New Zealand by missionaries arriving prior to organized colonization. Food production, which was small scale, was the main consideration of farm production for missionaries as these colonists often lived too far from each other for routine trade (Waswo 1996). Organized colonization began in 1840 and by 1848 there were approximately 17,000 European settlers in New Zealand, primarily of British and Scottish origin, farming several thousand acres of land (Evans 1969). Two principle styles of farming dominated early post-colonial agriculture: semi-intensive mixed farming and extensive pastoralism (Waswo 1996). As in the US, clearing land of native forest was a challenge faced by agriculturalists in the North Island (Alley and Hall 1941, Evans 1969, Waswo 1996). Agricultural production on the South Island proved significantly easier as the land was primarily covered in tussock and native grasses which could be easily plowed and used for arable crops and pasture (Evans 1969).

The 1860s saw a sharp rise in wool production, which proved a valuable export only to be exceeded in value by gold exportation. A gold rush was discovered on the South Island and caused a massive influx of new immigrants. The sudden increase in population caused food shortages in New Zealand, which in turn spurred an increase in arable farming. By 1870, cereals were being produced on 165,000 acres. "By the end of the decade arable farming, as well as sheep, had become firmly established, and gold, the most important export, was soon to be replaced by wool and wheat" (Evans 1969:3).

During the 1870s the acreage under cultivation quadrupled as the farming population of New Zealand steadily increased and new farming implements were introduced such as the double-furrowed plough and the reaping machine. Between 1871 and 1879 the area of land under some form of agricultural cultivation increased from 1 million acres to 4 million acres (Evans 1969). Farmers were receiving high prices for the exportation of portable farm produce. By 1880, the gold rush in New Zealand was nearly at an end and the nation's economy relied almost solely on agricultural production. New Zealand fell into a severe and prolonged depression when the international wool and wheat markets bottomed out in the 1880s (Evans 1969). The depression stimulated increased agricultural cultivation in New Zealand. Wool, wheat and oat exports increased during the depression but falling market values kept the total value of New Zealand exports static.

Despite the economic depression, the 1880s saw some major changes in New Zealand agriculture. The introduction of the steam traction engine allowed easier movement of farm produce throughout the nation and the advent of refrigeration opened up new economic horizons for New Zealand as it allowed for the export of perishable farm products such as cheese, milk and meat (Alley and Hall 1941). England became a major importer of New Zealand dairy and meat products. New Zealand farmers, "previously at their wits' end to know how to dispose of surplus stock, now began multiplying their flocks as fast as possible" (Evans 1969:5). Refrigeration ushered in a new era of New Zealand agriculture as pasture and root crop production increased and artificial fertilizer manufacture began (Evans 1969, Alley and Hall 1941). The fertilizers were produced from the nitrogenous by-products of refrigeration. Throughout the 1880s and 90s the number of farms continued to increase as did the exportation of agricultural products (Evans 1969). Wheat and oats ceased being important export crops during this period while wool, dairy and meat exportation increased.

In the early 1900s, "New Zealand was…run primarily for the benefit of the farmer. The farmer was the economic backbone of the country during this period. He was also the political power" (Alley and Hall 1941:93). Given that New Zealanders consumed less than 20% of the food produced within New Zealand during this period and farmers affectively paid for all imports to New Zealand as well as covered the nation's overseas debts, the political power held by farmers at this point in history is not surprising (Alley and Hall 1941).

The late 30's saw a trend towards further farm mechanization. Electric motors replaced combustion engines in the dairy and sheep industry and tractor use continued to increase (Evans 1967). Mechanization increased steadily through WWII, partly as a result of labor shortages caused by the war. In the 1940s, for the first time, tractors, an invention from the United States, began to displace horses as improved design allowed tractors to meet the requirements of multiple styles of farming (Evans 1967). According to Waswo (1996: 34),

> the speed with which farming has become a thoroughly mechanized industry since the second world war has become almost proverbial. In no more than three decades working horses disappeared, manpower was drastically reduced and the land worked instead by the mechanical power of tractors, combine harvesters…and a host of other implements.

An economic boom occurred in the 1950s and New Zealand's primary agricultural industries (sheep, cattle, dairy) expanded significantly. The high levels of pastoral production initiated during the 1950s were maintained throughout the 1960s. New Zealand faced economic uncertainty in the mid-1960s when Britain, New Zealand's primary trading partner, applied to join the European Common Market. Hoping to avoid economic fallout, New Zealand sought to diversify its markets into Asia. Japan has proven to be a particularly fruitful market for New Zealand meat and dairy products.

Following the lead of the US, New Zealand has sought to improve crop production via green revolution technologies such as HYVs and agrochemical sprays. However, unlike the US, New Zealand has not been a ready adopter of GE technology.

A History of Genetic Engineering and Genetic Engineering Policy in the United States

Genetic engineering policy in the United States unfolded within a culture of technological optimism. The root science behind genetic engineering is molecular biology. Molecular biology as a field was relatively uncontroversial until the late 1960s (Gottweis 1998). In the late 1960s, scientists began to conduct research on the recombination of DNA from different sources and this is when the term genetic engineering gained popularity and came to denote "the deliberate and controlled modification of genetic material" (Gottweis 1998:82). Early on, this technology was portrayed as a major breakthrough in science with important economic and social repercussions (Wright 1994). Although it was seen as a breakthrough it was also associated with risks and it became a hot topic in political discourse (Gottweis 1998).

Many of the early regulations in the US regarding recombinant DNA research were self-imposed by the scientific community with little involvement from Congress. The Berg Report was published in 1974, by scientist Paul Berg and colleagues, and marked the starting point for serious debate regarding genetic engineering. The report called for a voluntary cessation on certain types of recombinant DNA research until the risks of such research could be understood more clearly and precautionary measures taken to limit risk. This report laid out the principles that would guide early rDNA regulations. Recombinant DNA research was to be classified by three degrees of hazard. Type 1 experiments involved genes coding for antibiotic resistance and toxins being linked to bacterial plasmids. Type 2 experiments involved the linking of virus genes together. Type 3 experiments involved fragments of animal DNA being joined to bacterial plasmids and then inserted into bacteria. Type 1 and 2 experiments were to be deferred until the risks could be properly evaluated.

The report called for an international scientific meeting to discuss both the progress and risks associated with recombinant DNA molecules. This meeting occurred at Asilomar Conference Center in Pacific Grove, California in 1975 and was titled "The International Conference on Recombinant DNA Molecule Research." The conference had a worldwide attendance. One of the important discussion topics at the conference was how to minimize the risk of recombinant DNA technology. "The participants at the Conference agreed that most of the work on construction of recombinant DNA molecules should proceed provided that appropriate safeguards, principally biological and physical barriers adequate to contain the newly created organisms, [were] employed" (Berg et al. 1975:1981). Biological barriers consisted of genetically engineered host bacteria that could survive only in a very limited environment and not under natural conditions. Physical barriers referred to limiting genetic engineering work to controlled spaces. Gottweis (1998) contends that the results of the Asilomar conference produced a circular argument as the very technology used in genetic engineering (ie. plasmids and vectors) were to be used to manage the risks of the technology. Thus, risk was being fought with risk.

The early debates and self-imposed regulations by the scientific community "supplied crucial conceptual and procedural raw materials for structures that continued to operate when the world of biotechnology had grown a great deal more complex", namely accountability of scientists only to other scientists (Jasanoff 2005:47). Following Asilomar, the National Institute of Health (NIH) in 1976 established a framework of regulation regarding rDNA research. While positioning themselves as a legacy to Asilomar, NIH "attributed quasi-legal authority" to the conference (Gottweis 1998). NIH dominated US policy on genetic engineering into the 1980s.

NIH guidelines prohibited experiments with certain dangerous organisms, certain categories of DNA, large-scale recombinant DNA work, and the release of genetically engineered organisms into the environment. These restrictions could be lifted in the case of research that might produce direct social benefits as long as the research was NIH approved.

From the beginning of the recombinant DNA/genetic engineering debate in the United States, molecular biologists and other scientists have supplied most of the "key formulas that legitimated government policies favoring relatively unconstrained research and development" (Jasanoff 2005:62). In the US, scientists actively set the agenda and the state endorsed it" (Jasanoff 2005:63). In addition to scientists playing a formative role of shaping genetic engineering policy in the United States, litigation played a significant role as well. A genetic engineer by the name of Chakrabarty (1980) was the first person to request a patent on a living organism. The patent was for a bacterium of the genus pseudomonas. In 1980 he won the patent in the courts as the courts decided the bacterium fell within the realm of a man-made object that did not previously exist in nature. According to Jasanoff (2005:49), "by treating the patentability of microorganisms as a purely technical issue governed by existing law, the court effectively denied that the advent of molecular biology had caused any fundamental shifts to take place." The courts were not inclined to delve deeper and look at ethical threats to the integrity of life. Early court decisions such as this one helped constitute the consensus that the economic market and not the law was the right means by which to control the inventiveness of genetic engineering technology. Unlike many nations, which wrote new legislation to regulate genetic engineering technology, the US chose to adapt existing legislation.

The early debates amongst scientists about how to manage the processes behind recombinant DNA technology represent the first narrative regarding genetic engineering policies in the US (Jasanoff 2005). The second narrative emerged when researchers started to experiment with commercial uses of the technology (Jasanoff 2005). Safety of products became the focus of regulatory debates instead of the processes behind the technology. Again, Congress was absent from these policy debates.

Three US agencies have jurisdiction over genetic engineering technology: the Environmental Protection Agency (EPA), the Food and Drug Administration (FDA), and the United States Department of Agriculture (USDA). The EPA is in charge of environmental applications and environmental impacts, the FDA is in charge of foods, animal drugs and pharmaceutical products, and the USDA is in charge of new crops and animals. A Biotechnology Science Coordinating Committee was established to develop an interagency approach to regulating the technology. In 1986, the committee implemented the "Coordinated Framework for Regulation of Biotechnology," which said that genetic engineering products were not to be treated differently than conventional products in the eyes of the law. The committee focused on the products of genetic engineering as opposed to the more controversial process of genetic engineering and the products were deemed to be no different than conventional products.

The 1986 "Framework" met with criticism by environmental groups and some scientists. The criticism resulted in regulations of field trials of genetically engineered plants. However, by 1993, amendments were made that removed many genetically engineered products from government oversight. Although criticism led to a moderate amount of regulation regarding agricultural crops, genetically engineered foods sparked no such scientific debate and were regulated the same as their non-GE counterparts by the FDA (Skogstad & Moore 2004). A 1992 policy allowed industry to regulate genetically engineered foods and required no pre-distribution risk assessment. Under this framework, "biotechnology ceased to be a matter for broad participatory politics" and "became and object of bureaucratic decision making under the guidance of technical experts. The force of mainstream science and industry was to be in the drivers seat" (Jasanoff 2005:52).

The United States trajectory of genetic engineering regulation has been described by scholars as permissive compared to other nations like Britain and New Zealand (Skogstad and Moore 2004). One of the reasons US policy is so permissive compared to other nations is related to the US Administrative Procedures Act, which requires that all regulations on GE have a scientific basis. The notion that genetic engineering regulations were supported by "sound science" gave legitimacy to GE policies in the minds of the American public, given their very positive view of science and technology (Skogstad & Moore 2004, Jasanoff 1997). The US's permissive stance, left industry largely in charge of determining genetic engineering safety. The US government saw genetic engineering technology as,

> a means to enhance American economic competitiveness and US prosperity through international technological competitiveness…[and] sought a regulatory framework that would 'minimize uncertainties and inefficiencies that can stifle innovation and impair the competitiveness of the US industry' by providing regulatory certainty and protection against liability for the biotechnology industry." (Skogstad & Moore 2004:39)

According to Skogstad & Moore (2004), the US's permissive regulatory policies, which allowed industry to self-regulate with very limited administrative oversight, created power as a means of reproducing the technology. Industry was privileged while government oversight and opposition groups had only limited authority. Those opposed to the technology were distinctly disadvantaged in influencing policy due to a lack of resources and scientific expert knowledge compared to industry (Skogstad & Moore 2004). Further, the opinions of those opposed to the technology for socio-economic and ethical reasons were squelched because the central determinant of policy was science-based risk assessment.

A History of Genetic Engineering and Genetic Engineering Policy in New Zealand

Legislation and national debates regarding GE research and development occurred much more recently in New Zealand compared to the US. In 1996 the Hazardous Substances and New Organisms Act (HSNO) was passed which said that all laboratories must submit to the Environmental Risk Management Authority (ERMA), a 13 page application for permission to do individual genetic modifications. The regulatory process typically took 1 to 2 months. These requirements were particularly burdensome for those doing low risk research and the costs of applications placed significant financial burdens on research institutions.

ERMA had the capacity to delegate approvals of low-risk genetic engineering work to the Institutional Biological Safety Committee (IBSC) if it so chose. IBSCs were set up by individual research institutions and were required to report their findings back to ERMA. The HSNO Act defines low risk genetic engineering research to be work carried out under conditions designated as PC1 or PC2. PC1 conditions are those in which the microorganism as not likely to cause disease in humans, plants or animals. PC2 conditions are those in which the microorganism may cause disease in humans, animals or plants but the microorganism is not a serious threat to lab workers, the environment, community and livestock. In other nations, like the United States, Australia, and the United Kingdom, those research projects that meet PC1 criteria do not have to seek approval from regulatory agencies. According to Hamilton (2001), New Zealand has some of the most stringent laws in the world regarding genetic engineering.

In 1999, the New Zealand Green Party, a small but powerful political party, presented a petition with 92,000 signatures to the government. The petition called for an inquiry into the risks and benefits of genetic engineering as well as a moratorium on field trials and the release of genetically engineered organisms into the environment. The incoming government agreed to the

Green Party's demands and initiated the Royal Commission on Genetic Modification (RCGM) in April 2000. The RCGM was to hear submissions from all groups with a stake in the genetic engineering debate. Groups ranged from science researchers to Maori to church groups to the general public. The four-person commission, which consisted of a former Chief Justice, a medical practitioner, a scientist, and the bishop of the Auckland Anglican Church, was to meet with 107 interest groups over a period of 14 months. The Commission also received around 10,000 submissions from the general public regarding their thoughts on genetic engineering. The Commission was tasked with investigating and reporting on:

> the strategic options available to enable New Zealand to address, now and in the future, genetic modification, genetically modified organisms, and products; and any changes considered desirable to the current legislative, regulatory, policy, or institutional arrangements for addressing, in New Zealand, genetic modification, genetically modified organisms, and products (Eichelbaum et al. 2001:6 quoted in Hamilton 2001).

On 30 July 2001, the Royal Commission on Genetic Modification issued its report. The Commission's consultations with the people of New Zealand showed that New Zealanders were comfortable with genetic engineering for medical purposes but were opposed to its use in food and crops. Despite a high rate of negative portrayals of genetic engineering in the media and public opposition to the technology in food and crops, the report called for the nation to proceed with genetic engineering but with caution. The major theme of the report was "Preserving Opportunities". The Commission came to the conclusion that New Zealand had too much to lose economically to altogether ban genetic engineering technology (Hamilton 2001).

The Commission made several key recommendations regarding genetic engineering technology:

1. The Commission recommended that a Bioethics Council be established to provide appropriate cultural and ethical guidelines for various forms of genetic engineering.

2. The HSNO Act was to be eased with respect to low risk genetic engineering research (PC1) allowing for approval to be obtained for a whole project rather than for each individual genetically modified organism being produced. The HSNO act was also to begin covering issues such as genetic engineering product importation and human cell line research.
3. If adverse effects from the release of genetically engineered organisms were to occur, the Commission wanted laws in place such that those parties benefiting from the use of genetic engineering technologies would be required to meet the costs of righting any negative consequences.
4. A recommendation was made that a Parliamentary Commissioner on Biotechnology be appointed to serve as an auditor of the technology and to initiate public education on the technology.

Overall, the Royal Society's report called for "a stronger consultation, control and administrative framework" (www.rsnz.org/topics/biol/gene/). No time frame was given for the implementation of the report's recommendations. Although the report was in favor of proceeding with caution with respect to genetic engineering, it was believed that more safeguards were needed before genetically engineered organisms could be released into the environment. Thus, the government placed a two-year moratorium on their release. The Green Party was disappointed with the Commission's recommendations, as they believed the report to be contradictory. The report concurrently called for New Zealand to keep its options open with respect to genetic engineering and to proceed with caution. The Green Party argues that proceeding with caution effectively takes away the nation's options. In contrast to the Green

Party, the scientific community in New Zealand was pleased with the reports recommendations, as it saved them both time and money.

Since the Royal Commission on Genetic Modification submitted its report, parliament has enacted the New Organisms Bill, which proposes use of a new category of approval for genetically modified organisms, titled "conditional release". Under "conditional release" ERMA is given the freedom to impose a wide range of conditions on those wishing to release genetically modified organisms in the environment, including post-release monitoring. Following the Commission's recommendations, a Bioethics Council was established to look after cultural, ethical and social issues surrounding genetic engineering. The degree to which the council has been an influence on genetic engineering decisions is yet to be determined. In 2003 the moratorium on release of genetically engineered organisms was lifted. To date, very few GMOs have been approved for field trials in New Zealand and the Green Party is still in adamant opposition to the technology and pledges to oppose all applications for GE releases in New Zealand (www.greens.org.nz/ge/).

Similarities and Differences Between the US and New Zealand

The US and New Zealand share many similarities but also maintain many differences, thus making the two nations interesting from a comparative anthropological perspective. This section will briefly highlight important similarities and differences presented earlier in this chapter that should be kept in mind during the course of this dissertation.

The US and NZ are similar in a number of respects. Both nations are democracies with free-trade economic systems. Each has strong historical ties to Europe, in particular Britain and has an economy with a large agricultural sector. From an agricultural standpoint, both nations are heavily reliant on mechanization and green revolution technologies albeit with the US being a major innovator of agricultural technologies and New Zealand filling the role of technological adopter.

Some of the more striking differences between the two nations are with respect to age, size and power. The US is much older in terms of geographical existence, length of human habitation and nationhood. Moreover, the US is significantly bigger than New Zealand from a geographical area, population, and economic perspective. The US economy is more diversified than New Zealand's economy, which is dependent on agricultural commodities and tourism. Concerning power held in the international community, the US is a world super power and is known as a technological powerhouse. By contrast, New Zealand is characterized as a small island nation at the bottom of the world and is seen as a technological adopter as opposed to innovator. Finally, regarding GE agricultural technology, the US has been a ready adopter of the technology and has very permissive regulations regarding its use while New Zealand has adopted the precautionary principle and has very stringent laws concerning its application.

Chapter 3 - National Identity and Nation Branding

The Social Construction of Technology (SCOT) developed by Pinch and Bijker (1987) contends that most explanations for the genesis, acceptance, and rejection of science and technology should be sought by looking at the social world as opposed to the natural world. The problems and solutions offered by a particular form of technology must be considered in the context of a given society in order to understand the meanings that become attached to the technology and whether it becomes adopted into the society (Pinch and Bijker 1987). The socio-cultural attributes and political stances held by a nation shape its norms and values, thus influencing the meanings applied to technologies such as GE.

As discussed in the introduction, the SCOT paradigm has five main conceptual elements. This chapter will focus on the first conceptual element of the paradigm—the "wider sociocultural and political milieu" in which technological development and adoption take place (Klein and Kleinman 2002:30). The chapter will look at how sociocultural context, in the form of overarching national identities and nation branding, has likely influenced the acceptance and non-acceptance of genetic engineering.

This chapter will begin with a brief examination of anthropological national character research conducted in the 1940s and 1950s, a precursor to today's national identity and branding research. The chapter will then move on to explore current literature on national identity found outside the field of anthropology with a look at the unique national identities held by the United States and New Zealand. This discussion will be followed by a section focusing on what "nation branding" is, why it has become so important in this time of world globalization, and how both the United States and New Zealand have branded themselves. I will then discuss what "Brand

USA" and "Brand New Zealand" are worth to each nation from an economic standpoint. Finally, I will conclude by discussing how each nation's national identity and national brand have likely influenced their respective paths of genetic engineering adoption and non-adoption.

Anthropology and National Character Research

Mead (1953:646) defines national character studies as "…the attempt to delineate the regularities in character among the members of a national group attributable to the factors of shared nationality and the accompanying institutional correlates." National character research sought to understand the shared psychology and personalities of a nation's people (Neiburg and Goldman 1998).

This field of research within anthropology was tied to political exigencies. Pearl Harbor and the United States' entry into World War II provided the background for the "culture and personality" school to begin studies of national character (Neiburg and Goldman 1998). Anthropologists such as Margaret Mead, Ruth Benedict, Gregory Bateson and Geoffrey Gorer felt the United States entry into WWII demanded their "active engagement" (Neiburg and Goldman 1998:57). Many anthropologists became interested in contributing to a better understanding of both allied and enemy nations with the resulting information to be used by intelligence wings of the armed forces and in foreign policy (Neiburg and Goldman 1998). Gorer's article entitled "Themes in Japanese Culture" (1943), for example, focused on aspects of Japanese cultural psychology and personality, which would be viewed as odd by Westerners and Benedict's book *The Chrysanthemum and the Sword* (1989) looked at the rules and values of Japanese culture.

Within anthropology, the post war period saw a decline in stature of national character studies as these studies were criticized for being flawed generalizations and for perpetuating stereotypes (Neiburg and Goldman 1998). While ideas of national character have lost favor within anthropology, the perspective of looking at the nation as a unit of study set the stage for later work on national identity and branding. Notions of national identity and national branding —two concepts quite similar to national character although lacking its psychological base—have been increasingly studied in fields such as sociology, business, and marketing. In this age of globalization, an understanding of how nations identify and brand themselves is increasingly important.

US and New Zealand National Identities

National identity describes the feelings of connectedness of a nation's people within a common cultural idiom, which may or may not be based on actual social relationships. "Nation" theorist Benedict Anderson describes a nation as an "imagined community," meaning that while fellow-nationals may never meet in person they are connected by the "image of their communion" (Anderson 1983: 582, Bell 1996:9). Early European communities in the United States and New Zealand shared aspects of national identity such as egalitarianism and a frontier spirit as immigrants fled social and religious injustices in Europe and sought a new life in unknown, apparently untamed landscapes. However, as both nations developed, their national identities began to diverge. US national identity came to be linked to notions of productivity, progress, modernity, power and political ideology while New Zealand national identity came to be linked with it's dramatic landscape and reputation as clean and green (Bell 1996, Hirschberg 1995).

Matthew Hirschberg (1995), as cited in Bell (1996), has looked at national identities among college students in both the US and New Zealand. In his study of US students, Hirschberg found that students described the USA using words such as freedom, democracy, the US flag, powerful, and president. His findings suggest that American self-image is strongly linked to political ideology and Blum (1961) suggests that this has been the case since colonial times. By contrast, New Zealand students described their country using terms such as wide-open spaces, clean, green, and friendly. Such descriptions indicate that New Zealander's self-image focuses on landscape and lifestyle (Bell 1996). The NZ conception of national identity focuses on an "experientially based but idealized and emotionally laden notion of a safe, secure home, nestled in an unspoiled natural paradise" while the US conception focuses on "emotionally charged conceptions of freedom and democracy" (Bell 1996:11).

Upon colonization, European settlers conceived both the United States and New Zealand as lands of ecological bounty with ample food, land and natural resources (Gabriel 1961, Fairburn 1989). In both nations, the pioneer family and its way of life in nature were heavily romanticized and indigenous peoples were marginalized. These new settlers saw themselves as tamers and owners of the local landscape and this interaction of humans and the environment gave people the impression of closeness to nature. In both nations, people's relationship with nature was not so much rooted in an expression of love for it or environmentalism, as it was the Christian drive to civilize and improve upon the land (Bell 1996).

In the context of national ideology, the United States has sometimes been described as "the land of the free and the home of the scientist" (White 1961:17). Following the two world wars and the US's decisive military and medical successes, science and technology in the United States was greatly strengthened (Jasanoff 2005). Both the government and the general populace came to recognize the utility of publicly sponsored scientific research (Jasanoff 2005). The notion of progress and international power came to be intimately linked with science and technology and so began the United States' movement away from a national identity based on a frontier mentality of man and nature and towards a new frontier of man and technology.

One could contend that the US worships the religion of modernity. A socio-technical myth, modernity refers to the process of technological innovation being seen as the last unquestioned and transcendent means of achieving a common good (Hennen 1999). The United States represents one of the most extreme expressions of mechanization in the world (Larrabee 1961). A prominent US figure head is Henry Ford, famous father of the assembly line. According to Larrabee (1961), the United States is mass production. Mass production is based on the "economies of scale" principle. The more units a company is able to produce, the less it costs per unit to produce them, and the more people can afford to buy them. John A. Kouwenhoven (1948:50) wrote, "The technology of mass production is as indigenous to the United States as the husking bee." Larrabee (1961) contends that there is more to mass production than just technology. It is a social organization based on "an alliance, archetypically American, between machinery and democracy" (Larrabee 1961:179). Technology and mass production is intimately tied to the US political system. US technological achievements strengthened US political and social democracy and vice versa (Larrabee 1961). Mass production has been one of the most powerful forces shaping American culture. Mass production has helped shape the American ideal of productivity. The Anglo-American Council on Productivity was founded in 1948 as a joint United States and United Kingdom council with the purpose of promoting economic well-being through the exchange of knowledge in the field of industrial organization. In the mid-1950s the council concluded that:

> Americans—trade unionists and management, consumers and producers, politicians and professional men, men and women, old and young---are more productivity-minded than Europeans. They seem on the whole to be more aware than their British or European

> counterparts of the need to raise efficiency, to raise the effectiveness of machines and men, to turn out more goods, and to turn them out at lower prices (Larrabee 1961:181).

In contrast to the United States, New Zealand's natural landscape has remained an important source of national identity over time. Upon colonization, New Zealand national identity was grounded in a pioneering spirit that tamed the bush (Dew 1999). This grounding slowly changed to one based on a mystical contemplation of nature and into the recent invocations of being clean and green (Dew 1999). According to Bell (1996:34), "national identity based on physical geography, and on idealization of lifestyles within nature, is persistently used as [New Zealand's] claim to fame. We are far less notable for what we have in terms of everyday cultural creations that we have ourselves made, such as intellectual property, service, or glamorous or interesting towns," thus, "a powerful concept of New Zealand is based on nature: clean, green and beautiful." Nature is what gives New Zealand its uniqueness (Bell 1996) and New Zealander's look to the historic relationship with nature for their roots (Sinclair 1986). New Zealand's recognition of its unique landscape began with colonization. To attract new immigrants, settler associations touted the landscape as a major selling point (Bell 1996). Bell (1996) postulates that perhaps it is because New Zealanders cynically feel they have so little else to offer that nature is focused upon so strongly.

Hirschberg (1995) notes that while national icons in New Zealand symbolize the natural environment (fern and kiwi), national icons in the United States symbolize political and social components of the environment (liberty bell, statue of liberty, Uncle Sam). Even when the United States chose an element from nature as a national emblem it was tied to political ideology. The bald eagle was chosen as a national emblem because it symbolizes strength, courage, freedom and immortality. The lore surrounding the eagle being used as a national emblem says that during one of the Revolutionary war battles, the noise of the battle awoke the sleeping eagles, which then circled over the heads of the fighters with raucous cries. The patriots contended that the eagles were “shrieking for freedom” (http://www.baldeagleinfo.com/eagle/eagle9.html).

By contrast, the kiwi, a small, endemic, nocturnal, flightless bird, is a national emblem for New Zealand. New Zealanders are referred to globally as kiwis and are perhaps the only peoples known worldwide by a vernacular name referring to a national symbol (Bell 1996). In contrast to the bald eagle, the kiwi symbolizes New Zealand’s uniqueness both as a people and as a landscape. The flightless, nocturnal, quirky-looking and mysteriously secretive kiwi is a unique bird in a unique nation. The bird’s endemic status contributes to New Zealand’s special biodiversity and “its quirkiness” suits New Zealand culture (http://www.savethekiwi.org.nz/AboutTheBird/NewZealandsIcon/).

Nation Branding

The idea of “brand” has been used to refer to products and services in consumer trade. Anholt and Hildreth (2004:164) make the assertion that a brand is nothing more or less “than the good name” of something that is being offered to the public. A brand name is a short cut to an educated buying decision; it is easier to buy a brand that you trust than to exhaustively research all competing options. The brand name assures the buyer that time, money and expertise have been employed to make the product as good as possible.

The things onto which commercial branding can be applied have been expanding in recent years. According to Bell (2005:14), “branding is a buzzword that is now applied to nations…[it] is a deliberate process applied to the shaping of a nation’s image and reputation on the global stage.” Papadopoulos (2004:36) defined nation branding as:

> The broad set of efforts by country, regional and city governments, and by industry groups, aimed at marketing the places and sectors they represent. The intent of such

> efforts typically is to achieve one or more of four main objectives: enhance the place's exports, protect its domestic businesses from 'foreign' competition…attract or retain factors of development and generally position the place for advantage domestically and internationally in economic, political and social terms.

Nation branding has become so important, in part, because of increased globalization and competition within a nation's domestic and external markets (Dinnie 2004). The concept of "nation branding" and the "brand state" has attracted significant academic study in recent years. According to Peter van Ham (2001:2), the likes of "Singapore and Ireland are no longer merely countries one finds in an atlas. They have become 'brand states,' with geographical and political settings that seem trivial compared to their emotional resonance among an increasingly global audience of consumers" (Ireland "Gateway to Europe," Singapore "stable business beachhead for Asia"). A nation's branding influences how that nation's products are perceived by importing nations: the country of origin effect. Anholt and Hildreth hold that "German engineering, French chic, Japanese miniaturization, Italian Flair, Swedish design, British class, Swiss precision… are brand values which rub off onto all the products that come from those countries" (Anholt and Hildreth 2004:165).

It can be contended that nations already have a brand name (good, bad or mixed) as the world's population can readily make associations and assumptions about a nation when it's name is mentioned (Bell 2005). A country's brand image in the international community is in many cases intimately linked with the nation's national identity. The determinants of a country's brand image are often grounded in the political, cultural, and social contexts of the nation and are commodified by those with power (Dinnie 2004). Although based in national identity, Bell (2005) contends that branding is now supplanting discourses of national identity. The singular image of a nation produced by branding could not happen in the polarized political and cultural debates that are the shapers of national identity (Bell 2005).

Anholt and Hildreth (2004) assert that a nation acquires its brand via six channels: tourism, export brands, foreign and domestic policy, investment and immigration, culture and heritage, and public adoption. A country can influence the trajectory of their own brands if they have a clear and believable notion of what they stand for and if this message is portrayed consistently via the six channels of transmission (Anholt and Hildreth 2004).

Brand America

While France, Italy, and Germany, known respectively for chic, style and quality engineering, are megabrands, Anholt and Hildreth (2004) contend that Brand America is in a class of its own. “Brand America” was derived from America’s national identity, an identity shaped by notions of freedom, democracy, power, progress, efficiency, technological prowess and modernity. From the beginning, the idea of liberty and the freedom to make one’s fortunes have been significant ideas behind Brand America (Anholt and Hildreth 2004). In addition to liberty and wealth, America has been branded as having technological and engineering supremacy as the US has put a man on the moon, created the atomic bomb, and was the first to employ mass production… the list goes on.

Companies parading the U.S.’s supremacy in technology and engineering include: IBM, Compaq, Dell, Cisco, AT&T, Apple, Motorola, Intel, Dolby, Xerox, Maytag, 3M, Caterpillar, John Deere, Ford, Boeing, Chevrolet, General Motors, Chrysler, Lockheed, Firestone etc. America, via its large import and export trade presence and international policies, comfortably dominates the entire spectrum of national imagery that other nations commonly employ in their national branding (technology, information, fashion, health, sports, fun and leisure, tourism etc.) (Anholt and Hildreth 2004).

With respect to worldwide cultural influence, no other country comes close to the U.S.'s dominance (Anholt and Hildreth 2004). In recent years, Brand America has started to take a beating and has also become synonymous with words such as: "bullying, polluting, domineering, imperialistic, ignorant, fat, selfish, inconsistent, arrogant, self-absorbed, greedy, hypocritical and meddling" (Anholt and Hildreth 2004).

Brand New Zealand

Similar to the United States, national branding in New Zealand stemmed from notions of national identity. According to Anholt and Hildreth (2004), New Zealand represents a nation, which has done a very competent job of managing its brand image, an image based on its scenic landscapes and close associations with nature. New Zealand has improved its brand image in a very short period of time, leading to greater economic health and self-respect. For New Zealand, part of their post-colonial objective was to assert themselves as a nation, both to enforce national identity for New Zealand residents and to market the nation as distinctive and valuable to the international community (Bell 2005).

New Zealand has two types of branding related to nature, one that is for the outside market and one for the domestic market. Branding for the domestic market uses long-held stereotypes of the macho kiwi bloke in a majestic landscape, staunchly braving the elements. Branding for the foreign market relates to New Zealand's clean, green image. Through advertising campaigns such as "100% Pure New Zealand," the nation's first global marketing initiative, and "clean, green," New Zealand has asserted its distinctiveness in the international community by highlighting its unique landscape. These campaigns make New Zealand look good both politically and morally as they suggest environmental sensitivity and a national ethos of land conservation (Bell 2005). New Zealand's unique landscape was further highlighted and advertised in the Lord of the Rings films (New Line Cinema 2001, 2002, 2003). It was because of these three films that much of the world came to recognize New Zealand's majestic beauty. In addition to national branding as "clean green," the New Zealand government has been making strides towards catching the "knowledge wave" and branding themselves as "innovative and creative in business" (Oram 2001: online). Whether this branding will take hold is yet to be determined. Oram (2001:online) believes that New Zealand currently lacks the requisite confidence to make this branding happen: "We say we're innovative, entrepreneurial risk-takers, fiercely independent, early adopters of technology … you name it. But unlike the Israelis, the Singaporeans, even the Irish, we don't really believe we match the best in the world. We certainly don't demonstrate it to the world."

The Economics of Nation Branding

While closely tied to national identity, nation branding is more than a shared cultural idiom or ideology. Nation branding is economics, and as such it is driven by commercial interests and can make or break a nation financially. According to Kyriacou and Cromwell (accessed online 2008), corporate brands comprise one third of the world's wealth. Although intangible, brands can bring their owners significant economic success. This truth about branding is of enormous importance to the nations of today. It is part of a nation's strategic equity. A nation can be thought of "as a highly diversified international conglomerate, which trades internationally, seeks international partners to grow its businesses and depends on its reputation for business development" (Kyriacou and Cromwell, online). A study by Pantzalis and Rodriguez (1999) showed that international investors are often significantly influenced by nation branding, thereby affecting the movement of international capital into a nation. In the future, politicians and national representatives will have to train themselves in brand asset management;

they will have to find a niche for their nation, competitively market the nation, assure customer satisfaction and create loyalty to the brand (Van Ham 2005). Branded nations will compete not only with other nations for economic success but also with the world's super-brands such as CNN, Microsoft, and the Roman Catholic Church (Oram 2001).

Nation Branding and the New Zealand Economy

The environment of New Zealand is valuable both intrinsically as a unique functioning ecosystem as well as for its natural resource commodities sold by New Zealand internationally. New Zealand's Ministry for the Environment (2001) conducted research assessing the value of the nation's "clean green" image. Their research looked at how an image of "clean green" New Zealand contributes to earnings in the export market, comprising tourism, dairying, meat, and organic food. New Zealand is dependent on overseas trading for over half of its gross domestic product. Due to New Zealand's small population size, a lost export market means that exporters cannot redirect their product to the domestic market.

Over half of New Zealand's exports are from agriculture, including both pastoral and horticultural products. According to the Ministry's report, "agriculture is New Zealand's largest and foremost economic endeavor, regularly contributing more than $20 billion to the Gross National Product. New Zealand's temperate climate, fertile soil and relative isolation make it ideal for almost every kind of production—from sheep and cattle, to cropping and horticulture" (Ministry for the Environment, 2-2). Within the agricultural sector, the dairy sector is New Zealand's largest export earner with the nation producing 31% of the dairy products traded in the world market. Although currently not a huge contributor to GNP within New Zealand, the organic sector has experienced strong growth with a 77% increase in export earnings in 2000, in part because of recent international food scares. Worldwide, the organic industry is worth $27 billion US dollars and is expected to experience significant increases in growth in the coming years. In 2000, certified organic exports brought in NZ$60 million.

A 1999 report by Woodward-Clyde, a New Zealand environmental consulting company, on “green market signals” indicates three reasons why New Zealand’s “clean green” image would be important for the nation’s agricultural exports, including organic. First, worldwide food scares have led consumers to question agricultural production practices. Second, there has been increasing demand for environmentally friendly organic foods. Third, the presence of genetically modified materials in the food supply has caused concerns internationally. Consumers are becoming more safety conscious with respect to food, especially within Europe. Anchor, a major butter distributor and producer in New Zealand has used the international concern for food safety to its benefit by touting New Zealand’s clean, green image in the promotion of its butter. The New Zealand Dairy Board has done similar things in the marketing of milk. “Its brand position is based on consumer preference for New Zealand Milk products because they represent the pure and natural values of New Zealand (Ministry for the Environment Report 2001, 2-7)”.

In addition to agriculture, tourism is a huge contributor to New Zealand’s economy. The main tourism markets for New Zealand are Australia, the USA, UK, Japan and South Korea. The Ministry for the Environment (2001) estimated that tourism was responsible directly and indirectly for $5 billion in foreign exchange earnings. In a 1999 and 2000 survey, CM Research New Zealand (as sited in Ministry for the Environment 2001:2-17) reported that tourists to New Zealand associated the nation with “beautiful scenery; refreshing and revitalizing; outdoor lifestyle; adventure; and a time away from it all.” According to the Ministry for the Environment, tourism is one area in which “clean green” New Zealand is essential as it is the “cornerstone” for marketing the nation internationally. The target markets for New Zealand all see the nation as an unmarred paradise.

The Ministry for the Environment (2001) undertook research to determine empirically the economic consequences that would result for New Zealand should its “clean green” image be tarnished. Surveys conducted in Malaysia (a significant importer of New Zealand dairy products) indicate that the amount of dairy products purchased by Malaysians would decrease by 54% should New Zealand’s environment become degraded. It was thought that these results could be generalized to markets in Asia, Africa and the Middle East. The potential loss in revenue from these markets was estimated to be between NZ$241 million and NZ$569 million. With respect to tourism, research indicated that should New Zealand’s environmental image become tarnished, a steep decline in tourism from Asia, namely Japanese and Korean tourists, would be experienced with a decrease of 77% to 79%. Tourism from other countries would also drop. It was estimated that a loss of NZ$938 million to NZ$530 million would be experienced.

In addition to economic losses due to reduced consumer demand for products, a degraded environment would also expose New Zealand to nations invoking green protectionism. Green protectionism is a strategy used by First World nations to limit food imports from other countries by denying entry of a food product due to concerns about the chemicals used in production. It can be used by a nation to protect domestic farmers from cheap produce coming in from other nations. A study by McKenna and Campbell (1999) highlighted how the New Zealand kiwifruit industry experienced Italian green protectionism when Italian food authorities claimed kiwifruit from New Zealand had unacceptable levels of chemical residues. Green protectionist policies are not always independent of politics as shown in the Italian case with the restrictions on New Zealand imports occurring the same time as the Italian kiwi fruit harvest. In the future, it is likely that First World markets will become even more restrictive. Any change in New Zealand's environmental health could be used against New Zealand exporters in markets wanting to restrict imports.

Nation Branding and the Case of the United States Economy

While Brand New Zealand has been steadily improving, Brand USA has taken a beating in recent years. A change in international perceptions of Brand USA has emerged within the last few years as a result of the Bush administration's response to the 9/11 terrorist attacks (Johannson 2004). As previously mentioned, a nation's politics influence its international branding and it has primarily been changes in US political factors that have led to a decline in the status of Brand America (Rawson 2007).

The original Brand America was associated with liberty, wealth, quality lifestyle and technological and engineering supremacy. As previously mentioned, the US has come to be associated with the following words: "bullying, polluting, domineering, imperialistic, ignorant, fat, selfish, inconsistent, arrogant, self-absorbed, greedy, hypocritical and meddling" (Anholt and Hildreth 2004). Due to events such as the lingering war in Iraq, prisoner abuse, and detainment of prisoners without trial at Guantanamo Bay, the US is no longer seen to stand for liberty but rather intolerance. The wealth of the US has been transmuted into perceptions of the US as a greedy nation while notions of technological and engineering supremacy have now permutated to images of the US as a domineering, polluting, bully.

In a large scale survey, the Pew Research Center (2003/2004) found that the new Brand America had had a noticeable affect on international public opinion with the image of the US dropping steeply between summer 2002 and March 2003. The average decline was by more than 30 percentage points. Responding to the decline in Brand America, US multinationals have had to disassociate themselves from the US and have started localization campaigns. McDonalds, for example, offers Indian style cuisine in India, in addition to the quintessential quarter pounder with cheese.

Although American prestige abroad has diminished, American brands have not had a massive drop off in consumption. Johansson (2004:162) states, "Foreigners seem to dislike Brand America a lot more than before—but it seems not to have changed their feelings about American brands that much." A study by Fullerton et al. 2007 offers empirical evidence that international consumers negative attitudes towards the US has not caused them to "vote with their pocketbooks" by refusing to purchase US brands. Part of the reason for such a small drop off in consumption is related to the fact that in many instances there are few alternatives. Due to the pervasive onslaught of cheap American brands in the past, many local alternatives are no longer available having been driven out of business (Johansson 2004). Other factors likely influencing a reduced drop off rate are that many American franchises and businesses are run by locals not foreigners, many US products are produced in foreign nations such as China and American multinationals have gone to extensive efforts to distance themselves from the US and to localize their offerings (Johansson 2004).

Unlike New Zealand, where the nation's branding as "clean green" has proven to be a significant economic asset and an inability to maintain the branding would prove detrimental to economic returns, Brand USA and its decline in stature has not proven to have significant economic effects on the nation. Regional marketing schemes, limited local alternatives and an expansive scale of distribution have limited the economic repercussions that might normally result from a decline in brand image.

National Identity, National Branding and the Acceptance of Genetic Engineering Agricultural Technology

Pollution metaphors have been extremely powerful in framing biotechnological risk, and mainstream institutions have started to utilize pollution discourses when discussing the technology. In genetics debates, nature is often portrayed as "goodness and innocence" (Williams 1983, Hansen 2006:813) while genetically engineered food and crops have been stigmatized by anti-GE protestors as pollutants. Supermarkets in Europe, for example, will market "clean" food that is free of GE ingredients and retailers speak of threshold level of GE "contamination" (Levidow 2000). Levidow (2000:325) contends that "by deploying pollution metaphors, critics have de-legitimized agricultural biotechnology, while catalyzing public debate about choices for the future of nature and society." By using this metaphor, opponents of genetic engineering convey risk as both a moral slight against nature as well as physical harm to nature (Levidow 2000).

As previously discussed, New Zealand's national identity and national branding are intimately tied to the country's unique and scenic landscape. The 100% Pure website (www.newzealand.com/travel/international), for example, markets New Zealand as the youngest country on earth "with vast open spaces filled with stunning rugged landscapes, gorgeous beaches, often spectacular geothermal and volcanic activity, a temperate climate and fascinating animal and plant life." The 100% and purity themes of the campaign are echoed in all media visuals. The nation's scenery, wines, food, people and experiences are portrayed as "untainted, unadulterated, unaffected and undiluted" (Morgan and Pritchard 2002:12). Although primarily directed towards potential tourists to New Zealand, the 100% Pure and "clean green" campaign and their assertions of national distinctiveness through nature are reminders to the New Zealand people of the "centrality of nature in the formulation of national identity" (Bell 2005:19).

The association of GE with pollution metaphors, such as "contamination of nature," is viewed by many New Zealanders as a direct threat to both national identity and national branding. "Clean green" New Zealand is embedded in the nation's consciousness and is crucial for the economy. Not all New Zealanders believe that the nation truly is clean and green but an overwhelming majority feels that the image is important to maintain (see Chapters 5 and 6). New Zealanders have previously drawn upon the nation's "clean green" image to challenge environmental threats such as the rapid expansion of dairying in the Canterbury plains and the use of 1080, a lethal poison, to eradicate invasive pests. These challenges to environmental threats seemed "motivated by a desire to retain or improve the clean green image" (Coyle & Fairweather 2005:150). Coyle and Fairweather's (2005) research on genetic engineering suggest that it is viewed, like dairying and 1080, as a significant environmental threat.

Should New Zealand lose its "clean green" international image, the nation would experience significant economic setbacks in both agricultural exports and the tourism trade (Ministry for the Environment 2001). Genetic engineering is a potential threat to that image as a number of economically significant Asian and European export markets have qualms with the technology and view it as a pollutant. Thus, genetic engineering technology is viewed by many New Zealanders as a significant threat to the nation's brand and economy. In 2002 it was estimated the agriculture comprised 47% of export income and in 2003 it was estimated that tourism comprised 17.8% of export income. Should these two markets experience serious economic losses, the New Zealand economy would be in turmoil.

Despite the majority of New Zealanders having significant concerns with regard to genetic engineering agricultural technology, the government, although cautious, has been open to the technology. As mentioned in the section on New Zealand nation branding, New Zealand is keen to add innovator to its brand reputation. Imagery in government and industry brochures depict "clean green" fields of genetically engineered crops. Coyle and Fairweather (2005:154) contend that this is "an initial attempt to draw clean green New Zealand and (bio) technology into one picture." Pro-GE advocates highlight the environmental benefits of the technology and how it can be used as a tool to actualize "clean green" New Zealand. However, many participants in the Coyle and Fairweather (2005) study saw the notion of New Zealand as both biotech innovator and a clean green country to be contradictory. Although the government was attempting to merge "clean green" New Zealand with biotechnology, this merge was seen as a destabilizing threat to national identity (Coyle and Fairweather 2005).

In contrast to the New Zealand case, genetic engineering fits in well with the national identity and national branding of the United States. As previously mentioned, notions of US national identity revolve around political ideologies as well as technological superiority. Genetic engineering epitomizes technological prowess as it promises increased agricultural efficiency (increased crop yields, reduced agrochemical usage etc.). As was the case with mass production, the US values high productivity. The US has long been held as one of the most extreme expression of mechanization in the world (Larrabee 1961). Genetic engineering has brought the expression of that mechanization to a whole new level with the modification of genomes. Since the first planting of GE commercial crops in 1996, the United States has led the world in the adoption of biotech-derived crops and American farmers have steadily increased their acreage under GE production from 5 million acres in 1996 to 123 million acres in 2005 (Sankula 2006).

While many New Zealanders have opposed genetic engineering because they perceive it as a threat to a nature that is pure and good, a nature that is tied to their identity, Americans have been willing to accept relatively high levels of risks to the environment in order to gain benefits from the technology such as lower prices and improved taste (OTA 1987). Science and technology in the United States is held in very high regard and is a symbol of progress. With respect to GE, it appears that nature is viewed as a challenge rather than as pure and good. Genetic engineering is able to fix weaknesses in nature and make it more productive. A major aim of genetic engineering technology is to industrialize agriculture and biotechnology can be seen as a 'bioreactor', whose efficiency can be optimized through the correction of genetic defects (Levidow 2000). In this view of biotechnology, GE represents a "cornucopian imperative" as it can minimize chemical usage, increase food production, and improve economic competitiveness (Levidow 2000:328). "Greater efficiency and wealth-creation are attributed to nature, e.g. with terms such as 'value-added genetics'" (Levidow 2000:328).

In contrast to New Zealand, genetic engineering fits in well with the US's national branding as an innovator. While the technology is contentious in many parts of the world, it has been expanding significantly as far as acres planted and number of nations adopting the technology. The technology has been immensely profitable for American biotech companies and for farmers. The National Center for Food and Agricultural Policy estimates that in 2005 biotech-derived crops improved net return for American farmers by $2 billion by increasing yields and reducing production costs (Sankula 2006). Biotech companies like Monsanto are achieving significant profits. In 2006, Monsanto's profits reached $700 million and are on track to reach $1 billion in 2007.

In conclusion, both the United States and New Zealand's responses to genetic engineering technology make sense with respect to each country's national identity and nation branding. GE crop technology's image as a pollutant is a direct threat both ideologically and economically to New Zealand identity and branding. By contrast, that image of genetic engineering is not as significant for the United States, which lacks an identity and branding associated with nature. Instead, an alternate image of genetic engineering as progressive and productive ties in nicely with US identity and branding. Although placing the US and New Zealand on different poles of the genetic engineering debate, the national identity and national branding of both nations has allowed them significant economic success.

Chapter 4 - Cognitive Modeling: Introduction, Research Design, Methodology, and Analysis

Application of cognitive anthropological approaches to the study of technology is relatively new and provides a unique opportunity to empirically study differences in understanding of biotechnology across groups (such as diverse stakeholders) and to better understand how and why lay perspectives on new technologies develop, including the position of non-acceptance.

Although not addressed within cognitive anthropology, biotechnology has been addressed within the field of medical anthropology. Medical anthropologists have focused upon how lived categories, such as the body and death, can be transformed in and through the use of biotechnology (Casper et al. 1996, Lock 1995, 1996). Lock (1995), for example, using a critical ethnographic approach, evaluated how organ transplantation challenges traditional assumptions about death and self/body integrity. By "tampering" with death via organ transplantation and by mixing self with other, the nature of death and self are re-conceptualized. This arena of medical anthropology research into technology and the body has been particularly productive in the last few years (Nelkin 1996, Lock 1995, 1996, Pálsson & Rabinow 2001, Rapp 1988, 2000). However, this innovative body of work – based in critical ethnography - is not concerned, particularly, with empirical grounding and systematic comparison across groups. Using methodologies based in cognitive anthropology this research will contribute to understanding the interrelationship between health perceptions and biotechnology by shifting focus from how technology shapes external cultural conceptualizations (e.g. death in Lock's 1995 study) to instead focusing on the measurable problem of cognitive cultural meanings ascribed directly to a technology of relevance to health.

The goals of Chapter 4 are threefold. The first goal is to introduce the reader to cultural modeling, the theoretical perspective that is the foundation for research presented in Chapters 5 and 6 of this dissertation. The second goal is to introduce the reader to the research design and methodology utilized for the cultural modeling portion of this dissertation. The final goal is to present the quantitative research results and highlight key findings.

A History

Anthropology has a long history of using cognitive anthropological methodology to understand issues related to health and the environment in ethnomedicine and ethnobiology (see Berlin 1992, Berlin & Berlin 1996) and more recently in cognitive cultural modeling and cultural consensus research (see Blount 2002, Garro 2000, Dressler 2000).

Theoretically and methodologically developed in the 1980s, cultural models are a means to systematically analyze personal discourse and behavior. Cultural modeling developed as a reaction to anthropology's crisis of representation, spurred by the Redfield-Lewis debate (Colby 1996). Redfield and Lewis both conducted ethnographic research in Tepoztlan, Mexico—Redfield in 1930 and Lewis in 1951. Both researchers looked at multiple aspects of daily life during the course of their research including agriculture, distribution of wealth, politics and inter-personal relationships (Redield 1930, Lewis 1951). A number of their respective findings disagreed significantly and more than could be explained by the passage of time. For example, Redfield characterized Tepoztlan interpersonal relationships as cooperative while Lewis found villagers to be highly individualistic and uncooperative by nature. Further, both researchers made multiple value judgments about Tepoztlan society. Redfield's ethnography repeatedly characterized folk/rural societies as good and urban societies as bad while Lewis often characterized members of folk/rural societies as being inappropriately uncooperative in their social interactions (Redfield 1930, Lewis 1951). The Redfield-Lewis debate caused anthropology to question current ethnographic methods as being biased. Cognitive anthropology developed, in part, to counter this bias in representation by focusing on the indigenous person's view of things (Colby 1996).

Early work on cultural representations within cognitive anthropology focused on either lexical semantics or indexical reference. Researchers (see Berlin 1992, Berlin and Kay 1969) in lexical semantics searched for nomenclature and classification patterns in order to compare patterns across societies and potentially derive "transcultural universals" (Blount 2002). Lexical semantics researchers have successfully uncovered patterns in lexical structure across diverse societies for domains such as color terminology, ethnomedicine and ethnobotany, to name a few.

Much research on lexical semantics has revealed that words do not typically "reference their objects in a one-to-one isomorphic relationship, i.e., one word references one and only one object or even one kind of object" (Blount 2002:5). Instead, words are often labels for information clusters with the clusters being ordered in culturally complex and patterned ways (Blount 2002). Indexical reference researchers have looked at how words point to topics both as direct references and in a broader sense via meanings assigned to them as a result of discourse structure (Blount 2002). According to Blount (2002:5), "to understand the meaning of words, participants in discourse must share some expectations to what the word actually indexes, how it is used and what it means in that particular context" (see also Agar 1985, Brenneis and Myers 1984). Thus, words have a cultural dimension and can be considered artifacts of culture.

Drawing on ideas from indexical reference research, cultural modeling is a means to move beyond lexical semantic representations. Cultural models systematically draw on personal discourse thereby allowing researchers to get the insider's perspective on respondent knowledge, thought, and word meanings. According to D'Andrade (1990:65) and as quoted in Holland and Cole (1995:478):

> Culture consists of learned and shared systems of meaning and understanding, communicated primarily by means of natural language. These meanings and understandings are not just representations about what is in the world; they are also directive, evocative, and reality constructing in character.

Cultural models look at the meanings of semantic fields employed by people and take into account both internal mental constructs and external social constructs (Holland and Cole 1995). The meaning of cultural models is twofold. First, cultural models are presupposed, taken for granted models of knowledge and thought that are used in the course of everyday life to guide a person's understanding of the world and their behavior (D'Andrade 1984). Second, they are constructed representations made by researchers in order to describe shared knowledge and perceptions used by groups of people in their daily lives (Blount 2002, Cooley 2003).

Early cultural modeling work dealt mainly with social and psychological phenomena such as marriage, emotions, morality, and personal relationships. The application of cultural modeling to other topical areas was slower to develop and only started to take off in 1999 as cultural models began to be applied to ecological, environmental and medical anthropology research. As outlined by Blount (2002), cultural modeling has since been used to look at environmental movements and the construction of personal identity (Kitchell et al. 2000), the occurrence of "pfisteria hysteria" (Paolisso and Maloney 1999), illness construction (Garro 1999), historical environment reconstruction (Dailey 1999), coastal zone management (Cooley

1999), and issues concerning public water supplies in Georgia coastal communities (Childers 2001).

An assumption of cultural modeling is that when individuals engage the world they do so in a simplified and focused mannered that does not include all the detail and complexity of a situation (Holland and Quinn 1987, Blount 2002). According to Blount (2002:7),

> By focusing on a small set or subset of complexity, the world is reduced to perceptually and cognitively manageable portions, i.e., it is simplified. Cognitive engagement with the world could not possibly be otherwise, neither as a single snapshot that captures all of the reality of one instant nor as a series of rapid-fire snapshots. Engagement with the world in any specific instance is necessarily in simplified, scaled-down, modeled form. Individuals model their world as they encounter it, and since members of social groups need to model the world in similar, communicable ways, modeling tends to be along pathways that are mutually understood and shared, in other words, cultural.

Schema Theory

The Swiss philosopher and cognitive development theorist Jean Piaget (1926) first introduced the term schema—defining schema as mental representations of related perceptions, actions and ideas. He believed schemata to be the building blocks of thought (Woolfolk 1987). Drawing on concepts introduced by Piaget, R.C. Anderson (1977), an educational psychologist, developed schema theory to look at the process of learning. As a theory of learning, schema theory contends that knowledge is organized for each individual in an intricate complex of abstract mental structures representing one's means of comprehending the world. Since its introduction by Anderson (1977), schema theory has been adopted and modified to fit several fields of study including anthropology.

Within anthropology Holland and Cole (1995) and Strauss and Quinn (1997) have been strong advocates of schema theory. According to Holland and Cole (1995), schemata are the constituent pieces that comprise cultural meaning. By serializing, embedding, and hierarchically organizing multiple schemata into a series of foundational components of thought, identified via discourse analysis, cultural models of the world can be built (Strauss and Quinn 1997, Blount 2002). Schemata allow individuals to engage with the world in "relatively straightforward, predictable, and meaningful ways," as they maximize cognitive efficiency by scaling down the complexity of the world (Blount 2002:7).

Schemata are essentially selection mechanisms that specify how different elements relate to one another (Holland and Cole 1995). Cultural models can be used to illustrate how cultural groups reason about objects (thermostats, cars, remote controls), social institutions (marriage, funerals, birthday parties) and human properties (workings of the body and mind) (Holland and Cole 1995). For the purposes of this study, they will be used to illustrate how stakeholder groups reason about GE.

Research Questions and Corresponding Hypotheses

The following questions and corresponding hypotheses guided the cultural modeling research to be presented in Chapters 5 and 6 of this dissertation.

<u>Question 1</u>

How do the cultural meanings invoked by GE technology vary among stakeholder groups inter- and intra-culturally in the United States (US) and New Zealand (NZ)?

Hypothesis 1A

The cultural meanings given to GE technology will vary between stakeholders in the US and New Zealand with New Zealanders ascribing more negative attributes to the technology. As previously mentioned, surveys have shown a steady decline in acceptance of GE foods and agriculture among New Zealanders (Coyle 2003, Gamble et al. 2002, Hoban 1997) in contrast to what is described as general acceptance of GE technology within the US (Uzogara 2000).

Hypothesis 1B

The cultural meanings given to GE technology will vary between stakeholders (consumers, the organic farming community, the GE/GE amenable farming community) in the US and New Zealand intra-culturally.

Commentary

Question 1 and the corresponding hypotheses are used to establish that the US and New Zealand do differ regarding cultural meanings applied to GE technology. Further, the US and New Zealand are not made up of homogenous populations, thus the research seeks to highlight how three key stakeholder groups within the GE debate differ with regard to meanings afforded GE technology. Inter-cultural comparisons were made across stakeholder groups between the two countries (e.g. consumers to consumers, farming community to farming community), and intra-cultural comparisons were made across stakeholders in each region (e.g. GE farming community vs. organic farming community vs. consumers). Consumer respondents were divided into groups based on respondents' self-classification as Pro-GE, Anti-GE or neutral.

<u>Question 2</u>

How do the cultural meanings invoked by GE technology vary with the cultural meanings given to health and the environment? Previous economic research suggested that consumers consider both environmental and health factors as part of a trade-off in assessing GE food attributes (Hu et al. 2004).

Hypothesis 2A

The cultural meanings given to human health will be related to the cultural meanings ascribed to GE technology. In other words, those respondents ascribing similar meanings to human health will afford GE technology similar meanings.

Hypothesis 2B

The cultural meanings given to the environment will be related to the cultural meanings ascribed to GE technology. As with H2a, it is hypothesized that those respondents ascribing similar meanings to the environment will afford GE technology similar meanings.

Commentary

Question 2 and the corresponding hypotheses were used to understand how two important cultural factors, perceptions of health and perceptions of the environment, influence how people conceptualize GE technology.

Research Design, Methodology and Results

<u>Field Sites</u>

The US portion of the research was conducted in both Northeast Georgia, home to a mid-size organic farming community, and Southwest Georgia, home to a large GE farming community (Figure 4.1). The New Zealand portion was conducted in the South Island province of Canterbury (Figure 4.2). The research sites were selected because they share several key historical, biogeographic, and economic features, as discussed in Chapter 1.

<u>Informants</u>

Consumers, the organic farming community, and the GE farming community were selected for analysis because each group has the potential to be significantly impacted by both the benefits and risks of GE technology. The main criteria for selecting informants varied by stakeholder group. Informants for the organic farming community were either currently engaged in organic farming (ie. following organic farming protocols equal to or better than those established by an accredited organic certification agency) or an active member of the organic food movement as indicated by employment at organic food stores or locally grown cooperatives. All farmers within the organic community were small-scale farmers, farming less than 10 acres of mixed crops. Informants for the GE farming group were either currently engaged in GE crop cultivation or amenable to the planting of GE seeds, in the case of NZ farmers. GE farmer informants in the US tended to be large-scale agriculturalists, farming 500 to 5,000 acres. The primary GE crops planted were cotton, corn and soy. GE-amenable farmer informants in NZ were also large-scale farmers and farmed 200 to 3500 acres of mixed crops (wheat, barley, rye, potato, corn, grasses and brassicas). Informants within the consumer stakeholder group were the household member who did the majority of the household food shopping.

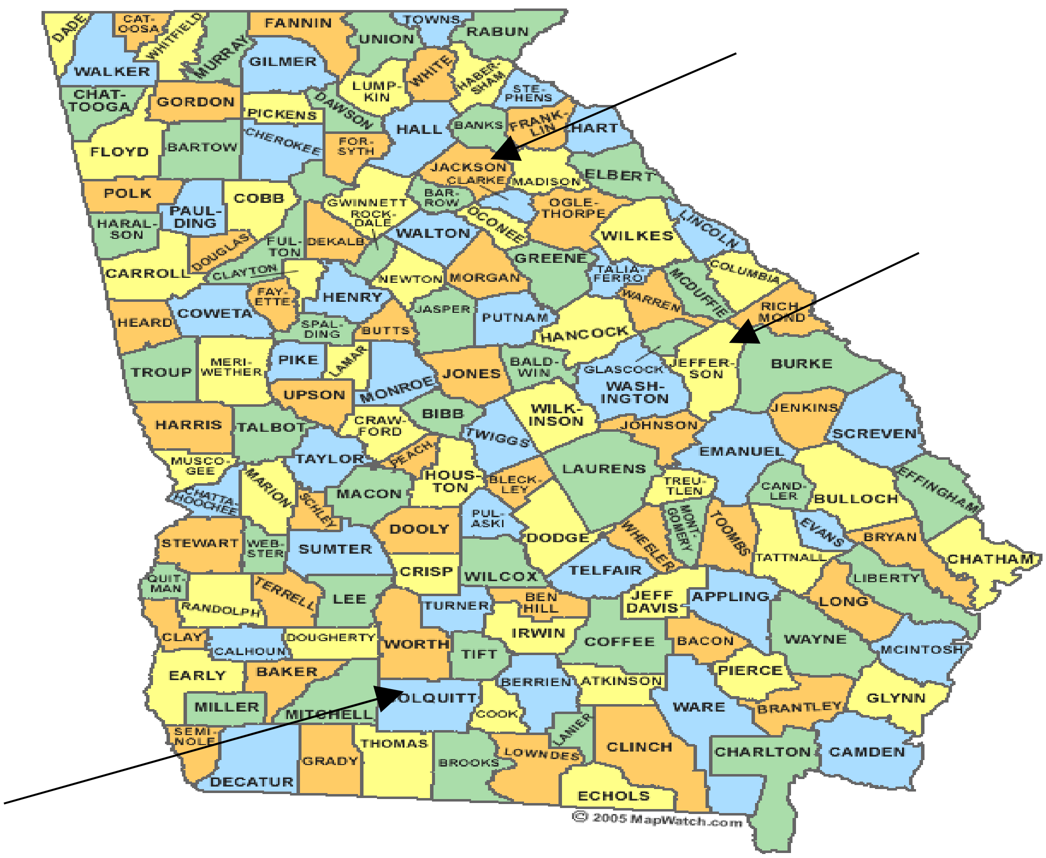

Figure 4.1: Map of Georgia
The arrows indicate the location of field sites within Georgia. Counties included in the sample include Clarke, Oconee, Jackson, Oglethorpe, Jefferson and Colquitt. Map obtained from www.mapwatch.com.

Figure 4.2: Map of New Zealand
The arrows indicate the location of the New Zealand field sites in Canterbury. Districts included in the sample include Christchurch, Selwyn and Ashburton. Map obtained from www.maft.govt.nz.

Table 4.1: Informant Groups

	Number of Respondents	Sex	Age Range	Average Age
US consumers	36	female	18-64	34
NZ consumers	32	female	18-78	36
US Organic	15	male and female	24-57	37
NZ Organic	16	male and female	21-64	44
US GE	18	male	26-65	45
NZ GE	6	male	35-63	51

Within the consumer group, only females were interviewed as women are generally more responsible for food shopping and preparation (Charles and Kerr 1988, Worsley et al. 2000) (Table 4.1). Within the GE farming group only men were interviewed due to an insufficient number of females to draw from who farm conventionally (Table 4.1). Within the organic farming/food community, both men and woman were interviewed as both sexes were prevalent in sufficient numbers within the farming community (Table 4.1). While sampling was conducted opportunistically due to the difficulty of finding respondents willing to participate in a one and half hour interview, effort was made to obtain respondents across the age spectrum (Table 4.1).

As the research design involves the methodological triangulation of both qualitative and quantitative data, particular care was taking in choosing an appropriate sample size. The sample size of each stakeholder group was kept relatively small, thus, allowing for an in-depth inquiry into perceptions of GE, the environment and health. According to Myers (2000: accessed online 2008), "a small sample size may be more useful in examining a situation in-depth from various perspectives, whereas a large sample would be inconsequential…small qualitative studies can gain a more personal understanding of [a] phenomenon."

The initial research goal was to obtain at least 15 respondents from each of the farming stakeholder groups and at least 30 respondents from the consumer respondent groups. Regarding the greater sample sizes for the consumer groups, it was felt that consumer groups would exhibit a greater diversity of thought regarding GE, health and the environment compared to farmer research participants, thus, a greater sample size was felt warranted. These initial sample size goals were tentative estimations of sample sizes thought necessary to achieve informational redundancy. Had informational redundancy not been achieved with the initial sample size estimations, further sampling would have been carried out until informational redundancy had been achieved. The sample size goals were met for all stakeholder groups except for the NZ GE-amenable group in which only 6 respondents were obtained due to a relative scarcity of farming individuals meeting the aforementioned selection criteria. It should be noted that the additional number of respondents interviewed above the sample size goals (15 farmer and 30 consumer respondents) are not indicative of informational redundancy not being achieved once the sample size goal was met. Instead, the additional number of respondents merely reflects additional interviews being schedule in case of participant cancellation.

As will be discussed in the following section, consensus analysis was an important quantitative-based methodological tool used in this research and was used in conjunction with additional quantitative measurements such as rank ordering, knowledge testing and Likert scaling. Cultural consensus analysis has been successfully used by researchers in both medical and ecological anthropology. For example, Dressler (2000), a medical anthropologist, used cultural consensus analysis to look at how cultural dimensions of lifestyle and social support affect arterial blood pressure in an African American community. Similarly, Garro (2000), also a medical anthropologist, used cultural consensus analysis to explore knowledge of diabetes in the Ojibway community of the Northern United States. Within ecological anthropology, Grant and Miller (2004) and Boster and Johnson (1989) have used cultural consensus to look at marine ecological knowledge in fishing communities.

According to Weller and Romney (1988), using consensus analysis and assuming an average cultural competence level among informants of 0.5 or higher, a confidence level of 0.95 can be achieved using nine respondents per sampling frame. Cultural competence refers to "how much of a given domain of culture each individual informant 'knows'." (Romney et al. 1986) Each frame used in the course of this research had more than nine respondents except for the NZ GE-amenable farming group, which only had six respondents due to sampling constraints. Thus the sample sizes chosen for this study were more than adequate for consensus analysis to be conducted in all cases but one. For the NZ GE group with only six respondents, consensus analysis could still be used assuming respondents exhibited a cultural competence level higher than 0.5. This assumption was not unwarranted given that members of this stakeholder group exhibited strong cohesion of thought regarding notions of health, environment and GE. The other forms of quantitative analysis were statistically analyzed using Mann Whitney U-tests, a statistical test designed for use with data from small samples.

Cultural Modeling

Within anthropology, cultural models have traditionally been derived via schema analysis of respondent discourse (see Cooley 1999, Garro 2000, Kitchell et al. 2000, Childers 2001). According to Blount (2002:9):

> Once a text is created from discourse, one works 'backwards,' asking questions about how the text was created, in effect asking what the conceptualizations are upon which the text is based. The conceptualizations are the raw materials of the analysis. They reflect the agent's underlying mental models, the framework with which the world is engaged. The reconstructed mental models of an individual constitute the cognitive architecture upon which the discourse is generated.

The research goal for this dissertation was to devise cultural models of health, environment, and GE for each respondent stakeholder group using discourse analysis. However, as qualitative research has been criticized for lacking scientific rigor and reproducibility, quantitative research methodologies including free-listing, rank-ordering, Likert scaling and risk scenario exercises were also employed to inform the cultural models. The quantitative measures taken during the course of this research contribute to cultural modeling by mathematically confirming and quantifying inter-group differences in model foundational components derived via schema analysis. Both schema analysis and the quantitative measures utilized in this research highlight patterns of agreement and disagreement among groups. It should be noted that the quantitative methodologies used during the course of this research were not used to form or structure the cultural models only to inform the models regarding degrees/directions of difference across groups for key areas of interest. Quantitative measures utilized for this research primarily focused upon measuring variability in health, environment and GE risk perceptions. These three areas were of particular interest as GE is associated with both risks and benefits with respect to health and the environment.

In the succeeding sections, the different research methodologies employed for purposes of cultural modeling will be highlighted. Following the presentation of each quantitatively based research methodology, the results obtained during the course of research will be presented in tables and key findings will be discussed.

Qualitative Data Collection and Analysis: Discourse Analysis

During the interview process, respondents were asked a series of semi-structured interview questions regarding various aspects of health, environment, GE and national identity to be used for discourse analysis (Appendix 4.1). Additionally, quantitative exercises such as free-listing, rank-ordering and Likert scaling, conducted during the course of the interview, sparked supplementary comments and discussion beyond what was called for in the exercise. These side bar discussions proved invaluable in uncovering small nuances of thought associated with health, environment and genetic engineering.

It should be noted that the interviews were not taped as initial work among the US farming community indicated that taping aroused suspicion among those interviewed and decreased participant willingness to engage in the interview process. Participants responses were instead recorded as exactly as possible in written form. Particular care was taken to record highly relevant information in quotation form.

In order to analyze the discourse obtained during the semi-structured interviews, each interview text was imported into NVivo 7 and coded according to key words and phrases. It was then inductively analyzed for patterns, structure, and linkages of schemata. The cultural models demonstrate how each stakeholder group assigns meaning to GE technology, human health, and the environment.

Quantitative Data Collection and Analysis: Free-listing

Free-listing is a standard and objective way to gather a meaningful sample of the domains being investigated with limited investigator bias (Romney 1999). The goal of the free-listing exercises was to elicit relevant items specific to the domains of human health, the environment, and GE technology. Respondents were asked to freely list items specific to the following categories: adjectives used to describe the United States/New Zealand, the most pressing problems facing the US/New Zealand, how to maintain health, characteristics of healthy food, human health threats, environmental threats, what you do to preserve/conserve the environment, adjectives used to describe GE; risks of GE, and benefits of GE.

To provide a quantitative base for the cognitive cultural modeling, cultural consensus analysis of free-list data was carried out using ANTHROPAC 4.0 statistical software (Borgatti

1997, Romney et al. 1986). Using factor analysis to compare participant responses, consensus analysis can contribute to cultural modeling by emphasizing the importance of sharing as a defining feature of cultural knowledge (Dressler & Bindon 2000). According to Borgatti (1997) consensus analysis methodology relies on three main assumptions: (1) everyone within a given cultural group shares the same cultural reality (2) the culturally correct answer is the only driving force drawing respondents to give a particular answer. Lacking knowledge of a particular answer, respondents make up an answer independently of each other (3) questions designed to uncover knowledge about a given domain actually pertain to the domain in question. For example, questions designed to elicit information about the domain of health, actually pertain to health and not other domains such as travel or UGA football etc.

Consensus analysis uses patterns of agreement, or consensus, among informants to generate a composite picture of all the informant's knowledge and perceptions about a specific domain (group of related items). It enables a researcher to determine if there is sufficient sharing in responses to structured questions within and among groups to make it reasonable to infer that respondents are drawing on a single cultural model (Romney et al.1986). Consensus analysis also provides a means of uncovering the culturally correct answers to a given set of questions.

The results of the consensus analysis were used in conjunction with respondent discourse analysis to inform stakeholder cultural models. The findings from consensus analysis were used to highlight and confirm key schemata for inclusion into the cognitive models.

Key Findings from Consensus Analysis of Freelist Data-Table 4.2

- NZ consumer respondents were in consensus that NZ was a green nation. In addition to being green, GE opposed NZ consumer respondents considered NZ to be a clean nation.

- All US and NZ stakeholder respondents considered exercise and good nutrition to be important factors in maintaining health.
- Anti-GE US consumer respondents, NZ consumer respondents, and both organic communities considered mental well-being to be important for maintaining health.
- US and NZ organic community respondents were in consensus that mainstream agriculture was a major threat to environmental health.
- US and NZ organic community respondents farmed organically, in part, to help preserve/ conserve the environment.
- US and NZ organic community respondents considered GE technology to be risky or dangerous, respectively. By contrast, respondents from the GE and GE-amenable stakeholder groups in the US and NZ described the technology as helpful or innovative, respectively.
- US and NZ organic community respondents felt that GE technology had no true benefits while respondents from the GE communities in each nation believed GE to be capable of increasing crop yields and reducing chemical usage.
- Consumer respondents and respondents from the organic communities in the US and NZ believed the biggest danger of GE was the potential for unforeseen consequences.

Quantitative Data Collection and Analysis: Rank Order Exercises

In conjunction with the free-listing exercises, rank-order exercises were used. In the rank-order exercises respondents ordered sets of cards according to given criteria (see Appendix 4.2 for rank-order card sets). Card sets to be ordered included:

1. threats to health,
2. threats to the environment,
3. reasons why a healthy environment is important,
4. benefits of genetic engineering in agriculture, and
5. risks of genetic engineering in agriculture.

For the purposes of this study, the content of card sets one and two was devised to include common, publicly acknowledged threats to health and the environment. Card set three was devised based on results from a ten person pilot study, in which respondents were asked the question, “What are the reasons why a healthy environment is important?” Items mentioned by at least five respondents were included in the rank-order card set. The content of card sets four and five was based on a literature search for common benefits and risks associated with GE agriculture (see Pimentel 1989, Wieczorek 2003). After each rank-order exercise was completed, the interviewee’s reasons for ordering the cards as they did was discussed to gain a richer and more nuanced understanding of their response.

Rank order exercises served several important functions in this research. The exercises helped establish how threatening, compared to other threats to health and the environment, GE was considered to be for each stakeholder group. Second, the exercises helped ascertain which applications of genetic engineering in food and agriculture were judged by participants as more or less beneficial and/or risky. Using SPSS statistical software, Mann-Whitney U tests of the rank-order data was conducted. The Mann Whitney U test is a nonparametric statistical test for determining whether a set of scores is from the same distribution in the case of relatively small sample sizes (Madrigal 1998). The findings from the rank order exercises were used in conjunction with respondent discourse analysis to inform stakeholder cultural models. The findings provided a quantitative means of comparing, between stakeholder groups, information on the relative degree of threat posed by GE technology as well as information concerning which benefits and risks were considered to be of comparatively greater importance.

Key Findings for the "Threats to Health" Rank-Order-Table 4.3

- Among US and NZ consumer respondents, GE opposed consumers ranked genetic engineering as a more significant risk to health than did Pro GE consumers.
- NZ consumer respondents saw GE as significantly more threatening to health than US consumer respondents.
- Organic farming community respondents in both the US and New Zealand viewed genetically engineered food as a significantly larger threat to health than did respondents from both the consumer and GE stakeholder groups in each nation.
- US organic farming community respondents ranked chemicals in food as significantly more threatening to health than both US consumer and GE farmer respondents.
- GE opposed US consumer respondents viewed chemicals in food as being significantly more threatening to health than did Pro-GE US consumer respondents.
- Similar to the US, NZ organic farming community respondents ranked chemicals in food as more threatening to health than did NZ GE-amenable farmer respondents.
- Overall, NZ consumer respondents saw chemicals in food as being significantly more threatening than did US consumer respondents.

Key Findings for the "Threats to Environment" Rank-Order-Table 4.4

- US organic farming community respondents viewed genetic engineering in agriculture as significantly more threatening to the environment than did their counterparts in the consumer stakeholder groups.

- Respondents from the US organic community found pesticides to be significantly more threatening to the environment than did respondents in both the consumer and GE stakeholder groups.
- Within the US consumer respondent group, GE opposed consumers ranked genetically engineered crops as a more significant risk to the environment than did Pro GE consumers.
- Organic community respondents in NZ viewed GE as a bigger threat to the environment than did respondents from the consumer and GE-amenable stakeholder groups.
- Both NZ consumer respondents and members of the organic community regarded pesticides as a more significant threat to the environment did GE-amenable farmer respondents.
- Comparing the US and NZ, NZ consumer respondents ranked genetic engineering in agriculture as significantly more threatening to the environment than did US consumer respondents.

Key Findings for the "Reasons for a Healthy Environment" Rank-order-Table 4.5

- There were no significant differences inter-culturally between stakeholder respondents in the US and NZ with respect to how items in the rank-order were positioned. All significant differences in ranking occurred intra-culturally.
- US and New Zealand organic farming community respondents ranked Moral Obligation to Future Generations as being a more important reason for a healthy environment than did consumer respondents in each country.

- US consumer respondents considered the supply of economic resources provided by the environment to be a more important reason for a healthy environment than did US organic farming community respondents.
- Among NZ consumer respondents, Pro GE respondents ranked human health and provisioning of economic resources as more important reasons for a healthy environment than did GE opposed respondents.

Key Findings for the "Benefits of GE" Rank-order-Table 4.6

- NZ organic farming community respondents ranked reduced chemical use as a significantly more important benefit of GE than did NZ consumer respondents. It should be noted that while NZ organic farming community respondents ranked reduce chemical use higher in importance compared to NZ consumer respondents, the group was ranking the items as if they were all true benefits.
- US and NZ organic farming community respondents almost unilaterally did not believe that any of the items in this rank order set were true benefits of GE.
- US consumer and GE farmer respondents were the only two US stakeholder groups between which significant differences in ranking were found for multiple items on the rank-order list. US consumer respondents believed that increased food availability and improved nutritional quality were more important benefits of GE while GE farmer respondents felt that reduced chemical use and improved shelf-life were of greater benefit.
- GE opposed consumer respondents in the US and NZ were more likely to rank improved environmental health as an important benefit of GE (if all the benefits of GE were true) than were Pro GE consumer respondents.

- Comparing stakeholder respondents inter-culturally, the only significant difference was between US GE and NZ GE amenable farmer respondents. NZ GE amenable farmer respondents viewed edible vaccines as being a more important benefit of GE technology compared to US GE farmer respondents. This difference may reflect an awareness of the newly emerging biopharming industry within New Zealand and the potential for economic growth that comes with it.

Key Findings from the "Risks of GE" Rank-order-Table 4.7

- Comparing US consumer and US organic farming community respondents, consumers ranked the creation of viruses and food toxicity as being more important risks of GE. Organic farming community respondents ranked limited access to seeds, gene transfer, and decreased crop genetic diversity as being more important risks of the technology. When asked about the reasons for their rankings, US consumer respondents often stated that viruses and toxicity were direct threats to their personal health while respondents in the organic farming community felt that limited seed access, gene transfer, and decreased crop genetic diversity were significant threats to agriculture and therefore the world.
- NZ GE-amenable farmer respondents considered the production of allergens as a greater risk of GE than did NZ consumer or organic farming respondents.
- NZ consumer respondents ranked the production of viruses as a greater risk of GE than did GE-amenable farmer respondents.
- NZ organic farming community respondents ranked limited access to seeds as a bigger risk of GE than did NZ consumer respondents.

- GE opposed NZ consumer respondents were more concerned about GE risks such as gene transfer and loss of crop genetic diversity than were Pro GE NZ consumer respondents who were more concerned about a lack of labeling.
- The only statistically significant difference in ranking between the two countries was with respect to the production of viruses with both US consumer and GE farmer respondents considering viruses to be a bigger risk than their NZ counterparts.

Quantitative Data Collection and Analysis: Likert Scales

Likert scales are commonly used in survey research to quantitatively measure attitudes regarding a given topic. For the Likert scaling exercises, respondents were asked to rate the likelihood of GE risks happening within the next 20 years (Appendix 4.13), their trust in the groups involved in determining GE policy (Appendix 4.14), religiousness and political stance (Appendix 4.15), and their level of engagement with GE (Appendix 4.16).

The Mann-Whitney U test was used to analyze the results and compare attitudinal scores between stakeholder groups. After each Likert scaling exercise was completed, the interviewee's responses were discussed in order to gain a full and nuanced understanding of their thinking while completing the exercise. The findings from the Likert scaling exercises were used in conjunction with respondent discourse analysis to inform stakeholder cultural models. The Likert scales provided another quantitative means of comparing stakeholder attitudes.

Key Findings for the "Likelihood of GE Risks" Likert Scale-Table 4.8

- Table 4.8 shows several clear and consistent trends in how stakeholder respondents felt with respect to the likelihood of GE risks occurring within the next twenty years. Organic farming community respondents in each nation consistently rated GE risks as being more likely to occur than did consumer and GE stakeholder respondents.

- Consumer respondents in both the US and New Zealand consistently ranked the risks of GE as being more likely to occur than did GE farming stakeholder respondents.
- GE opposed NZ consumer respondents believed that decreased crop genetic diversity, gene transfer, negative alterations in the nutritional quality of food and the introduction of allergens were all more likely to happen in the next 20 years as a result of GE than did Pro GE NZ consumer respondents.

Key Findings for the Trust Likert Scale Exercise-Table 4.9

- US and NZ Pro GE consumer respondents were significantly more trusting of scientists involved in GE development than were GE opposed consumer respondents in each nation.
- NZ Pro GE consumer respondents were more trusting of both farmers and industry involved with GE technology than were GE opposed NZ consumer respondents.

Key Findings from the Religion and Politics Likert Scale Exercise-Table 4.10

- Table 4.10 indicates that respondents from the US GE stakeholder group were more religious and more politically conservative than US consumer and organic farming respondents. US consumer respondents were more conservative politically than respondents in the US organic farming community.
- Within New Zealand, NZ GE amenable farmer respondents were more conservative politically than both NZ consumer respondents and those in the organic community.
- All US stakeholder group respondents rated themselves as significantly more religious than their New Zealand counterparts.

Key Findings from the "Engagement with GE" Likert scale exercise-Table 4.11

- The results presented in Table 4.11 suggest that US organic farming community respondents are significantly more engaged in the GE debate than both US consumer and GE farmer respondents.
- Compared to US GE farmer respondents, respondents from the US organic community are more willing to read an article or watch a TV program about GE and are more willing to attend a public debate about GE.
- Respondents from the US organic community are more likely than US consumer respondents to have talked about GE with other people and are more likely to attend a public meeting concerning GE.
- GE farmer respondents in the US are more likely than consumer respondents to have talked about GE with other people but are less likely to read an article or watch a TV program on GE.
- Within New Zealand, GE amenable farmer respondents are more likely than consumer and organic respondents to have talked about GE with others.
- Respondents from the NZ organic community are significantly more likely than consumer respondents to have talked about GE in daily life.
- Comparing US and NZ stakeholder respondents, only respondents from the organic stakeholder groups differed significantly with respect to one of the measures of engagement. US organic community respondents were significantly more likely to read an article or watch a TV program about GE compared to their NZ counterparts.

Quantitative Data Collection and Analysis: Knowledge Tests

Within the field of Science and Technology, the sub-discipline Public Understanding of Science (PUST) has been concerned with the public adoption of preeminent scientific ideologies and technologies. Within PUST it is believed that public rejection of science and technology is based, at least in part, on a lack of scientific understanding and knowledge (Wynne 1991). This dissertation included knowledge testing within the research framework in order to assess what role knowledge or the lack of knowledge might play in GE acceptance or rejection. Multiple knowledge fields relating to GE agricultural and food technology were assessed. Respondents were given a four-part test assessing general science knowledge, GE knowledge, environmental knowledge, and health/nutrition knowledge (Appendices 4.24 & 4.25). It was felt that the degree of knowledge respondents possessed in each of these four fields might influence GE acceptance. GE is a technology based on a new and comparatively complicated science, which has implications, both positive and negative, for health/nutrition and the environment.

The knowledge tests given in each country were adapted, where appropriate, to take into account cultural differences. For example, the environmental knowledge test used in this study was designed by the US National Environmental Education and Training Foundation to test the environmental knowledge of US citizens. Two questions within the test regarding primary methods of power generation and methods of nuclear waste disposal had to be modified to suit the NZ situation as NZ's primary method of power generation differs from that of the US and NZ is a nuclear-free nation. Using SPSS statistical software, Mann-Whitney U tests of the knowledge test data were conducted and used to compare knowledge between stakeholder groups.

Key Findings from the Knowledge Test Exercise-Table 4.12

- The knowledge test results presented in Table 4.12 indicate that US organic community respondents are more knowledgeable about both general science and the environment than both US consumer and GE farmer respondents.

- In New Zealand, both organic community respondents and GE amenable farmer respondents are more knowledge about the environment than NZ consumer respondents.
- Comparing US and NZ stakeholder respondents, only respondents from the GE stakeholder groups differed significantly with respect to knowledge. New Zealand GE amenable farmer respondents were more knowledgeable about the environment than US GE farmer respondents.
- Pro GE consumer respondents in the US were more knowledgeable about GE than were GE opposed US consumer respondents.
- GE opposed consumer respondents in NZ were more knowledgeable about the environment than were Pro GE NZ consumer respondents.

Quantitative Data Collection and Analysis: Risk Scenarios

GE agricultural technology is a potentially risky technology from both a health and environmental standpoint. Risk scenario testing was included in the research framework in order to ascertain the level of risk tolerance/aversion held by stakeholder groups in the GE debate. People's willingness to accept risk is likely an important factor influencing GE acceptance/rejection. Thus, obtaining a quantitative measurement of respondent willingness to accept risk was thought to be an important research component for informing the cultural models.

Two types of risk scenarios were presented to research participants. Both consumer and farmer research participants completed the "General Risk" scenario exercise. The goal of the general risk scenario exercise was to ascertain each respondent's indifference value (see review in Wu, Zhang & Gonzalez 2007). For this scenario the indifference value represented the range of monetary values for which respondents would be indifferent choosing between an assured monetary return of $40 or a 50% chance of either increasing their monetary return by a certain amount or losing it all (Appendix 4.26).

The second type of risk exercises administered to research participants was the “Benefits Willing to Forego for No Risk” scenario exercises. Consumer and farmer respondents completed different versions of these exercises. The goal of these scenarios was also to determine an indifference value. For the consumer exercises, the indifference value represented the range of values, in the form of percentage reduction in food prices, for which respondents would be indifferent choosing between no decrease in food prices and food reduced by a certain percentage with a 2% risk to either health or the environment (Appendix 4.28-4.32). For the farmer exercises, the indifference value represented the range of values, in the form of increased crop yields, for which respondents would be indifferent choosing between no increase in crop yields and crop yields increased by a certain percentage with a 2% risk to consumer health or the environment (Appendix 4.33 & 4.34). As GE is potentially risky from a health and environment perspective, both the consumer and farmer risk exercises were presented using health and environmental risks as the type of risks respondents were choosing to either accept or reject.

Key Findings from the Risk Scenario Exercises-Table 4.13

- Compared to GE and GE amenable farmer respondents, organic community respondents in the US and New Zealand were significantly more risk averse. Organic community respondents were willing to forego a monetary benefit presented as increased crop yields in order to avoid risking both native plant species and consumer allergenicity.
- NZ organic and consumer respondents were risk averse compared to GE amenable farmer respondents with respect to general money wagering.

- Compared to GE opposed NZ consumer respondents, Pro GE NZ consumer respondents were significantly more willing to risk either health or the environment in order to received monetary compensation.
- Between the US and New Zealand, only respondents from the GE stakeholder groups differed cross-culturally, with US GE farmer respondents being more risk averse with respect to general money wagering.

Table 4.2: Consensus Analysis Results for Free Lists

What adjectives would you use to describe the United States/New Zealand?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
----	*Pro-GE* Green *Anti-GE* Clean, Green	----	----	----	----
What are the most pressing problems faced in the US/New Zealand today?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
War	----	Environment	----	Farming regulations	Farming regulations, Race relations
What things must a person do to maintain/achieve health?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Pro-GE Exercise, Good nutrition, Regular Check-ups *Anti-GE* Exercise, Good nutrition, Mental well-being	Exercise, Good nutrition, Mental well-being	Exercise, Good nutrition, Mental well-being	Exercise, Good nutrition, Mental well-being	Exercise, Good nutrition	Exercise, Good nutrition
What do you consider to be the main threats to human health that are occurring today?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Food, Pollution	Food	Food, Pollution	Food	Pollution	Malnutrition, Obesity
What do you consider to be the main threats to the environment that are occurring today?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Pollution	Pollution, Humans	Pollution, Humans, Agriculture	Pollution, Deforestation, Agriculture, Humans	Pollution, Development	----
What things do you do to preserve/conserve the environment?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Recycle	Pro-GE Recycle *Anti-GE* Recycle, compost, consume respons-ibly	Recycle, Farm organically, Reuse, Consume responsibly	Recycle, Compost, Farm organically, Consume responsibly	Prevent Erosion, Correct Use of Chemicals	----
What adjectives would you use to describe GE?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
----	----	Risky	Dangerous	Helpful	Innovative
What do you think are the benefits of GE?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Increased yields	----	No true benefits	No true benefits	Increased yields Less chemicals, Less work	Increased yields, Less chemicals
What do you think are the risks of GE?					
US Consumers	NZ Consumers	US Organic	NZ Organic	US GE	NZ GE Amenable
Unforeseen consequences	Unforeseen consequences	Unforeseen consequences, Gene transfer, Loss of crop genetic diversity, Pest resistance	Unforeseen consequences, Gene transfer	Cost	----

Note: This table presents results of consensus analysis conducted on respondent free list data. The free list prompt is given and any items achieving consensus are listed below their respective stakeholder group heading. Note: (----) denotes table cells in which no consensus was found.

Table 4.3: Statistically Significant Mann Whitney U Results for the Threats to Health Rank Order

This table presents Mann Whitney U results for the "Threats to Health Rank order" exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group ranked the item as being more threatening to health (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
See Appendices 4.3 and 4.4 for sample size (n), mean and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained

Rank Order Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumer	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumer	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Illicit Drug Use	U=86.5 p=0.045 G^	----	U=21.5 p=0.004 G^	----	----	----	----	----	----	----	----
Lack of Exercise	----	----	----	----	U=41 p=0.027 G^	----	U=11 p=0.013 G^	----	----	----	----
Obesity	----	----	----	----	----	----	----	----	----	----	----
Lack of Health Insurance	U=71 p=0.013 C^	U=132 p=0.047 C^	----	----	----	----	----	U=43 p=0.002 Pro^	U=149 p=0.000 US^	----	----
Stress	----	----	----	----	----	----	----	----	----	----	----
Inadequate Sleep	----	----	----	----	U=46 p=0.041 G^	----	----	U=53.5 p=0.036 Pro^	----	----	----
Environmental Pollution	----	U=104 p=0.007 O^	U=22.5 p=0.005 O^	----	----	----	----	----	----	U=46 p=0.025 US^	----
Smoking	----	----	----	----	----	----	----	----	----	----	----
Chemicals in food	----	U=76 p=0.001 O^	U=25 p=0.008 O^	U=45.5 p=0.033 Anti^	U-38.5 p=0.020 C^	----	U=8.5 p=0.007 O^	----	U=329.5 p=0.032 NZ^	----	----
Overpopulation	----	U=125.5 p=0.031 O^	----	----	----	----	----	----	----	----	----
Genetically Engineered Foods	----	U=100 p=0.005 O^	U=23 p=0.005 O^	U=20 p=0.000 Anti^	U=19.5 p=0.002 C^	U=114.5 p=0.018 O^	U=2 p=0.001 O^	U=50 p=0.025 Anti^	U=242 p=0.001 NZ^	----	----

Table 4.4: Statistically Significant Mann Whitney U Results for Threats to the Environment Rank Order

This table presents Mann Whitney U results for the “Threats to environment Rank order” exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group ranked the item as being more threatening to the environment (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).

See Appendices 4.5 and 4.6 for sample size (n), mean and SD information

Note: (----) denotes table cells for which no statistically significant results were obtained

Rank Order Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	***Consumer vs.*** Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Global Warming	----	----	----	----	----	----	U=13.5 p=0.022 O^	----	----	----	----
Air Pollution	----	----	----	----	----	----	----	U=34.5 p=.003 Pro^	----	----	----
Oil Drilling	----	----	----	U=49.5 p=0.05 Pro^	U=43.5 p=0.033 G^	----	----	----	U=298.5 p=0.009 US^	----	----
Deforestation	----	----	----	----	----	----	----	----	----	----	----
Ozone Depletion	----	----	----	----	----	----	----	----	----	----	----
Development (housing and commercial)	----	----	----	----	U=22 p=0.003 G^	----	U=4 p=0.001 G^	----	U=303.5 p=0.013 US^	U=26.5 p=0.002 US^	----
Pesticides and Herbicides	----	U=83.5 p=0.001 O^	U=25 p=0.015 O^	----	U=31.5 p=0.009 C^	----	U=2.5 p=0.000 O^	----	----	----	----
Water Pollution	----	----	----	----	----	U=16.5 p=0.021 C^	----	U=32 p=.002 Pro^	----	U=45.5 p=0.026 US^	U=10.5 p=0.05 US^
Consumerism	U=74 p=0.041 G^	U=106.5 p=0.009 O^	----	U=46 p=0.037 Pro^	----	----	----	----	----	U=46 p=0.028 US^	----
Over-harvesting of animals and fish	----	----	----	----	----	----	----	----	----	----	----
Overpopulation	----	----	----	----	----	----	----	----	----	----	----
Genetic Engineering in Agriculture	----	U=81 p=0.001 O^	----	U=22 p=0.000 Anti^	----	U=73.5 p=0.001 O^	U=12 p=0.017 O^	----	U=304 p=0.011 NZ^	----	----
Land Pollution	----	----	----	----	----	U=23 p=0.032 C^	----	----	----	U=45 p=0.024 US^	----

Table 4.5: Statistically Significant Mann Whitney U Results for the Reasons for a Healthy Environment Rank Order

This table presents Mann Whitney U results for the " Reasons to Maintain a Healthy Environment Rank order" exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group ranked the item as being more important (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).

Note: (----) denotes table cells for which no statistically significant results were obtained.

See Appendices 4.7 and 4.8 for sample size (n), mean and SD information

Note: N/A denotes table cells for which comparisons were not made due to an insufficient number of responses for US GE farmer participants

Rank Order Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Maintenance of Food Chains	N/A	----	N/A	----	----	----	----	----	----	----	N/A
Aesthetics	N/A	----	N/A	----	----	----	----	----	----	----	N/A
Moral Obligation to Future Generations	N/A	U=120 p=0.043 O^	N/A	----	----	U=70.5 p=0.001 O^	----	----	----	----	N/A
Provides Economic Resources (water, timber)	N/A	U=118.5 p=0.038 C^	N/A	----	----	----	----	U=51 p=0.026 Pro^	----	----	N/A
Human Health	N/A	----	N/A	----	----	----	----	U=47 p=0.014 Pro^	----	----	N/A
Moral Obligation to other living inhabitants of the earth (animals, insects, plants)	N/A	----	N/A	----	----	----	----	----	----	----	N/A

Table 4.6: Statistically Significant Mann Whitney U Results for the Benefits of GE Rank Order

This table presents Mann Whitney U results for the "Benefits of GE rank order" exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group ranked the item as being more beneficial (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
See Appendices 4.9 and 4.10 for sample size (n), mean and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained.

Rank Order Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Reduced Chemical Use	U=122.5 p=0.006 G^	----	----	----	----	U=133.5 p=0.017 O^	----	----	----	----	----
Increased Crop Yields	----	----	----	----	----	----	----	----	----	----	----
Improved Taste	----	----	----	----	----	----	----	----	----	----	----
Improved Nutritional Quality	U=144 p=0.05 C^	----	----	----	----	----	----	----	----	----	----
Crop Defense Against Diseases and Pests	----	----	----	----	----	----	----	U=49.5 p=0.036 Pro^	----	----	----
Protection of the Environment	----	----	----	U=70.5 p=0.032 Anti^	----	----	----	U=28.5 p=0.001 Anti^	----	----	----
Improved Food Shelf-life	U=142.5 p=0.044 G^	----	----	----	----	----	----	U=14.5 p=0.000 Pro^	----	----	----
Production of Edible Vaccines and Drugs	----	----	----	----	----	----	----	----	----	----	U=14.5 p=0.029 NZ^
Increase in Food Availability	U=142 p=0.044 C^	----	----	----	----	----	----	----	----	----	----
Wealth and Job Creation	----	----	----	----	----	----	----	----	----	----	----

Table 4.7: Statistically Significant Mann Whitney U Results for the Risks of GE Rank Order

This table presents Mann Whitney U results for the "Risks of GE rank order" exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group ranked the item as being more risky (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
See Appendices 4.11 and 4.12 for sample size (n), mean, and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained.

Rank Order Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Human Antibiotic Resistance	----	----	----	----	----	----	----	----	----	----	----
Creation of New Viruses	----	U=109.5 p=0.041 C^	----	----	U=31.5 p=0.027 C^	----	----	----	U=407 p=0.03 US^	----	U=11.5 p=0.044 US^
Decrease in Crop Genetic Diversity	----	U=73.5 p=0.002 O^	U=34.5 p=0.015 O^	----	----	----	----	U=52.5 p=0.034 Anti^	----	----	----
Unintentional Gene Transfer to Wild Plants	----	U=75 p=0.002 O^	----	----	----	----	----	U=53 p=0.037 Anti^	----	----	----
Toxicity in GE Foods	----	U=113.5 p=0.05 C^	----	----	----	----	----	----	----	----	----
A Negative Alteration in the Nutritional Quality of Food	----	----	----	----	----	----	----	----	----	----	----
Limited Access to seeds through Patenting of GE Crop Varieties	----	U=108 p=0.038 O^	----	U=78.5 p=0.044 Pro^	----	U=161 p=0.036 O^	----	----	----	----	----
Lack of Labeling of GE Ingredients in Food	----	----	----	----	----	----	----	U=45 p=0.012 Pro^	----	----	----
Introduction of Food Allergens	----	----	----	----	U=30.5 p=0.026 GE^	----	U=16 p=0.05 GE^	----	----	----	----

Table 4.8: Statistically Significant Mann Whitney U Results for Likelihood of GE Risk Likert Scale Items

This table presents Mann Whitney U results for the “Likelihood of GE risks” exercise given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those Likert scale items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group saw the item as being more likely to happen within the next 20 years (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
See Appendices 4.17 and 4.18 for sample size (n), mean and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained.

Likert Scale Item	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti -GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Human Antibiotic Resistance	U=154 p=0.000 C^	----	U=74.5 p=0.004 O^	----	U=47 p=0.043 C^	U=151.5 p=0.018 O^	U=10 p=0.004 O^	----	----	----	----
Creation of New Viruses	U=136.5 p=0.000 C^	----	U=68.5 p=0.002 O^	----	U=42 p=0.026 C^	----	U=12.5 p=0.007 O^	U=55.5 p=0.041 Anti^	----	----	----
Decrease in Crop Genetic Diversity	----	U=121.5 p=0.011 O^	U=81 p=0.005 O^	----	U=32 p=0.008 C^	U=166.5 p=0.039 O^	U=8.5 p=0.002 O^	U=34.5 p=0.002 Anti^	----	----	----
Unintentional Gene Transfer to Wild Plants	U=242.5 p=0.015 C^	U=130.5 p=0.020 O^	U=62 p=0.001 O^	----	U=32 p=0.007 C^	----	U=9.5 p=0.002 O^	U=40 p=0.004 Anti^	----	----	----
Toxicity in GE Foods	----	U=127.5 p=0.017 O^	U=63.5 p=0.001 O^	----	U=40 p=0.022 C^	----	U=9 p=0.003 O^	U=52.5 p=0.031 Anti^	----	----	----
A Negative Alteration in the Nutritional Quality of Food	U=188.5 p=0.001 C^	U=138 p=0.034 O^	U=40.5 p=0.000 O^	----	U=40 p=0.021 C^	----	U=10 p=0.004 O^	U=39 p=0.006 Anti^	----	----	----
Limited Access to seeds through Patenting of GE Crop Varieties	----	U=101.5 p=0.002 O^	----	----	----	U=159.5 p=0.021 O^	----	----	----	----	----
Lack of Labeling of GE Ingredients in Food	U=192.5 p=0.001 C^	U=116 p=0.004 O^	U=33.5 p=0.000 O^	----	U=36 p=0.012 C^	----	U=11 p=0.004 O^	U=54 p=0.031 Anti^	----	----	----
Introduction of Food Allergens	U=140 p=0.000C^	U=116 p=0.007 O^	U=22.5 p=0.000 O^	----	U=23.5 p=0.003 C^	----	U=6.5 p=0.002 O^	U=26 p=0.001 Anti^	----	----	----

Table 4.9: Statistically Significant Mann Whitney U Results for the Trust Assessment Exercise

This table presents Mann Whitney U results for the "Level of Trust in Groups Involved in GE Policy Formation" exercise given to consumer research participants. Only those Likert scale items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group was more trusting (Pro^=Pro-GE consumers, Anti^=Anti-GE consumers).

See Appendix 4.19 for sample size (n), mean and SD information

Note: (----) denotes table cells for which no statistically significant results were obtained

Groups involved in GE Policy Formation	US Pro vs. Anti-GE Consumers	NZ Pro vs. Ant-GE Consumers
Industry	----	U=56, p=0.042 Pro^
Medical Doctors	----	----
Ethics Committees	----	----
Consumer Organizations	----	----
The Church	----	----
Newspapers and Magazines	----	----
Farmers	----	U=52, p=0.022 Pro^
Government	----	----
Environmental Groups	----	----
Grocery Stores	----	----
Scientists	U=70, p=0.023 Pro^	U=29.5 p=0.001 Pro^
Individual Citizens	----	----

Table 4.10: Significant Mann Whitney U Results for Religion and Politics Likert Scales
This table presents Mann Whitney U results for the "Religion and Politics" Likert scale exercises given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group was either more religious or more conservative politically (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
See Appendices 4.20 and 4.21 for sample size (n), mean and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained.

Likert Scale	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Religion	U=82 p=0.001 G^	----	U=45 p=0.025 G^	----	----	----	----	----	U=310 p=0.001 US^	U=56.5 p=0.030 US^	U=4 p=0.002 US^
Politics	U=56.5 p=0.000 G^	U=157.5 p=0.012 C^	U=5 p=0.000 G^	----	U=16 p=0.001 G^	----	U=2 p=0.001 G^	----	----	----	----

Table 4.11: Statistically Significant Mann Whitney U Results for the Engagement in the GE Debate Likert Scales
This table presents Mann Whitney U results for the "Engagement in the GE Debate" Likert scale exercises given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group was more engaged (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).
*The designation "Engagement 1" refers to the frequency with which participants spoke about issues related to GE with other people, "Engagement 3" refers to how likely participants were to read newspaper articles or watch TV program about GE and "Engagement 4" refers to how likely participants were to attend public meetings about GE.
See Appendices 4.22 and 4.23 for sample size (n), mean and SD information
Note: (----) denotes table cells for which no statistically significant results were obtained.

Likert Scale	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Engagement 1*	U=98 p=0.001 G^	U=64 p=0.000 O^	----	----	U=15 p=0.001 G^	U=133.5 p=0.010 O^	U=20 p=0.035 G^	----	----	----	----
Engagement 3*	U=137 p=0.016 C^	---	U=31.5 p=0.002 O^	----	----	----	----	----	----	U=58 p=0.024 US^	----
Engagement 4*	----	U=129 p=0.006 O^	U=41 p=0.014 O^	----	----	----	----	----	----	----	----

Table 4.12: Statistically Significant Mann Whitney U Results for Knowledge Tests

This table presents Mann Whitney U results for the Knowledge Test exercises given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group scored higher on the knowledge test (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).

See Appendices 4.26 and 4.27 for sample size (n), mean and SD information

Note: (----) denotes table cells for which no statistically significant results were obtained

Knowledge Test	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
Test 1-General Science Knowledge	----	U=157 p=0.017 O^	U=47 p=0.010 O^	----	----	----	----	----	----	----	----
Test 2-GE Knowledge	----	----	----	U=63.5 p=0.002 Pro^	----	----	----	----	----	----	----
Test 3-Environment Knowledge	----	U=136.5 p=0.005 O^	U=54.5 p=0.023 O^	----	U=15.5 p=0.003 G^	U=88 p=0.000 O^	----	U=43 p=0.010 Anti^	----	----	- ---
Test 4-Health and Nutrition Knowledge	----	----	----	----	----	----	----	----	----	----	- ---

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Table 4.13: Statistically Significant Mann Whitney U Results for Risk Scenario Exercises

This table presents Mann Whitney U results for the Risk scenario exercises given to study participants. The table is divided into three sections: United States stakeholder comparisons, New Zealand stakeholder comparisons, and United States vs. New Zealand stakeholder comparisons. Only those rank-order items with statistically significant differences between stakeholder pairs are presented. The Mann Whitney U value is reported as is the level of significance (p< or =0.05) and a designation of which stakeholder group was more risk averse (C^=consumers, O^=organic farming community, G^=GE farming community, Pro^=Pro-GE consumers, Anti^=Anti-GE consumers, US^=US stakeholders, NZ^=NZ stakeholders).

See Appendices 4.35 and 4.36 for sample size (n), mean and SD information

Note: N/A denotes table cells for which the risk scenario exercise was not administered to both sets of participants

Note: (----) denotes table cells for which no statistically significant results were obtained.

Risk Scenario	United States				New Zealand				United States vs. New Zealand		
	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Anti-GE Consumers	Consumer vs. GE	Consumer vs. Organic	Organic vs. GE	Pro vs. Ant-GE Consumers	Consumer vs. Consumer	Organic vs. Organic	GE vs. GE
General Risk Scenario	----	----	----	----	U=11 p=0.001 C^	----	U=1.5 p=0.001 O^	----	----	----	U=17 p=0.036 US^
Benefits willing to forego for no risk to health	N/A	N/A	N/A	----	N/A	N/A	N/A	----	----	N/A	N/A
Benefits willing to forego for no risk to the environment	N/A	N/A	N/A	----	N/A	N/A	N/A	U=51.5 p=0.043 Anti^	----	N/A	N/A
Benefits willing to forego for no allergenicity risk	N/A	N/A	N/A	----	N/A	N/A	N/A	U=42 p=0.009 Anti^	----	N/A	N/A
Benefits willing to forego for no risk to native plants	N/A	N/A	N/A	----	N/A	N/A	N/A	U=49 p=0.034 Anti^	----	N/A	N/A
Benefits willing to forego for no risk of consumer allergenicity	N/A	N/A	U=35 p=0.000 O^	N/A	N/A	N/A	U=18 p=0.009 O^	N/A	N/A	----	----
Benefits willing to forego for no risk to native plant species	N/A	N/A	U=15 p=0.000 O^	N/A	N/A	N/A	U=0 p=0.000 O^	N/A	N/A	----	----

Chapter 5 - Cultural Models of Health and the Environment

Anthropology, via cultural modeling, can play a pivotal role in understanding technological acceptance, an increasingly important endeavor given the mass production and global distribution of new technologies. Previous research on GE technology within the fields of economics and communications has focused either on the public's understanding of the science behind GE technology or on consumer market behavior (Burton et al. 2001, Chern and Rickertsen 2002, Frewer et al. 1998, Hu et al. 2004, Marks et al. 2002). These studies have taken the respondents out of social context and have not emphasized the culturally mediated nature of GE technology acceptance. The research findings from this dissertation will help to better understand cross-cultural conflicts over GE technology, and biotechnology in general, by moving beyond simple survey methods of knowledge and perception and looking at how culture shapes meaning. This research will use cultural modeling to describe and analyze how key stakeholder groups in the GE debate understand and perceive GE and whether these attitudes and patterns of thought are idiosyncratic or shared within the group. Cultural modeling can enhance communication across stakeholder groups by accurately documenting and evaluating the interrelated thoughts and feelings of affected constituent groups. By gaining a fuller understanding of how cultural elements, such as health and environmental beliefs, influence the GE debate, a greater understanding of international conflict over biotechnology will be garnered.

The objective of Chapter 5 is to present the cultural models of health and the environment held by important stakeholder groups in the GE debate—consumers (Pro and Anti GE), organic farming community, and GE farming community. Consumers were divided into groups based on each respondent’s self-classification as Pro-GE, Anti-GE or neutral. Only Pro-GE and Anti-GE respondent data was modeled as an insufficient number of respondents (three in each nation) classified themselves as neutral towards the technology. As discussed in Chapter 4, cultural models were devised by inductively analyzing respondent discourse for patterns and linkages of schemata. Additional quantitative tests were conducted to further inform the cultural models. Results from the quantitative tests can be found in the appendices at the end of the dissertation and important findings are referred to throughout Chapters 5 and 6—the name of the test, important findings, p-values, and the appendix number are referenced. The relationship between health and environment models presented in this chapter and stakeholder models of genetic engineering agricultural technology will be explored in Chapter 6.

Health Models

Pro-GE US Consumer Health Models

Discourse analysis of Pro-GE US consumer interviews as well as cultural consensus analysis of free-list data revealed that personal health for this consumer group was comprised of three primary schematic components: regular medical check-ups, exercise and a diet of healthy foods (Table 4.2). Respondents believed a person should exercise three to five times a week for 30 minutes to reach optimal health. The form of exercise did not matter as long as it elevated the heart rate and made you sweat. A healthy diet was comprised of non-processed food based on the food pyramid while also being calorie conscious. The fruits and vegetables component of the food pyramid was heavily emphasized as being particularly important for health. With respect to calorie consciousness, respondents often stated that healthy food was low in fat and sugar and was consumed in moderation. It should be noted, that while their was consensus within this group that diet, exercise, and regular medical check-ups were needed for health, this does not mean that people were putting their health model into practice. When respondents were asked what they did to maintain their health, many stated that they did not regularly follow their model for health and were unhealthy as a result.

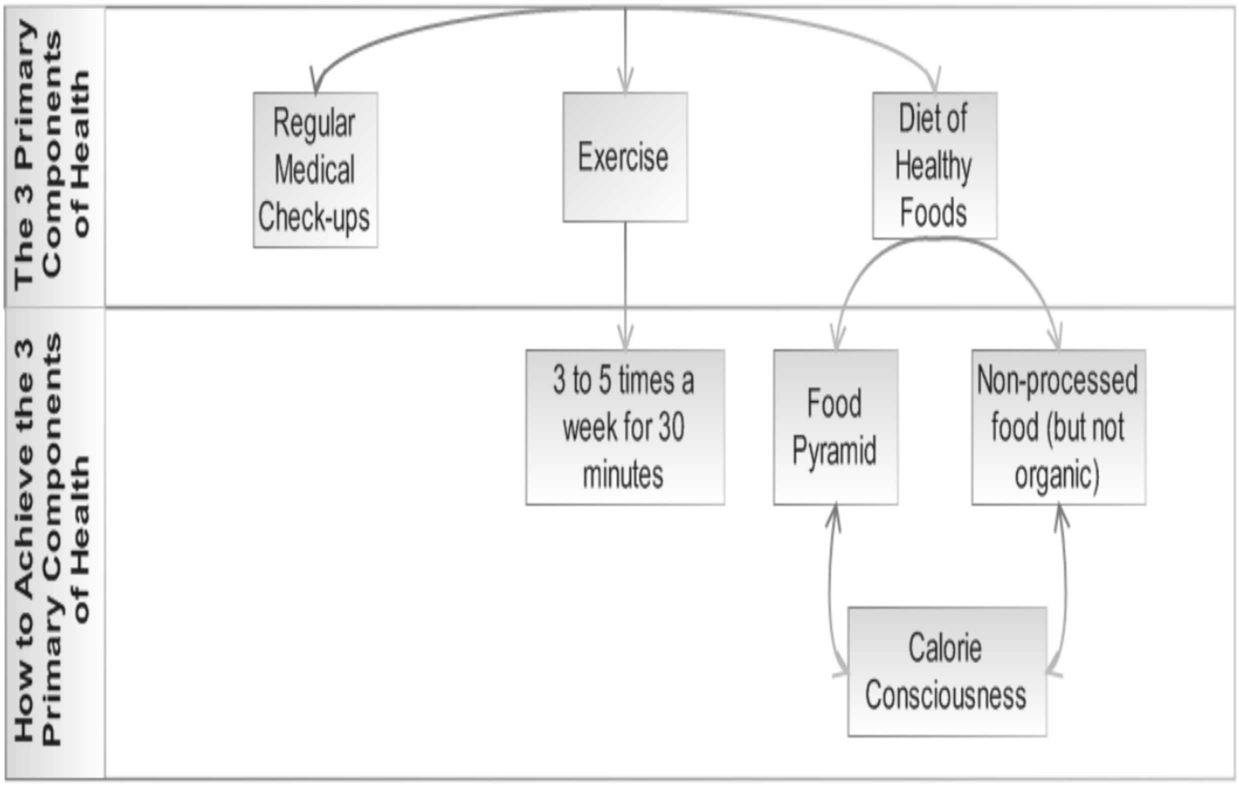

Figure 5.1: Pro-GE US Consumer Health Model

<u>Anti-GE US Consumer Health Model</u>

For Anti-GE US consumers, discourse analysis in conjunction with cultural consensus analysis revealed similar schematic components to Pro-GE US consumer respondents with a few key differences (Table 4.2). As was the case with Pro-GE US consumer respondents, Anti-GE US respondents believed health to be based on exercise and a diet of healthy foods. However, the models differ in the third component with Anti-GE US consumer respondents believing mental well-being was needed for health. Mental well-being could be achieved by having a low stress lifestyle and by getting an adequate amount of sleep.

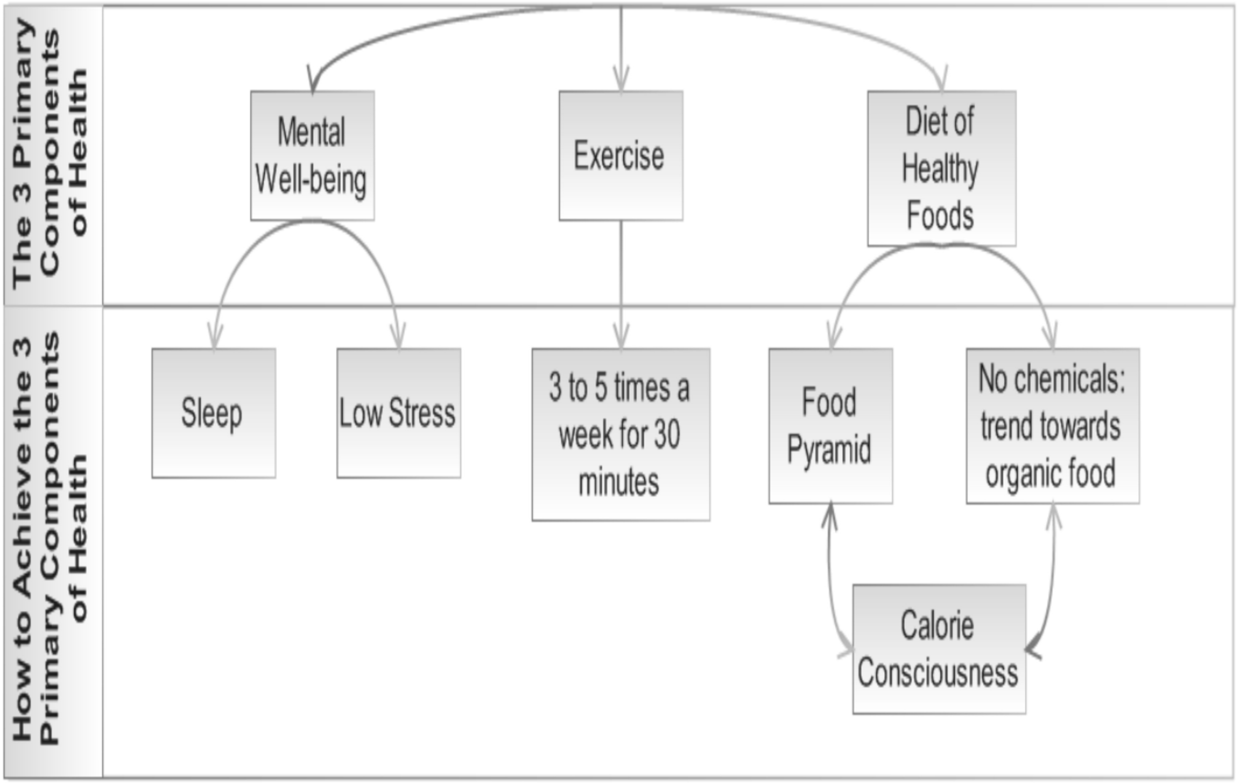

Figure 5.2: Anti-GE US Consumer Health Model

Semi-structured interview questions coupled with findings from the rank-order exercises revealed that Pro and Anti-GE respondents shared similar views on diet and exercise with one key difference. The Anti-GE respondents were more concerned with food not having chemicals rather than it being non-processed. The "Threats to Health" rank order exercise (Table 4.3) revealed that Anti-GE US consumers considered chemicals in food to be significantly more threatening to health than their Pro-GE counterparts ($n1=16$, $n2=11$, $U=45.5$, $p=0.033$). Furthermore, there was a strong trend within this group towards wanting organic food. The following are a few representative comments regarding chemicals on food and organics:

> "The chemicals on food cause cancer, if I could I'd like to only purchase organics but it's the expense" Anti-GE US Consumer 1, Age 45

> "Organics just taste better, organics taste real" Anti-GE US Consumer 29, Age 20

> " My dad has cancer and my mom has done a lot of research that organics are better. He was a farm boy and probably exposed to pesticides" Anti-GE US Consumer 31, Age 22

As was the case with Pro-GE US consumers, respondents in this group did not necessarily follow their own health model and many considered themselves to be unhealthy.

US Organic Community Health Model

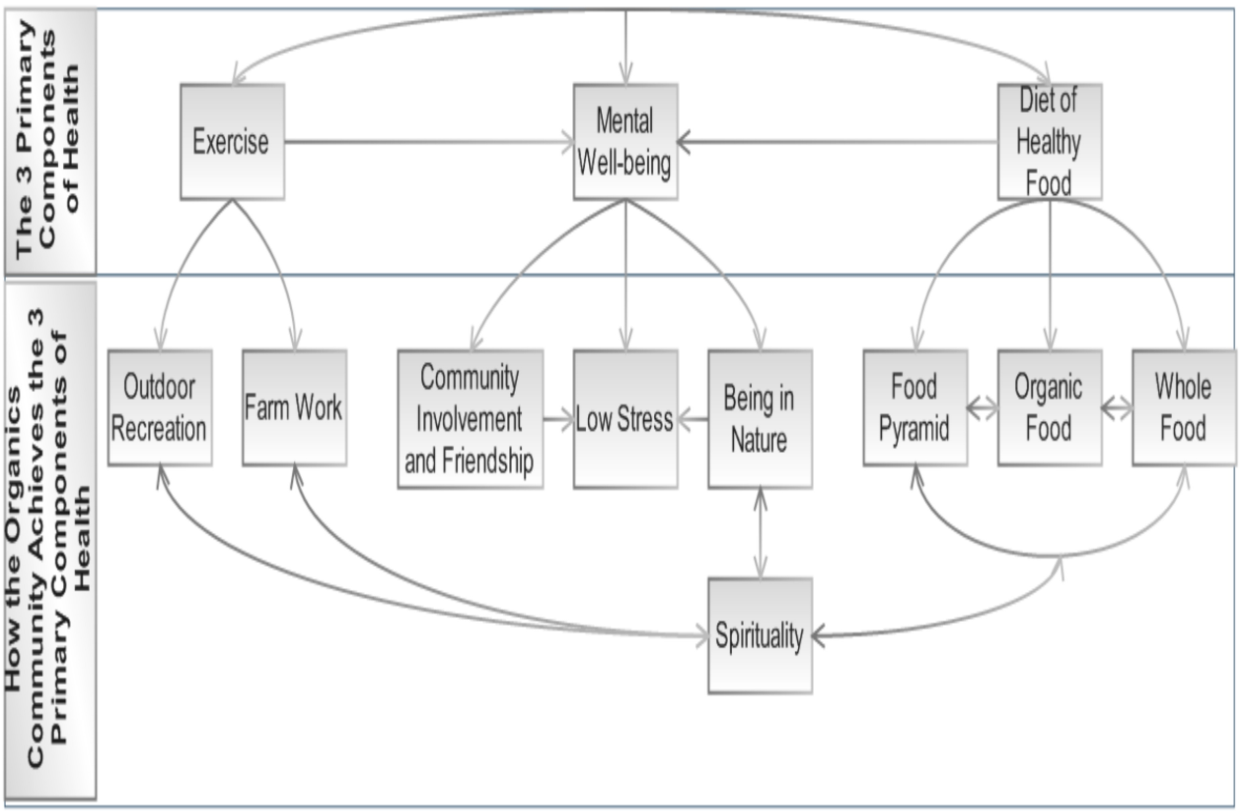

Figure 5.3: US Organics Community Health Model

Compared to US consumer respondents, US organic farming community respondents had a much more detailed model of what was needed to achieve health. As was the case with Anti-GE US consumer respondents, both discourse analysis and consensus analysis (Table 4.2) suggested that US organic community respondents believed health to be derived from three schematic components: mental well-being, exercise, and a diet of healthy food. However, semi-structured interview data revealed what was considered to be necessary to achieve these three primary elements differed significantly.

Mental well-being was believed to be intimately associated with exercise and a healthy diet and resulted from a low stress lifestyle that included community involvement/friendships and being in nature. For US organic community respondents, exercise was less structured as far as time and frequency compared to US consumer respondents and included participating in outdoor activities (hiking, biking, running) and doing farm work.

As was the case with US consumer respondents, a healthy diet was based on the food pyramid. Unlike US consumer respondents, however, it was also believed that for food to be healthy it also had to be both organically grown and whole food. Organic food is free of chemicals like pesticides, which are a major concern for US organic community respondents as indicated by the "Threats to Health" rank order. The results show organic community respondents to be significantly more concerned about chemicals in food threatening health than both US consumer respondents ($n1=30$, $n2=14$, $U=76$, $p=0.001$) and US GE farmer respondents ($n1=14$, $n2=10$, $U=25$, $p=0.008$) (Table 4.3). Members of this group emphasize that:

> "Food should not be poisoned with chemicals or fortified with things it doesn't need, it should be unrefined and closer to basic food properties." US Organic 5, age 30

> "The chemical foods we eat are the problem. If you feed an engine nasty gas it won't run well." US Organic 9, age 57

An interesting differential between the organic health model and the consumer health models is the addition of a spirituality component. Each of the three schematic components of health for the organic group is tied to their spirituality, which is based on a symbiotic-type relationship with nature. Interestingly, spirituality was both a means to achieve health and a result of its achievement. The following are a few comments highlighting this group's thoughts on health, the environment and spirituality:

"Nature fuels me, invigorates, keeps me grounded. It's my connection to the rest of the world, to other people in other countries who are connected to it. It makes me feel small and insignificant in a health way" US organic 15, age 30

"It's all ecological even if people don't recognize it, it is all interconnected. The main threat to health is being apart from nature " US organic 5, age 30

Given respondent's view of how nature, health and spirituality are interconnected, it is not surprising that their views on health are closely tied to their perceptions of environmental health. For this group, threats to the environment were deemed to be threats to health. The "Threats to Health" rank order exercise coupled with additional questioning indicated that pollution (Consumers vs. Organic- n1=30, n2=14, U=104, p=0.007) (GE farmers vs. Organic- n1=10, n2=14, U=22.5, p=0.005), overpopulation (Consumers vs. Organic- n1=30, n2=14, U=125.5, p=0.031), and genetically engineered food and crops (Consumers vs. Organic- n1=30, n2=14, U=100, p=0.005) (GE farmers vs. Organic- n1=10, n2=14, U=23, p=0.005), were considered to be greater threats to health, in part, because they were believed to be dangerous for the environment (Table 4.3).

US GE Community Health Model

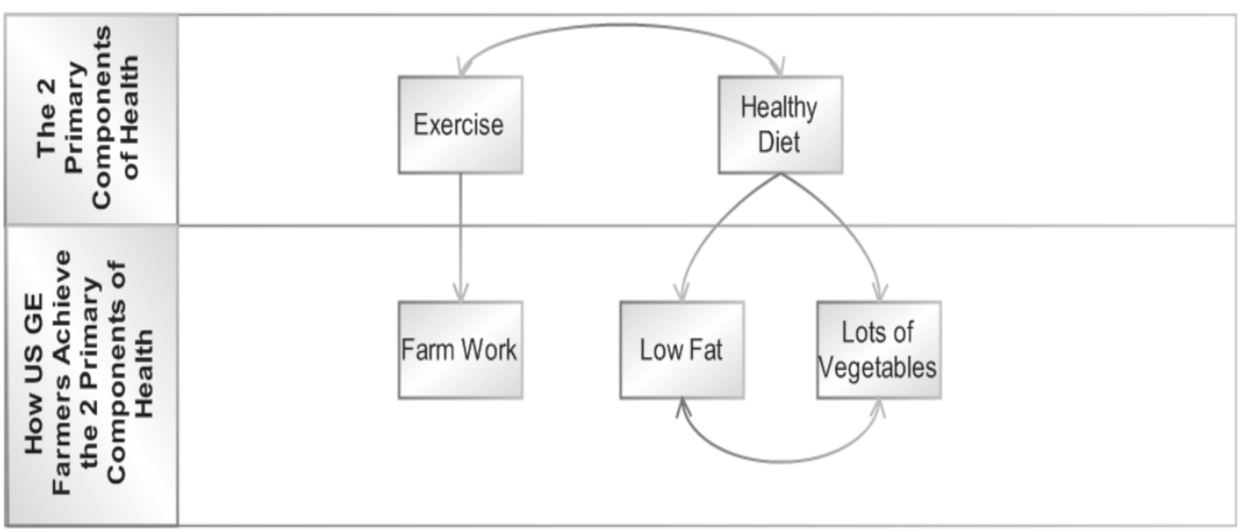

Figure 5.4: US GE Community Health Model

Compared to both US consumer and organic respondents, GE farmer respondents had a much simpler model of health. Both discourse analysis and consensus analysis (Table 4.2) suggest that as a group, GE farmers believe health to result from two schemata, exercise and a healthy diet. A healthy diet had lots of vegetables and was low in fat. Sufficient exercise was believed to come from doing farm work. Many GE farmer respondents were moderately perplexed by questions regarding health maintenance and characteristics of healthy food. The topics of health in general and their own personal health, in particular, are not often thought or talked about within this stakeholder group. Thus, the simplicity of their health model is not surprising.

Pro-GE NZ Consumer Health Model

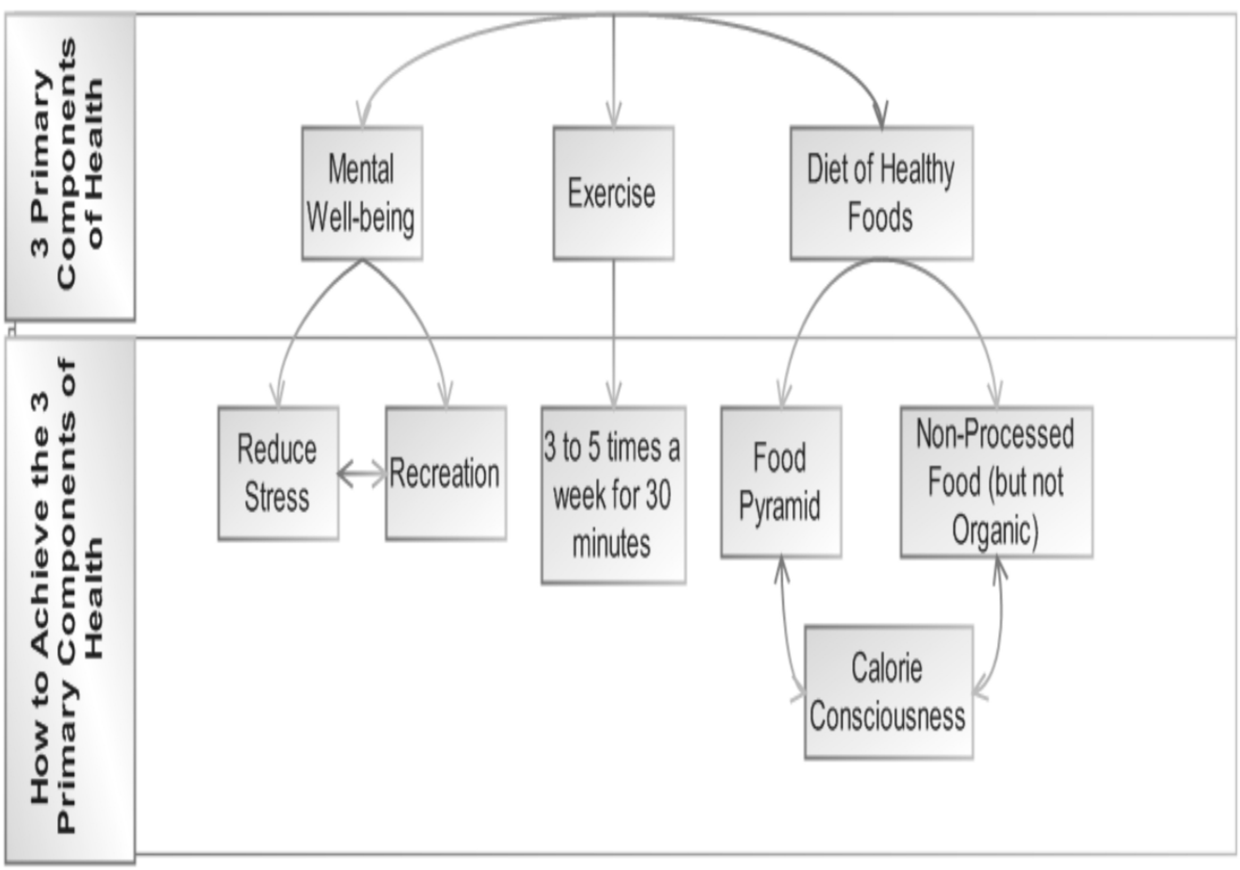

Figure 5.5: Pro-GE NZ Consumer Health Model

Discourse analysis of Pro-GE NZ consumer interviews as well as cultural consensus analysis of free-list data revealed that personal health for Pro-GE NZ consumer respondents was comprised of three primary schematic components: mental well-being, exercise, and a diet of healthy foods (Table 4.2). Semi-structured interview data uncovered further details of what each of these three primary components should entail. Mental well-being could be achieved through a low stress lifestyle with plenty of recreation. Exercise should consist of workouts three to five times a week, which increased your heart rate. A diet of healthy food was based on the food pyramid and had a variety of foods in it, particularly fruits and vegetables. To be healthy, the foods should be non-processed and preferably low in fat and sugar. It should be noted that respondents did not necessarily follow their own health model and many felt they did not live a healthy lifestyle.

Anti-GE NZ Consumer Health Model

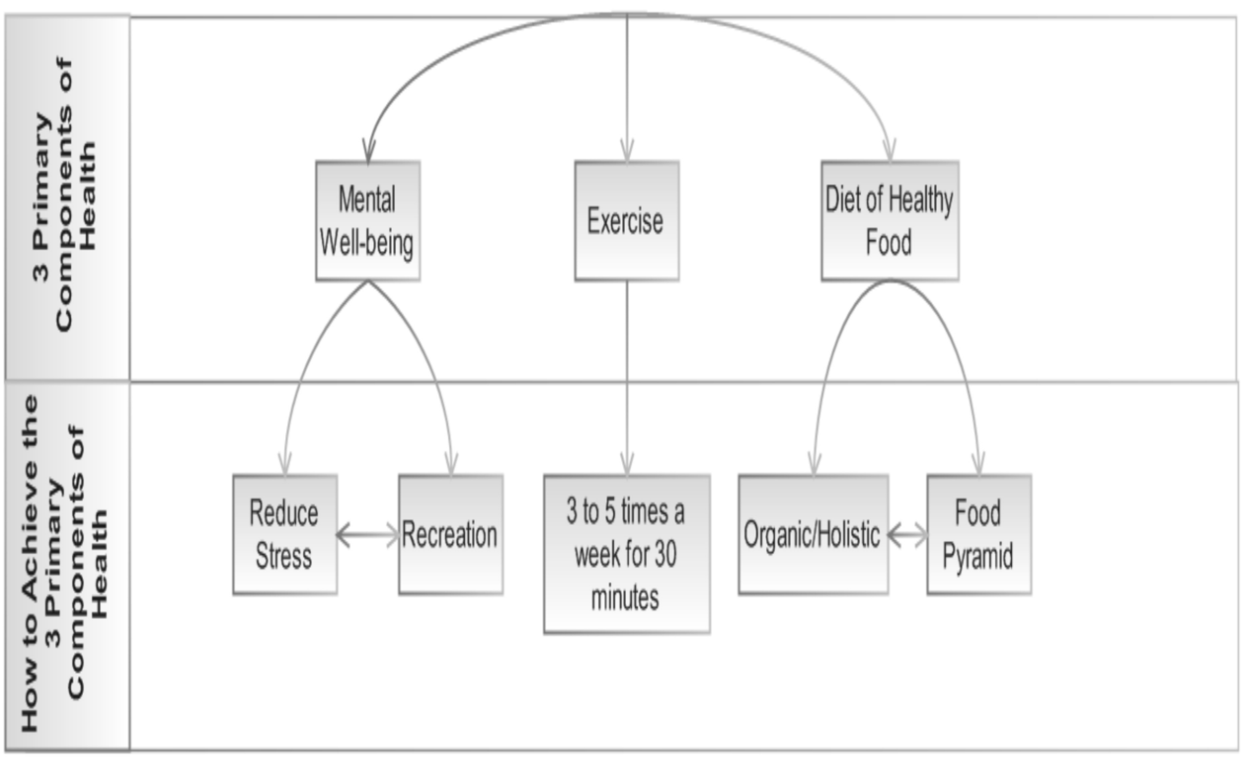

Figure 5.6: Anti-GE NZ Consumer Health Model

Similar to Pro-GE NZ consumer respondents, Anti-GE NZ consumer respondents were in consensus that mental well-being, exercise, and a diet of healthy food were needed for health (Table 4.2). There was also agreement between the two groups with regard to what mental well-being and exercise entailed. The main difference between the Pro and Anti-GE models is with respect to what is meant by a diet of healthy foods. For Anti-GE respondents, a healthy diet was comprised of a variety of foods based on the requirements set out by the food pyramid and it was thought that food should be organic. Organic food was considered to be more healthy because it lacked chemicals like pesticides and was closer to what was natural. Comments include:

> "Organic food is better than normal food about causing cancer" NZ consumer 1, age 18
>
> "Organic food could help for optimal health because it's missing preservatives" NZ consumer 2, age 21
>
> "I like organic food, it's the healthiest type of food, there is no poisons in the food" NZ consumer 19, age 69

This group was also not calorie conscious like respondents in the Pro-GE group. It was thought that by eating healthy organic foods, one could maintain a proper weight without being particularly calorie conscious. It should be noted that while respondents in this group thought food should be organic to be healthy, they did not always buy organic food due to its high cost.

NZ Organic Community Health Model

NZ organic farming community respondents had an identical health model to their organic farming counterparts in the US. This is not surprising given that the underlying philosophy of the organic farming movement crosses international borders.

Compared to NZ consumer respondents, NZ organic community respondents had a much more detailed model of what was needed to achieve health. Similar to NZ consumers, semi-structured interview data and consensus analysis (Table 4.2) suggested that NZ organic community respondents believed health to be derived from three schematic components: mental well-being, exercise, and a diet of healthy food, however, what was needed to achieve these three primary elements differed significantly.

Mental well-being was believed to be closely associated with exercise as well as a healthy diet and resulted from a low stress lifestyle comprised of community involvement/friendships and being in nature. For NZ organic community respondents, exercise was less structured as far as time and frequency compared to NZ consumer respondents and included participating in outdoor recreational activities in addition to physical labor on the farm.

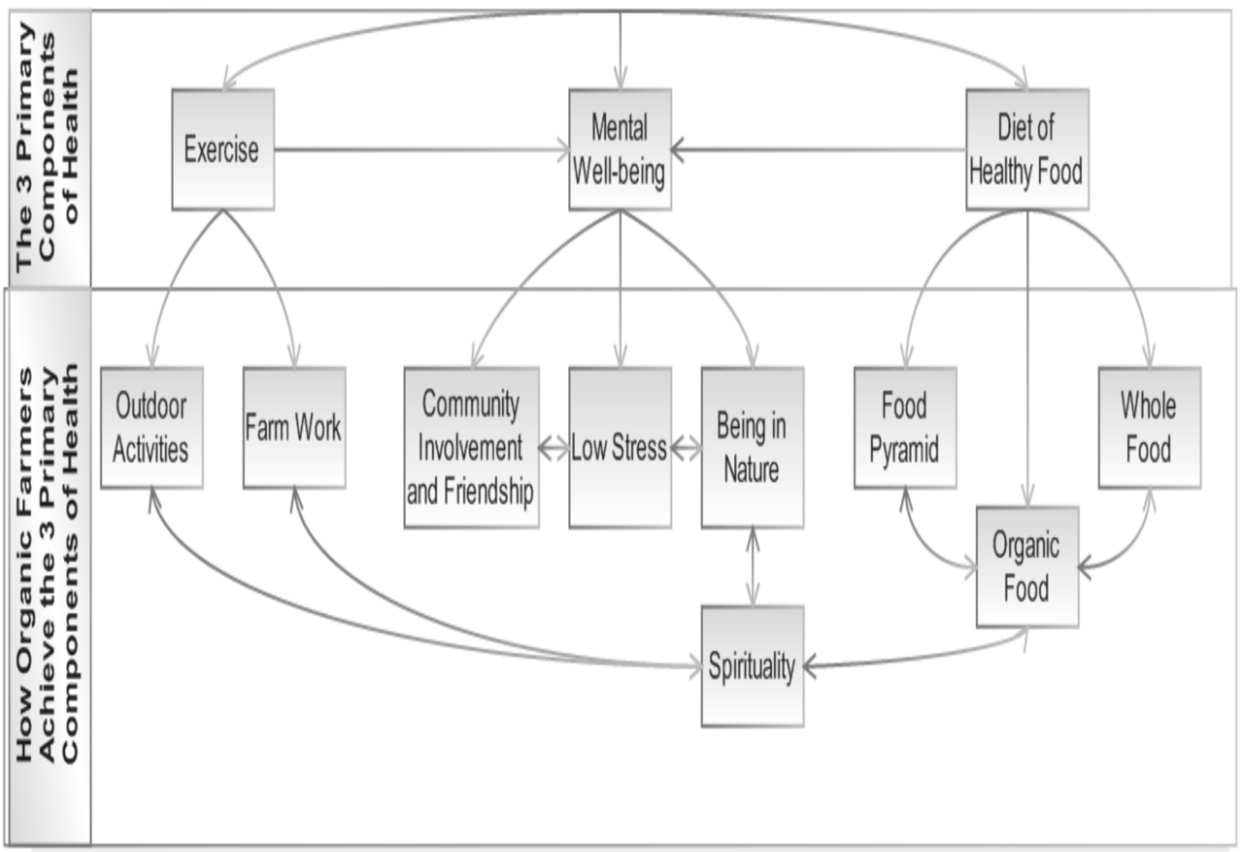

Figure 5.7: NZ Organics Community Health Model

Like Anti-GE NZ consumer respondents, respondents from the NZ organics community believed a healthy diet was based on the food pyramid and was organically grown. However, unlike Anti-GE NZ consumers, this group actively ate organic food on a daily basis. Organic food is pesticide free, and pesticides are a major concern for NZ organic community respondents as indicated by the "Threats to Health" rank order. The results show the organics community to be significantly more concerned about chemicals in/on food threatening health than NZ GE farmer respondents (n1=13, n2=6, U=8.5, p=0.007) (Table 4.3).

NZ organic community respondents felt a spiritual tie to nature and believed a similar connection existed between the environment and health as was highlighted during the discussion of the US organic community's health model.

NZ GE-Amenable Farmer Health Model

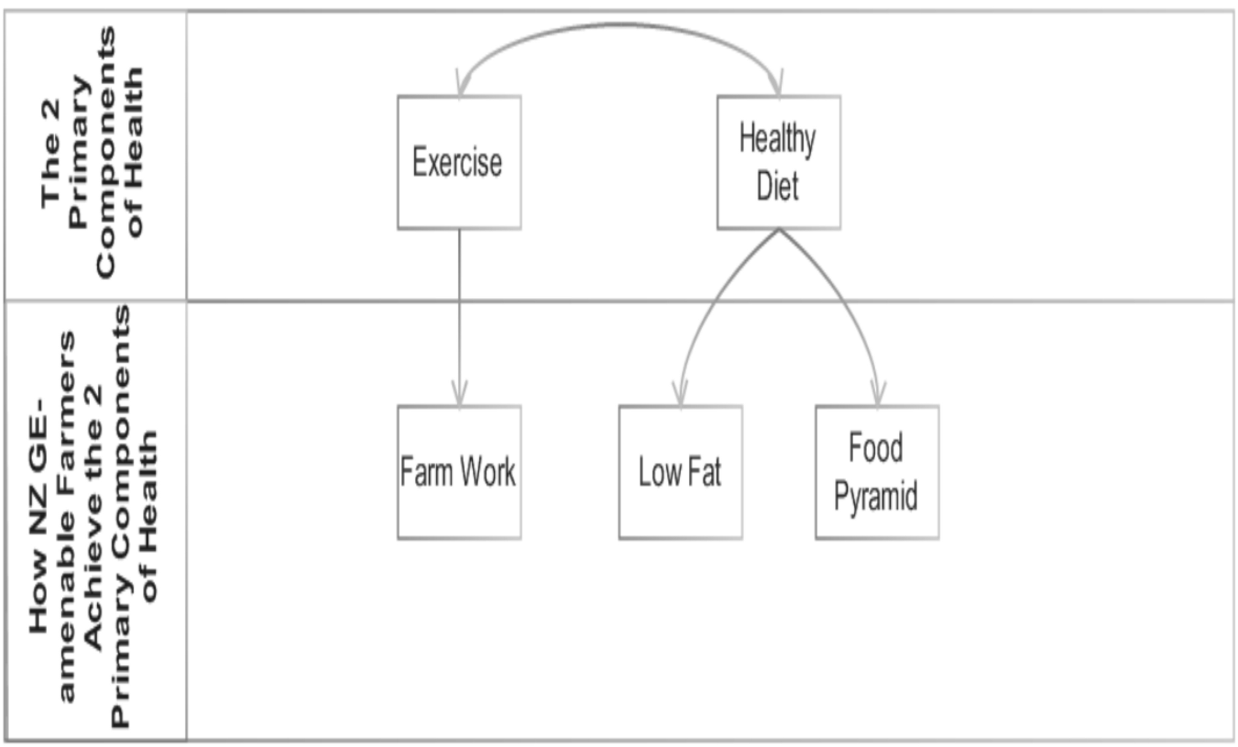

Figure 5.8: NZ GE-Amenable Farming Community Health Model

NZ GE amenable farmer respondents had only two schemata at the base of their health model as opposed to three for NZ consumer and organic respondents. Similar to US GE farmer respondents, discourse and consensus analysis (Table 4.2) indicated that exercise and a healthy diet were the two primary schematic components for the health model. A healthy diet was based on food pyramid recommendations and was low in fat. Sufficient exercise was believed to come from doing farm work. One farmer commented:

> "If I want to get more exercise I'll buy a bigger tractor with another step on it" NZ GE-Amenable 1, age 54.

Similar to US GE farmer respondents, many NZ GE-Amenable farmer respondents were moderately perplexed by questions about what should be done to maintain health and what are characteristics of healthy food. Health is not a topic discussed frequently within that community, thus, it is not surprising that their health model was relatively simplified.

Discussion of Health Models

The primary purpose of this section is to discuss key stakeholder differences intra- and inter-culturally, with respect to perceptions of health.

Comparatively, members of the organics communities in the US and NZ had by far the most comprehensive model of health. Notions of health are important components of organic farming philosophy and are strongly tied to notions of environmental health and spirituality. For respondents from the organic farming community, health was synonymous with being out in nature and eating food that was grown in harmony with nature i.e., organic and whole foods. In other words, nature fed the mind, body and soul. Topics regarding personal and environmental health were talked about frequently within the community and were at the forefront of people's minds on a daily basis.

By contrast, respondents from the GE farming and GE amenable farming communities had a much more truncated model of health as personal health was not something members of this community often thought about. Their models of health were based on only two schema components (exercise and a healthy diet) while other stakeholder groups had models based on three components (exercise, healthy diet, mental well-being/regular medical check-ups). In addition to their health models having only two schema components as opposed to three, the contents of the schemas were more simplified. For example, the healthy diet schema employed by US GE farmers consisted of only two components: low fat food and lots of vegetables. By contrast, the healthy diet schema used by respondents from the US organic community included three components, with each of those components comprised of comparatively deeper sub-components. For example, the "organic food" component in their model stands for food that was grown in a sustainable fashion without pesticides and damage to nature whereas the "vegetable and low fat" components of the GE farmer schema lack further subcomponents.

With respect to complexity, US and NZ consumer respondent health models fell in between those of the organic and GE farming communities. Respondents had health models based on three components like those of the organics communities, however, their models of health lacked a spiritual tie to nature as was seen for organic community respondents. Consumer models of health mirror what is touted by medical health practitioners as necessary for health (ie. a low stress lifestyle with exercise 3 to 5 times a week for 30 minutes and a healthy diet).

Comparing Pro and Anti-GE consumer respondents, the main difference in the health models was with respect to the "healthy diet" schema. Anti-GE consumer respondents had a strong concern about chemicals like pesticides in and on food. Due to their concern about chemical contamination, respondents often mentioned organic food as something they occasionally purchased. Anti-GE NZ consumer respondents had a strong interest in organic food as a healthy alternative to conventionally farmed foods. US Anti-GE consumer respondents were more undecided with respect to their feelings towards organic food but were open to learning about its health benefits. Neither group was prepared to routinely pay high prices to eat organic on a daily basis.

Overall, the main variability in stakeholder health models occurred intra-culturally with only minor variations occurring between US and NZ stakeholders.

Environment Models

Pro and Anti-GE US Consumer Environment Model

Figure 5.9: US Consumer Environment Model

The environment models for Pro and Anti-GE US consumer respondents was very simplified as the environment proved to be something about which US consumer respondents rarely think. There was no over-arching schematic foundation, as will be seen in organic and GE respondent environment models, by which US consumer respondents viewed the environment. Semi-structured interview data indicates that US consumer respondent perceptions of the environment do not extend much beyond that of their personal environmental space (ie. their home, neighborhood, community area).

Although their primary view of the environment was heavily focused on their own personal environment, they also saw the wider environment as an “amorphous other”. Pro and Anti-GE US consumer respondents differed in the degree in which they saw the wider environment as important, with Anti-GE US consumer respondents being more environmentally concerned.

Most respondents seemed puzzled by questions regarding their interactions with and perceptions of the environment. When respondents were asked directly about their “relationship” with nature, many stated that they had “no relationship”. One respondent said,

> “I don’t notice the environment in the day to day, I don’t see or feel it. I don’t have a relationship with the environment except maybe animals like deer near the house” US Consumer 33, age 53

Due to the very limited nature of the relationship US consumer respondents have with the environment, it is not surprising that the group as a whole does very little in the way of actively trying to preserve/conserve the environment. As consensus analysis (Table 4.2) indicates, the only “environmental” activity commonly undertaken by this group is recycling, a practice which is a standard offering in most Georgia counties. Although respondents stated that they frequently recycled, respondents did not always recycle and a willingness to recycle was based on the convenience of the activity (i.e. availability and nearness of recycling bins).

For US consumer respondents, a healthy environment was recognized as necessary for personal health but it was not an idea at the forefront of their thinking. The connection made between human health and environmental health was not as strong as the same connection made by respondents from the organic farming community, the difference being that this respondent group was not actively seeking to have a connection with nature and was not actively seeking, in day to day living, to maintain a healthy environment for health purposes.

As depicted by the absence of arrows interconnecting the model's schematic components, US consumer respondents lack a cohesive model of the environment. For them, the environment is their own personal environment; this view is neither connected to the activity of recycling - an activity done more out of habit than any real desire to actively participate in environmental protection - nor is it strongly connected to the recognition that environmental health and human health are related.

<u>US Organic Farming Community Environment Model</u>

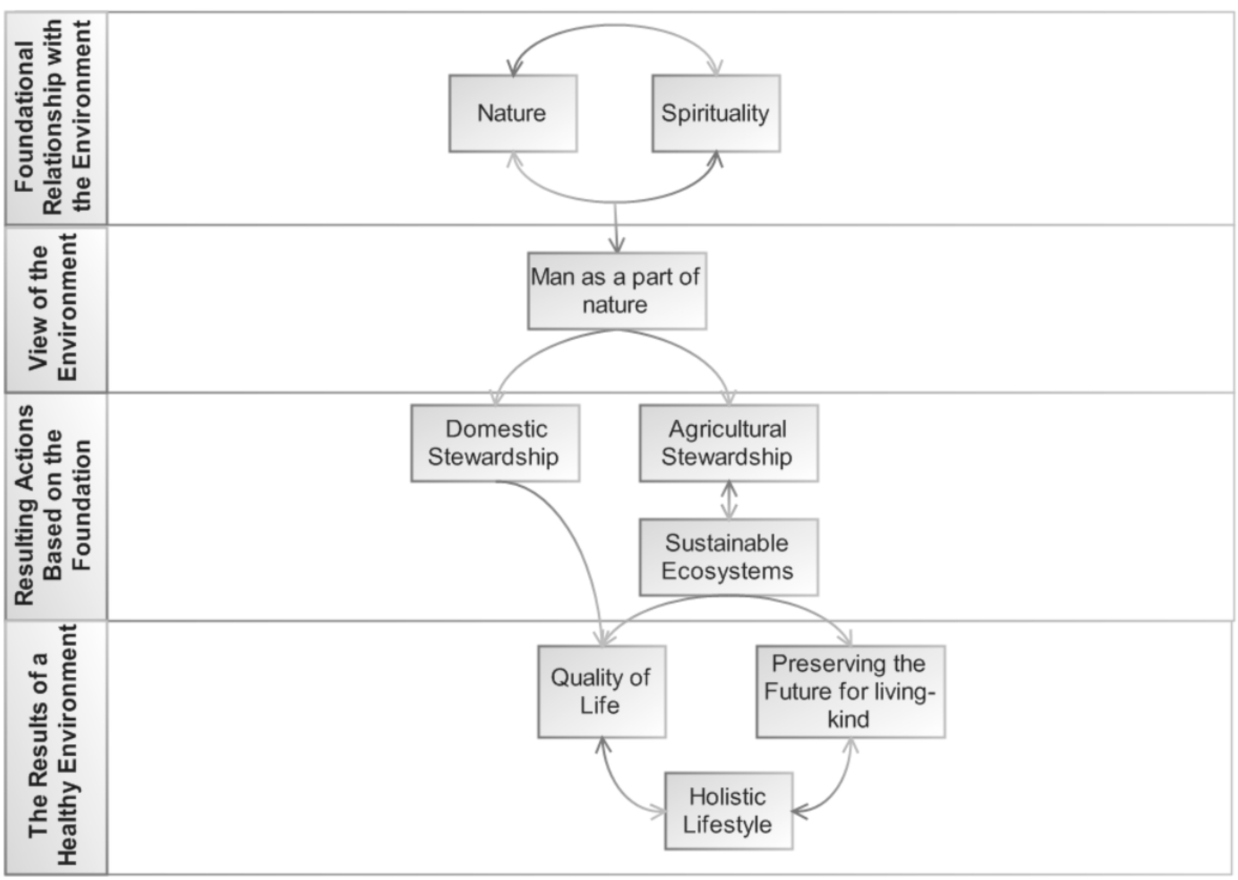

Figure 5.10: US Organic Community Environment Model

Compared to US consumer respondents, US organic community respondents had a much more detailed model of the environment. Their conception of the environment extended well beyond their own personal environment to an idealized conception of the natural world. The schematic base of the model was a view of the environment as nature and nature was seen as a form of spirituality. In many cases, “nature” was the respondent’s religion. Through the intertwining of nature and spirituality, respondents viewed the environment as one in which man was an integral part of nature.

Because these respondents feel a deep connection with the environment, part of their perceptions of the environment include their interactions with it, as indicated by the third tier of the model. Stewardship, both at the domestic household level and at the agricultural farm level, was a key idea for these respondents. Consensus analysis (Table 4.2) shows this stakeholder group to be more involved in environmental preservation/conservation efforts on a day-to-day basis than US consumer or GE farmer respondents. With regards to domestic stewardship activities, group members recycled, reused items and in general consumed responsibly (reduced their energy, water, and fuel usage; purchased items with limited packaging, limited consumerism behaviors). The “Threats to the Environment” rank order indicates that compared to US consumer respondents, respondents from the organic farming community saw consumerism as significantly more threatening for the environment ($n1=30$, $n2=14$, $U=106.5$, $p=0.009$). Thus it is not surprising the group sought to limit their own levels of consumerism. The following are a few comments made by members of the organics community, which highlight their positions regarding consumerism:

> “To help the environment I limit my fossil fuel usage, I take my own bags to the grocery. I try to be responsible with what I buy. I try to vote with my pocketbook” US Organic Respondent 15, age 30

> “I don’t buy unnecessary things, people buy to much that is unnecessary, it’s a waste” US Organic Respondent 7, age 31

In addition to domestic stewardship activities, both discourse and consensus analysis indicate that farming organically was another means by which this respondent group sought to work towards environmental health. For these respondents, agricultural stewardship was synonymous with organic agriculture in which no pesticides were used on the land. The goal of the organic farming enterprise was to create a sustainable ecosystem.

Both domestic and agricultural stewardship were viewed as leading to a high quality of life (see US organic health model-Figure 5.3). Quality of life was seen as interconnected to a holistic lifestyle, which could be achieved through harmony with nature and a rejection of mainstream consumption patterns. A holistic lifestyle was linked to preservation of the future for all living kind. In the “Reasons for a healthy environment” rank order, respondents from the US organic farming community ranked “moral obligation to future generations” significantly higher than US consumers (n1=30, n2= 13, U=120, p=0.043) and the group as a whole was very future oriented (Table 4.5).

<u>US GE Farming Community Environment Model</u>

Discourse analysis revealed US GE farming community respondents had models of the environment rooted in Christian religious values. On the religiosity Likert scale, US GE farmer respondents were found to be significantly more religious than both US consumer respondents (n1=36, n2=12, U=82, p=0.001) and US organic community respondents (n1=15, n2=12, U=45, p=0.025) (Table 4.10). As opposed to respondents from the US organic community, who viewed the environment as nature, semi-structured interview data revealed that US GE farmer respondents viewed the environment as land; land over which they had dominion. The idea of dominion over the land is tied to the group’s Christian religious values. Genesis 1:28 states, “Be fruitful, and multiply, and replenish the earth, and subdue it: and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth." The idea of having dominion over the land is very different from the organic community's notion of man as a part of nature and led to very different farming goals for each group. While respondents from the organic community sought to integrate themselves into their local ecosystem and "be one with nature," GE farmer respondents saw themselves more as tamers and shapers of the land. It was thought that humankind could best serve God by increasing land productivity via increased crop yields.

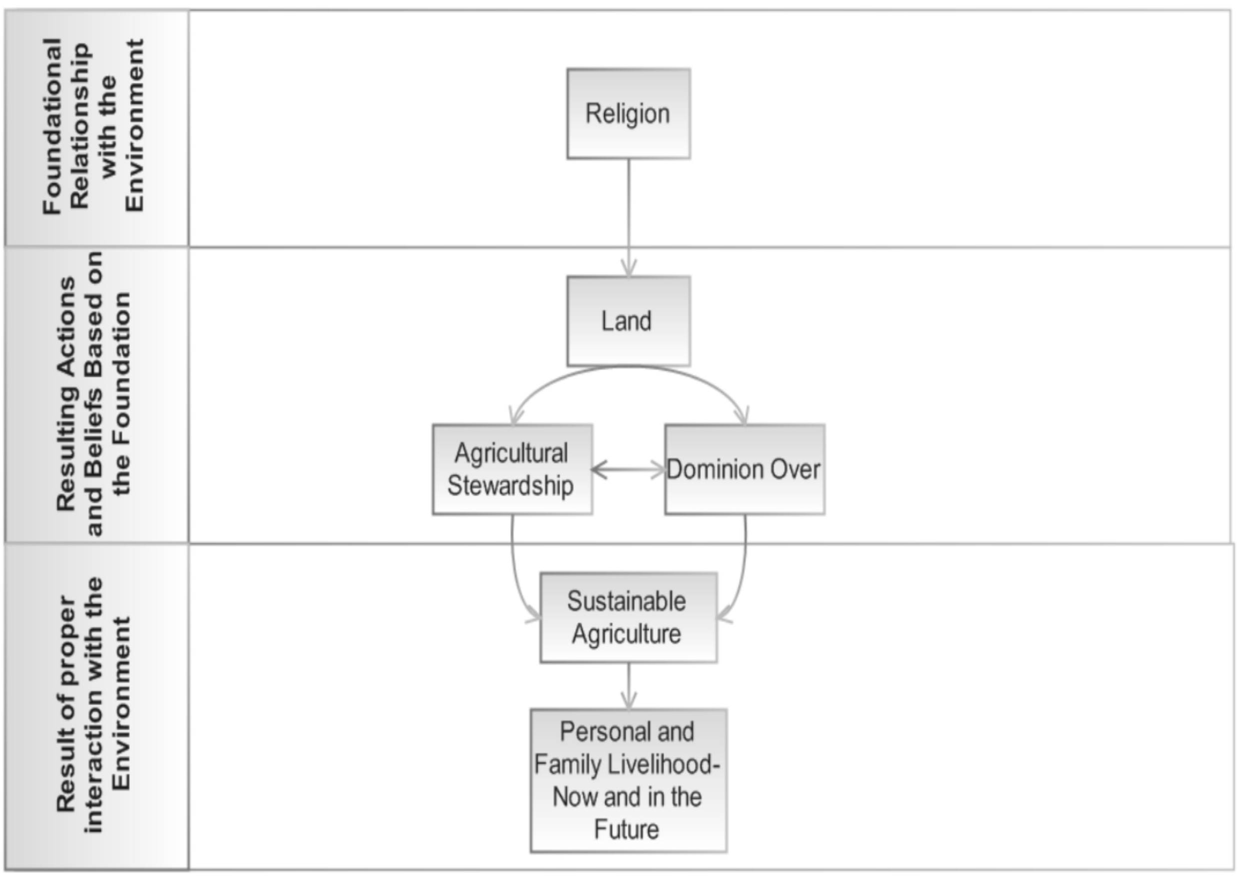

Figure 5.11: US GE Community Environment Model

Although US GE farmers felt that they held dominion over the land, they also possessed a strong land stewardship ethic. US GE farmer respondents often stated that they had been unfairly characterized by environmentalists as rapists of the land. According to one farmer:

> "No one is a bigger environmentalist than a farmer, without the land we can't make a living." US GE farmer 16, age 45

Unlike US organic farmer respondents who viewed stewardship as land management that would lead to sustainable ecosystems, US GE farmer respondents viewed stewardship as management leading to the ability to farm in perpetuity. Consensus analysis (Table 4.2) shows that, for US GE farmer respondents, preserving/conserving the environment (for this group synonymous with the term "land") means preventing erosion and applying chemicals correctly. Farmers felt that these two actions helped secure land fertility and the future of the farm.

Pro-GE NZ Consumer Environment Model

Compared to US consumer respondent environment models, the environment model for pro-GE NZ consumer respondents was considerably more integrated and developed. As previously discussed, New Zealand has an international reputation for being clean and green and part of the nation's economy is based on tourists coming to New Zealand to see its majestic surroundings. This clean green image has shaped the country's national identity with national identity, in turn, shaping conceptions of the environment. Semi-structured interview data reveals that NZ consumer respondents are very proud of their nation's scenic landscapes and consensus analysis indicates that NZ consumers were in agreement that the nation is "green" (Table 4.2). The term green was used to refer to the nation's physically green and environmentally healthy landscape. For Pro-GE NZ consumer respondents, the overarching view people had with respect to the environment was to see the environment as New Zealand. With a national identity based on the environment, it is not surprising that the term "environment" and the associations that follow from it are linked to conceptions of nationhood.

While respondents felt a strong affinity for the environment as part of their national identity, they were not active participants in environmental conservation efforts and were involved in only one environmental conservation activity, recycling, a standard action throughout much of New Zealand (Table 4.2).

For NZ Pro-GE consumer respondents, a healthy environment was recognized as necessary for quality of life. It helped maintain quality of life by giving New Zealanders a place for recreation, which in turn provided them with reinvigoration and relaxation. It was also seen as directly tied to good human health by providing a source of relaxation as well as a healthy, non-toxic environment in which to live. Finally, a healthy environment meant a healthy New Zealand economy, another facet of quality of life.

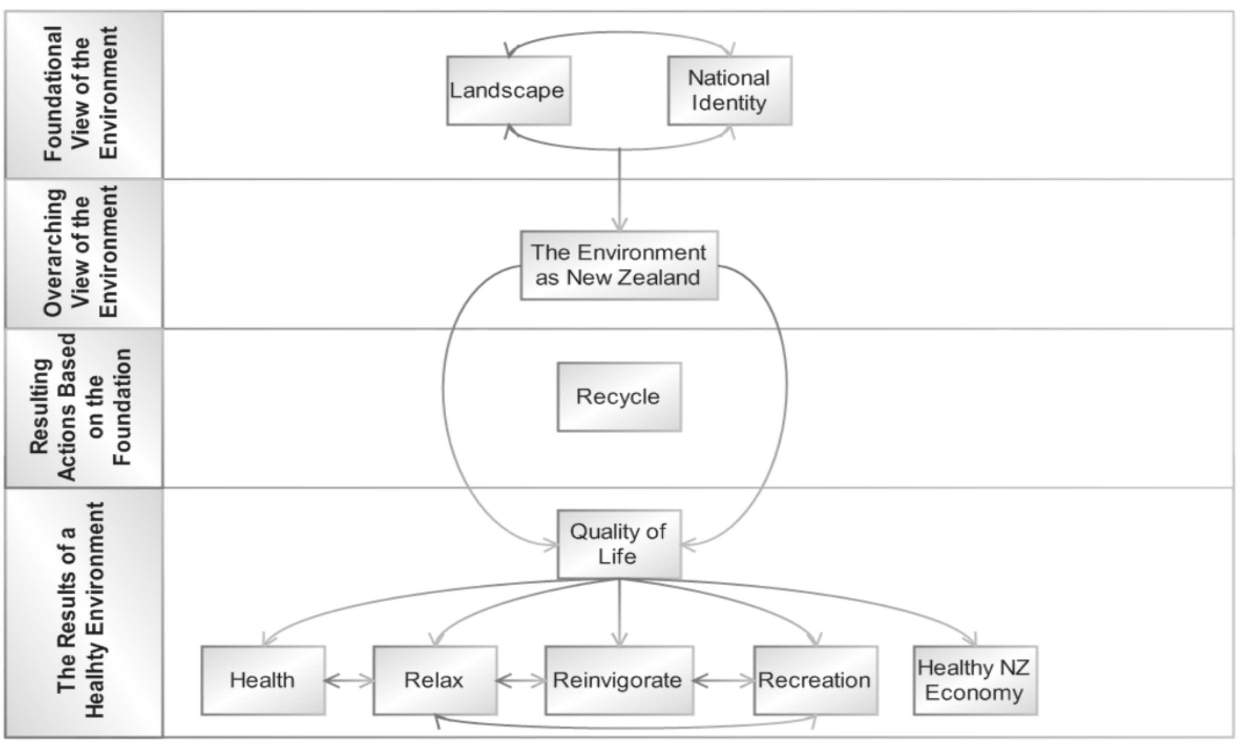

Figure 5.12: Pro-GE NZ Consumer Environment Model

Anti-GE NZ Consumer Environment Model

For Anti-GE NZ respondents, New Zealand national identity and notions of the environment were integrally related, with each shaping the other. Both discourse and consensus analysis indicate that this group was in agreement that clean and green were appropriate adjectives to describe New Zealand (Table 4.2). As was the case for Pro-GE respondents, the overarching view of the environment was to view the environment as New Zealand.

While Anti-GE respondents felt that the nation's environment was healthy compared to other countries, they felt New Zealand's cleanness and greenness were functions of its low population, isolation and limited industry and not the result of New Zealanders being particularly environmental in their actions. Compared to Pro-GE consumer respondents this group was more involved in domestic stewardship activities and scored higher on the environmental knowledge

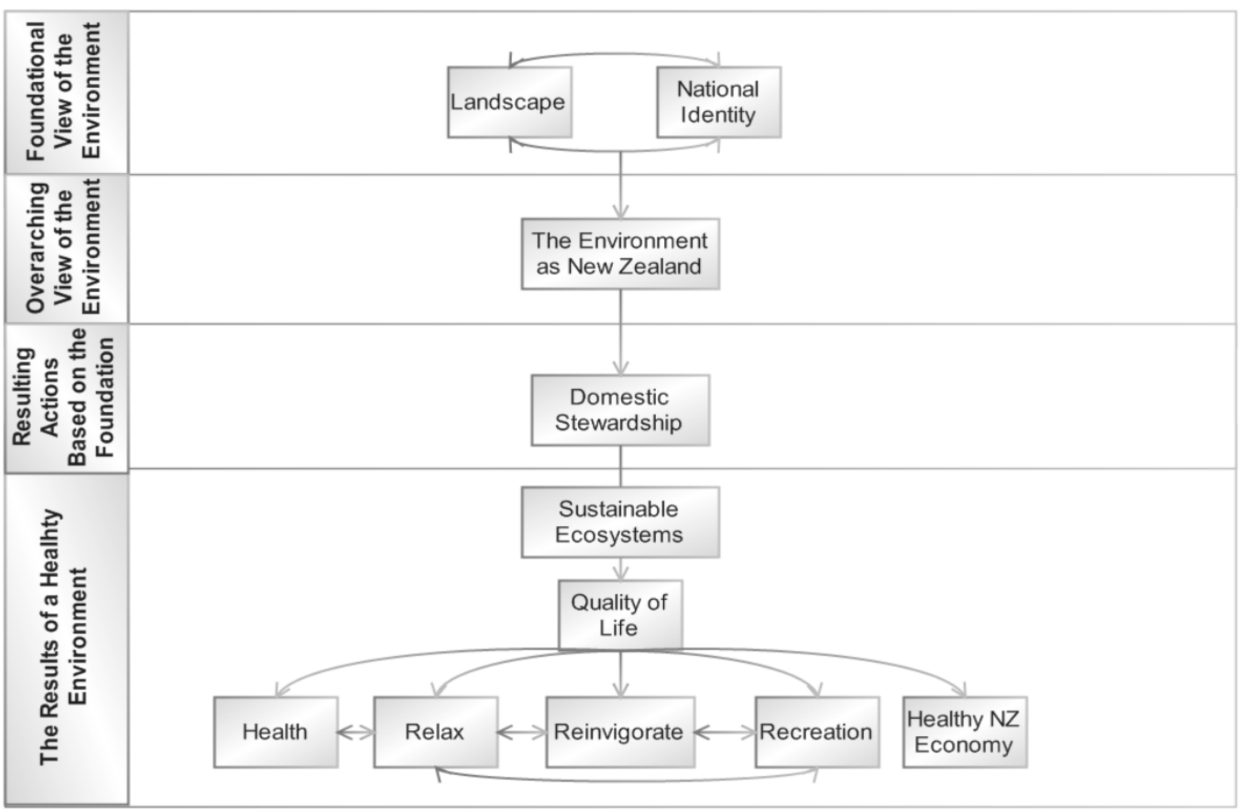

Figure 5.13: Anti-GE NZ Consumer Environment Model

assessment (n1=11, n2=18, U=43, p=0.010) (Table 4.12). Consensus analysis shows that this respondent group recycled and composted to protect the environment and tried to consume responsibly by limiting energy and fossil fuel consumption (Table 4.2). Moreover, as was mentioned in the health model for this group, respondents preferred organic food. Discourse analysis revealed their primary reason for preferring organics was perceived health benefits but a secondary reason was positive benefits for the environment.

Similar to Pro-GE respondents, this group believed a healthy environment provided New Zealanders with a high quality of life. More environmentally minded, the Anti-GE respondents were also concerned with New Zealand achieving a landscape of sustainable ecosystems, as this was needed for a stable quality of life. Respondents in this group mentioned biodiversity, self-regeneration, and balance as key features of sustainable ecosystems.

NZ Organic Farming Community Environment Model

Respondents from the NZ organic farming community had an identical environment model to that of the US organic community except for the addition of the national identity factor as a foundational component in the model. As was previously discussed, the philosophy of the organic community transcends international borders, thus, it is not surprising that the organic communities in both the US and New Zealand share almost identical models of the environment.

Compared to NZ consumer respondents, NZ organic farming community respondents had what might be characterized as a deeper relationship with the environment and thus had a much more detailed model of the environment. The environment was seen as nature and nature was a form of spirituality. Through the intertwining of nature and spirituality, respondents viewed the environment as one in which man was an integral part of nature.

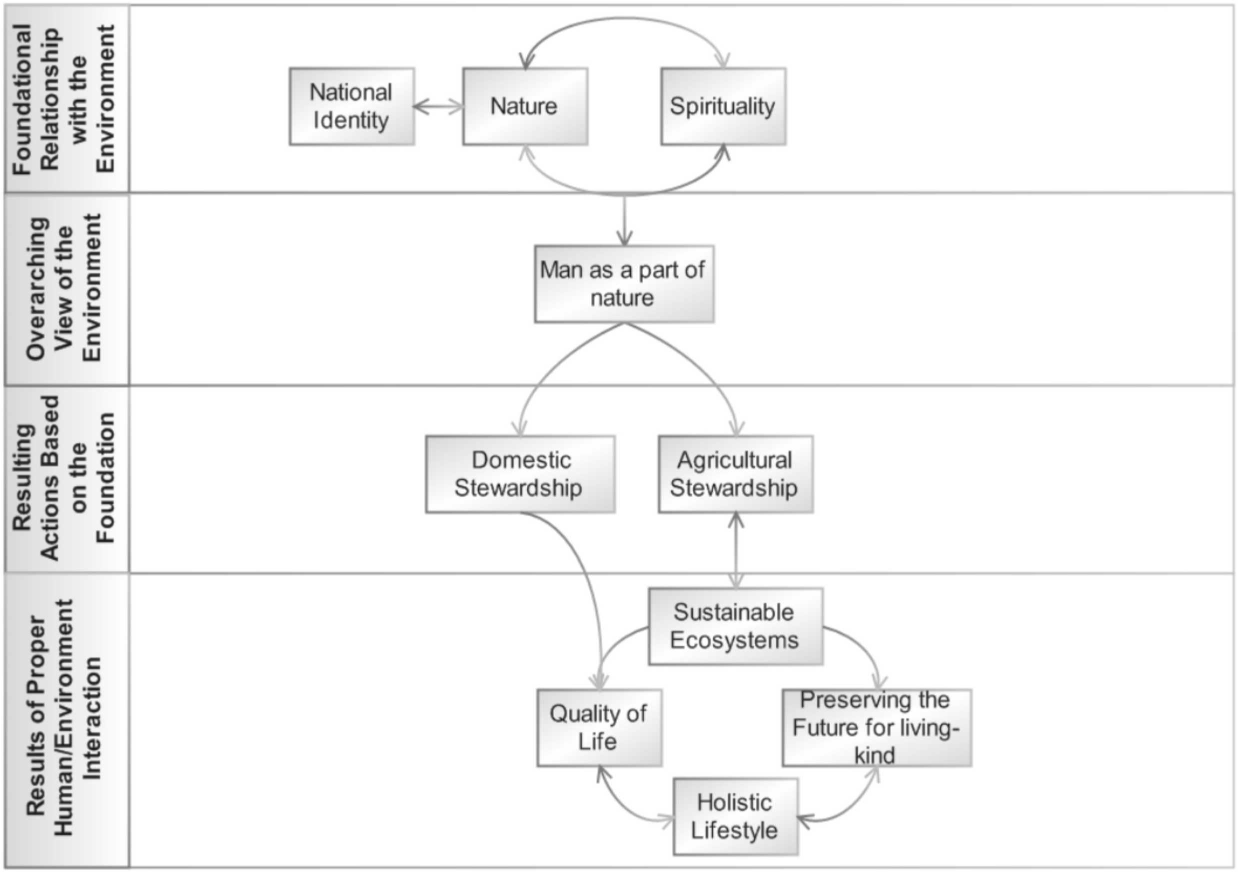

Figure 5.14: NZ Organic Farming Community Environment Model

As was the case with the US organic community, part of this respondent group's perceptions of the environment included their interactions with it, as indicated by the third tier of the model. Stewardship, both at the domestic household level and at the agricultural farm level, was a key idea for these respondents. Consensus analysis (Table 4.2) shows this stakeholder group to be more involved in environmental preservation/conservation efforts on a daily basis than NZ consumer or GE-amenable farmer respondents. With regards to domestic stewardship activities, group members recycled, composted and actively tried to consume responsibly (reduced their energy, water, and fuel usage; purchased items with limited packaging, limited consumerism behaviors).

Both discourse and consensus analysis indicated that farming organically was another means by which this respondent group sought to work towards environmental health (Table 4.2). For these respondents, agricultural stewardship was synonymous with organic agriculture in which no pesticides were used on the land. The goal of the organic farming enterprise was to create a sustainable ecosystem.

Both domestic and agricultural stewardship were viewed as leading to a high quality of life, a holistic lifestyle and the preservation of the future for living-kind. A holistic lifestyle was conceived of being one in which balance is achieved in life through harmony with nature and the rejection of mainstream consumption patterns. Like US organic community respondents, respondents from the NZ organic community ranked “moral obligation to future generations” significantly higher than NZ consumer respondents (n1=32, n2=12, U=70.5, p=0.001) in the “Reasons for a healthy environment” rank order (Table 4.5). The group as a whole was very future oriented.

NZ GE-Amenable Farming Community Environment Model

Unlike US GE farmer respondents, Christian religious values did not play a role in how NZ GE-amenable farmer respondents viewed the environment and there was not the same conception of dominion over the land. The religion likert scale (Table 4.10) indicates that US GE farmer respondents were significantly more religious than NZ GE-amenable farmer respondents (n1=12, n2=6, U=4, p=0.002).

Instead of an environment model based on religion, this respondent group, like New Zealand consumer respondents, had national identity and the idea of landscape as foundational schematic components of their model. For this respondent group, however, national identity was not synonymous with clean and green New Zealand but rather with agricultural New Zealand.

New Zealand has a long agricultural history and those interviewed felt farming was a more appropriate representational identity for the nation than clean and green.

Respondents saw the environment as both landscape and land. The terms land and landscape have different connotations for GE-amenable farmer respondents as landscape brings to mind picturesque vistas and aesthetic qualities, all part of the New Zealand tourist package, while land brings to mind cultivation, productivity, and personal livelihood.

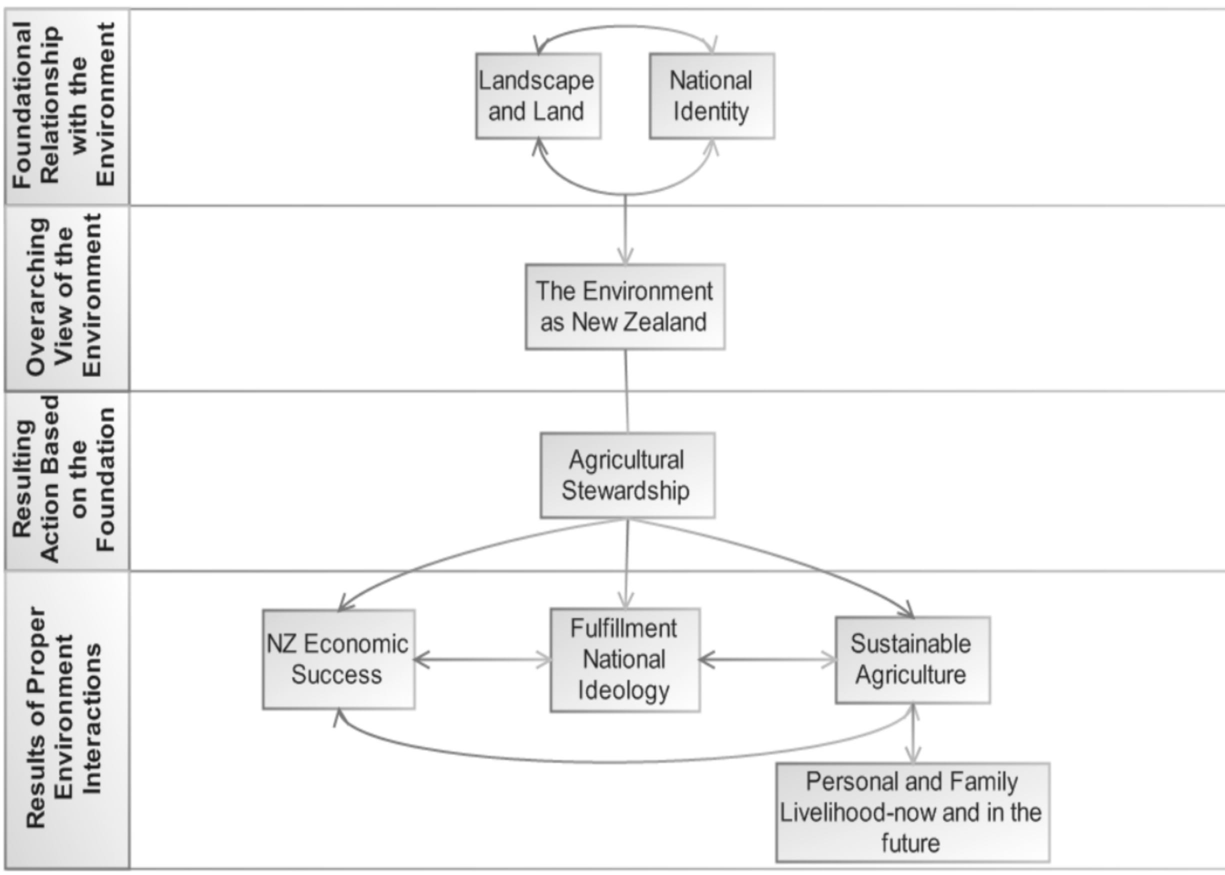

Figure 5.15: NZ GE-Amenable Farming Community Environment Model

Similar to NZ consumer respondents, this group viewed the environment as New Zealand and as such, they saw themselves as stewards of the land. They believed that agriculture was still the backbone of the nation and farming was a fulfillment of national ideology. By farming responsibly, they helped to keep the nation beautiful, increase New Zealand's economic success and ensure a future in agriculture (sustainable agriculture) both for New Zealand and themselves. With respect to agricultural sustainability, the following are representative comments:

> "If you've got the resources and its sustainable and you're not going to damage it you can manipulate it. To grow things you only need soil to stand a plant up in and then add fertilizer but that isn't very sustainable. If its not sustainable it will affect you and it will crash down overnight." NZ GE-Amenable Farmer 1, age 54.

> "Farmers are the biggest environmentalists because if we get it wrong it affects us directly in our back pocket. I'm fully aware of what I'm dealing with. I live and work with the land and make decisions about what it is doing at a given time. I change my way of farming to suit what the environment needs" NZ GE-Amenable Farmer 1, age 54.

> "A healthy environment is sustainable. It's not deteriorating. Some of them are highly modified but still healthy. I want to hand over my farm in better condition than I took it over in...this needs to be done for the whole of the environment." NZGE-Amenable Farmer 2, age 61.

Discussion of Environment Models

Respondents from the US and NZ organic farming communities had a more comprehensive and intricate environment model than did consumer respondents and respondents from the GE communities in each country. The two environment models were identical except for the addition of a national identity component in the NZ model. National identity played a key role in how all NZ stakeholder respondents viewed the environment as NZ has historically had a national identity based on the beauty of its landscapes. As previously discussed, notions of nature were intimately tied to spirituality for respondents within the organic farming community and man was seen as an integral component of nature – humankind did not stand above nature but was instead seen as a component of it. Due to this view, respondents were active stewards of the environment as they sought to achieve sustainable ecosystems. Working to achieve sustainable ecosystems was seen as a spiritual duty. Secondarily, sustainable ecosystems was seen as a means of protecting New Zealand national identity.

GE and GE amenable farming community respondents in the US and NZ had very different environment models. The main foundational elements respondents from each group drew upon in their environment models were quite different. Christianity played a significant role in the US model with the notion of dominion over the land being pervasive. By contrast, the NZ model had national identity as a significant shaper of how community members viewed the environment. While NZ consumer respondents saw the nation's national identity as "clean green New Zealand", GE amenable farmer respondents saw the national identity as being "agricultural New Zealand".

Although having different foundations, the environment model for both groups conceptualized the environment as "land", land to be tended and cultivated. This is in contrast to how respondents from the organic farming communities viewed the environment, as they conceptualized the environment as "nature". US GE farmer respondents, with their conception of land dominion, had more of a paternalistic relationship with the environment as opposed to the symbiotic relationship prevalent among those in the organic community. It was seen as something one uses and manipulates to make a living. They approached farming from a very utilitarian perspective as opposed to the spiritual perspective prevalent among organic farmer respondents. NZ GE-Amenable farmer respondents had a relationship with the environment that was less than spiritual but more than simply utilitarian. For members of this community, the land was a utilitarian means to make a living but it was also a symbol of national identity. Both GE community groups touted agricultural stewardship as a tenet by which they live as it was believed to lead to sustainable agriculture and personal livelihood. Additionally, for the NZ community it was thought to lead to a fulfillment of national ideology and economic success.

The end goal of agricultural stewardship was very different for respondents from the GE and organic farming communities. The goal of agricultural stewardship for the GE communities was sustainable agriculture. GE farmer respondents wanted to ensure the farms ability to produce economic returns into the future. By contrast, the goal for the organic farming community respondents was sustainable ecosystems and the preservation of a healthy planet into the future. Thus, organic community respondents had a much more expansive goal driving their actions on behalf of the environment.

US and NZ consumer respondent environment models differed significantly from each other and from the models employed by respondents from the organic and GE farming communities. US consumer respondents had a non-integrated environment model. There was no over-arching foundational views driving their perceptions of the environment with most respondents admitting that they did not often think of the environment as an entity onto itself. When respondents did think of the environment the focus tended to be on their own personal environment. Respondents abstractly recognized that environmental health was tied to personal health but respondents still remained disengaged from thinking about larger environmental issues. The larger environment was seen as an amorphous entity that was removed from their day-to- day life. In contrast, the environment was very much an integral part of daily life for both organic and GE farming community respondents, spiritually for respondents in the organic community and economically for those in the GE community.

In contrast to the non-integrated environment model of US consumer respondents, NZ consumer respondent models showed more detail and interconnection. Similar to NZ organic community respondents, national identity was a foundational component for how members of this group thought about the environment. Clean green New Zealand was the national identity with which most respondents identified and that identity was tied into notions of the environment as a landscape. New Zealand is known internationally for its scenic landscapes so it is unsurprising that the average New Zealander associates the environment with notions of landscape. Similar to NZ GE-Amenable farming community respondents, members of this group viewed the environment as New Zealand. The environment and its landscapes were seen as integral to New Zealand quality of life as it provided health, a place for recreation, and economic viability. Although both the consumer and GE groups saw the environment as New Zealand, their perceptions of New Zealand national identity were very different – agricultural New Zealand versus clean green New Zealand.

Overall, the environment models exhibited a lot of variability both inter and intra-culturally especially with respect to each respondent group's conceptions of the environment – organic community respondents saw the environment as nature, US GE community respondents saw it as land, NZ GE amenable community respondents saw it as land and landscape, US consumer respondents viewed it as both an amorphous other and as their own personal environment, and NZ consumer respondents viewed it as a landscape.

Chapter 6 - Models of Genetic Engineering

The objective of Chapter 6 is to present the cultural models of GE technology held by important stakeholder groups in the GE debate—consumers (Pro and Anti GE), organic farming community, GE farming community. Consumers were divided into groups based on each respondent's self-classification as Pro-GE, Anti-GE or neutral. Only Pro-GE and Anti-GE respondent data was modeled as an insufficient number of respondents (three in each nation) classified themselves as neutral towards the technology. The cultural models were devised by inductively analyzing respondent discourse for patterns and linkages of schemata. Additional quantitative tests were conducted to further inform the cultural models. Results from the quantitative tests can be found in the appendices at the end of the dissertation and important findings are referred to throughout Chapter 6—the name of the test, important findings, p-values, and the appendix number are referenced. Potential relationships between health and environment models presented in Chapter 5 and stakeholder models of genetic engineering agricultural technology will also be explored in this chapter.

US Stakeholder GE Models

Pro-GE US Consumer GE Model

Discourse analysis revealed Pro-GE US consumer respondent perceptions of genetic engineering in agriculture to be rooted in a strong faith in science. This was further support by results from the Likert trust scale (Table 4.9) which showed pro-GE US consumer respondents to be significantly more likely to trust scientists ($n1=19$, $n2=13$, $U=70$, $p=0.023$) than anti-GE US consumer respondents. Discourse analysis also indicated that pro and anti-GE US consumer respondents felt they lacked knowledge about GE. For pro-GE respondents, their strong faith in science coupled with their perceived lack of knowledge regarding the technology resulted in the respondents deferring judgment on the safety and benefits of GE to scientists. A few indicative comments include:

> "I trust scientists the most because when dealing with something so new and untried, the professionals would be the most able to predict possible outcomes" Pro-GE US Consumer 8, age 26.

> "I trust scientists, they have fewer opportunities and desires for personal gain. I think they're in it for the passion" Pro-GE US Consumer 7, age 22.

It should be noted that although Pro-GE US consumer respondents felt they lacked knowledge about GE, they did score significantly higher than Anti-GE US consumer respondents on the GE knowledge assessment (n1=22, n2=14, U=63.5, p=0.002) (Table 4.12).

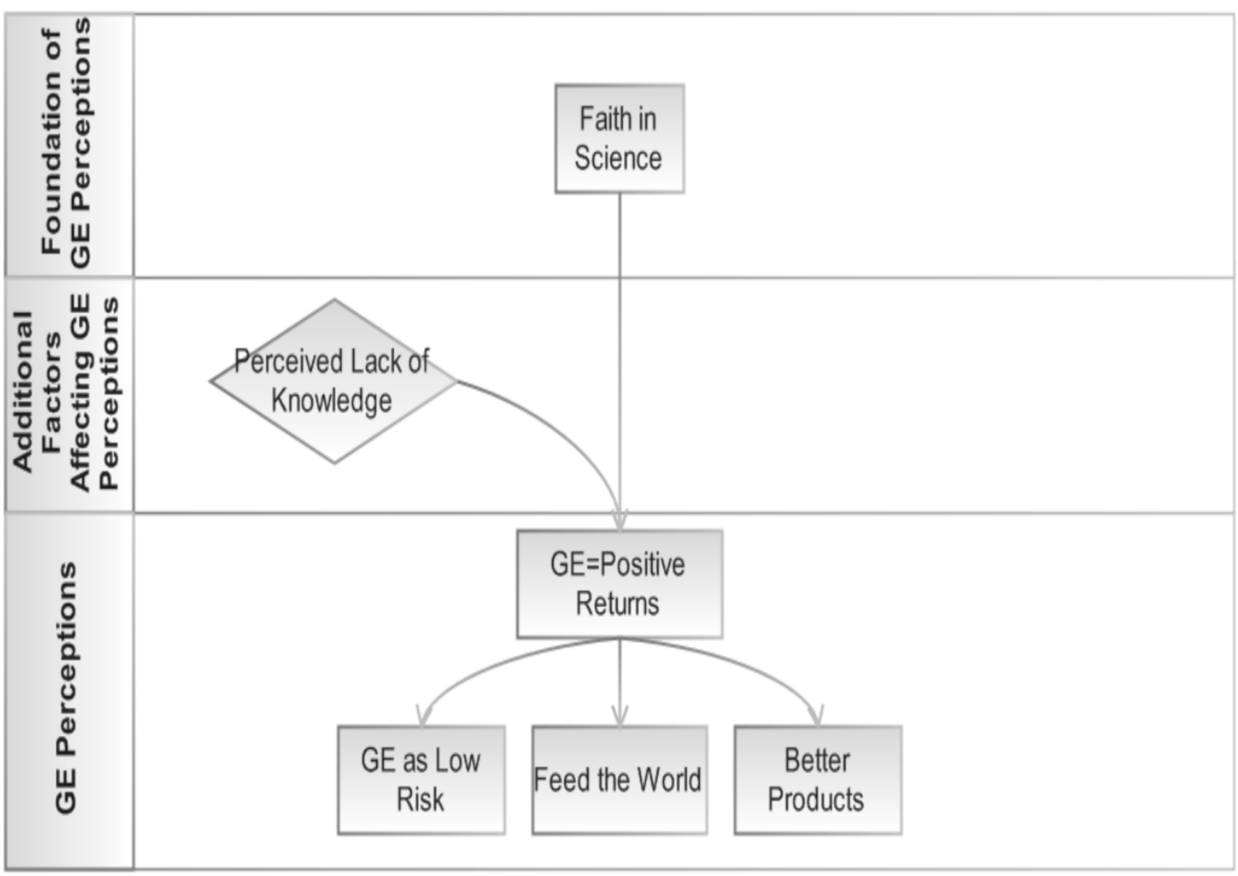

Figure 6.1: Pro-GE US Consumer GE Model

Discourse analysis revealed that respondents believed GE was a relatively low risk to society. Results from the health and environmental threat rank-order exercises confirmed this assessment. Compared to anti-GE consumer respondents, Pro-GE respondents saw GE as being significantly less threatening to both health and the environment ($n1=16$, $n2=11$, $U=20$, $p=0.000$ and $n1=16$, $n2=11$, $U=22$, $p=0.000$ respectively) (Tables 4.3 & 4.4). Furthermore, when Pro-GE respondents did think a certain GE risk was likely to happen, they felt the risk would be contained in a laboratory or scientists would find a swift solution and minimal harm would result. Pro-GE US consumer respondents felt the technology was worth the minimal risks it posed as it could offer consumers better products in the form of food that was more nutritive, better looking, and more tasteful and it could help feed the world.

Anti-GE US Consumer GE Model

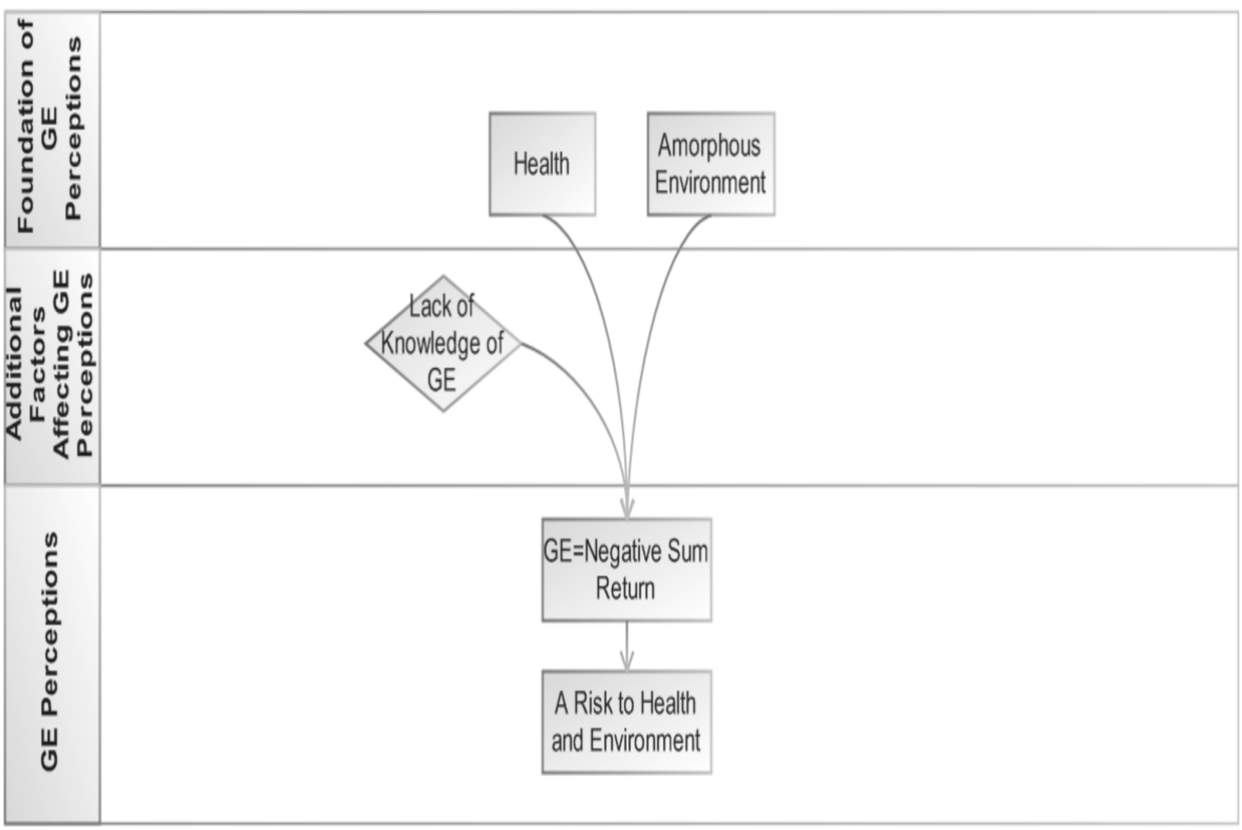

Figure 6.2: Anti-GE US Consumer GE Model

Analysis of respondent discourse revealed anti-GE US consumer respondent's perceptions of GE to be rooted in their perceptions of health and the environment. Respondents expressed more concern about the risks associated with GE technology than their pro-GE US counterparts. Supporting this finding, the threats to health and environment rank order results suggested that anti-GE US consumer respondents viewed GE as being a greater threat to health (n1=16, n2=12, U=20, p=0.000) and the environment (n1=16, n2=12, U=22, p=0.000) than did Pro-GE US respondents (Tables 4.3 & 4.4). For respondents within this group, GE was strongly associated with chemicals like pesticides and herbicides, which were deemed to be unhealthy and something the group as a whole sought to avoid.

As discussed previously, US consumer respondent's environment model does not extend much beyond their personal environment on a daily basis. However, when asked to think about threats to the wider environment, they are able to do so and Anti-GE US consumer respondents saw GE as a greater threat to the environment than Pro-GE consumer respondents. Although this respondent group does not have a highly specified model of the environment, they do have a generalized concern for it and are in favor of activities done for its benefit. For example, in the benefits of GE rank-order exercise Anti-GE US respondents ranked "protection of the environment" as a more significant potential benefit (if all benefits were true benefits) of GE than did Pro-GE US consumer respondents (n1=18, n2=14. U=70.5, p=0.032) (Table 4.6).

As was the case with pro-GE US respondents, this group also felt unknowledgeable about GE technology. However, for this respondent group, potential fears resulting from a lack of knowledge about this novel technology were not assuaged by a faith in science. The result was a general distrust of the technology and greater perceived risk. While respondents in this group felt

GE was a risk to both health and the environment, only a few of those interviewed could name specific risks; the main risk was considered to be unforeseen consequences.

It should be noted that the likelihood of GE risks Likert scale showed no difference between Pro and Anti-GE respondents with respect to how likely they thought GE risks were to come to pass (Table 4.8). Discourse analysis indicated the main difference between the two groups with respect to GE risk perceptions was not in how likely they felt the risk was to occur. Instead, the main difference was in how controllable and fixable they felt negatives resulting from GE could be. Unlike Pro-GE respondents, respondents from this group felt that scientists would not be able to sufficiently fix any negative GE repercussions.

US Organic Farming Community GE Model

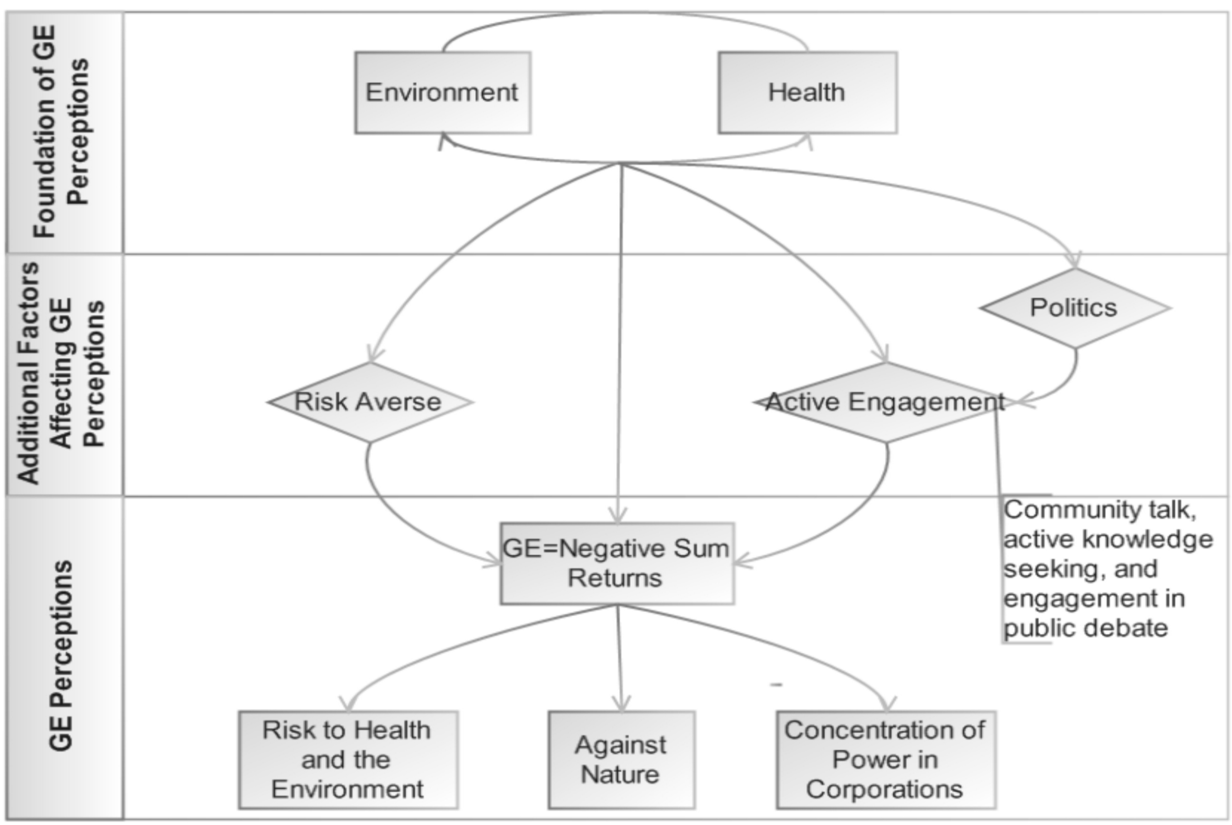

Figure 6.3: US Organic Community GE Model

US organic farming community respondent perceptions of GE are rooted in the circular interconnection of their models of environment and health. As indicated by the health and environment models (Figures 5.3 and 5.10), organic community respondents have a very strong relationship with nature that extends into the spiritual realm. Environmental health and personal health are believed to be strongly interlinked. Respondent models of health and the environment fed into their political views. Members of this respondent group were quite active politically and often said that they vote with their consumer dollar and actively advocate on behalf of the environment. The Likert politics scale indicates that respondents from the organic farming community are significantly more liberal than both US consumer and GE farmer respondents (n1=36, n2=15, U=157.5, p=0.012 and n1=15, n2=12, U=5, p=0.000 respectively) (Table 4.10). Community respondents considered the US Democratic party to be more socially responsible and environmentally friendly.

This respondent group's environment and health models, combined with their political activism, led them to be actively engaged in the GE debate. Their engagement took the form of actively talking about GE within the community, seeking out knowledge regarding GE through television and print media sources and being willing to engage in public meetings concerning GE. The engagement Likert scale (Table 4.11) indicates that organic farming community respondents are significantly more likely to seek knowledge of GE via the media than US GE farmer respondents (n1=14, n2=13, U=31.5, p=0.002) and are more likely to engage in public debates than both US GE farmer respondents (n1=14, n2=13, U=41, p=0.014) and consumer respondents (n1=36, n2=14, U=129, p=0.006). They are also more likely to have talked about GE than consumer respondents (n1=36, n2=14, U=64, p=0.000) (Table 4.11).

Analysis of respondent discourse indicated that organic community respondent stances on what constitutes human health behavior and a healthy environment shape their risk behavior. The community has a high level of risk aversion with respect to the environment and health, in part, because the environment and health were tied so closely with their spirituality. Supporting this conclusion, the economic risk scenario tests indicate that respondents from the organic farming community are significantly less willing to risk either health or the environment in return for increased crop yields compared to respondents from the GE farming community (n1=14, n2=14, U=35, p=0.000 and n1=14, n2=14, U=15, p=0.000 respectively) (Table 4.13). Furthermore, US organic community respondents ranked GE as significantly more threatening to health (n1=30, n2=14, U=100, p=0.005 and n1=14, n2=10, U=23, p=0.005) than both US consumer and GE farmer respondents, respectively (Table 4.3) and significantly more threatening to the environment (n1=30, n2=14, U=81, p=0.001) than US consumer respondents (Table 4.4). Given the groups risk aversion and perception of GE as a significant environment and health threat - environment and human health being two key elements of both organic farming philosophy and their personal spirituality – it is not surprising that respondents were GE opposed.

Coupled with respondent's risk aversion, organic community respondents believed GE risks to be more likely to come to fruition than did US consumer and GE farmer respondents. Compared to US consumer respondents, respondents from the US organic farming community saw the following risks of GE as being significantly more likely to happen: loss of crop diversity (n1=32, n2=14, U=121.5, p=0.011), gene transfer to wild varieties of plants (n1=32, n2=14, U=130.5, p=0.020), toxicity from GE foods (n1=32, n2=14, U=127.5, p=0.017), negative alterations in nutritional quality (n1=32, n2=14, U=138, p=0.034), limited access to GE crop varieties (n1=32, n2=14, U=101.5, p=0.002), a lack of labeling of GE ingredients in food (n1=32, n2=14, U=116, p=0.004), and increased risk of food allergens (n1=32, n2=14, U=116, p=0.007) (Table 4.8). Similarly, compared to US GE farming community respondents, respondents from the US organic community saw the following risks as being significantly more likely to happen: human antibiotic resistance (n1=14, n2=14, U=74.5, p=0.004), creation of new viruses (n1=14, n2=14, U=68.5, p=0.002), loss of crop diversity (n1=14, n2=14, U=81, p=0.005), gene transfer to wild varieties of plants (n1=14, n2=14, U=63.5, p=0.001), toxicity from GE foods (n1=14, n2=14, U=63.5, p=0.001), negative alterations in nutritional quality (n1=14, n2=14, U=40.5, p=0.000), a lack of labeling of GE ingredients in food (n1=14, n2=14, U=33.5, p=0.000), and increased risk of food allergens (n1=14, n2=14, U=22.5, p=0.000) (Table 4.8).

US organic farming community respondent's root models of health and the environment, coupled with their political activism, general risk aversion and active engagement in the GE debate leads to a view of GE as being a negative sum return. Consensus analysis indicates that this group saw GE as a technology with no true benefits. It is against respondent's conception of nature and concentrates power in the hands of a few large corporations while risking health and the environment. According to one respondent:

> "GE is trying to make nature out of equations, it's a tool of control, we are sucking at the nipple of a technological cow and it is a false idol" US Organic 5, age 30.

US GE Farmer GE Model

Discourse analysis revealed GE farming community respondent perceptions of GE to be rooted in their schemas of religion, business, and the environment. As seen in respondent's environment model (Figure 5.11), GE farmer respondents tend to have strong religious values with an accompanying notion of dominion over the land. The idea of dominion ties in nicely with the group's business mindset as fulfilling a religious doctrine to make the land productive also is profitable from a business perspective.

Unlike respondents from the US organic farming community, who participate in farming to fulfill a spiritual desire to work with the land, to be a part of nature and to make a living, GE farmer respondents approach farming with a business mind-set. They enjoy their work but they do not have a spiritual connection to the land. Their farm is a business to them and they farm to make a living. For them, farming is about the economic bottom line.

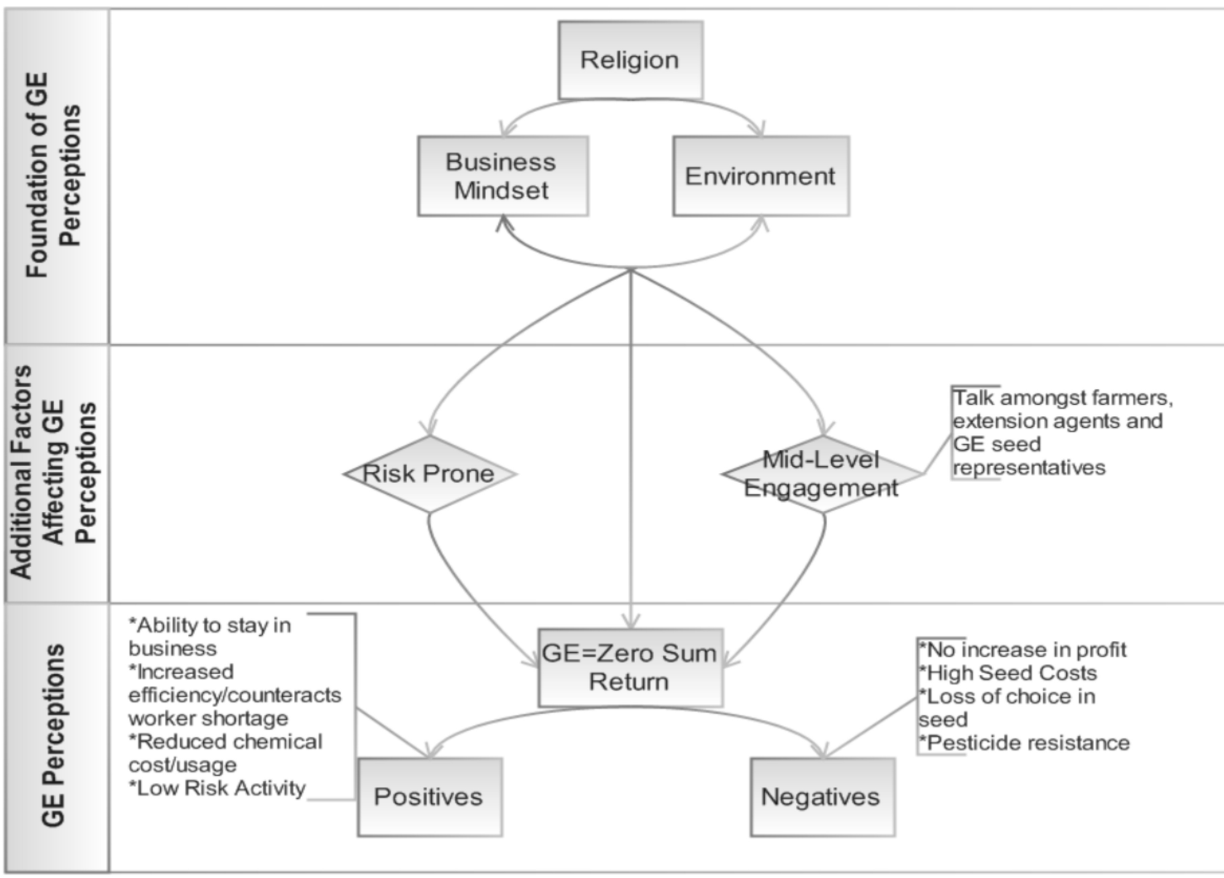

Figure 6.4: US GE Farming Community GE Model

The use of GE products as part of their business, leads GE farmer respondents to have a mid-level of engagement in the GE debate. They talk about GE within the community on a regular basis but do not actively seek out or read news articles regarding GE as did respondents from the US organic community. For GE farmer respondents, GE seed company representatives were the primary sources of knowledge concerning GE. It is important to note that the information they receive regarding GE is likely to have a Pro-GE bias as it, in many instances, comes directly from GE seed companies. GE farmer respondents often stated that they did not seek out mainstream media information about GE because they believed it to be unfairly biased against the technology. The engagement Likert scale results support these findings and indicate that GE farmer respondents were significantly more likely than US consumer respondents to have talked about GE (n1=36, n2=13, U=98, p=0.001) but were less likely than consumer respondents or respondents from the organic community to seek out and read an article or watch a show on GE (n1=36, n2=13, U=137, p=0.016 and n1=14, n2=13, U=31.5, p=0.002 respectively) (Table 4.11). As stated previously, compared to organic farmer respondents, GE farmer respondents were also less likely to attend a public meeting about GE (n1=14, n2=13, U=41, p=0.014) (Table 4.11).

Analysis of GE farmer respondent discourse indicated a strong orientation towards being business-minded which in turn influenced their willingness to accept risks to health and the environment. Respondents viewed risk-taking as a normal part of farming as neither crop harvests nor crop prices could be guaranteed. Providing further support for the attitudes about risks identified via discourse analysis, the risk scenario exercises indicate that GE farmer respondents were significantly more willing to risk human health and the environment for a benefit of improved crop yields (n1=14, n2=14, U=35, p=0.000 and n1=14, n2=14, U=15, p=0.000 respectively) (Table 4.13) than were organic farmer respondents.

Overall, GE farmer respondents perceived genetic engineering technology as a zero sum return. Consensus analysis indicated that as a group, GE farmer respondents saw the chief negative of GE as being high seed costs (Table 4.2). Additional negatives identified via discourse analysis included loss of choice in seed and pesticide resistance. Companies such as Monsanto have a virtual monopoly over seeds in general and GE seeds in particular. GE farmer respondents had little to no choice in what seed varieties they could choose for farming. In many cases, conventional, non-GE varieties of seeds were no longer sold in sufficient quantities for them to be used on a large-scale US farm. Furthermore, GE crops were not improving respondent farmer profit margins. The money respondents saved on agricultural chemicals was negated by the high cost of GE seeds. Both discourse and consensus analysis revealed the chief positive of GE technology to be increased farming efficiency (increased yields with reduced chemical spraying), which helped to counteract a worker shortage (Table 4.2). US GE farmer respondents have, in recent years, been faced with worker shortages coupled with the need to increase the amount of land under cultivation in order to stay in business. GE has allowed respondents to farm more land with fewer people.

GE farmer respondents viewed GE as a low risk technology and considered its low risk level to be another of its benefits. As indicated during the discussion of the organic farming community GE model, GE farmer respondents, compared to organic community respondents, viewed the technology as being significantly less risky with respect to: human antibiotic resistance ($n1=14$, $n2=14$, $U=74.5$, $p=0.004$), creation of new viruses ($n1=14$, $n2=14$, $U=68.5$, $p=0.002$), loss of crop diversity ($n1=14$, $n2=14$, $U=81$, $p=0.005$), gene transfer to wild varieties of plants ($n1=14$, $n2=14$, $U=63.5$, $p=0.001$), toxicity from GE foods ($n1=14$, $n2=14$, $U=63.5$, $p=0.001$), negative alterations in nutritional quality ($n1=14$, $n2=14$, $U=40.5$, $p=0.000$), a lack of labeling of GE ingredients in food ($n1=14$, $n2=14$, $U=33.5$, $p=0.000$), and increased risk of food allergens ($n1=14$, $n2=14$, $U=22.5$, $p=0.000$) (Table 4.8).

New Zealand Stakeholder GE Models

Pro-GE NZ Consumer GE Model

Similar to Pro-GE US consumer respondents, Pro-GE NZ consumer respondent perceptions of genetic engineering in agriculture were rooted in a strong faith in science. Compared to anti-GE NZ consumer respondents, pro-GE NZ consumer respondents were significantly more likely to trust scientists (n1=11, n2=18, U=29.5, p=0.001) as indicated on the Likert Trust Scale (Table 4.9). The following are a few respondent comments regarding trust and GE technology:

> "I'm concerned enough about the technology to look into it, to investigate its dangers but I assume the people behind it, the scientists, can be trusted" NZ Consumer 6, age 27

> "I love science, its how the world works…GE isn't unnatural, we've been doing it for years in the form of grafting and cross-breeding. NZ Consumer 3, age 24.

Additionally, the Likert Trust Scale exercise revealed pro-GE respondents trusted farmers (n1=11, n2=18, U=52, p=0.022) and industry (n1=11, n2=18, U=56, p=0.042), two other key groups involved in GE development and implementation, more than their Anti-GE counterparts (Table 4.9).

Compared to Anti-GE respondents, discourse analysis suggested that Pro-GE respondents tended to be more willing to accept the risks associated with GE in return for positive benefits. Respondents felt that some measure of risk was normal. This was confirmed by the risk scenario exercises. The exercises suggest that Pro-GE NZ consumer respondents are more willing to risk the environment (n1=11, n2=16, U=51.5, p=0.043), native species (n1=11, n2=16,U=49, p=0.034), and food allergenicity (n1=11, n2=16,U=42, p=0.009) in order to receive discount food prices than were Anti-GE respondents (Table 4.13).

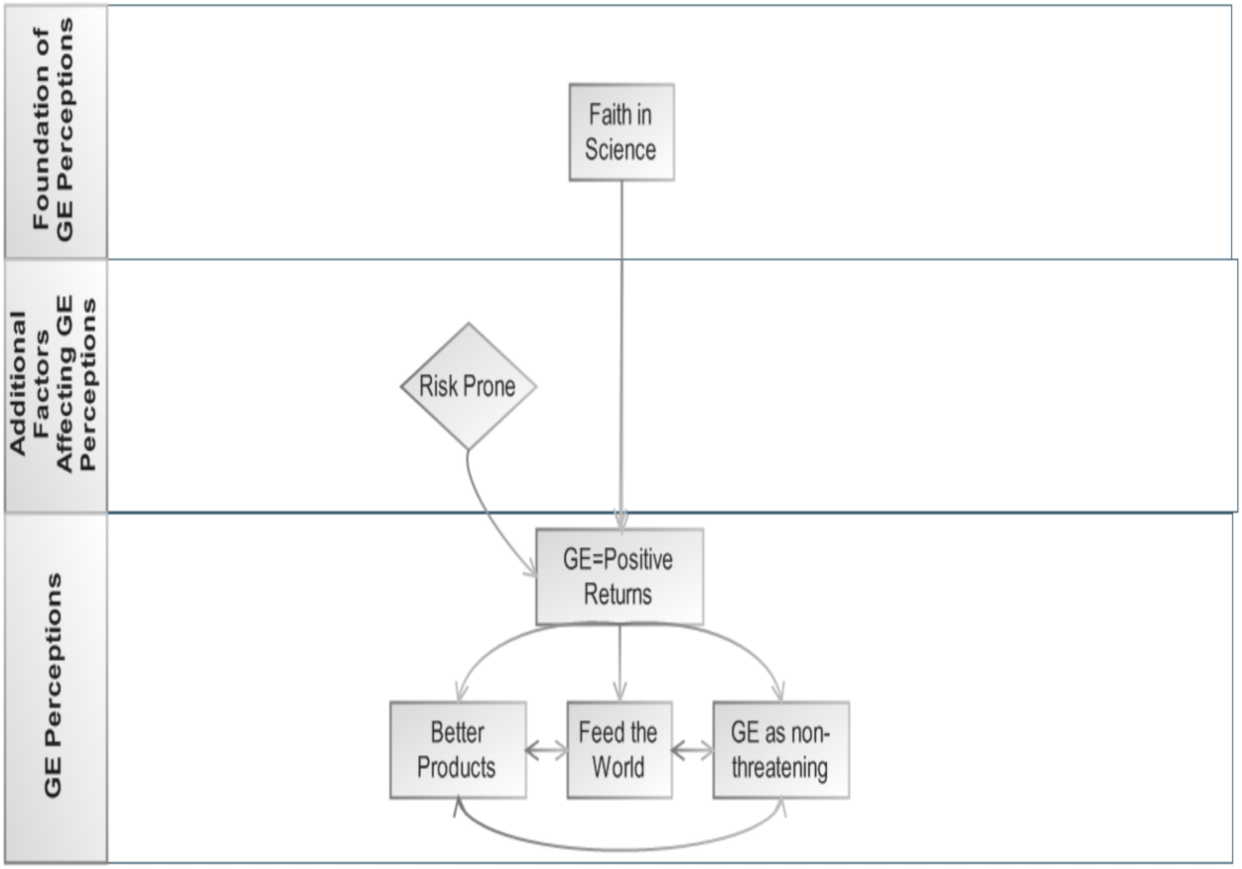

Figure 6.5: Pro-GE NZ Consumer GE Model

In addition to being willing to accept a certain measure of risk, respondents also viewed GE as being a low risk technology compared to their Anti-GE counterparts. According to the health threats rank order exercise, Pro-GE NZ consumer respondents saw GE as being significantly less threatening to health than did consumer respondents opposed to GE (n1=11, n2=18, U=50, p=0.025) (Table 4.3). Compared to Anti-GE respondents, this group also felt GE risks such as creation of viruses (n1=11, n2=18, U=55.5, p=0.041), food toxicity (n1=11, n2=18, U=52.5, p=0.031), decreased crop genetic diversity (n1=11, n2=18, U=34.5, p=0.002), gene transfer (n1=11, n2=18, U=40, p=0.004), negative alterations in nutritional quality (n1=11, n2=18, U=39, p=0.006), lack of labeling for GE food products (n1=11, n2=18, U=54, p=0.031) and the introduction of allergens into food (n1=11, n2=18, U=26, p=0.001) were less likely to occur (Table 4.8).

Overall, Pro-GE NZ consumer respondents felt the technology was worth the minimal risks it posed as it could offer consumers better products in the form of food that was more nutritive, better looking, and more tasteful. Further, it was felt that the technology could help feed the world by increasing shelf life and expanding production. It should be noted that while supportive of GE technology, in general, a number of respondents within this group were not supportive of its use in New Zealand. Even though they believed the technology was safe and worth the risk in world agriculture, they felt the current negative climate towards GE in parts of the world made GE to big of a risk for New Zealand to become irrevocable involved with the technology.

Anti-GE NZ Consumer GE Model

Discourse analysis suggested that anti-GE NZ consumer respondent's perceptions of GE were rooted in their models of health and the environment. Risks to health and the environment were cited by respondents as being the main reasons for their opposition to the technology. Respondents in this group preferred organic foods as they were considered more natural and as a result of being natural, more healthy. GE was seen as unnatural. The following are a few representative comments made by respondents from this stakeholder group regarding naturalness and GE:

> "GE would affect my life because I wouldn't feel natural or healthy, it would stress me out" NZ consumer 2, age 21.

> "I don't want GE to happen it's like fundamentally wrong, unnatural. If it happens I want to know about it for sure" NZ consumer 5, age 27.

> "GE is just messing with the natural" NZ consumer 8, age 34.

"GE is unnatural because it's not a process that would happen without human interference. It being unnatural is one of the fundamental issues I have with it" NZ consumer 10, age 40.

The threats to health rank order results support this finding and show anti-GE NZ consumer respondents to view GE technology as being a greater threat to health than pro-GE NZ consumer respondents (n1=11, n2=18, U=50, p=0.025)(Table 4.3).

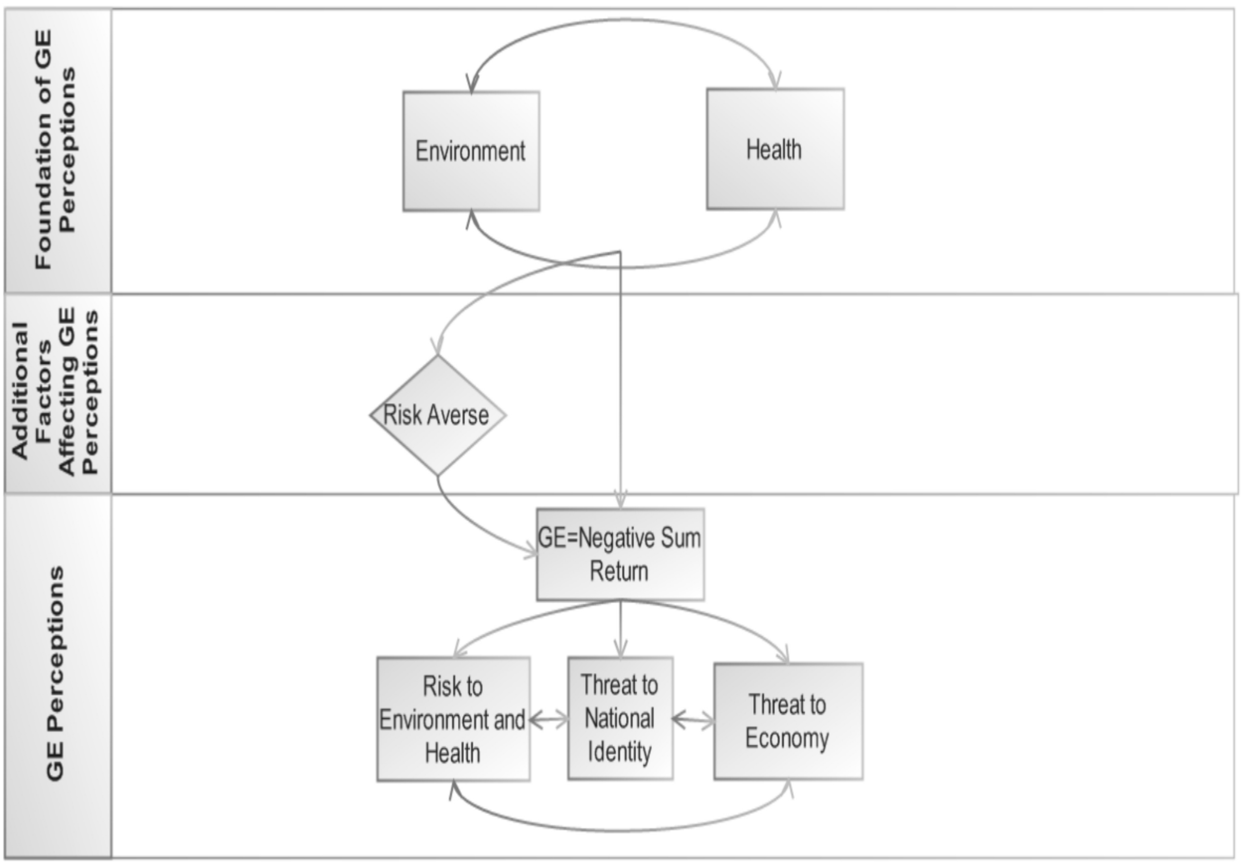

Figure 6.6: Anti-GE NZ Consumers GE Model

There was not a statistically significant difference between pro and anti-GE NZ consumer respondents with respect to how they ranked GE as an environmental threat in the threats to environment rank order. Discourse analysis revealed that both groups saw GE as a potentially serious threat to the environment and to New Zealand's clean and green image. By threatening environmental health, GE was seen as a threat to both national identity and the economy. This finding is supported by results from the threats to environment rank order which indicate that, compared to US consumer respondents, NZ consumer respondents saw GE as significantly more threatening to the environment (n1=32, n2=30, U=304, p=0.011) (Table 4.4).

Although both consumer groups saw GE as a potential environmental threat, Anti-GE consumer respondents were averse to taking risks while pro-GE consumer respondents were more risk prone. As previously discussed, the risk scenario exercises suggest that anti-GE consumers are less willing to risk the environment (n1=11, n2=16, U=51.5, p=0.043), native species (n1=11, n2=16, U=49, p=0.034), and food allergenicity (n1=11, n2=16, U=42, p=0.009) in order to receive discount food prices than are pro-GE respondents (Table 4.13). Furthermore, the likelihood of GE risks Likert scale exercise indicates this respondent group felt a number of GE health and environment risks to be more likely to occur than their pro-GE counterparts. Those risks included creation of viruses (n1=11, n2=18, U=55.5, p=0.041), food toxicity (n1=11, n2=18, U=52.5, p=0.031), decreased crop genetic diversity (n1=11, n2=18, U=34.5, p=0.002), gene transfer (n1=11, n2=18, U=40, p=0.004), negative alterations in nutritional quality (n1=11, n2=18, U=39, p=0.006), lack of labeling for GE food products (n1=11, n2=18, U=54, p=0.031) and the introduction of allergens into food (n1=11, n2=18, U=26, p=0.001) were less likely to occur (Table 4.8).

NZ Organic Farming Community GE Model

As was the case for US organic respondents, NZ organic respondent's perceptions of GE are rooted in the circular interconnection of their models of environment and health. As indicated by respondent health and environment models (Figures 5.7 and 5.14), respondents from the organic community have a spiritual relationship with nature and hold the view that environmental health and personal health are strongly interlinked. Respondent's perceptions of

GE as a threat to both the environment and health led them to be quite active politically. All the respondents from the NZ organic community were members of the NZ Green Party, a party known for its liberal attitudes and activism on behalf of the environment and against GE technology. Supporting this finding, respondents from the NZ organic farming community rated themselves as significantly more liberal than their GE-amenable counterparts ($n1=14$, $n2=6$, $U=2$, $p=0.001$) on the politics Likert scale (Table 4.10).

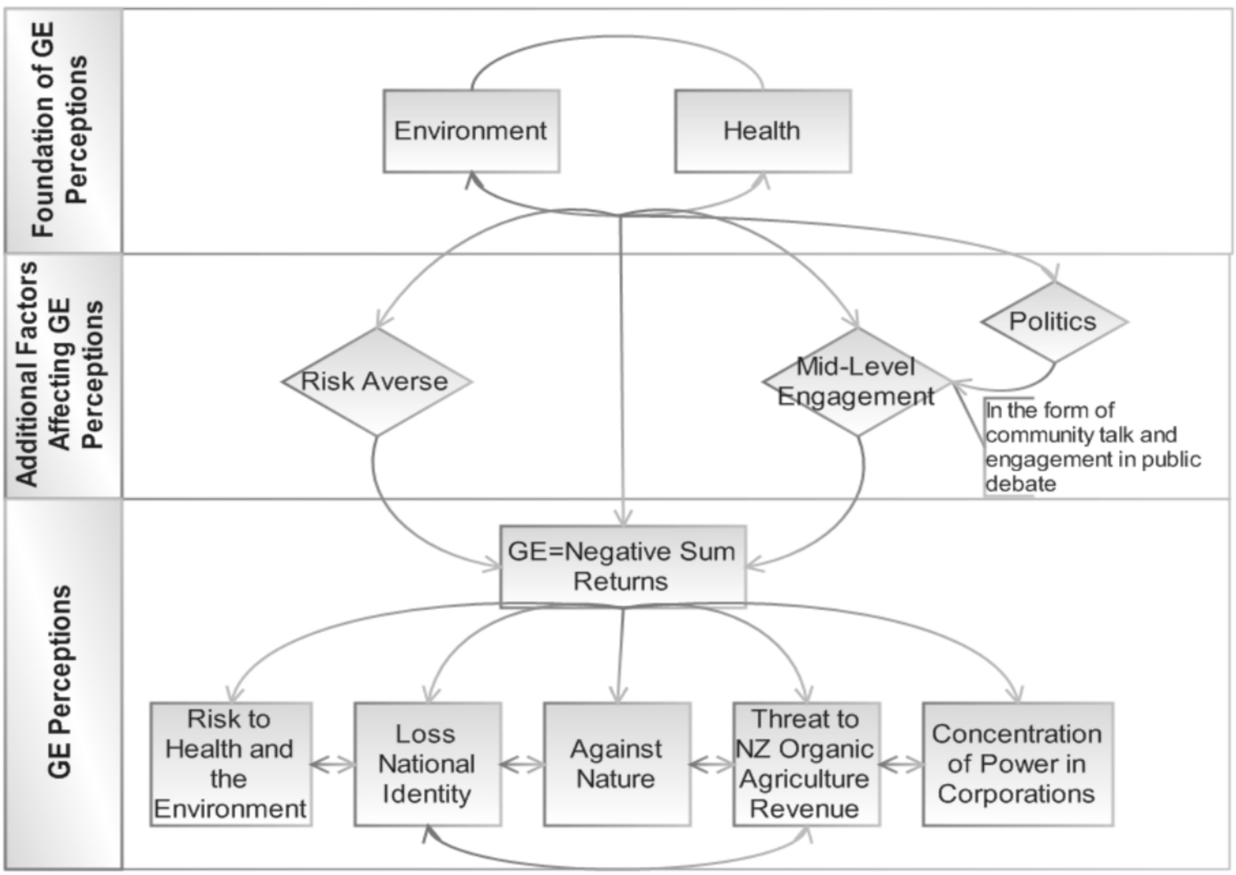

Figure 6.7: NZ Organic Community GE Model

This respondent group was not as actively engaged in the GE debate as their US counterparts with what could be characterized as a mid-level of engagement. Discourse analysis revealed that the comparatively more limited engagement with GE found among this community compared to US organic community respondents is due, at least in part, to the fact that GE agriculture is not yet practiced extensively throughout NZ. As the technology was not yet an on the ground threat to their livelihood, respondents felt less inclined to seek out information about GE technology. Should the technology become more pervasive within NZ, it is likely that respondents from the organic community would show more signs of engagement. The engagement Likert scales indicate that this group was more likely to talk about GE than NZ consumer respondents but less likely to talk about it than GE amenable farmer respondents (n1=32, n2=15, U=133.5, p=0.010 and n1=15, n2=6, U=20, p=0.035 respectively) (Table 4.11). Compared to US organic respondents, they were less likely to seek out knowledge regarding GE via the media (n1=15, n2=14, U=58, p=0.024) (Table 4.11).

Analysis of respondent discourse revealed NZ organic community respondents to have a high level of risk aversion with respect to the environment and health. Respondent discourse suggests that the organic community's stance on what constitutes human health behavior and a healthy environment shapes their risk perceptions and behavior. Respondents had a high level of risk aversion with respect to the environment and health, in part, because the environment and health were tied so closely with their spirituality. Supporting this conclusion, the economic risk scenario tests suggest that this respondent group is significantly less willing to risk either health or the environment in return for increased crop yields compared to respondents from the GE amenable community (n1=12, n2=6, U=18, p=0.009 and n1=12, n2=6, U=0, p=0.000 respectively) (Table 4.13). GE is potentially risky for both health and the environment; thus, it is not surprising that organic community respondents are averse to its application in farming. The threats to health and threats to the environment rank-orders support this finding. NZ organic community respondents ranked GE as significantly more threatening to health (n1=32, n2=13, U=114.5, p=0.018 and n1=13, n2=6, U=2, p=0.001) (Table 4.3) and the environment (n1=32, n2=13, U=73.5, p=0.001 and n1=13, n2=6, U=12, p=0.017) (Table 4.4) than both NZ consumer and GE amenable farmer respondents, respectively.

In addition to respondent's risk aversion with respect to health and the environment, respondents viewed many of the risks posed by GE as being more likely to come to fruition than did NZ consumer or GE amenable farmer respondents. Compared to NZ consumer respondents, respondents from the NZ organic community saw the following risks of GE as being significantly more likely to happen: human antibiotic resistance (n1=32, n2=16, U=151.5, p=0.018), loss of crop diversity (n1=32, n2=16, U=166.5, p=0.039), and limited access to GE crop varieties (n1=32, n2=16, U=159.5 p=0.021) (Table 4.8). Similarly, compared to NZ GE amenable farmer respondents, respondents from the NZ organic farming community saw the following risks as being significantly more likely to happen: human antibiotic resistance (n1=16, n2=6, U=10, p=0.004), creation of new viruses (n1=16, n2=6, U=12.5, p=0.007), loss of crop diversity (n1=16, n2=6, U=8.5, p=0.002), gene transfer to wild varieties of plants (n1=16, n2=6, U=9.5, p=0.002), toxicity from GE foods (n1=16, n2=6, U=9, p=0.003), negative alterations in nutritional quality (n1=16, n2=6, U=10, p=0.004), a lack of labeling of GE ingredients in food (n1=16, n2=6, U=11, p=0.004), and increased risk of food allergens (n1=16, n2=6, U=6.5, p=0.002) (Table 4.8).

NZ organic community respondent's foundational models of health and the environment, coupled with their general risk aversion leads to a view of GE as being a negative sum return for New Zealand. The technology is against the group's conception of nature, concentrates power in the hands of mega-corporations, risks health and the environment, risks the economic enterprise of organic farming in New Zealand and endangers the nation's national identity. With respect to endangering the nation's organic farming industry, respondents were concerned that crops would become contaminated by GE pollen. Contamination would result in lost revenue, as farmers could no longer demand organic price premiums for their products.

NZ GE-Amenable Farmer GE Model

Analysis of respondent discourse indicates that views on the environment coupled with a business mindset lay the foundation for how NZ GE amenable farmer respondents view GE technology.

NZ GE amenable farmer respondents approach farming with a business mind-set as opposed to the spiritual mindset pervasive among organic farming community respondents. For them, the environment is not nature, as it is for organically minded individuals, it is land and landscape. They enjoy being outdoors but they do not have a spiritual connection to the land. Their farm is a business and an economic bottom line. By being successful farmers, they feel that they are helping to maintain New Zealand national ideology. They considered that ideology to be, not clean green New Zealand, but agricultural New Zealand - a landscape dotted with rolling agricultural fields. The following are a few representative comments:

> "We are an agricultural nation and depend on agricultural products but urban people can't get their heads around it. New Zealand's agricultural base brings consumer goods into the country but the urban people think New Zealand would be better without farmers, they see farmers as polluters not producers" NZ GE-Amenable Farmer 1, age 54.

> "New Zealand is a food basket, it's what we do. We export food to the world. 12% of New Zealand's workforce is involved in just dairy farming. We help feed the world. Agriculture has made New Zealand green and scenic, all the rolling green farm fields" NZ GE-Amenable Farmer 3, age 58.

The business orientation of GE amenable farmer respondents influenced their willingness to take risks with both health and the environment. Comments include:

> "Man will always have an influence on the environment. If we need to knock over bush to grow more food, we'll do it. It's what we do…we have to recognize the constraints to staying alive…the environment may become degraded to do this" NZ GE-Amenable 3, age 58.

"The environment should be below economic and social viability in importance. Environmental regulations and the RMA are too restrictive" NZ GE-Amenable 4, age 41.

Further supporting this idea, the risk scenario exercises indicate that GE amenable farmer respondents were significantly more willing to risk human health and the environment for a benefit of improved crop yields (n1=12, n2=6, U=18, p=0.009 and n1=12, n2=6, U=0, p=0.000 respectively) (Table 4.13) than were organic farmer respondents.

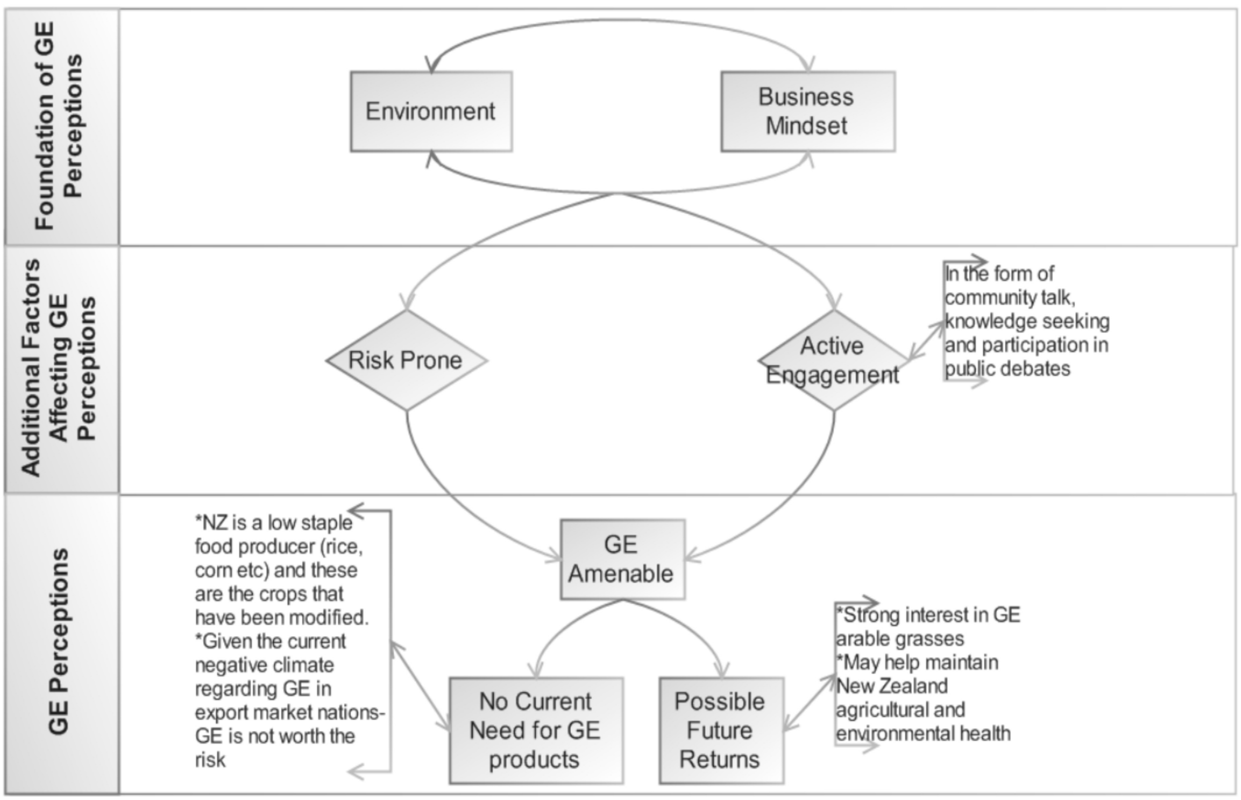

Figure 6.8: NZ GE-Amenable Farming Community GE Model

In addition to being risk prone, GE amenable farmer respondents were also less likely to see GE as risky. As indicated during the discussion of the NZ organic community's model of GE, GE amenable farmer respondents, compared to organic community respondents, viewed GE crops and food as being significantly less risky with respect to: human antibiotic resistance (n1=16, n2=6, U=10, p=0.004), creation of new viruses (n1=16, n2=6, U=12.5, p=0.007), loss of crop diversity (n1=16, n2=6, U=8.5, p=0.002), gene transfer to wild varieties of plants (n1=16, n2=6, U=9.5, p=0.002), toxicity from GE foods (n1=16, n2=6, U=9, p=0.003), negative alterations in nutritional quality (n1=16, n2=6, U=10, p=0.004), a lack of labeling of GE ingredients in food (n1=16, n2=6, U=11, p=0.004), and increased risk of food allergens (n1=16, n2=6, U=6.5, p=0.002) (Table 4.8). Similarly, GE amenable farmer respondents, compared to NZ consumer respondents, found GE to be less risky with respect to: human antibiotic resistance (n1=32, n2=6, U=47, p=0.043), creation of new viruses (n1=32, n2=6, U=42, p=0.026), decreased crop genetic diversity (n1=32, n2=6, U=32, p=0.008), gene transfer to wild varieties of plants (n1=32, n2=6, U=32, p=0.007), toxicity in GE foods (n1=32, n2=6, U=40, p=0.022), negative alterations in the nutritional quality of food (n1=32, n2=6, U=40, p=0.021), a lack of labeling of GE ingredients in food (n1=32, n2=6, U=36, p=0.012), and increased risk of food allergens (n1=32, n2=6, U=23.5, p=0.003).

The desire to have the opportunity to use GE products as part of their business, leads GE amenable farmer respondents to be actively engaged in the GE debate. GE technology and how to bring it successfully into NZ agriculture is a common topic of conversation among this relatively small community. This finding is supported by results from the engagement Likert scales which indicates that respondents were significantly more likely than NZ consumer respondents and NZ organic community respondents to have talked about GE (n1=32, n2=6, U=15, p=0.001 and n1=15, n2=6, U=20, p=0.035 respectively) (Table 4.11). Respondents often advocated on behalf of GE in public forums on the subject and at local community farming meetings.

Overall, GE amenable farmer respondents perceived genetic engineering technology as a technology that has future potential but also one that is not needed currently. Respondents felt there was little current need for the technology as it is presently most common in staple food crops like corn, soy and rice; crops New Zealand does not produce in large quantities. Moreover, the technology is not widely accepted throughout the world and many key New Zealand export markets do not want GE food at this time. Respondents do want the ability to use GE technology in the future should agricultural seed varieties be developed that suit New Zealand agriculture and should key export markets become more amenable to the technology. They are proud of the nation's reputation as an early adopter of technology and do not want to be left behind. A few representative comments follow:

> "New Zealand agriculture has been so competitive because we pick up new science technology so fast and understand how it works and we adapt the technology to us" NZ GE Amenable Farmer 1, age 54.

> "Technology, it's what farmers do. Farmers in New Zealand have a quick uptake of new farming ideas and systems" NZ GE-Amenable 3, age 58.

> "I can't see the benefit of releasing it into New Zealand now. It would jeopardize our image for not much return. When the technology has moved to the next stage, when its widely accepted round the world, New Zealand will follow suit and may lead in the technology" NZ GE-Amenable 4, age 41.

> "I want GE to be a future option so we can stay sustainable" NZ GE-Amenable 6, age 31.

Discussion of Stakeholder GE Models

Views of the environment and health proved to be important determinants of stakeholder respondents stances regarding GE technology. For respondents from the organic farming communities in the US and New Zealand, GE does not fit in with their schemas of health and the environment. GE is viewed as an unholy and dangerous modification of nature, the very nature that is revered by respondents. To modify nature in such a way is a direct affront to their spiritual ideals of living in harmony with the natural world. Furthermore, by threatening nature, GE is seen as a serious threat to human health, as environmental and human health are believed to be intimately related. Due to the high values placed upon the environment and health by respondents from the US and NZ organic communities, members are unwilling to accept even low levels of risk to either factor. Thus, GE technology is seen as a technology with a negative sum return.

GE easily fits in with the health and environment models espoused by respondents from the GE farming communities. Without a spiritual tie to the environment, respondents can approach the environment in a more utilitarian business-oriented fashion and view it as land to be cultivated. For US GE community respondents, with their ties to Christian tenets of land dominion and improvement, GE is viewed as yet another technology enhancing man’s control over nature and furthering land production efforts. It is seen as a technology improving upon weaknesses in the environment for the benefit of mankind. For NZ GE amenable farmer respondents, the technology is seen as one that could enhance New Zealand agriculture and ensure its competitiveness in world markets. By staying abreast of the latest agricultural technologies, respondents from this community feel that they are reaffirming agriculture as the backbone of New Zealand. Both groups of respondents are more accepting of the risks associated with GE, compared to respondents from the organic farming community, as they believe risks to be a standard part of farming and business. It should be noted that while both respondent groups are accepting of GE technology, it is not an unequivocal acceptance for either group. US farming community respondents accept the technology as it is believed to be necessary to stay in business but they have not found that the technology increases their profit margins. NZ farming community respondents are accepting of the technology in theory but only if the technology is applied towards crops important for NZ agriculture and if worldwide opinion of the technology changes such that the export market for GE crops is assured.

Compared to respondents from the organic and GE farming communities in the US and NZ, consumer respondents had more simplified models of GE technology. The health and environment models of Pro-GE US and NZ consumer respondents lacked any factors that would preclude acceptance of the technology. Faith in science was the primary reason for the acceptance of GE technology by Pro-GE consumer respondents. Both groups felt that scientists were relatively unbiased regarding the safety of GE technology, and should the risks of GE come to fruition, respondents felt that scientists could adeptly handle and correct any problems that might arise. Overall, Pro-GE consumer respondents felt the benefits of the technology outweighed the minimal risks it posed.

By contrast, the health and environment models of Anti-GE US and NZ respondents possessed factors that precluded acceptance of GE technology. Anti-GE consumer respondents were very concerned with the health repercussions of chemical contaminations (pesticides, herbicides). While not the same as chemical contamination, Anti-GE respondents often associated GE technology as being something similar. Synthetic chemicals were seen as artificial manipulations of nature as was GE technology. Thus, both respondent groups felt the technology posed a risk to health. With respect to environment models, NZ consumer respondents had an environment model based in notions of clean green New Zealand. By associating GE with chemical contaminations, a form of pollution, GE is seen as a direct threat to national identity and thus to respondent's model of the environment. The environment model of Anti-GE US consumer respondents was less developed than that of NZ consumers but respondents did consider GE to be more harmful to the environment than did Pro-GE US consumer respondents. This group felt they lacked sufficient knowledge about GE. However, unlike Pro-GE US consumer respondents whose lack of knowledge was mediated by a strong faith in science, this groups lack of knowledge caused members to want to proceed with caution with respect to GE. They did not feel that science could handle all of the risks of GE that might come to pass.

Conclusions Derived from the Cultural Models

The perceptions and meanings of GE technology uncovered during the course of this research clearly support Hypotheses 1a and 1b presented in Chapter 4, regarding inter and intra-cultural variation in cultural meanings evoked by GE technology. With respect to Hypothesis 1a, the research shows that New Zealand consumer respondents do, by and large, ascribe more negative attributes to GE technology than do US consumer respondents. Out of 32 NZ consumers interviewed, only 11 were in favor of the technology. Furthermore, those stakeholder respondents open to GE technology (pro-GE consumers and GE amenable farmers) felt that either the technology was not currently needed in New Zealand (NZ GE amenable farmer respondents), it was currently a potential danger for New Zealand from an economic standpoint (pro-GE NZ consumer respondents, NZ GE amenable farmer respondents), or that it could tarnish the nation's image (pro-GE NZ consumer respondents).

Intra-culturally, the meanings ascribed to GE varied widely, thus, supporting Hypothesis 1b (Chapter 4). Respondents from the organic farming communities in each nation saw the technology as inherently risky and an affront to nature and their life philosophy of living in balance with nature. By contrast, respondents from the GE farming communities saw the technology as innovative and as necessary from a business perspective. US GE farmer respondents need the technology to stay in business due to labor shortages and NZ GE amenable farmer respondents hope to gain a competitive advantage in international markets should the technology gain increased acceptance worldwide and be applied to crops relevant to NZ agriculture. Consumer respondents in both nations were less engaged with the GE debate compared to those in the organics and GE communities and were divided with respect to their stances on GE technology. Those consumer respondents with a strong faith in science were more accepting of the technology while consumer respondents highly concerned with chemicals in and on food often felt very negatively towards GE. They associated GE technology with agrichemicals, like pesticides and herbicides, and thus viewed it as a potential food pollutant.

With respect to stakeholder GE models, differences in stakeholder perceptions of health and the environment often played a significant role in determining respondent stances on GE. As predicted by Hypothesis 2a, health proved to be a key component in explaining intra-cultural variation in stances on GE. Anti-GE consumer respondents associated the technology with chemical contamination of food, which they considered a health risk and respondents from the organic farming communities associated the technology with unnaturalness and saw it as an affront to their spiritual connection with nature, an essential component of health. By contrast, pro-GE consumer respondents and respondents from the GE farming community, while not necessarily seeing the technology as better for health, also did not see it as a threat to health.

Analysis showed respondent environment models to be an important determinant of GE stances both inter and intra-culturally as predicted by Hypothesis 2b. From an intra-cultural perspective, each respondent group had a very unique conception of the environment. For example, respondents from the organic farming community viewed the environment as nature and GE, with its manipulation of genes, was seen as unnatural. By contrast, respondents from the GE community viewed the environment as land used to make a living and the technology was seen as one offering improvements to the land and securing agricultural sustainability.

From an inter-cultural perspective, New Zealand's clean green national identity was often a key feature influencing respondent stances on GE technology. For example, Anti-GE NZ consumer respondents were opposed to the technology partially because they felt GE was a direct threat to national identity. By contrast, Anti-GE US consumer respondents do not have a national identity associated with the environment or a comprehensively conceived environment model and opposed the technology primarily because they lack knowledge about the technology and want to proceed with caution.

Overall, cognitive cultural modeling proved an affective means of representing stakeholder perceptions of GE technology. By modeling factors associated with the risks and benefits of GE technology (i.e. health and environment), one could gain a clearer picture of why groups both support and oppose the technology.

Contributions of Research to Anthropology

In addition to providing greater understanding regarding intra- and inter-group differences in perceptions of GE technology, the cultural modeling component of my dissertation makes two methodological contributions to anthropology. Cultural models have traditionally been derived via schema analysis of respondent discourse (see Cooley 1999, Garro 2000, Kitchell et al. 2000, Childers 2001). Schema analysis has been criticized for providing "no explicit grounds for determining whether something is shared" with sharing being considered a defining feature of cultural integrity (Garro 2000:285). Garro (2000:285) suggests that, "both cultural consensus and cultural models approaches could productively be applied in a converging manner to learn about underlying cultural knowledge and intracultural variation for a given topic." This dissertation supports Garro's supposition as it affectively utilizes both methods to formulate and inform respondent models. Cultural consensus analysis of respondent free-list data regarding health, environment and GE helped to confirm the cultural sharing of foundational components seen in respondent's cultural models derived via discourse analysis.

As a form of qualitative research, cultural modeling can be criticized for lacking scientific rigor and reproducibility. This research addresses that criticism by including additional quantitative research methodologies such as rank-ordering, likert scaling and risk scenario exercises to inform the cultural models. The quantitative measures taken during the course of this research contribute to cultural modeling by mathematically confirming and quantifying inter-group differences in model foundational components derived via schema analysis. Both schema analysis and the quantitative measures utilized in this research highlight patterns of agreement and disagreement among groups and inform the models regarding degrees/directions of difference across groups for key areas of interest.

By combining both qualitative and quantitative methods to create and inform cultural models, a rich picture of cultural perceptions and meanings can be painted that is both nuanced yet mathematically rigorous.

Chapter 7 - Media Analysis

Introduction

Within agriculture, genetic modification is a concept that dates back centuries as farmers used selective breeding and crossbreeding to achieve a product with improvements in size, taste, growth, and shelf-life (Ackerman 2002). With recent scientific innovations, however, genetic modification has taken on a whole new connotation. Previously, genetic modification involved breeding between species that could sexually mate or cross-pollinate with each other and produce viable offspring. Thus, breeding usually occurred within a genus and most often within a species. With the advent of 20th century genetic engineering (henceforth GE) techniques, species and genus boundaries could be crossed, including the boundary between animals and plants.

As discussed in Chapter 1, GE has both benefits and risks and has been a controversial technology since its inception in the 1970s. There has been considerable variation in its level of acceptance around the world. Commonly cited reasons for this divergence are differences in trust in regulatory authorities, scientific literacy, and press coverage (Gaskell et al. 1999). The focus of this chapter will be on press coverage, in particular, press coverage in the United States and New Zealand. The amount of media coverage and the focus of that coverage can influence public opinion regarding GE. Furthermore, the more attention a given topic gets, via increased reporting, the more salience the topic has for the public (Botelho 2004). If coverage "is consistently focused on a few issues, then members of the public will associate GE food with those issues" (Botelho 2004:6). Previous research suggests that consumers acquire knowledge about biotechnologies like GE primarily from media sources (Hallman and Metcalf 1995, Hoban 1998, Botelho 2004). GE technology in its current form is a relatively new technology not previously encountered by people and one in which understanding often does not come easily. For example, recent US surveys indicate that few Americans understand the processes behind GE or are aware of the products that result from the technology (Hallman et al. 2003, Hallman et al. 2004). Only 19% of those surveyed remembered any events or news stories regarding GE and when presented with both true and false GE stories, recognition was in the range of 7 to 36% (Hallman et al. 2003, Hallman et al. 2004). Newspapers and television news sources are one of the easiest ways in which an average person can garner a basic understanding of the technology. Priest (2002) contends that the media is the primary means of influencing public reaction regarding GE technology. According to Nelkin (1995), the media sets the boundaries for scientific debates like GE by framing scientific problems and solutions in particular ways. The public's lack of experience in dealing with GE technology means that news coverage via outlets like the TV and newspaper are likely a strong influence on people's opinions. Priest (1999) contends that the media's power to influence public opinion is strongest for issues surrounding science and technology.

A Brief Review of Previous Newspaper and Television Analyses Relating to GE

The main focus of this review will be on US media sources. A literature search indicates that media analysis of GE coverage in NZ newspapers and TV has not occurred with the exception of one paper by Rupar (2002), which will be discussed. The section will begin with a review of US newspaper and TV analyses followed by a discussion of Rupar's (2002) research findings.

<u>US Media Coverage of GE Technology Issues</u>

Nisbet & Lewenstein (2002) conducted a comprehensive study of biotechnology-related media coverage in the US. They completed a quantitative content analysis in the New York

Times and Newsweek for biotech related coverage occurring between 1970 and 1999. Early media coverage of biotechnology primarily focused on recombinant DNA technology (rDNA), a precursor to today's GE technology, and risk was the primary emphasis in media articles. Scientists were the primary sources of information for the media and they effectively managed media content, the result being a focus on "laboratory-based technical risk" (Nisbet & Lewenstein 2002:363). The broader social and ethical implications of the new technology were given less legitimacy and attention in the media. By controlling media content, scientists were the primary shapers of early rDNA policy outcomes. In the 1980s, the power of scientists to direct media content gave way to the power of industry. Media coverage was "characterized by one-sided promotion of the biotechnology industry, with the press 'held captive' by industry publicity. Every new scientific finding was heralded by media reports as a major new cure or agricultural application" (Nisbet & Lewenstein 2002:364). Media coverage in this era shifted to an emphasis on "breakthroughs and economic benefits" (Nisbet & Lewenstein 2002:364). In the 1980's government policy makers were also a significant influence on the media as they considered the development of the biotech industry to be critical for US economic growth (Krimsky 1991). The rhetorical device used first by scientists and then by industry and policymakers to frame the biotech/GE debate is called specious reduction. According to Altimore (1982), proponents of technological innovation try to narrow how the technology is portrayed in the media by dispensing with non-technical issues and putting the focus on demonstrable benefits that can be achieved in a short to medium term time frame.

Starting in 1991, media coverage of biotechnology turned less positive with increased media coverage of risks associated with the technology (Gaskell et al. 1999, Nisbet & Lewenstein 2002). A time series study of the Wall Street Journal, USA Today, and Washington

Post between 1990 and 1999 showed increased coverage of agricultural biotechnology with coverage focused more on risks than benefits (Marks et al. 2000, Nisbet & Lewenstein 2002). The sharp increase in coverage is due to landmark events like Dolly, the cloned sheep, and contamination of the US food supply with GE corn unapproved for human consumption. These landmark events opened up the debate on GE technology and allowed for the introduction of topics such as ethics, risk, and accountability into the debate (Nisbet & Lewenstein 2002, Nucci & Kubey 2007).

In comparison to research focused on print media, there has been little research on television coverage of biotechnology despite the fact that the 2006 Science and Engineering Indicators Survey indicated 51% of Americans relied on TV news as their primary source of information about current events (National Science Board 2006, Nucci & Kubey 2007). Bauer and Bonfadelli (2002) suggest that TV news is the single most important media outlet by which the public gains information about biotechnology. In the only comprehensive analysis of TV news coverage of biotechnology, Nucci and Kubey (2007) looked at evening news coverage of GE food between the years 1980 to 2003. ABC World News Tonight, CBS Evening News, and NBC Nightly News were analyzed and the results of the study indicate that news coverage was minimal over the time frame examined by researchers. According to Nucci & Kubey (2007:163), "this lack of in-depth news reporting during this period that was critical for the dissemination of information and development of public opinion about GE food…is a concern as a test case for news coverage of science and scientific issues." Only 169 GE food stories occurred over a 23 year time frame, an average of 7 stories per year. Compared to the elite press, TV coverage was sporadic and minimal, except for spikes in coverage that occurred during crisis events.

New Zealand Media Coverage of GE Technology Issues

Focusing on the NZ media, Rupar (2002) looked at press coverage of the Royal Commission on Genetic Modification's (RCGM) final report on GE/GM technology. As discussed in Chapters 1 and 2, the RCGM was to hear submissions from all groups with a stake in the genetic engineering debate. The Commission was tasked with investigating and reporting on:

> the strategic options available to enable New Zealand to address, now and in the future, genetic modification, genetically modified organisms, and products; and any changes considered desirable to the current legislative, regulatory, policy, or institutional arrangements for addressing, in New Zealand, genetic modification, genetically modified organisms, and products (Eichelbaum et al. 2001:6).

The final RCGM report called for the nation to proceed with genetic engineering but with caution. The NZ Green party and much of the NZ populace was disappointed in the report's recommendations (Rupar 2002).

Rupar monitored five metropolitan NZ newspapers for a three-month period. During that period, 383 items (news stories, opinion pieces and letters to the editor) concerning the RCGM report were published. Rupar (2002:59) found that the "print media framed the story primarily as a political conflict between environmentalists and a government that was routinely employed as an authoritative (rather than a contested) source." In the media, the government and environmentalists were portrayed as having two conflicting visions of NZ—wealth and healthy NZ vs. clean and green NZ, respectively. The press helped the pro-GE government dominate the discussion on GE as government officials were the main source of media quotation. Rupar contends that the press, in its news stories and editorials, took a pro-GE stance, despite the fact that this position did not reflect the stance of its readers. With the media's focus on the conflict story between Greens and the government, the risks and benefits associated with GE were largely ignored.

Research Design and Methodology

Research Question

The purpose of this chapter is too look at both newspaper and TV coverage of genetically engineered/modified food and agriculture within both the US and NZ to ascertain how media coverage in the two nations both converges and diverges. The primary question addressed in this chapter is:

> Question 1:
>
> Is there variation in newspaper and TV coverage in the United States and New Zealand in terms of amount of coverage, frames used and sources cited?

The information obtained in this chapter will then be used in Chapter 8 to assess how the media in both nations has likely influenced consumer respondent stances on GE technology.

Theoretical Framework: Framing

Beginning with its inception in the 1970s, framing has proven to be a popular theoretical approach for analyzing media. According to Crawley (2007), an analysis of framing can aid in understanding what factors are influencing media coverage, dominating public debate and impacting public policy. Framing is a means to make some issues more salient than others.

> In the case of a scientific controversy such as GMOs, news media can select to focus on the dangers of 'Frankenfoods' as opposed to the promise of new technologies to fight hunger and disease; can frame the issues as a risk or as a scientific opportunity; can emphasize cross-pollination of GE crops versus reduction in pesticide use; and can highlight a positive or negative stance toward agrifood biotechnology. In so doing, news media can also use as news sources the industrial developers with a vested interest in the technology or the environmental activists with a publicly stated interest in protecting the environment (Crawley 2007:318).

A frame is an organizing idea, which enables journalists and the general public to understand a given topic such as GE (Botelho 2004, Gamson & Modigliani 1989). Frames are selected aspects of reality that are made more salient in news text in order to highlight certain problems, causal interpretations, and treatment options (Botelho 2004, Entman 1993). Journalists create frames by both the presence and absence of keywords and images (Botelho 2004, Entman 1993). Furthermore, in order to meet space requirements, journalists use a certain amount of abstractions in their writing. According to Botelho (2004:7), “it is this abstraction and the subsequent increased importance of what is kept in the news article that constitutes framing.” By choosing certain words and imagery over others, the media determines how the public will react to and digest a given issue (Botelho 2004, Van Dijk 1998). For example, in a study of how US media coverage of biotechnology influences public reaction to the technology, Nisbet and Lewenstein (2001), found that a decline in public opinion coincided with a switch in frames from frames emphasizing economic prospect and progress to frames emphasizing ethics and controversy.

Media Sources

This research looks at newspaper and TV coverage of GE food and agricultural technology in both the US and New Zealand. Two US and two NZ newspapers were analyzed, The Atlanta Journal and Constitution, The Athens Banner Herald, The New Zealand Herald, and The Press, respectively. Three US TV news stations (ABC, NBC, CBS) and one NZ TV news station (NZTV1) were also analyzed. The choice of newspapers for analysis was based on US and New Zealand consumer responses to a question asking what newspapers they most frequently read with the two top choices being chosen for analysis.

Many respondents stated that they read the newspaper infrequently and received most of their news via the TV. Common TV news sources utilized by respondents included ABC, NBC, CBS, FOX, and CNN. Only the free to air news sources (ABC, CBS, and NBC) were chosen for analysis as they resemble NZTV1, a free to air channel in NZ and the only TV media source within NZ with archives readily available for analysis. NZ respondents also stated that they watched TV3 news but transcripts and/or video archives of news segments from TV3 news could not be obtained.

The Lexis-Nexis Database was used to obtain articles from The Atlanta Journal and Constitution, The New Zealand Herald, The Press and to obtain TV news transcripts for ABC, NBC, and CBS news shows. Articles from the Athens Banner Herald were not found on Lexis-Nexis and were obtained directly from the Athens Banner Herald electronic archives. NZTV1 news transcripts were also not available from Lexis-Nexis and video of news segments was obtained directly from the TVNZ video archives. Using the Lexis-Nexus database as well as the Athens Banner Herald and TVNZ archives, a search was conducted using the following key words: genetically engineered crops, genetically engineered food, genetically modified crops, and genetically modified food. Articles were cross-referenced to remove duplicates and articles, found within either the Letters to the Editor section or Opinions section, were removed. Articles without a focus on GE food or technology were also removed. The time frame for analysis was January 2005 to December 2007. This three-year period was chosen for analysis as it both predates and coincides with the period in which in-person interviews were conducted with US and NZ consumer respondents regarding their opinions about GE. Later analysis will look at how the media is likely to have influenced consumer perceptions of GE, thus, a time frame predating interviews by at least a year was felt necessary.

Methodology

Following Botelho's (2004) methodological format for newspapers and expanding it to include TV, four types of data were collected: article identifiers, frames, sources and bias scores. Identifiers collected during analysis include the name of the newspaper or TV source, the date, and for newspapers, the word length. Word length was recorded as this variable indicates issue salience. For example, shorter articles are considered to be less salient than their longer counterparts likewise for length of TV news segments. In other words, more important issues are given greater news coverage in the form of both more frequent reports on the issue and lengthier reports (Botelho 2004).

For frame data, article text was analyzed for the presence of the following frames identified by Botelho (2004): discovery, economic implications, ethical issues, food and agricultural security issues, public accountability, globalization, environment issues, health implications, labeling, public opinion, and moratorium. Botelho (2004) defined each of the coding frames (Appendix 7.1) and identified keywords to aid in the identification of frames (Appendix 7.3). In order to be considered a frame within the article, it had to occur at the paragraph level. Thus, if an idea occurred in one sentence but the next sentence moved to a different focus, it would not be considered a frame. Articles could have multiple frames.

It should be noted that in similar research, investigators often employed multiple coders for frame analyses in order to check for inter-coder reliability and reproducibility. However, due to the smaller scope of this research and limited monetary funding, additional coders were not used to analyze this data. Like Botelho (2004), in the place of coders, “the find/search command” within Microsoft Word was utilized to help find keywords and their associated frames. This method helps to increase data reproducibility and curb researcher subjectivity.

For each article, transcript, and newscast, journalistic source data was also collected. To be considered a source, the source name and or organization had to be given in addition to the presence of a quote from said source. As in Botelho (2004), source data was made more quantifiable by putting the data into categories: government official, university professor, farmer/

farm association, environmental organization, biotech industry, other industry, other interest groups.

Using methodology developed by Bendix and Liebler (1999) and further employed by Botelho (2004), this study evaluated both the frame and source data for bias. GE positive frame and source data was assigned a +1 and GE negative frame and source data a –1. Neutral data was assigned a value of 0. During analysis source and frame scores were averaged for each newspaper or TV outlet in order to elucidate their balance of reporting. To evaluate article frames and source quotes for bias, each sentence was evaluated regarding its stance on GE and tallied as positive, negative, or neutral. The tallies for each sentence within the frame or quote were then added up to give a total score. If the score was positive the frame or quote was considered positive and vice versa. If a score of 0 was achieved the frame or quote was considered neutral. Further, if the number of neutral sentences outnumbered both positive and negative sentences, the frame or source quote was also marked as neutral.

Results

As previously mentioned, the research question addressed by this chapter is whether there is variation in newspaper and TV coverage in the United States and New Zealand in terms of amount of coverage, frames used, and sources cited.

In terms of amount of coverage, a total of 82 articles and newscasts met the selection criteria for the research. At the nation level, 66% of articles/newscasts meeting the selection criteria were from New Zealand while 34% were from the United States. Median and total number of words used in news articles is another measure of the amount of media coverage. The median number of words in print media ranged from 205 words per article for the Atlanta Journal and Constitution to 785 words per article for the Athens Banner Herald (Figure 7.1). The total number of words in print coverage of genetic engineering or genetic modification ranged from 2711 words in the Athens Banner Herald to 15,436 words in the Press (Figure 7.2). It should be noted that although the Athens Banner Herald had the highest median number of words it also had the fewest articles on GE and the lowest total number of words.

Table 7.1: Number of Articles per Media Outlet

Newspaper	**Number of articles/newscasts between 1/2005-12/2007**
New Zealand Herald	19
The Press	26
Atlanta Journal and Constitution	16
Athens Banner Herald	3
US TV News	9
NZTV1 News	9
Total	82

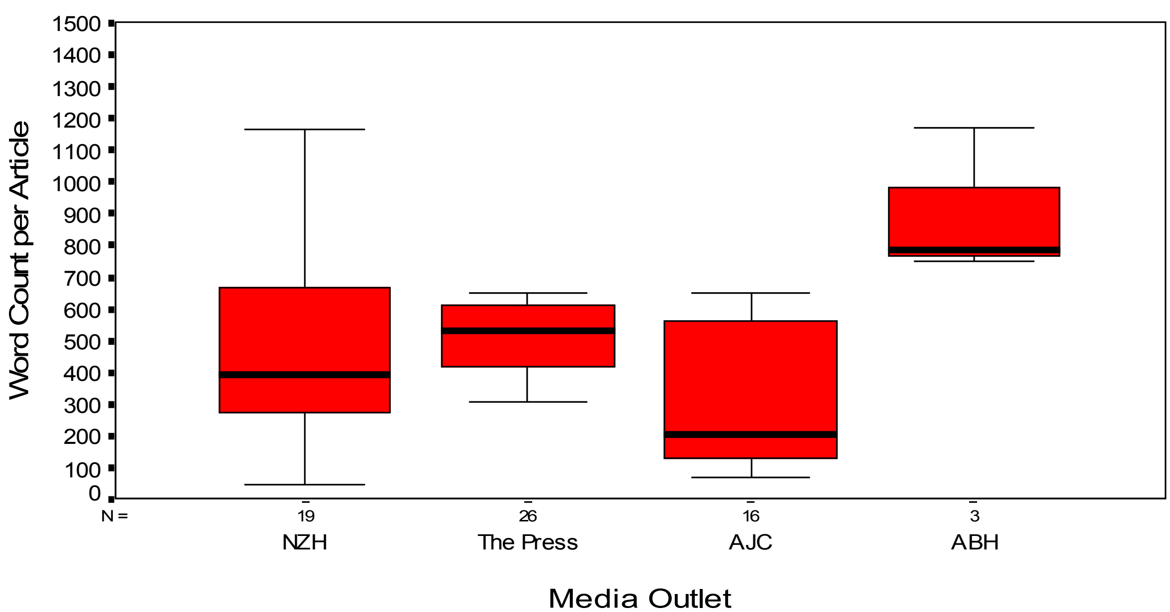

Figure 7.1: Boxplot of word count per article.

The median word count for each dataset is indicated by the black centerline, and the first and third quartiles are indicated by the shaded area, known as the inter-quartile range (IQR). The extreme values (within 1.5 times the inter-quartile range from the upper or lower quartile) are at the ends of the lines extending from the IQR.

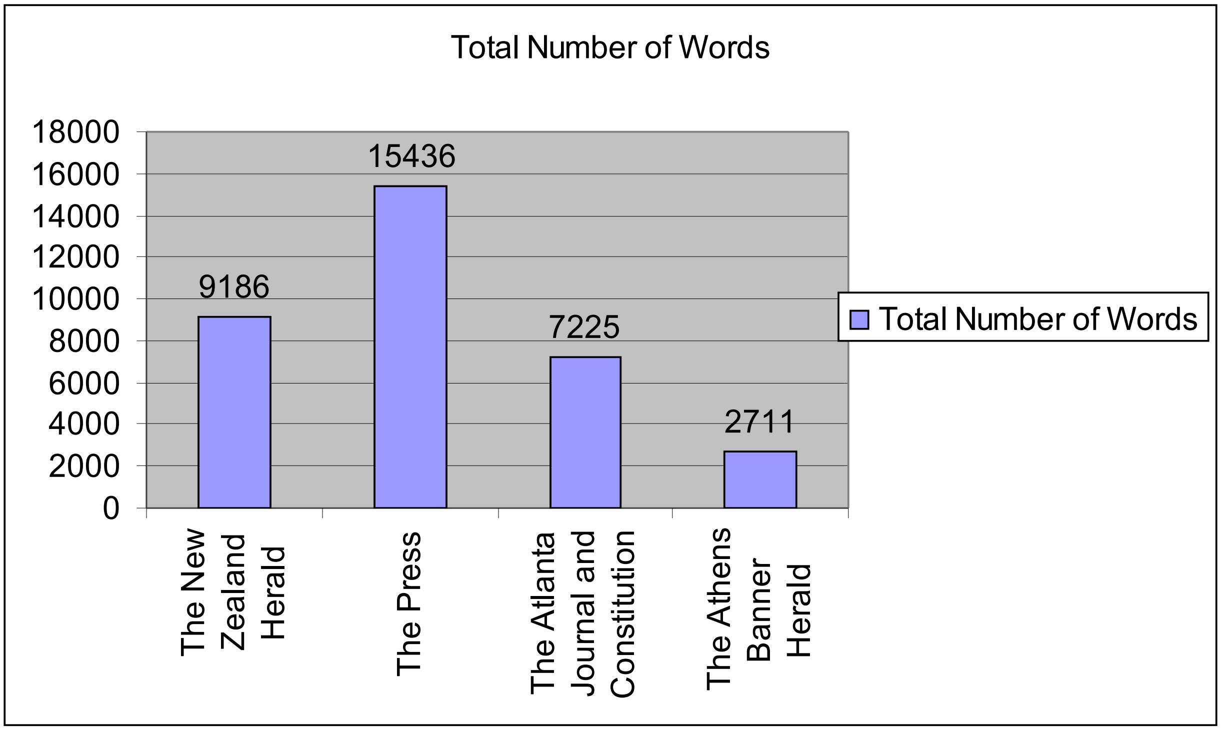

Figure 7.2: Total Number of Words in Print Media

Looking at Table 7.1 and Figures 7.1 & 7.2, variations in amount of print media coverage in the US and NZ become apparent. The New Zealand media sources had a greater frequency of print articles concerning GE compared to the United States media sources and a larger total number of words printed about the subject. Compared to the US, NZ print sources had more than double the number of words printed about GE (24,622 words in NZ compared to 9936 words in the US). It should be noted that word length for TV media was not compared as the archival forms obtained for analysis were in different formats. Printed transcripts, with word length information, were obtained for USTV news sources while complete video segments, with information about segment length in minutes, were obtained for NZTV1.

Analysis of Frames

Framing is the main theoretical and methodological underpinning of the research presented in this chapter as it offers an important means to examine the variation in GE media coverage between the US and NZ. This section will look at the median number of frames for both the newspaper and TV media sources chosen for analysis. This section will also look at how the 11 aforementioned frames are utilized by the media to convey a message about GE, taking note of noticeable absences as well as comparably high frequency levels. The bias scores for each frame will also be presented and discussed.

Figure 7.3 indicates the same median number of frames per article for both newspaper and TV media sources in the US and NZ. In Figures 7.4-7.9, each frames percentage of occurrence in a given news source is given. In order to highlight frame frequency differences between NZ and US media sources, this section will present a composite picture of frames that occurred in a given media source at a frequency of 15% or higher. A frequency cut off of 15% or higher was chosen as this designated range isolated the two to three most prominent frames used by each media source. The New Zealand Herald had two such frames: public accountability (28%) and food and agricultural security (20%). Similar to the New Zealand Herald, The Press had three frames meeting the 15% or greater requirement: public accountability (26%), environmental issues (20%) and food and agricultural security (18%). NZTV1 had only one frame with a frequency rate of 15% or higher: food and agricultural security (43%). Switching to US sources, the Atlanta Journal and Constitution had three frames: globalization (28%), discovery (15%) and food and agricultural security (15%). For the Athens Banner Herald, the following three frames met the requirement: discovery (60%), environmental issues (20%), and health implications (20%). Finally, the top frames for US TV (ABC, CBS, and NBC) were discovery (36%), health implications (16%) and labeling (16%).

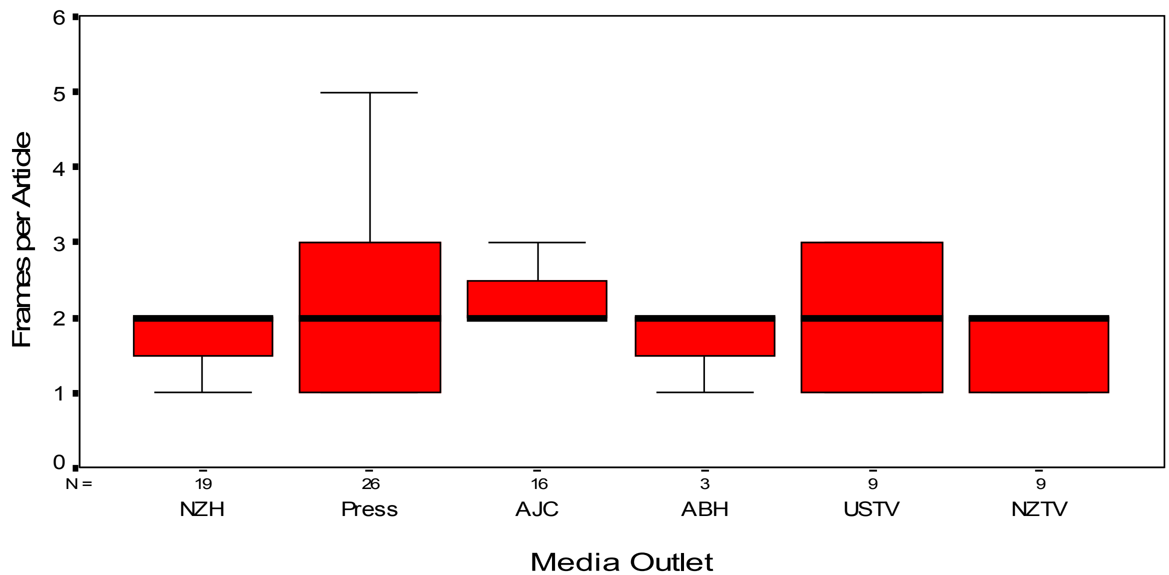

Figure 7.3: Boxplot of frames per article.

The median number of frames for each dataset is indicated by the black centerline, and the first and third quartiles are indicated by the shaded area, known as the inter-quartile range (IQR). The extreme values (within 1.5 times the inter-quartile range from the upper or lower quartile) are at the ends of the lines extending from the IQR.

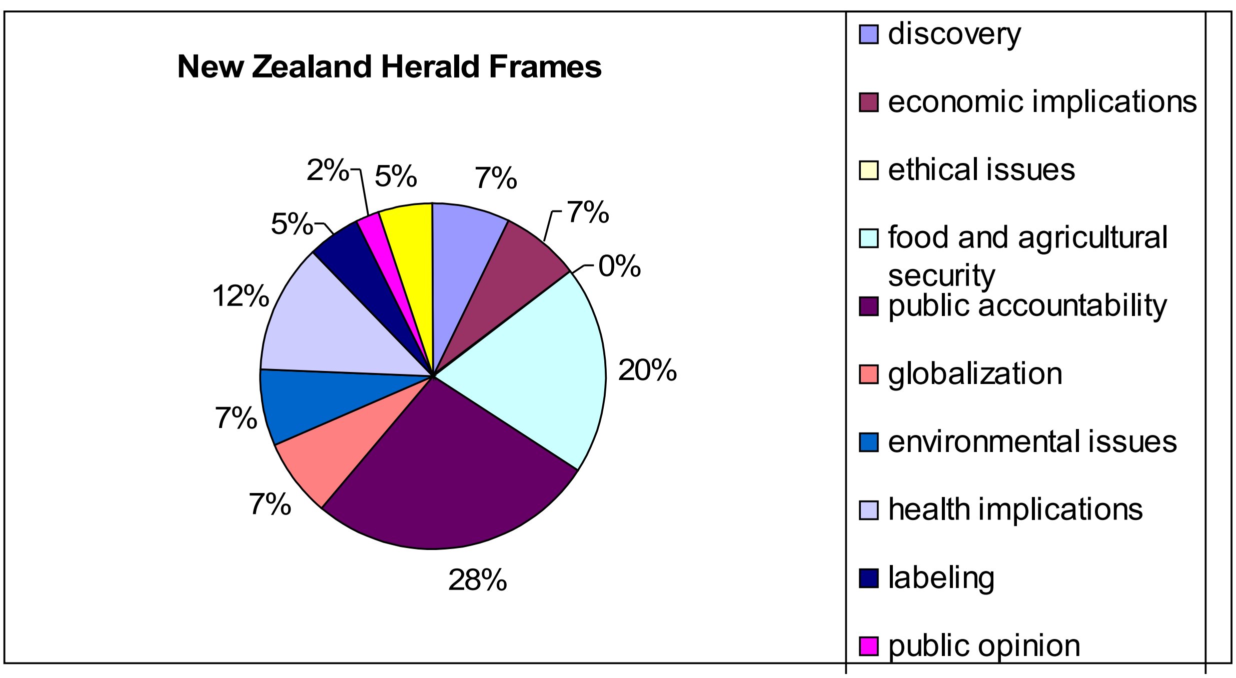

Figure 7.4: The New Zealand Herald Frame Distribution

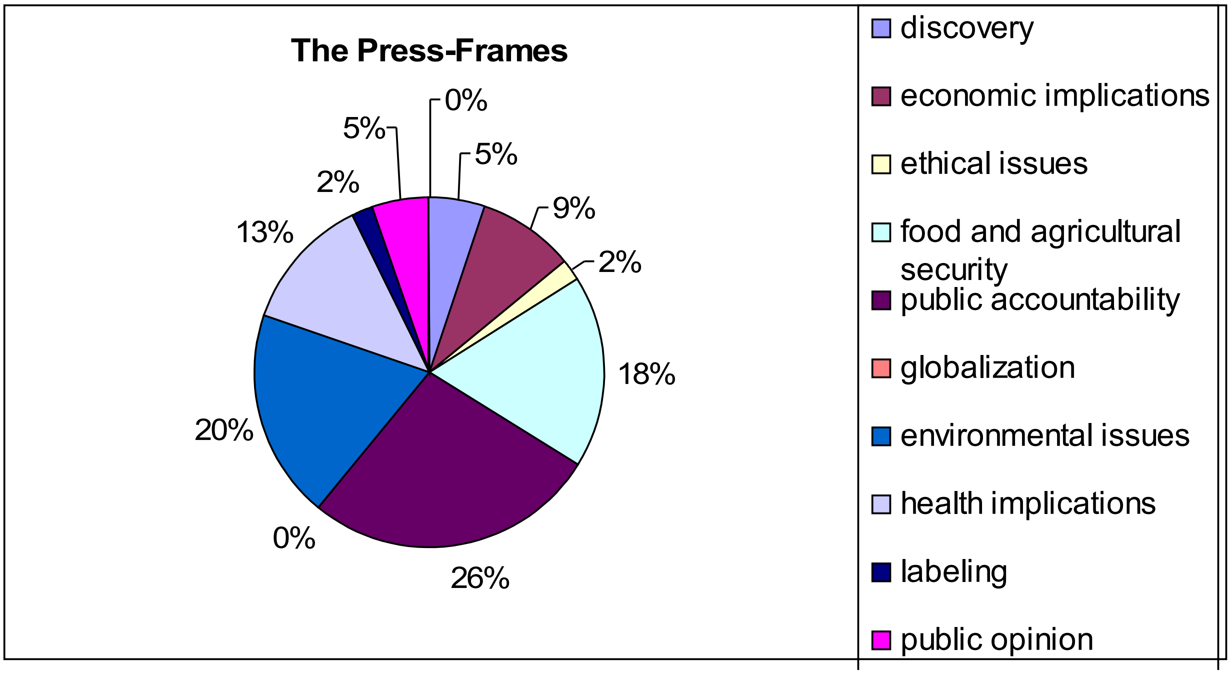

Figure 7.5: The Press Frame Distribution

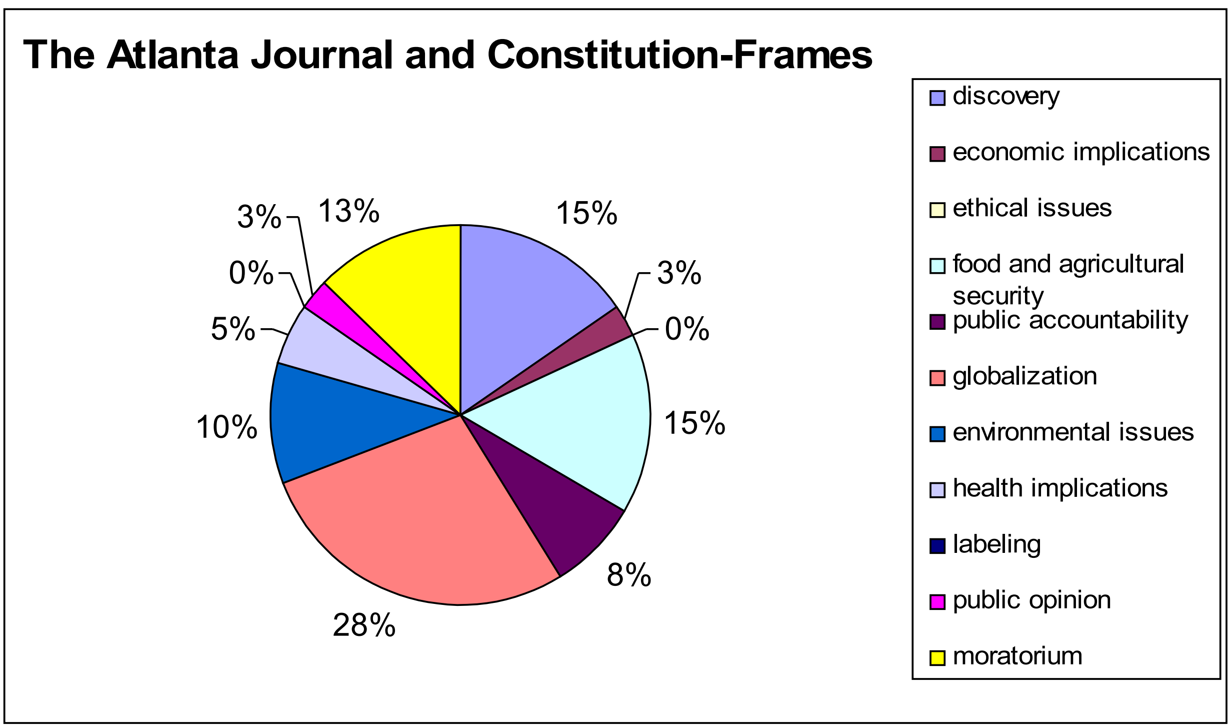

Figure 7.6: The Atlanta Journal and Constitution Frame Distribution

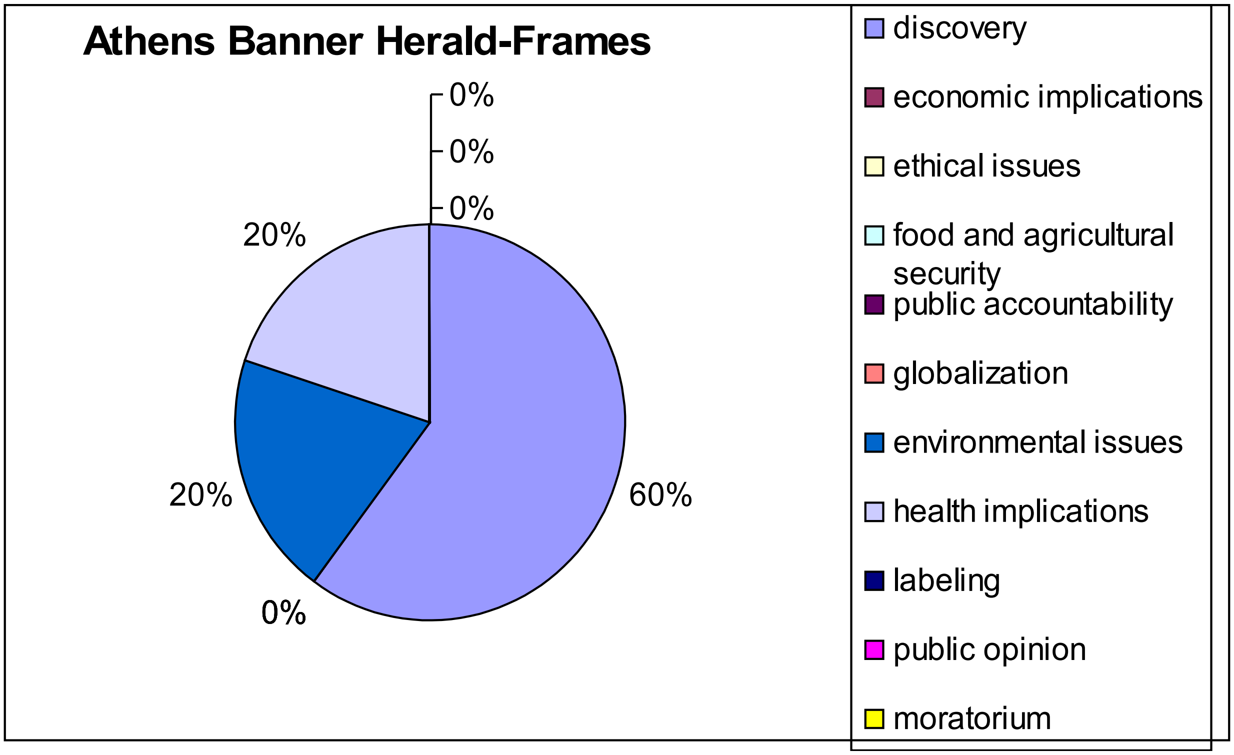

Figure 7.7: The Athens Banner Herald Frame Distribution

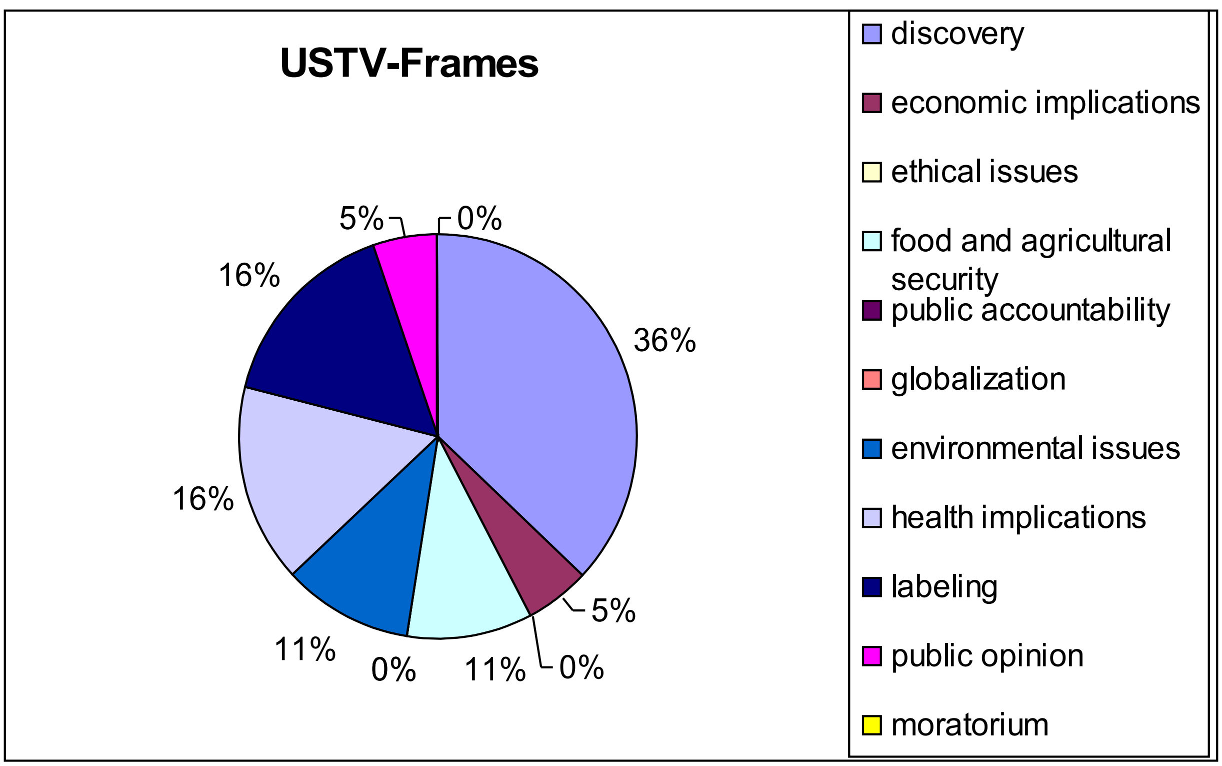

Figure 7.8: US TV Frame Distribution

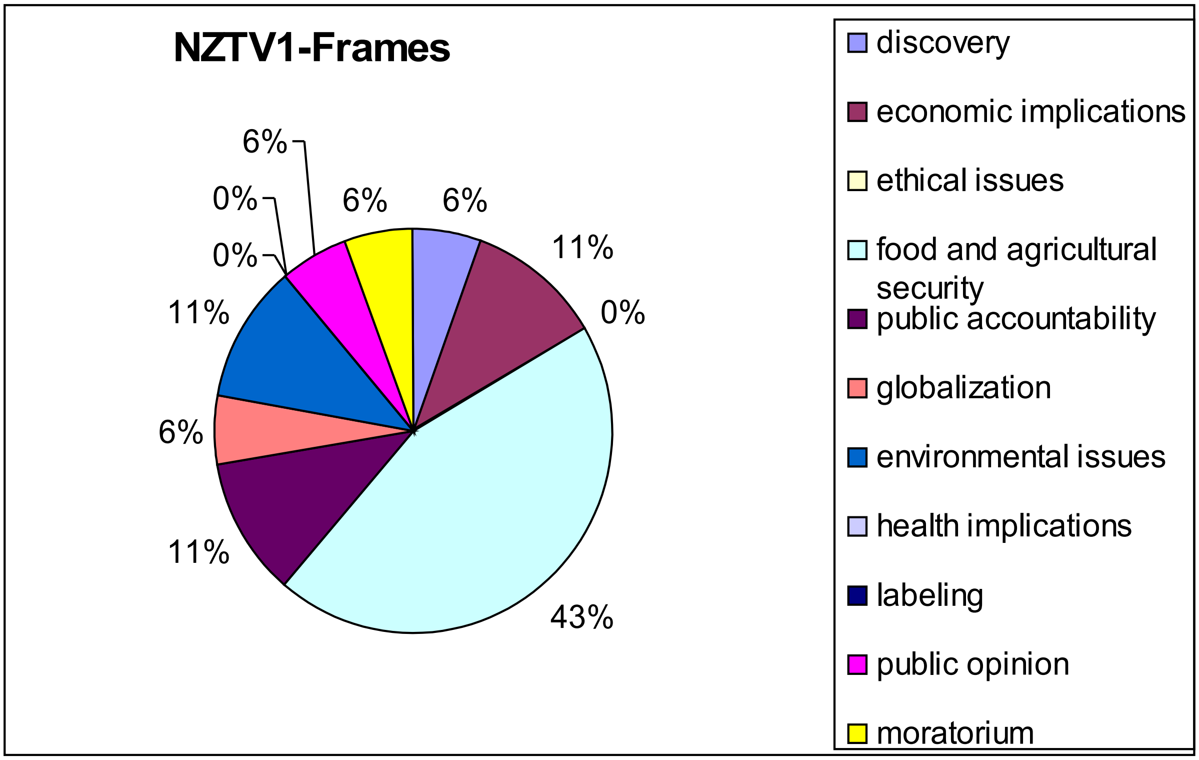

Figure 7.9: NZTV1 Frame Distribution

Notably, the public accountability and food and agricultural security frames appeared at appreciably higher frequencies in the NZ print media sources compared to the US print sources (public accountability-Atlanta Journal and Constitution-8%, Athens Banner Herald 0%, USTV-0%)(food and agricultural security-Atlanta Journal and Constitution-15%, Athens Banner Herald-0%, USTV-0%). Likewise, the discovery frame appears at a much higher frequency in US print media sources than in NZ sources (The New Zealand Herald-7%, The Press-5%, NZTV1-6%).

Frame Bias

In order to determine a given news outlets bias for or against GE food or agriculture, frame bias was calculated. To calculate frame bias, the difference in the number of positive and negative frames was tabulated to give a composite score for the media outlet.

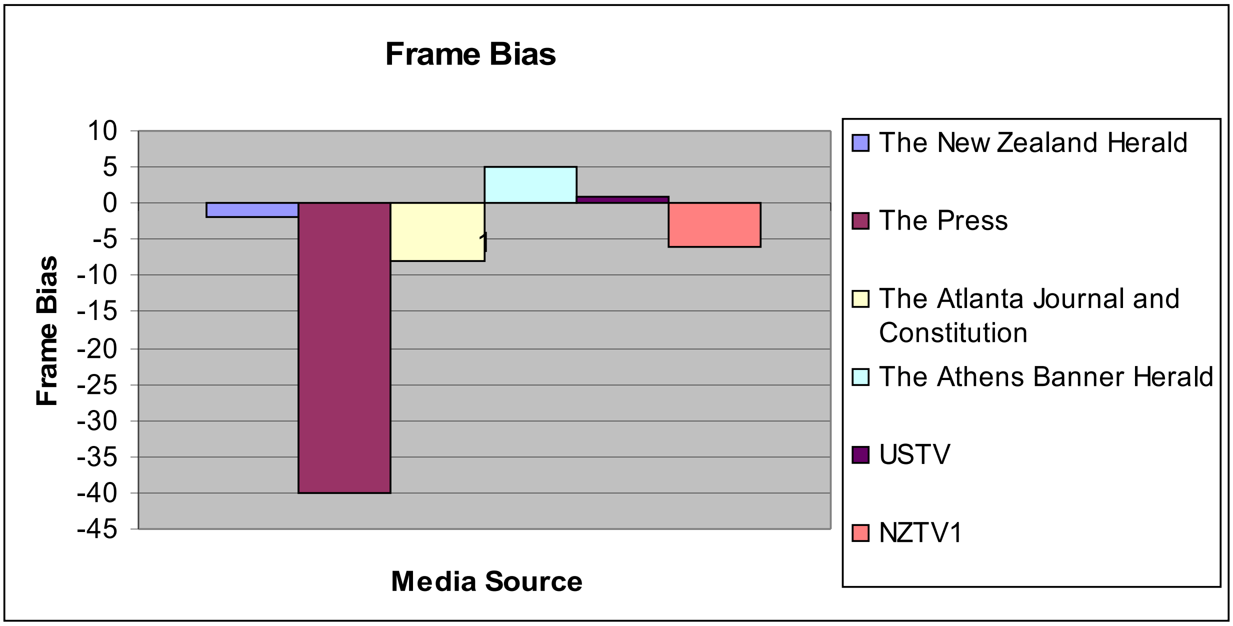

Figure 7.10: Frame Bias for US and NZ Media Sources

As figure 7.10 indicates all three New Zealand media sources employed negative frames more frequently than positive frames. In contrast, two of the three media sources from the United States employed positive frames more frequently than negative ones, with the Atlanta Journal and Constitution being the only US media source in the sample to use negative frames more often than positive ones. The Press was the most negatively framed media source in the sample while the Athens Banner Herald was the most positively framed media source.

Analysis of Sources

According to Botelho (2004) the number of sources used within a given article or news broadcast indicates the importance of sources to both the media and to the news public. Overall, the New Zealand media had a higher median number of sources compared to the US media (Figure 7.11). The greater use of sources in NZ could represent "a form of validation used by the journalists to support what they are saying, or possibly a lack of trust in reporters to tell the truth without some supporting evidence (Botelho 2004)."

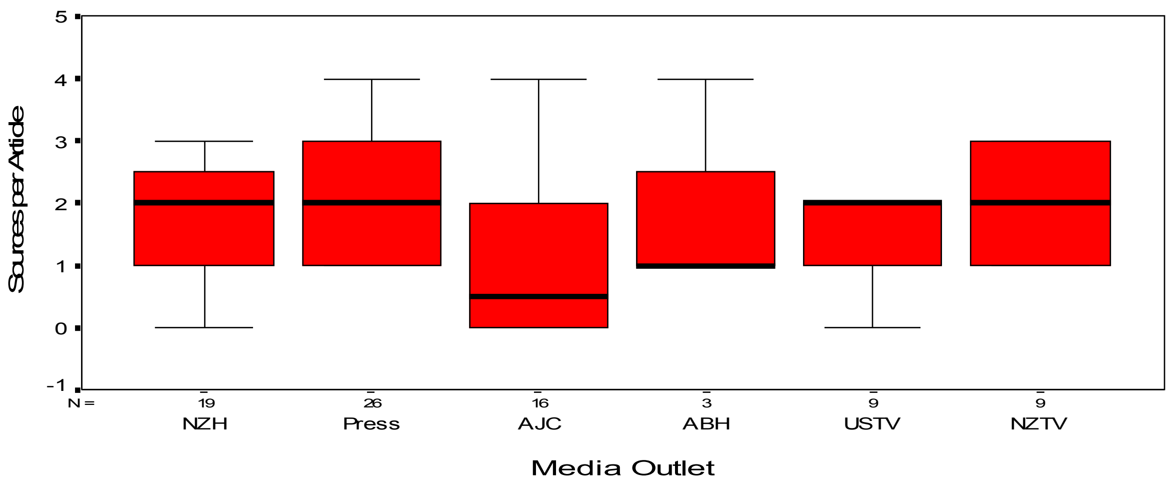

Figure 7.11: Boxplot of sources per article

The median number of sources for each dataset is indicated by the black centerline, and the first and third quartiles are indicated by the shaded area, known as the inter-quartile range (IQR). The extreme values (within 1.5 times the inter-quartile range from the upper or lower quartile) are at the ends of the lines extending from the IQR.

Looking at figures 7.12-7.17, there are clear differences between the United States and New Zealand in source usage for GE coverage. The most frequently quoted news source within New Zealand is the government and government officials (New Zealand Herald 45%, The Press 30%, NZTV1 70%). By contrast, the government and government officials were quoted in only one US media outlet, the Atlanta Journal and Constitution, and then at only a 3% frequency rate. Likewise, university professors were frequently quoted sources within the US media (Atlanta Journal and Constitution 24%, Athens Banner Herald 33%, USTV 25%) but were only quoted frequently in one New Zealand media source (New Zealand Herald 22%). Environmental organizations and the biotech industry were also more frequently quoted in the US media, each appearing in two US sources at a frequency rate over 15% (environmental organizations-Atlanta Journal and Constitution 24%, Athens Banner Herald 17%)(biotech industry-Atlanta Journal and Constitution 31%, USTV 25%). Finally, for US media outlets, a large number of sources fell within the “other interest group” category (Atlanta Journal and Constitution 18%, Athens Banner Herald 50%, USTV 38%). Examples of groups falling within this category are the Union of Concerned Scientists, the Center for Food Safety, and Consumers International.

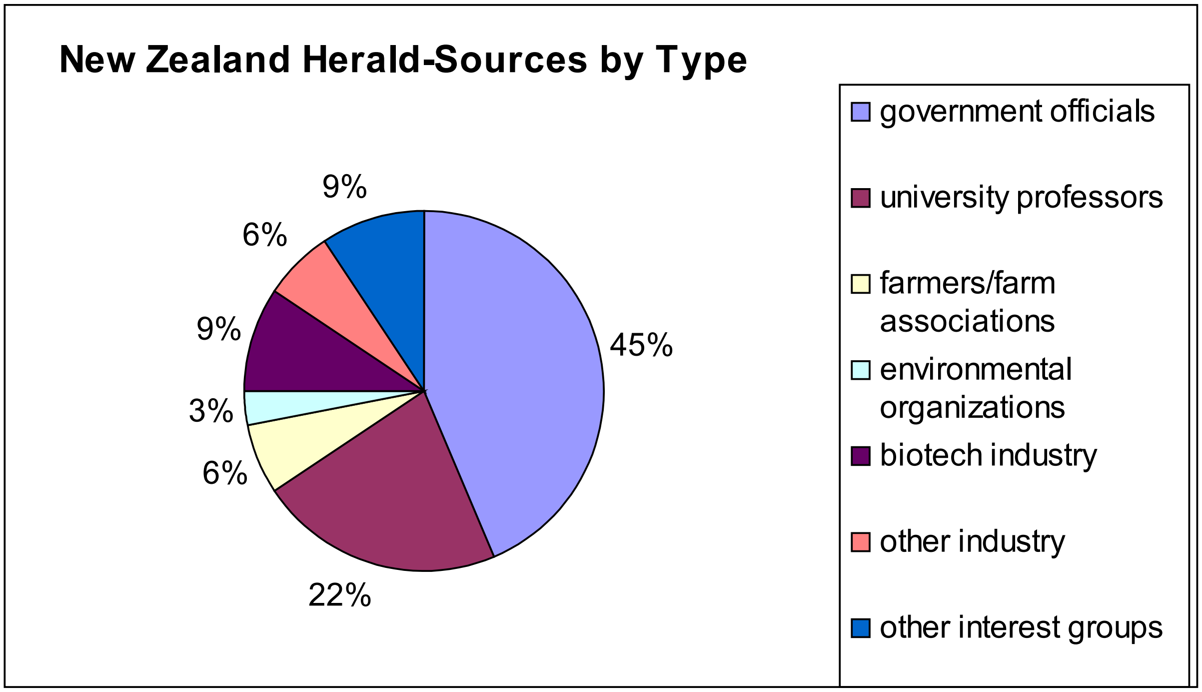

Figure 7.12: Source Frequency for the New Zealand Herald

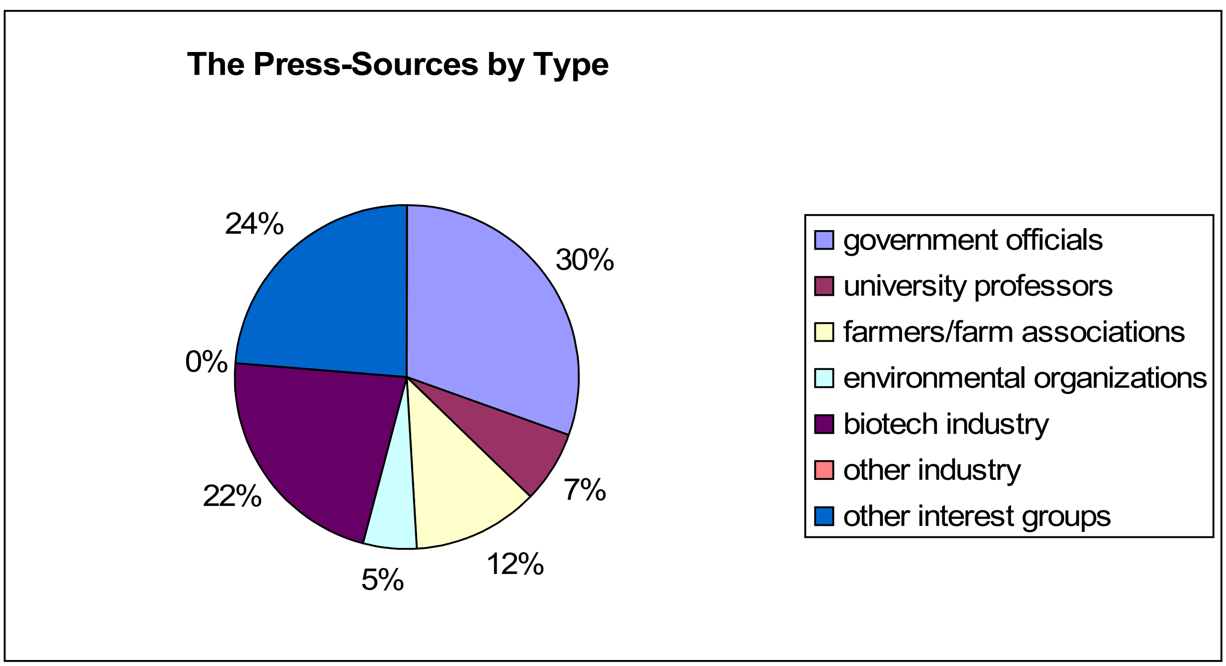

Figure 7.13: Source Frequency for The Press

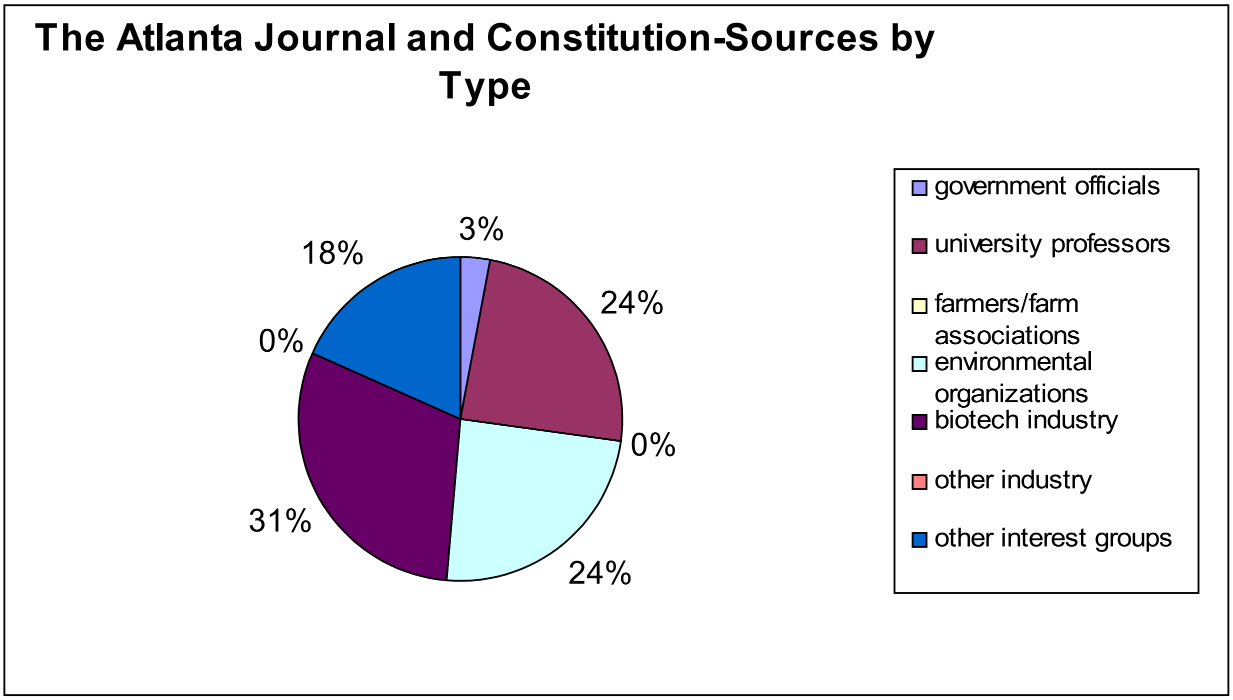

Figure 7.14: Source Frequency for The Atlanta Journal and Constitution

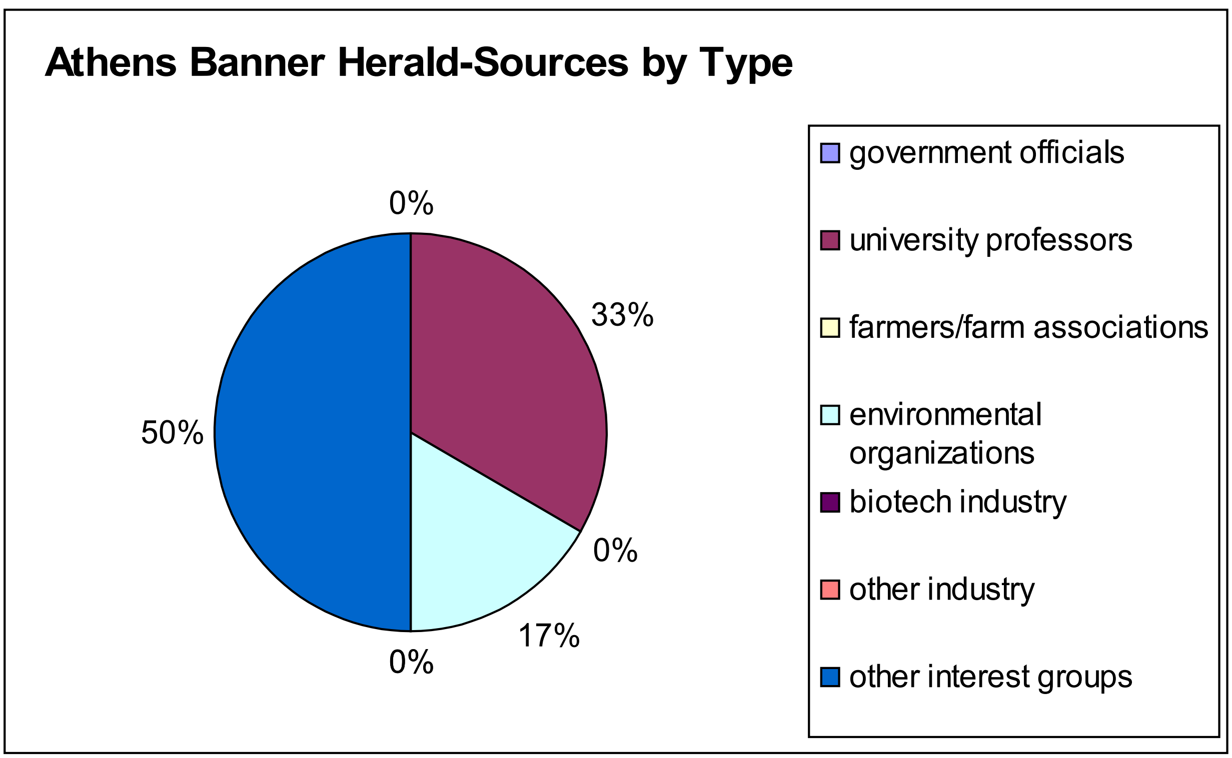

Figure 7.15: Source Frequency for the Athens Banner Herald

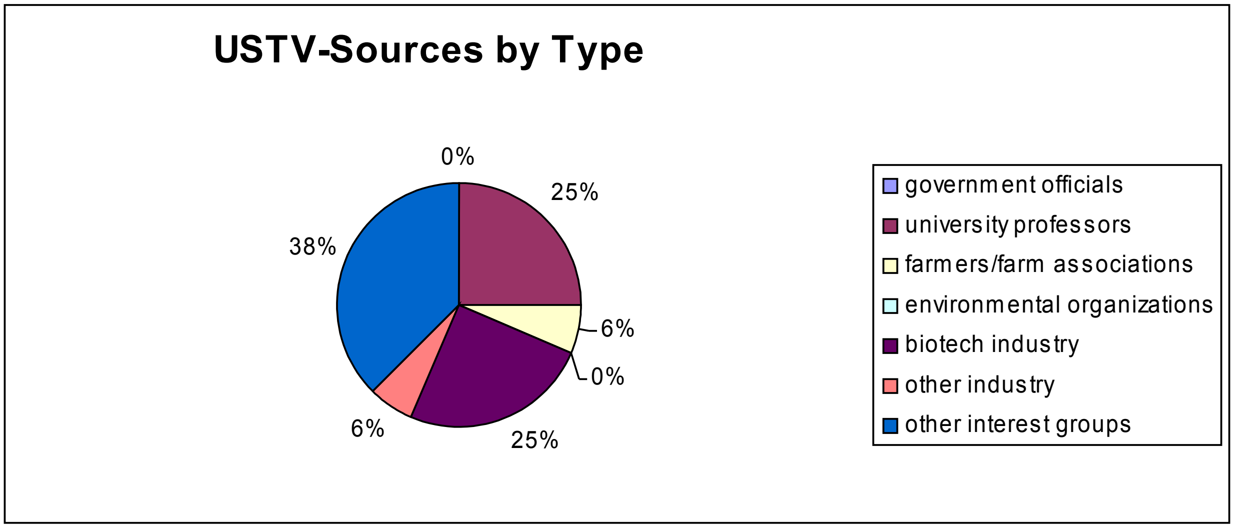

Figure 7.16: Source Frequency for US TV (ABC, NBC, CBS)

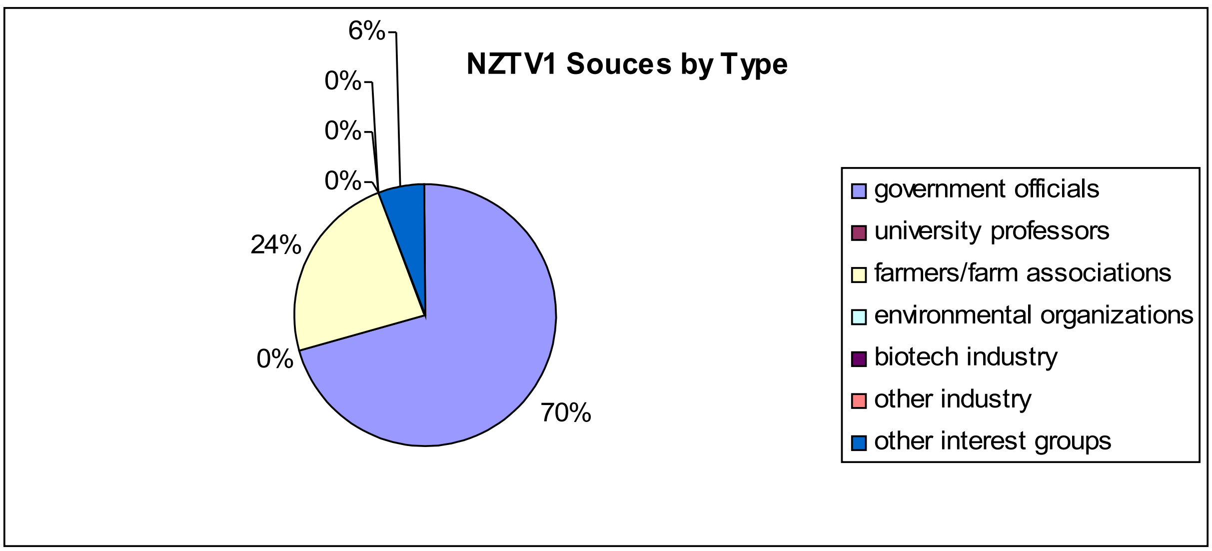

Figure 7.17: Source Frequency for NZTV1

As with frame bias, source bias is the calculated difference between the number of positive and negative sources. Figure 7.18 indicates clear differences between the United States and New Zealand with respect to source bias with New Zealand sources showing negative bias towards GE food and agriculture while the US sources showed positive bias.

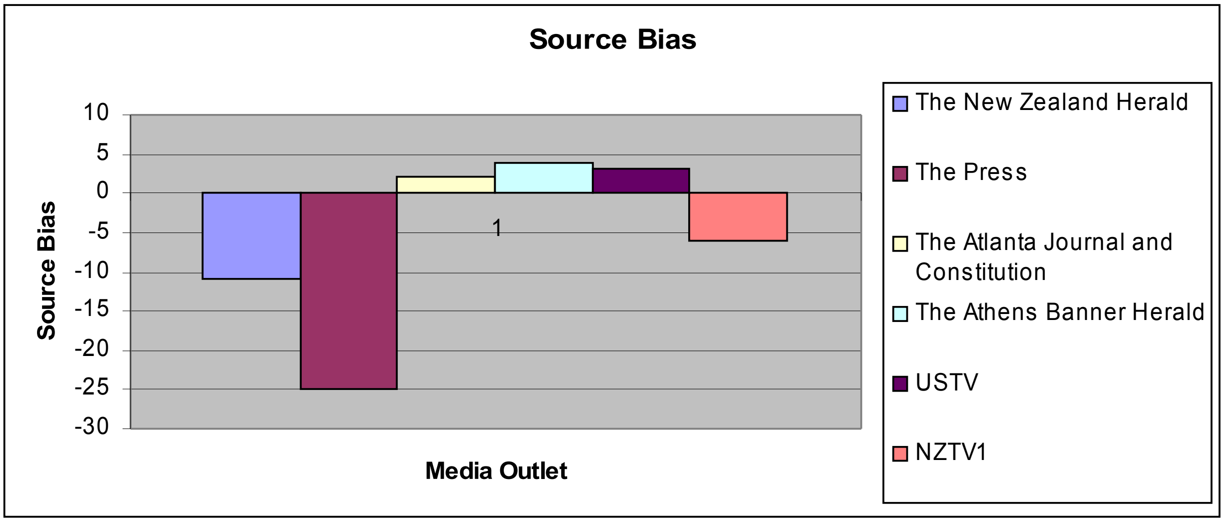

Figure 7.18: Source Bias

Discussion

The purpose of this chapter was to look at differences in media reporting practices between US and New Zealand media outlets and the data indicates interesting differences and points of convergence between the two nations.

Amount of Coverage

The first interesting difference between the US and New Zealand is in the amount of coverage GE food and agriculture received in both nations. GE was covered much more frequently in New Zealand than in the US with 66% of the articles and newscasts in the sample coming from New Zealand. Further, compared to the US, the New Zealand print media wrote more than double the number of words on the topic of GE. The greater amount of coverage of GE in New Zealand compared to the US, indicate the GE is a much more salient issue in New Zealand. The greater saliency of GE for New Zealand makes sense given how controversial the technology has been within New Zealand as indicated by a previous moratorium on the technology and the initiation of a Royal Commission on Genetic Modification to investigate its risks and benefits. As previously mentioned, New Zealand is said to have some of the strictest laws in the world regarding GE technology. By contrast, GE technology in the US has occurred with little public debate and/or knowledge. Thus, it is not surprising that US coverage of GE technology is less frequent. News is a business and the goal is to make money. Controversies sell newspapers and for the US, GE has not proven to be a significant controversy in recent years. By contrast, GE has been and still is a controversial topic within New Zealand. The moratorium on GE technology was lifted in 2003 and since then controversial field trials of GE technology have occurred as have accidental contaminations of conventional crops with GE seed. The field trails and contamination events have served to keep media attention on GE technology.

<u>Framing and Source Differences</u>

This section will look at differences in framing and source use between the US and New Zealand. Within the New Zealand media, two frames received a particularly high level of attention: public accountability and food and agricultural security. By contrast, within the US media, the discovery frame received an equally high level of attention.

The public accountability frame appeared in two of three New Zealand media sources at a frequency of 15% or higher and the food and agricultural security frame appeared in all three media sources at a high rate. I will discuss these two frames together as they are intimately related. A majority of the articles appearing during the period of analysis have had a combined focus on both regulation and transparency surrounding actual or possible agricultural/food contamination events. Articles have focused on (1) proper regulation of agricultural field trials so that conventional crops are not contaminated and (2) accidental contamination of New Zealand seed supplies by outside sources and government transparency and management of those contaminations. As discussed in Chapter 3, New Zealand relies heavily on its national image of being a “clean, green” nation for economic purposes. Both the agricultural and tourism industry are predicated on this image. With the end of the GE moratorium in 2003 and the initiation of field trials, there is considerable worry among New Zealanders that GE could hurt the nation economically. New Zealand has a long history of introduced species becoming invasive species and overrunning the environment, damaging native ecosystems and wildlife. This history has made the New Zealand public particularly sensitive about possible contamination of the landscape they hold so dear. For many, GE crops are just another set of species that might escape and wreak havoc on their valued environment and consequently on their national identity. Thus, with the end of the moratorium, the regulations surrounding the conditional release of GE crops have come under significant scrutiny as both the general public and the agricultural industry want GE technology properly confined for the time being until proven safe.

Another reason for the prevalence of the public accountability frame within the New Zealand media is related to an alleged government cover-up of accidentally released GE corn that occurred in 2000. Nicky Hager's book, "Seeds of Distrust", published in 2002 made national news as it outlined how the government suppressed information of GE contamination within New Zealand at the same time the Royal Commission on Genetic Modification was convening to give its recommendations regarding the technology's place in New Zealand. This incident jeopardized public trust in the government and has since led to a high level of government transparency concerning GE technology, which is accounted for in the high frequency of public accountability frames used by the media.

Rupar's (2002) research showed the media to have pro-GE leanings during the time period surrounding the RCGM report. However, given the subsequent government scandal and multiple instances of accidental GE release, it is not unexpected that figures 7.10 and 7.18 should indicate that the frames employed by and sources quoted in the New Zealand media are biased against GE technology, overall.

The primary source used in NZ media coverage was the government and government agency officials (New Zealand Herald 45%, The Press 30%, NZTV1 70%). Government source quotes were typically used in one of two ways. The first and most prevalent way government source quotes were used was to speak to the dangers of GE technology in regard to food and agricultural safety. Green Party officials in the New Zealand government are a very vocal source of opposition to GE technology within New Zealand and are often quoted in articles or newscasts dealing with GE regulations and/or contamination incidents. Despite being a small party with comparatively few ministers of parliament, the Green party has a high profile within New Zealand and has kept GE as one of their central rallying points. The second way in which government source quotes were used was to allay public fears regarding the technology and to speak to government transparency regarding any GE contamination events. Sources quoted in this regard were from the Environmental Risk Management Authority, Biosecurity New Zealand, and the parliament and were neutral in tone.

For the US media, the predominant frame was discovery, which occurred in all three media sources at a frequency rate greater than 15%. Previous research has shown GE breakthroughs to be a commonly employed frame in US media (Botelho 2004, Nisbet and Lewenstein 2002). Given that the roots of GE technology are in the United States, the US is the largest adopter of the technology worldwide, and the US has a national identity based partially on technological prowess, the prevalence of this frame is not surprising. Figure 7.10 indicates that two of three US media sources employed frames that were, on the whole, biased positively towards GE technology.

Source data shows the biotech industry to be commonly quoted by the US media (Atlanta Journal and Constitution 31%, USTV 25%) along with university professors (Atlanta Journal and Constitution 24%, Athens Banner Herald 33%, USTV 25%). Both the biotech industry and university professors are involved in the development of GE technology, thus, the fact they are often quoted in the media makes sense given the prevalence of the discovery frame in US media. Although Figure 7.18 indicates that US quoted sources were positively biased overall, environmental organizations opposing GE technology were also frequently quoted in the media (Atlanta Journal and Constitution 24%, Athens Banner Herald 17%) and often served as a counterbalance to the discovery frames within a news article.

Conclusion

The purpose of this chapter was to examine variation in newspaper and TV coverage of GE agricultural and food technology in the US and New Zealand. The data suggests that media coverage varied significantly between the two countries with coverage in New Zealand negatively biased and focused on public accountability and food and agricultural security and coverage in the US largely positively biased and focused on discovery. These results fit well with what would be expected of media coverage in the two nations given the prevalence of the technology in the US and the controversy surrounding the technology in New Zealand.

Having an understanding of the media's role in determining public opinion on a topic is essential. Chapter 8 will utilize information presented in this chapter to explore how the media has likely influenced consumer respondent GE perceptions in each nation.

Chapter 8 - The Media and Cognitive Models

Introduction

As previously discussed, the science behind genetic engineering in agriculture is relatively new and the technology itself is novel. Thus, genetic engineering in agriculture may be a technology that is not easily understood by a common audience. For the general public, formal science education ends upon the completion of high school or college and given the novelty of the technology, much of the public never encountered information about GE technology's development and use in the course of their education.

One of the easiest means of gaining a basic understanding of a technology and the issues surrounding its use is through the media. In 1977, the Roper Organization conducted a national survey in which they asked US citizens where they get most of their information about the world. Over 95% of respondents stated that they received most of their information from the mass media (Roberts and Bachen 1981). According to Nisbet (2003), the media is one of the primary means by which controversial issues are made known to the public and research by Frewer et al. (1996) indicates that the media is the most frequently cited and important source of information concerning food related risks.

Public opinion can be influenced by both the amount and the focus of press coverage. Roberts and Bachen (1981:309) contend,

> Almost every dimension of social behavior is at least potentially influenced by mass communication. Politics, health, pro-social and antisocial behavior, attitudes toward almost every definable group within society, occupational knowledge, education, consumer behavior, all these and more have been pointed to…as being influenced, for better or ill, by mass communication.

Chapters 5 and 6 of this dissertation presented cognitive cultural models of health, environment and genetic engineering for stakeholder groups in the US and NZ. Chapter 7 employed framing methodology to analyze GE media coverage in the most utilized respondent news sources. The goal of this chapter is to bring together the information presented in Chapters 5, 6 and 7 of this dissertation and look at the possible interrelationships between the media and consumer cultural models of GE. As discussed previously, cultural models are presupposed, taken for granted models of knowledge and thought that are used in the course of everyday life to guide a person's understanding of the world and their behavior (D'Andrade 1984). By looking at the primary media sources utilized by consumer respondents, this chapter will evaluate how an important external source of knowledge may influence consumer cultural models. Conversely, media frames are interpreted based on prior beliefs and this chapter will look at how previously existing cognitive schemas influence media interpretation.

The frames and biases present in US and New Zealand media sources will be compared and contrasted with the schemas present in the cultural models of the consumer research participants in each nation. According to Gamson et al. (1992), frames play a similar role in the analysis of media discourse as schema do in analyzing respondent discourses. Both frames and schema are central organizing principles that are used to make sense of a diverse and complex array of information. Gitlin (1980) contends that media frames organize the world both for journalists who report news and for the public who rely on journalist reports.

Within the field of anthropology there has been only a limited amount of research on the intersection of media and culture much of it occurring within the last 10 years. In a 1993 article, Spitulnik stated, "there is as yet no 'anthropology of mass media.' Even the intersection of anthropology and mass media appears rather small considering the published literature to date"

(Spitulnik 1993:293). This chapter will attempt to bridge the gap between media studies employing framing methodologies and cognitive anthropology studies employing schema analysis. Given the similarities between the two approaches, it is a natural progression to look at the relationship between media frames and cognitive schemas within a single research study.

Although previous research has been done on the media's influence on public perceptions of GE technology (Nisbet and Lewenstein 2001), none has yet made a direct comparison of the coverage found in respondent's top media sources for GE information and respondents actual perceptions regarding the technology. Instead research has relied on data from media analyses of the elite press and comparisons of that data with public perception surveys conducted by separate research groups. The research found within this chapter remedies that omission and takes a sharper look at the possible interrelationships between the media and perceptions of GE.

In the beginning of this chapter, I will briefly review how opinions regarding the media's effect on public perceptions have evolved and highlight representative research that has been conducted. I will then discuss the methodology used in this research to compare media frames and cognitive models. Lastly, I will highlight and discuss possible relationships between media framing and audience cognition.

An Evolution of Opinions Regarding the Influence of Media on Public Perceptions

Early work in the 1940s on the effects of the media on public attitudes assumed that public opinion was directly related to the opinions set forth in the media. In other words, it was believed that the media was a major force in dictating popular thought in a stimulus/response type fashion. According to Priest (2002), this "magic bullet" assumption has since been rejected. This view was reversed during the period between WWII and the 1970s as the dominant view argued that the media had only a minimal effect on public opinions and attitudes (Jacobs and

Shapiro 1996, Klapper 1960). This view was termed the “law of minimal effects” and emphasized that the mass media only serves to reinforce the status quo or common opinion of the day (Roberts and Bachen 1981)

The “law of minimal effects” no longer holds an esteemed position among media researchers. It has been replaced by the view that the media calls attention to issues via “agenda setting” and suggests means of interpretation through issue “framing” but does not directly determine public opinion as was believed prior to WWII. Agenda setting refers to the process by which a problem becomes a salient issue meriting public attention and as discussed in Chapter 7, a frame is a central organizing idea that gives coherency and meaning to a news article or TV broadcast.

The media help determine what “ the public sees as high on the policy agenda, … how the public learns about issues, and … the standards or criteria that individuals use in making judgments and forming attitudes” (Jacobs and Shapiro 1996:11). If media coverage consistently focuses on a few main issues then the public will come to associate the technology with those issues to the exclusion of others and deem them more salient (Botelho 2004).

<u>Previous Research on Media and Public Perceptions</u>

A number of studies have sought to assess the relationship between media coverage and different aspects of public perceptions. A few representative studies that were drawn upon for the purposes of this research will be highlighted in this section. It should be noted that none of the studies discussed here demonstrate a causal connection between media coverage and public perceptions. A majority of research done on media and public perceptions establishes correspondence rather than causality due to the difficulties of designing and implementing experiments, which can effectively control either the media's portrayal of an issue or the public's exposure to the media.

Media and Perceptions of Social Problems

Mutz and Soss (1997) conducted a year-long study in which they evaluated a newspaper's attempts to influence public opinions concerning low income housing. The goal of the study was to trace "the effects of a purposefully chosen news agenda on the perceived and actual opinions of members of the mass public" (Mutz and Soss 1997:431). The results suggest that the media has a limited ability to change the opinions of individual citizens or the salience they attach to an issue at a personal level. However, the results do suggest that the media can influence individual perceptions regarding issue salience for the community. This means that individuals may not perceive a given issue as being of greater personal importance to him or herself if more news stories on the issues are encountered. However, they may deem the issue to be of greater importance to other individuals and society at large with increased news coverage.

Media and Risk Perceptions

In addition to studies on how the media influences perceptions of and stances on social problems, a significant amount of research has been done on how the media influences personal risk perceptions. A common topic of study is crime reporting. Researchers have sought to assess how news crime coverage impacts people's concern about being personally victimized by crime. The results show that people separate their societal and personal level judgments about social and environmental risks with the media primarily influencing societal level judgment (Tyler and Cook 1984). Thus, crime news may increase the public's awareness of crime as a significant social problem but it does not necessarily make them more personally concerned that they will fall victim to crime.

Ethnographic Assessment of Media Interpretations

Several researchers have employed ethnographic methodologies to assess how the public draws upon experiential knowledge, popular wisdom and the media to make sense of current issues (Hobson 1980, 1982, Palmer 1986, Liebes and Katz 1990, Liebes 1991). For example, in one representative study by Liebes (1991) the differential interpretation of Israeli TV news in Jewish and Arab families was evaluated. Liebes found that hard-line Israeli families accepted TV broadcasts at face value and believed them to be transparent representations of reality. In contrast, hard-line Arab families interpreted the broadcasts from an opposing viewpoint and inverted the points of views presented during the broadcast. Israeli and Arab moderates approached the broadcast information as a negotiation, taking into account points of view derived from their collective experience.

Media and Perceptions of Biotechnology

To date, only a few major studies have been conducted assessing the media's role in influencing public opinion on biotechnology. One such study is that by Nisbet and Lewenstein (2001), which looked at the relationship between US media coverage of biotechnology in the elite press and public perceptions of biotechnology between the years 1995 and 1999. Using the framing methodology discussed in Chapter 7 and developed by Bauer et al. (2001), the researchers found that media coverage during the study period switched from coverage dominated by positive frames (progress, economic prospects) to coverage, which emphasized controversies surrounding the technology. A negative turn in public opinion of biotechnology, as measured by a National Science Board survey, occurred following the negative media portrayal suggesting that the media was serving an agenda setting and framing function for the public regarding biotechnology.

This research draws upon facets of each of these studies as it looks at both the agenda setting function of the mass media regarding GE, a potentially risky form of biotechnology, as well as how already existing cognitive models influence media interpretation.

Methods

For the cognitive cultural modeling component of this research, consumer respondents were obtained opportunistically. However, care was taken to obtain respondents from diverse age groups and socioeconomic brackets. US consumer respondents were currently residing in the state of Georgia while NZ consumer respondents were residing in the Canterbury district of New Zealand. By restricting this study to these two communities, other forms of intra-cultural variation such as regional community variations were controlled. For information about the methodology employed to construct the cultural models please see Chapter 4.

Consumers were asked to identify their top news sources for information about GE. The top US news sources were the Atlanta Journal and Constitution (AJC), the Athens Banner Herald (ABH), and USTV news sources. The top NZ news sources were the New Zealand Herald (NZH), the Press, and NZTV1. For information about the news sources used in the analysis and the methods used in their evaluation please see Chapter 7.

The time frame for the media analysis was January 2005 to December 2007. This three-year period was chosen for analysis as it both predates (by at least one and a half year) and coincides with the period in which in-person interviews were conducted with US and New Zealand consumer respondents. Due to the extended time frame over which interviews were conducted in the US and NZ, a small portion of the US media data (less than ¼) was collected after the period in which US consumer respondents were interviewed. An analysis of the media data reveals that US media coverage did not vary significantly from year to year for the three years analyzed. Thus, the data presented in Chapter 7 is fully representative of the type of coverage US respondents received prior to their interview.

To investigate the agenda-setting function of the mass media in the United States and New Zealand with respect to GE technology, the cultural models employed by consumer research participants in assessing GE technology were qualitatively compared to the frames used within the media sources utilized by respondents. Similarities and differences in content were noted.

The results of the qualitative analysis will suggest what role the media is playing in influencing consumer cognition of GE and will suggest what role cognitive cultural models are playing in respondent interpretation of news media. While the methods employed in this analysis will not allow for causal inferences to be drawn, the information derived here does allow for correspondences to be noted and for a preliminary bridge to be built between cognitive anthropology and media/communication studies, an important endeavor given the purported power of the media as a social driver of thought.

Results

New Zealand's clean green national identity and branding made GE a more contested issue within New Zealand. As discussed in Chapter 7, the topic of GE was covered much more frequently in New Zealand than in the US, with 66% of the articles and newscasts in the sample coming from a New Zealand media source. Furthermore, NZ media sources wrote more than double the number of words on the topic of GE. The greater amount of news coverage of GE topics indicates that GE is a more salient issue within New Zealand. Comparatively, the US had very little news coverage of GE related issues. Thus, it is not surprising that US consumer respondents were largely unaware of GE technology and felt un-knowledgeable about GE's benefits and risks. One would expect a higher level of awareness and knowledge for an issue considered to be of importance socially.

In the following sections, the GE models for US and NZ consumer respondents will be re-presented and the ways in which the models correspond to the frames utilized in the media will be discussed.

US Respondent Cognitive Models

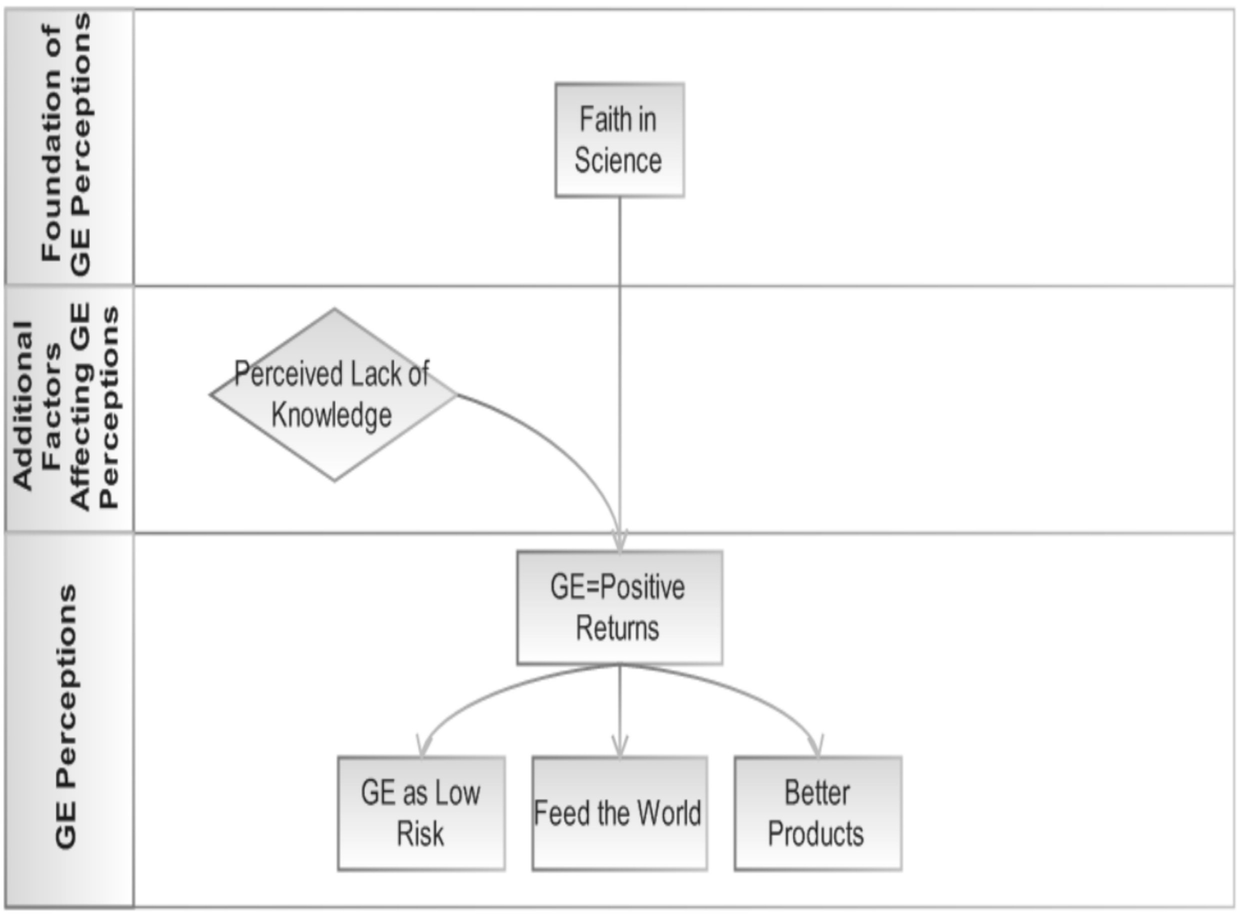

Figure 8.1: Pro-GE US Consumer GE Model

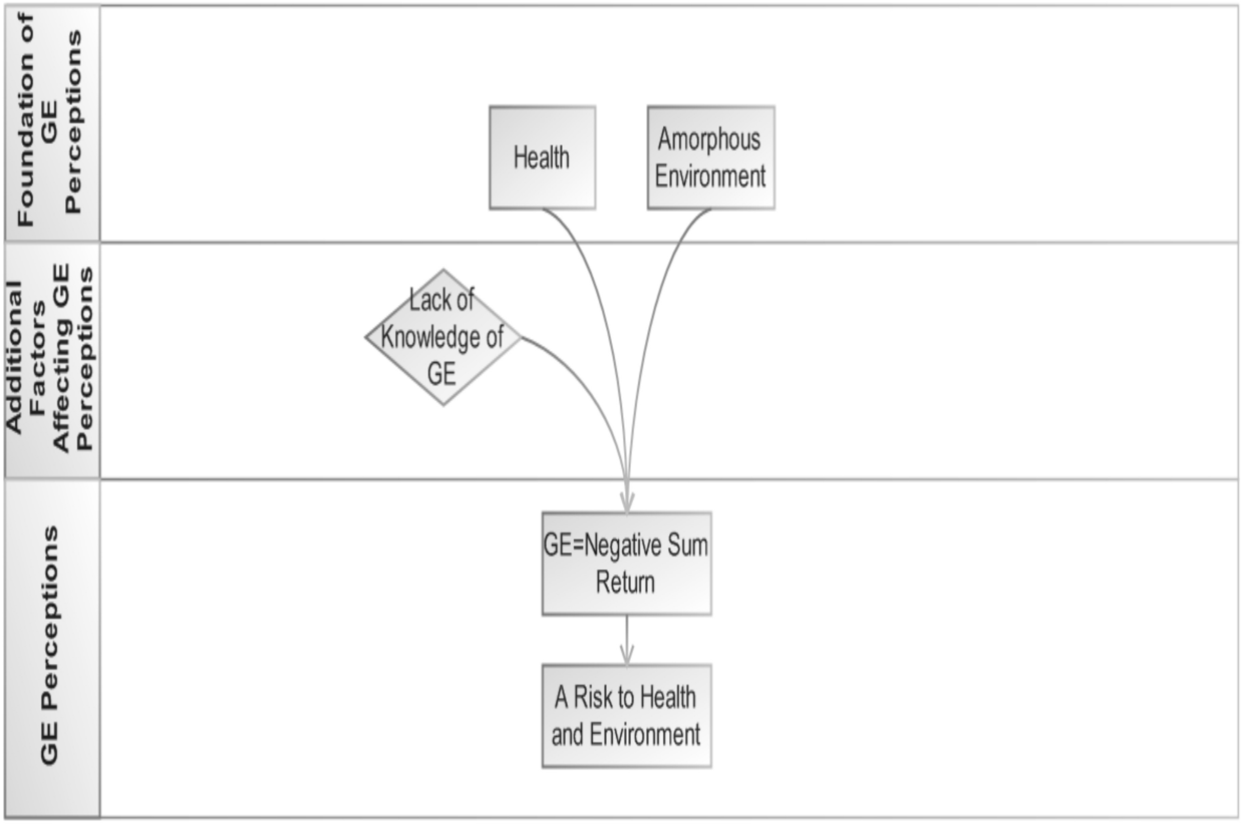

Figure 8.2: Anti-GE US Consumer GE Model

The cognitive model of GE technology employed by Pro-GE US consumer respondents indicates that members of this group have a strong faith in science and feel that they lack significant knowledge regarding GE technology. Due to their perceived lack of knowledge concerning the technology, they defer judgment of the technology to scientists, a group they trust significantly more than Anti-GE US consumer respondents (Table 4.9). They view GE food and crop technology as low risk and as having the potential to provide the world with better products.

Unlike, Pro-GE US consumer respondents, consumer respondents in the anti-GE consumer group did not have a strong faith in science. They also felt unknowledgeable about the technology. However, instead of deferring judgment on the technology to scientists, respondent's lack of knowledge caused them to instead be fearful of the technology. The cultural model shows that notions of health and the environment play an important role in this group's conceptions of GE technology. With respect to health, respondents were concerned about chemicals in food and considered GE technology to be akin to pesticides and other agro-chemicals. GE and agro-chemicals were both viewed as hidden food dangers that should be guarded against. Further, while not having a well-developed model of the environment and little sense of a personal relationship with the environment, Anti-GE US consumers were still opposed to technologies that were potentially dangerous to it and viewed GE as having this potential.

US Media Frames, Sources and Biases

Overall, the US media presented GE crop and food technology in a positive light. As discussed in Chapter 7, the most dominant frame (by percentage of all frames) used in the US media's discussion of GE technology was the frame of discovery (15% AJC, 60% ABH, 30% USTV)(Figures 7.6-7.8). Further, two of the three news sources analyzed had an overall positive bias towards GE technology (Figure 7.10). Finally, analyses show that university scientists were one of the most frequently quoted sources regarding GE technology (24% AJC, 33% ABH, 25% USTV) with quoted sources in the US media being biased in favor of GE technology (Figures 7.14-7.16 &7.18).

Despite an overall positive bias towards GE technology, journalists did include quotes from GE-opposed sources. For example, environmental groups were often quoted within the media (24% AJC, 17% ABH) and offered anti-GE opinions to counter the pro-GE stances proffered by university scientists and the biotech industry. Environmentalists often mentioned health and environment risks of GE technology. Although GE risks were mentioned within GE news stories, the depth of their discussion was often limited and not sufficient to be classified as a media frame (see Chapter 7 for framing criteria).

If not directly stated, possible risks to health and the environment were often included in news stories in an implied form. For example, a number of articles discuss the European Unions moratorium on GE food and crops (13% AJC). Such articles would not often go into the details of why the EU would not want GE food and crops but the fact that some places in the world have a moratorium does imply that the technology may be potentially dangerous.

The Relationship between US Media Frames and US Consumer Cultural Models

The dominance of the discovery frame in the US media, the positive bias of the news stories and the high frequency with which university scientists are quoted are all highly compatible with the cultural model of GE employed by Pro-GE US consumer respondents. This group puts their faith in science and scientists to do the right thing with respect to GE technology and the news sources they rely on for information about the technology paint a picture of science making significant discoveries regarding GE that could potentially benefit humankind. Moreover, this consumer group has a comparably high level of trust in scientists, one of the most frequently quoted sources by the media and one biased in favor of the technology.

As previously mentioned, journalists have preferred meanings and interpretations for their news stories. Given the dominance of positively biased discovery frames, it appears that the US media wishes to cast GE technology in a positive light -- highlighting GE as science at its best. The pro-GE consumer group, which possesses a “faith in science” schema, appears willing to accept this portrayal and draw upon it to construct their cultural models of GE. Pro-GE US consumers commonly mentioned better products and GE’s low risks as major selling points of the technology and these ideas are common focal points when discovery frames are used within a media story.

For anti-GE US consumers respondents, the dominant frames and sources utilized by the US media do not correspond with the cultural model employed by this group. Respondents' cognitive schema regarding health and the environment and the absence of a faith in science schema may have had a significant influence on how US media stories were interpreted. It appears that Anti-GE US consumer respondents chose to ignore the dominant pro-GE themes presented by the media in favor of secondary ideas presented within the media. The prevalence of GE news stories with quotes from environmentalists concerning health and environment risks as well as the use of news stories with implied risks, such as in stories concerning the EU moratorium, is consistent with the very generalized concerns respondents in this group expressed when discussing GE risks. Respondents were not knowledgeable about specific risks that might result from the use of GE technology but considered unknown health and environmental repercussions to be a problem. Given this group's generalized concern for the environment, quotes from environmental groups may have held more weight for this group than for pro-GE US consumers whereas pro-GE quotes from university scientists may have held comparatively little weight as respondents lacked a faith in science.

New Zealand Respondent Cultural Models

The cultural model of GE technology employed by Pro-GE NZ consumer respondents indicates that members of this group have a strong faith in science and are risk prone. They believe the benefits of GE to be worth the low risks posed by the technology. Benefits include better products and the ability to feed the world.

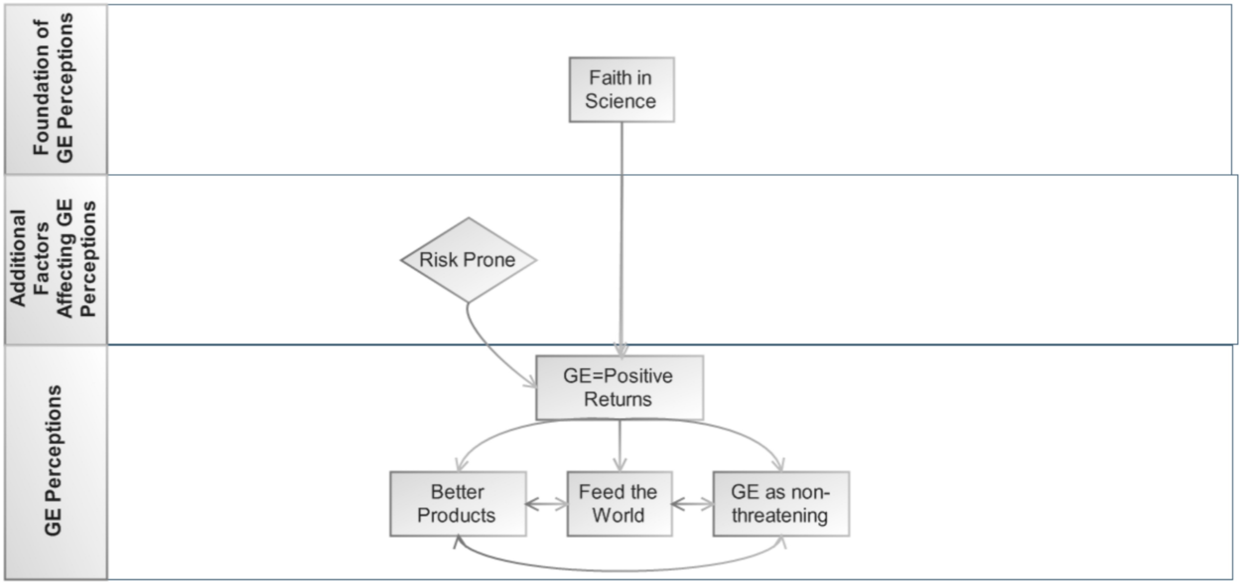

Figure 8.3: Pro-GE NZ Consumer GE Model

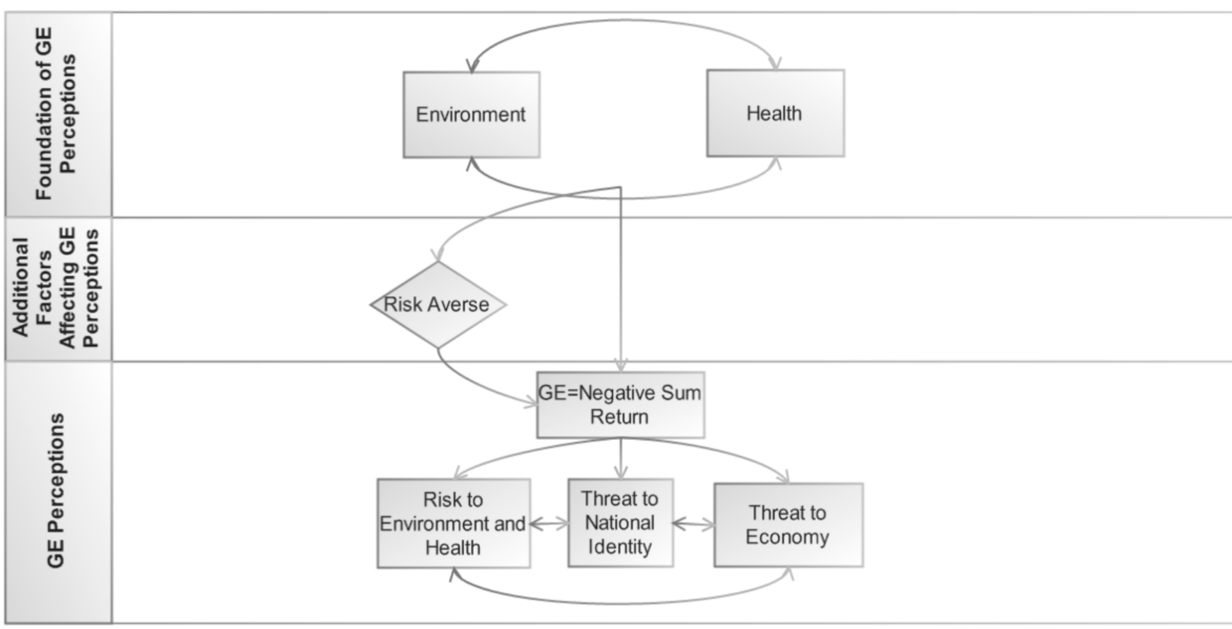

Figure 8.4: Anti-GE NZ Consumers GE Model

The cultural model of GE technology employed by Anti-GE NZ consumers suggest that for members of this group notions of health and the environment play an important role in the group's conceptions of GE technology. With respect to health, this group deemed GE to be unnatural and respondents had a strong interest in organic food. Regarding the environment, GE was seen as a threat to the environment and a threat to the nation's clean and green image. By threatening NZ national identity, GE was seen as a threat to the nation's economy.

NZ Media Frames, Sources and Biases

As presented in Chapter 7, the most dominant frames (by percentage of all frames) used in the NZ media's portrayal of GE technology are the frames – food and agricultural security (20% NZH, 18% The Press, 43% NZTV1) and public accountability (28% NZH, 27% The Press, 11% NZTV1) (Figures 7.4, 7.5, and 7.9). In addition to the two aforementioned frames, health and environment frames were also prevalent within NZ media stories, although to a lesser extent (Health-12% NZH, 13% The Press) (Environment-7% NZH, 20% The Press, 11% NZTV1). All three news outlets analyzed were negatively biased towards GE technology, overall, as were those quoted in the media (Figure 7.10 & 7.18).

The Relationship between NZ Media Frames and NZ Consumer Cognitive Models

The dominance of the food and agricultural security and public accountability frames in the NZ media coupled with the overall negative bias of NZ media frames and sources is compatible with the cultural model of GE employed by Anti-GE NZ consumer respondents. A majority of articles, with food and agricultural security and public accountability frames, dealt with cases in which GE seeds were accidentally planted among mainstream crops. GE products are viewed as tainted in many parts of the world. Thus, GE crop contamination is a significant threat to the clean green image of New Zealand agricultural exports and to the economy should the market for exports decline. Agricultural exports are extremely important to the New Zealand economy and the nation's clean and green image is worth a significant amount of money with respect to these exports. The prevalence of these frames is consistent with members of this group seeing GE as a threat to national identity and the economy.

The visibility of health and environment frames in NZ media is also consistent with members of this group being opposed to GE technology as these frames presented GE as dangerous. The health and environment schema employed within this group's model of GE show an aversion to things deemed unnatural and stories with a health frame were predominantly about the dangers of modified corn with unnaturally high levels of lysine. Likewise, the news stories utilizing an environment frame often focused on an assortment of dangers GE poses to the environment and New Zealand's national identity.

Given the dominance of negatively biased food and agricultural security and public accountability frames, it appears that the NZ media wishes to cast GE technology in a negative light -- highlighting GE as potentially dangerous from an economic, health and environment perspective. Further, anti-GE NZ consumer respondents, a group demonstrating a trend towards health and environment beliefs based in the philosophy of the organics movement, appear willing to accept this portrayal and draw upon it to construct their cultural models of GE. Anti-NZ consumers were concerned about GE contaminations effects on the economy and national identity, common focal points when food and agricultural security and public accountability frames were used within a media story.

For Pro-GE NZ respondents, the frames used by the NZ media correspond very little with the group's cultural model of GE technology. In contrast to the US media, the discovery frame was not used extensively within the New Zealand media (7% NZH, 5% The Press, 6% NZTV1). Thus, for members of this group, the news offered very little detailed information on the scientific benefits that may result from GE technology - benefits that might spur one's faith in science. Moreover, university scientists were frequently quoted in only one of the three news sources (22% NZH) with quotes being largely negative in tone and referring to possible negative health repercussions of GE corn with high lysine content.

Overall, the NZ media offered this consumer group very little to draw upon in either forming or affirming their model of GE technology. Neither scientific discovery frames nor scientific sources were utilized in a manner that would support consumers in this group having positive opinions of GE technology. One possible reason for the lack of consistency between this groups GE model and the media's portrayal of GE is New Zealand's burgeoning public campaign to define NZ, not only as clean and green, but as innovator. While NZ GE news stories did not frame GE using an innovation frame, media stories addressing the government's new identity campaign, "NZ as innovator," may be influencing this group's stance on GE. The NZ innovation campaign presents scientific innovation as the nation's next economic windfall. Another possible reason for the lack of consistency found between respondent models and the utilized media frames is that respondents in this group are simply choosing to reject the media's portrayal of GE and rely on their own experiential thoughts regarding science and technology. This group is risk prone compared to Anti-GE NZ consumer respondents and may be willing to view the risks highlighted within the media as a natural part of scientific innovation.

It is interesting to note that while supportive of GE technology, in general, many respondents in this group were hesitant about its use within New Zealand. They felt the current negative climate towards GE in parts of the world made GE an economic risk for New Zealand – a risk of which they were wary. Therefore, despite having a personal model of GE inconsistent with the portrayal of GE within the media, consumers in this group were aware of the current climate towards the technology and the need to maintain the nation's clean and green image – notions that were clearly portrayed within the media.

Discussion

A lot of past research on media and public perceptions has attempted to ascertain whether the media plays a role in determining values, beliefs and interpretations. The current consensus, though not uncontested, is that the media does play a role in determining public perceptions. Current research indicates that the media serves an agenda setting function and is influential in determining what the public deems to be socially salient issues. The findings from this research support this conclusion.

However, according to Gamson et al. (1992:388), “texts may have a preferred meaning and points of view which the reader is invited to accept. But many readers decline the invitation, either entering into some negotiation with the dominant meaning or rejecting it outright with an oppositional reading”. Fiske (1987) contends that the barrage of voices present within the media, many contradictory to each other, and the structure of media’s narrative are insufficiently powerful to dictate which ideas should receive the most attention and be used as a framework to understand the topic at hand. As a result, the public “evaluates news in light of past learning and determine how well it squares with the reality that they have experienced directly or vicariously” (Graber 1988 in Gamson et al. 1992:390). The findings from this research also support this conclusion.

The observations made during the course of this research suggest that information presented within media articles is being assessed based on the presence or absence of certain foundational cognitive schema (Tier 1 of the cultural models). Pro-GE consumers in both nations utilized a faith in science schema as the foundation of their cultural models of GE. When they encountered GE news stories, it appears that they interpreted those stories based on this foundation. Pro-GE US consumers accepted the US media portrayal at face value and utilized the media to gain information about the specific scientific benefits of GE (ie. better products), ideas which showed up in the third "GE Perceptions" tier of their cultural models. On the other hand, pro-GE NZ consumers chose to largely ignore the negative portrayal of GE in NZ media.

For anti-GE consumers in the US and NZ it was foundational health and environment schema which appear to have influenced media frame interpretation. In the US, anti-GE US consumer respondents chose to ignore the dominant media frames in favor of secondary information presented about health and environmental risks, information which was likely incorporated into the third "GE Perceptions" tier of their cognitive model. Anti-GE NZ consumers chose to accept the NZ media portrayal at face value as it aligned with their concerns regarding health and the environment and chose to incorporate information about the specific risks of GE into the third "GE Perceptions" tier of their cultural model.

Conclusion

The research indicates that prior existing foundational cognitive schema may determine how news stories are interpreted. In the case of GE technology, additional factors such as health and environment schema and faith in science schema may play an important role in determining which media frames are incorporated into respondent cultural models. While this study's research design will not allow for causality to be proven - linking the media definitively to public perceptions - the findings do suggest that the media may provide important information used in the formation of GE perceptions as presented in the third tier of consumer cultural models.

Chapter 9: Research Summary and Applications

Using the Social Construction of Technology paradigm as a research framework, this dissertation has explored how GE agricultural technology has been socially constructed in the US and NZ by three important stakeholders in the GE debate (consumers, organic farming community, GE farming community). By looking at the social construction of GE technology from multiple perspectives—historical, branding, media, cognitive cultural models—this dissertation has provided a deep and layered understanding of what GE agricultural technology means to different stakeholder groups in the US and NZ.

I will begin this chapter by briefly summarize significant research findings presented in this dissertation. I will then review the historical rise of deliberative democracy in recent years and explore how research conducted using the SCOT framework can be used to improve communication among GE stakeholder groups during intra- and inter-cultural deliberations concerning GE technology.

Summary of Significant Research Findings

The historical review presented in Chapter 2 revealed several important points of similarity and difference between the US and NZ to be kept in mind when evaluating each nations position towards GE technology. Similarities between the US and NZ include the presence of democratic governments, free-trade economic systems, large agricultural sectors and historical ties to Europe. Key differences include issues of size and international power as the US is a large nation from a geographic and economic standpoint and holds considerable power in the international community while New Zealand is a small island nation with a smaller economy and less international influence. A review of each nation's technological and agricultural history reveals another important difference between the two countries, the US is a technological innovator while NZ has historically been a technological adopter.

A review of national identity and national branding literature in Chapter 3 reveals that both the United States and New Zealand's responses to genetic engineering technology make sense with respect to each country's national identity and nation branding. New Zealand has a national identity partially based on its majestic landscapes and a national brand closely tied to that identity. GE crop technology has been portrayed as a pollutant in much of the world and is thereby seen as a direct threat both ideologically and economically to New Zealand identity and branding as a "clean green" nation. By contrast, the image of genetic engineering as a pollutant is not as significant for the United States, a nation lacking a national identity and branding associated with nature and landscapes. Instead, an alternate image of genetic engineering as progressive and productive situates well with US national identity and branding as a technological powerhouse.

The cultural models of health, environment and GE technology presented in Chapters 5 and 6 of this dissertation clearly show inter- and intra-cultural variation in cultural meanings applied to health, environment and GE technology. The research indicates that New Zealanders do ascribe more negative attributes to GE technology than do US consumers. Even those stakeholders open to GE technology (pro-GE consumer respondents and GE amenable farmer respondents) felt that either the technology was not currently needed in New Zealand (GE amenable farmer respondents), it was currently a potential danger for New Zealand from an economic standpoint (Pro-GE NZ consumer respondents, NZ GE amenable farmer respondents), or that it could tarnish the nation's image (Pro-GE NZ consumer respondents). Intra-culturally, the meanings ascribed to GE varied widely. Members of the organic farming communities in both the US and NZ saw the technology as innately risky and as an affront to their personal values of wanting to live in balance with nature. Contrastingly, respondents from the GE farming communities saw the technology as innovative and as necessary from an economic and business perspective. Consumers in both nations were less engaged with the GE debate compared to their counterparts in the organic and GE communities and were divided with respect to their stances on GE technology. Those consumers with a strong faith in science were more accepting of GE technology while consumers highly concerned with food additives and chemicals often felt very negatively towards GE. They associated GE technology with agrichemicals, like pesticides and herbicides, and thus viewed GE technology as a potential pollutant of food.

The research findings presented in Chapters 7 and 8 indicate that media coverage varied significantly between the US and NZ. Coverage in New Zealand was negatively biased and focused on public accountability and food and agricultural security. By contrast, coverage in the US was largely positively biased and focused on discovery. While the media analyses in Chapter 7 revealed reporting in the US and NZ to be biased for and against GE technology, respectively, the analyses also revealed that the media did present both pro and anti-GE perspectives. Chapter 8 indicates that prior existing foundational cognitive schema may influence which aspects of media stories are integrated into respondent cultural models. In other words, respondents may be interpreting GE news stories based on schema contained within their cultural models, choosing to adopt media frames consistent with their cultural schema while ignoring other portrayals within the media.

Deliberative Democracy and the Application of Research Findings

Genetic engineering food and agricultural technology is the focus of intense and divisive debates around the world. According to Pellizzoni (2001:205), “the uncertainties inherent to these technologies, the contrasting assessments of the risks for the environment and health, and the strong conflicting interests involved, make policy-making and implementation very problematic."

The focus of this section of Chapter 9 is on the role the SCOT framework and cognitive cultural modeling in particular, can play in improving communication across three important stakeholder groups in the US and New Zealand involved in the GE deliberative process. I will begin by highlighting the historical rise of deliberative democracy and the coincident fall of technocracy as well as briefly reviewing what is meant by deliberative democracy/technological assessment. I will then discuss what role anthropologists can play in the deliberative democracy process. Lastly, I will highlight and discuss commonalities and discontinuities in language and thought among three key stakeholders in the GE debate from the US and New Zealand and what role these similarities and differences might play in the deliberative democratic process.

From Technocracy to Deliberative Democracy

The "religion of modernity", otherwise known as the technocratic view, has been pervasive for the better part of a century in many Western nations. The "religion of modernity" refers to technological innovation being viewed as the last unquestioned and transcendent principle of the common societal good (Hennen 1999). Science and technology have long been regarded as the means to solve society's ills. According to Hennen (1999), "critics have accused this technocratic view of effectively de-politicising society to the extent that society's development is no longer regarded as essentially a question of democratic debate and social conflict, but merely a matter of scientific-technical expertise." Wynne (2001:472) argues that, "science has become the culture of policy" thereby undermining the democratic process via "the importation of unacknowledged and arbitrary human values and ethical commitments that then silently impose themselves on other societal values and commitments" (Goven 2006:566).

The technocratic view formed the foundational basis of the field Public Understanding of Science research (PUST). The field of PUST developed in order to counter growing discontent regarding science and technology among the mainstream public. Researchers were primarily interested in improving communication of science to the public. Within PUST, a model known as the "deficit model" stated that scientists were knowledge experts, the public was to varying degrees ignorant of science and public dissatisfaction with science and technology was the result of the public's ignorance (Durant 1999). Thus, adequate public dissemination of scientific knowledge was needed.

The deficit model has recently been criticized for several reasons. First, the model operates with an overly simplistic view of science as an unproblematic entity of true knowledge (Durant 1999). Science and technology is often "partial, provisional and even on occasions deeply controversial" (Durant 1999:315). In the case of scientific political controversies, decisions are often made in the face of uncertainty, thus, it is not self evident that science and technology deserve first priority in political decision-making (Hagendijk 2004). Second, the model portrays the public in a purely negative manner, as an ignorant public. This is an unfair characterization as the public often has informal knowledge, which is highly relevant during the process of technological assessment (Durant 1999). Public knowledge is often measured via surveys, which emphasize the mastery of textbook knowledge (Hagendijk 2004). Such surveys ignore the public's capacity to understand and appreciate scientific implications that affect day-to-day life. Third, the model attributes disagreements between science and the public, to public ignorance when in fact multiple other factors may be to blame. The interface between science and the public is also influenced by cultural, economic, institutional and political factors (Durant 1999).

Running counter to the deficit model/PUST and their technocratic underpinnings, is a mounting interest in deliberative democracy in the form of participatory technology assessment. The term "deliberative democracy," introduced by a political theorist Joseph Bessette in 1980, refers to a merger between representative democracy and public consensus decision-making/deliberation (Bessette 1980). During the 1960s in Western countries, societal controversies over technology began to develop, which raised barriers to technology development and production (Nielsen 2007). These barriers led to the emergence of participatory technology assessment as a formal discipline (Nielsen 2007). Around the world, governments, the general public, and businesses have been wrestling with the causes and consequences of rapid scientific and technological change (Hagendijk 2004). The issue of genetic engineering in agriculture and food, for example, has generated a significant amount of public controversy in countries around the world as it is both risky from a health and environment perspective as well as being ethically contentious for some. Deliberative democracy allows for the arguments and claims of all interested stakeholder groups to be heard during public deliberation (Brouillet and Turner 2005). Democratic political theory "emphasizes inclusiveness, shared deliberation, and broad participation in political dialogue" (Brouillet and Turner 2005:49).

The conditions under which deliberative technological assessment may be suitable include:

> when there is a technology question of current societal interest with significant implications for the future; (2) when there is controversy surrounding such an issue, usually when there is a class of social, political, and economic or ethical values; (3) when the issue is complex and involves unresolved questions; and (4) when there are many (and competing) interests at stake (Einsiedel et al. 2001:86).

Deliberative democracy can take several forms (Button and Mattson 1999): educative, consensual, activist, and conflictual. Educative deliberation is a means of promoting citizen learning for a given issue. The main objective of public discussions is to provide the public with information with the expectation that a public exchange with an emphasis on educative content will allow the public to participate in future collective decision-making processes. Consensual deliberation refers to deliberation in which the goal is to find a common ground. Common ground is achieved through the expression of all points of view. Activist deliberation refers to deliberation, which actively stresses legislative results as the purpose of deliberation. Finally, conflictual deliberation focuses on providing a space for the expression and development of conflicting points of view. Unlike consensual deliberation, which focuses on resolution, conflictual deliberation stresses conflict and differences.

One of the most common forms of deliberative democracy is consensual deliberation as this form seeks to find a common ground for diverse stakeholders with opposing values and preferences. According to Hamlett (2003:122), the outcome of such deliberations should be a "reasoned, informed, consensual judgment forged out of the initially disparate knowledge, values, and preferences of the participants, as they have evolved through the deliberative process itself." During the course of the deliberation process, participants gather background information regarding the topical issue and the preferences of diverse stakeholders and learn of alternative approaches to the issue at hand (Hamlett 2003). It is expected that participants in the deliberation will have their preferences molded through interactions with other stakeholders, the result being a gravitation of all participants towards solutions that are mutually acceptable for everyone (Hamlett 2003). It should be noted that the goal of the deliberative process is not to have participants engage in bargaining and advantage seeking behavior as a means to achieve their goals but rather to have their goals change and reach a common ground with other stakeholders through the deliberative process (Hamlett 2003).

The impacts of consensus conferences, both socially and politically, can be divided into three categories (Einsiedel 2001). The first substantive impact is with regard to effects on current public debate and on political decisions (Einsiedel 2001). For example, a 1987 consensus conference in Denmark recommended against GE being applied towards animals. The Danish Parliament took heed of conference results and did not fund projects that involved genetic engineering in animals in their first biotechnology development program (Einsiedel 2001). The second potential impact of consensus conferences is the procedural impact, which refers to how different stakeholder groups view the consensus conference. Do stakeholders adopt consensus conferences as a means of decision-making resulting in its institutionalization? The third substantive impact regards the symbolic value of such conferences as a means for the public to take part in the democratic process and make complex decisions.

What Anthropology Can Bring to the Study of Deliberative Democracy

The theory of democracy has increasingly taken a deliberative turn as the idea that legitimate democracy can only be achieved through authentic deliberation as opposed to political interest aggregation has taken hold (Dryzek and Braithwaite 2000). Anthropologists, through their attention to alternative worldviews, bring to the study of deliberative democracy "an examination of local meanings, circulating discourse, multiple contestations, and changing forms of power" (Paley 2002:469). Discourses can be thought of as combinations of beliefs, attitudes, and values that are shared among individuals in the process of issue interpretation and contextualization (Dryzek and Braithwaite 2000). By analyzing different discourses via analysis of current literature and the media as well as through cultural modeling, researchers can address the problem of how different stakeholder groups with diverging political interests can engage in constructive dialogue with one another.

Effective democratic deliberation requires more than bringing together representative samples of issue stakeholders and waiting for inter-group agreement to arise naturally (Hamlett 2003). Rather, facilitators are needed to guide the deliberative process and are cited as serving two main functions in the deliberative process. An important role of any facilitator is to present background information on the deliberative topic to the participants. Such information must be comprehensive, balanced and at a level easily understood by all stakeholders (Hamlett 2003). As was done for this research, pertinent background information might include elements from historical, branding and media research as these three areas provide important information about the social context of a technological debate. The facilitator must also be skilled at "deconstructing the apparent agreements and consensus, and at pointing out how language and rhetoric are so often used as weapons in power struggles." (Hamlett 2003:129).

With the aid of research based in the SCOT framework and employing methodologies such as cognitive cultural modeling, facilitators could also play an additional role in the deliberative process. Cultural modeling, for example, can uncover potential points of semantic and ideological miscommunication between groups as well as points of cohesion. By making participants aware of possible points of miscommunication and cohesion in the framing process prior to the initiation of the deliberation, an environment of mutual understanding as opposed to frustration could be cultivated from the outset of the deliberative process. Hamlett (2003:134) contends that, "effective deliberation rests on 'frames' that are constructed by participants, through which specific technologies may be assessed and assigned meaning." Cultural modeling and schema analysis are a means of identifying key frames utilized by stakeholders and thus are an appealing point of initiation for the exploration of constructive interchange across stakeholder groups with divergent discourses

According to Dryzek and Braithwaite (2000:251), "constructive dialogue between disparate groups requires sympathetic engagement with, and understanding of, the position of the other, as opposed to the dogmatic assertion of identity." Although different stakeholder groups may subscribe to divergent value systems utilizing unique sets of cultural meanings, productive deliberation is possible. Such deliberation can inspire each stakeholder group to genuinely reflect on its own interests while also considering the perspectives presented by opponents subscribing to an alternate discourse (Dryzek and Braithwaite 2000). While consensus may not be reached, positive sum outcomes can be achieved.

<u>Semantic and Idealogical Continituities and Discontinuities for Three Stakeholder Groups in the GE Debate</u>

Intra-Cultural Discontinuities

From an intra-cultural perspective, the cultural models discussed in Chapters 5 and 6 revealed multiple points of potential semantic miscommunication and ideological discontinuity. In both the US and New Zealand, the three stakeholder groups under investigation (consumers, members of the organic farming community, members of the GE/GE amenable farming community) had very different conceptualizations of what is meant by the term "environment". For respondents from the organic farming communities in the US and NZ, the environment was viewed as nature, a spiritual entity from which they gleaned peace and strength. For GE and GE-amenable farmer respondents, the environment was land, an economic commodity. US consumer respondents saw the environment as either an amorphous entity outside their general experience or thought of it as their personal day-to-day environment of home, neighborhood, workplace etc.

NZ consumer respondents, on the other hand, saw the environment as part of their nation's unique national identity. The term environment means very different things to each of these stakeholder groups but is a very commonly used term bandied around when discussing the pro's and con's of GE technology. Use of the term environment could prove to be a major point of miscommunication during the deliberative democratic process surrounding GE if the stakeholder groups involved in that process remain unaware of what that term means to each group of their co-deliberators.

Notions of health are likely to cause miscommunication between respondents from the organic farming communities in each nation and respondents from the other two stakeholder groups. For organic community respondents, health is a very holistic idea, which goes well beyond federal guidelines for a healthy diet and common recommendations issues by your local physician to exercise and limit stress. For respondents from the organic farming communities, health has mental, spiritual and physical components, which are all intimately tied to their conceptions of being in nature. GE was seen by organic community respondents as a direct affront to the mental, spiritual and physical components of health. It threatens environmental health, a source of spiritual and mental well-being as well as physical recreation, and it threatens the integrity of food, a source of physical well-being. GE and GE-amenable farmer respondents and pro-GE consumer respondents, have a narrower view of health in comparison and are unlikely to understand this groups vehement opposition to GE on the grounds of health. For GE and GE-amenable farmer and pro-GE consumer respondents, GE would only be a threat to health if the foods produced via GE methods were unsafe. These groups do not recognize how GE could be seen as a health threat on a multitude of fronts-spiritual, mental and physical. They instead believe that if scientists and government agencies have confirmed GE food to be safe then it is safe.

A potential point of miscommunication between US GE farmer respondents and organic farming community respondents, specifically, has to do with religion and notions of spirituality. Religion and spirituality are central ideas utilized by each stakeholder group to affirm their stance regarding genetic engineering. For GE farmer respondents, the Christian notion of improving upon the land gives them license to adopt GE, the ultimate form of improving upon nature's weaknesses. Contrastingly, notions of religious spirituality held by respondents from the organic farming community form a central reason for GE opposition as GE is seen as playing with nature. As previously discussed nature serves a spiritual purpose for this community. Thus, both stakeholder groups approach GE from entirely different religious perspectives with each group's religious perspective serving to support their stance towards GE.

An additional point of potential miscommunication between respondents from the GE and organic farming communities has to do with the idea of agricultural stewardship. Both groups used the term agricultural stewardship to describe their motto on proper farming practices. However, that term means very different things to respondents from each stakeholder group. For respondents from the organic farming community, agricultural stewardship is synonymous with achieving sustainable ecosystems. By contrast, for respondents from the GE farming community, agricultural stewardship is commensurate with sustainable agriculture. Organic farming community respondents have a much more expansive view of what sustainable agriculture entails. For them, it is a means to preserve an ecosystem in perpetuity as opposed to the preservation of only agricultural farmland. The difference in scale of sustainability denoted by the term agricultural stewardship for these two stakeholder groups would likely cause miscommunication during public debate should the term be utilized by participants.

Intra-cultural Continuities

In order for the deliberative process to be fruitful, identification of points of common ground between stakeholder groups can be particularly helpful. Points of common ground allow stakeholder groups to identify with each other and can create a sense of a larger community among groups with disparate values and ideas. As identified above, GE and organic community respondents in the US and NZ approach ideas of health, environment and GE from very different perspectives. However, there are points of common ground between the two groups that could serve as launching points for communication during public debate regarding GE.

By looking at the cognitive cultural models presented in Chapters 5 and 6, two points of common ground between respondents from the organic and GE farming communities become clear. The first point of common ground shared by both communities is an orientation towards looking to the future. Respondents from both communities are concerned about being able to continue there chosen lifestyle into the future. This future orientation leads community members to want to practice agricultural stewardship. As discussed previously, agricultural stewardship means something different to each community (ie. sustainable ecosystems vs. sustainable agriculture) but the ultimate goal of agriculture stewardship is the same, community members want to preserve their lifestyle and livelihood in perpetuity. Recognition of this shared goal could prove to be a good starting point for negotiations about GE agriculture.

The second point of common ground is that both organic and GE farming community respondents in the US and New Zealand include in their cognitive models of the environment the idea of the environment as a livelihood. The type of livelihood is very different for each group but both groups recognize that their lifestyle and livelihood is very much tied to the environment, whether the environment be conceptualized as nature or as land. Recognition of shared dependence on the environment for ones livelihood is another good starting point from which to begin public debate regarding GE agriculture.

An Inter-Cultural Discontinuity

By looking at the cultural models of GE in the US and NZ and by analyzing the national identity and national branding literature for each nation, issues of national identity and branding are revealed as potentially important points of contention between the two nations. The US is one of the original innovators of GE technology and has swiftly adopted the technology into mainstream agriculture. GE fits in well with the US's long history of being a technocracy. As highlighted in Chapters 2 and 3, the US has viewed technology as a source of human well-being and economic prosperity and the US has a national identity based partially on technological innovation. New Zealand, on the other hand, lacks a technocratic history. As discussed in Chapter 2 in the history of NZ technology section, New Zealanders have been ready adopters of technology should a given technology suit their needs but lack a strong history of technological innovation and have imported most of their technology from overseas.

Instead of a national identity based on technological innovation, New Zealand's national identity is based on being "clean green", "100% Pure" New Zealand. A healthy, majestic environment is one of New Zealand's number one commodities. As depicted in the cognitive cultural models for New Zealand stakeholders, NZ national identity is strongly linked to how NZ consumer and organic community respondents conceptualize the environment, which is in turn linked to why GE is conceptualized negatively.

Each nation is likely to approach a public debate on GE from the standpoint of how GE fits in with their national identity. In order for effective communication to occur between the two nations each nation must recognize and understand what GE means to the other nation's identity. What is seen as threatening to the environment and the economy in New Zealand is seen as an acceptable environmental risk and prosperous for the economy in the US. As long as GE is seen as a potential threat to the environment, New Zealand is unlikely to adopt the technology as it goes against the fabric of their society.

The New Zealand government is currently pushing to add another dimension to New Zealand national identity, that of New Zealand as innovator. If this new initiative is successful and the idea of New Zealand as innovator becomes entrenched in New Zealand culture, the people of New Zealand may become more open to GE technology. If this were to occur, participants in a public debate between the US and NZ regarding GE technology would have a common point of interest—innovation—to begin the deliberative process.

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Appendices

Appendix 4.1: Examples of Common Semi-Structured Interview Questions

Examples of semi-structured interview questions are:

1. What are the characteristics of a healthy human?
2. How can human health be maintained?
3. Can you describe for me what components a healthy diet should have or not have?
4. What are your opinions about organic food?
5. How would you characterize your own health?
6. What are the biggest threats to human health?
7. How would you describe the current state of people's health in your country?
8. What are your opinions about technology? Benefits? Risks?
9. What are the characteristics of a healthy environment?
10. How can a healthy environment be maintained?
11. What are the biggest threats to environmental health?
12. How healthy is the current state of the environment in your country?
13. Should the environment be a top, mid, or lower level concern for the nation? Why?
14. How important is environmental health for human well-being?
15. How important is the environment to you?
16. How would you characterize your relationship with the environment? Nature?
17. Can you give me your definition of genetic engineering in agriculture?
18. How knowledgeable do you feel about GE technology
19. What opinions do you have about genetic engineering agricultural technology?
20. How do you think GE technology might benefit society?
21. Do you have any concerns about GE agricultural technology?
22. How do you feel about eating GE food?
23. What factors do you consider when evaluating the risks and benefits of GM technology [examples might include 'type of genetic modification' (microbial, plant or animal), 'rationale for modification' (nutritional, sensory, or economic), 'associated health and environmental benefits and risks', and 'ethical concerns' (playing god, tampering with nature)]?
24. What influences will GE agricultural technology have on your life?
25. How prevalent do you think the technology is in the US/NZ?

Based on participant answers, further questions were asked to discern deeper meanings and to get a clear picture of how participants thought about health, the environment and GE technology.

Appendix 4.2: Rank Order Card Sets

Threats to Health
Respondents were asked to order cards from most serious threat to human health to least serious threat to human health.

1. Recreational Drug Use
2. Lack of Exercise
3. Obesity
4. Lack of Health Insurance
5. Stress
6. Inadequate Sleep
7. Environmental Pollution
8. Smoking
9. Chemicals in Food
10. Overpopulation
11. Genetically Engineered Foods

Threats to the Environment
Respondents were asked to order cards from most serious threat to the environment to least serious threat to the environment.

1. Global Warming
2. Air Pollution
3. Oil Drilling
4. Deforestation
5. Ozone Depletion
6. Development (housing and commercial)
7. Pesticides and Herbicides
8. Water Pollution
9. Consumerism
10. Over-harvesting of Animals and Fish
11. Overpopulation
12. Genetic Engineering in Agriculture
13. Land Pollution

Reasons to Maintain a Healthy Environment
Respondents were asked to order cards from most important reason to maintain a healthy environment to least important reason to maintain a healthy environment.

1. Maintenance of Food Chains
2. Aesthetics
3. Moral Obligation to Future Generations
4. Provides Economic Resources to Society (ex. water, timber)
5. Human Health
6. Moral Obligation to the Other Living Inhabitants of the Earth (animals, insects, plants)

Benefits of Genetic Engineering in Agriculture and Food Production
Respondents were asked to order cards from most important benefit of GE to society to least important benefit of GE to society if all the cards represented true potential benefits.

1. Reduced Chemical Use
2. Increased Crop Yield
3. Improved Taste
4. Improved Nutritional Quality
5. Crop Defense Against Diseases and Pests
6. Protection of the Environment
7. Improved Food Shelf-Life
8. Production of Edible Vaccines and Drugs
9. Increase in Food Availability
10. Wealth and Job Creation

Risks of Genetic Engineering in Agriculture and Food Production
Respondents were asked to order cards from most risky for society to least risky for society if all the risks were equally likely to happen.

11. Creation of New Viruses
12. Threats to Crop Genetic Diversity
13. Negative Alteration in the Nutritional Quality of Food
14. Introduced Food Toxicity
15. Introduction of Allergens into Food
16. Limited Access to Seeds through the Patenting of GE Seeds
17. Human Antibiotic Resistance
18. Lack of Labeling of GE Ingredients in Food
19. Unintentional Gene Transfer to Wild Plants

Appendix 4.3: Means and Standard Deviations for Items in the Threats to Health Rank Order - US Respondents

	United States														
Threats to Health: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Obesity	30	4.43	2.473	16	4.13	2.446	11	4.91	2.809	14	3.86	2.214	10	3.40	1.506
Exercise	30	5.77	2.176	16	5.50	2.066	11	6.09	2.548	14	5.00	2.038	10	5.90	2.331
Environmental Pollution	30	4.70	2.891	16	4.88	2.778	11	4.27	3.349	14	2.21	1.626	10	4.90	2.132
Chemicals in/on Food	30	6.47	2.417	16	7.19	2.073	11	5.18	2.676	14	3.64	2.098	10	6.80	2.530
Overpopulation	30	6.90	3.487	16	6.56	3.577	11	6.55	3.588	14	4.71	3.245	10	6.90	3.843
Lack of Health Insurance	30	6.10	3.845	16	5.56	4.016	11	6.18	3.868	14	8.43	3.056	10	9.70	1.377
Stress	30	5.10	3.263	16	4.94	3.395	11	5.64	3.202	14	4.93	2.269	10	4.50	2.653
Illicit Drugs	30	5.40	3.169	16	5.25	2.543	11	6.64	3.641	14	7.07	3.125	10	3.00	2.261
Smoking	30	4.53	2.556	16	4.56	2.308	11	5.18	2.926	14	5.86	2.825	10	3.90	1.912
Sleep	30	7.33	2.783	16	7.06	2.863	11	7.64	3.107	14	7.71	2.840	10	7.00	2.906
Genetically Engineered Food	30	9.27	2.258	16	10.38	1.258	11	7.73	2.328	14	6.57	3.056	10	10.00	.943

Appendix 4.4: Means and Standard Deviations for Items in the Threats to Health Rank Order - NZ Respondents

	New Zealand														
Threats to Health: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Obesity	32	4.00	2.00	11	3.64	1.629	18	4.39	2.227	13	4.23	2.006	6	3.17	1.835
Exercise	32	6.22	2.661	11	6.27	2.970	18	6.11	2.632	13	6.69	2.323	6	4.00	1.414
Environmental Pollution	32	4.06	2.355	11	4.18	1.991	18	3.83	2.455	13	4.46	2.876	6	5.33	2.733
Chemicals in/on Food	32	5.16	2.490	11	5.82	3.027	18	4.67	2.169	13	3.92	1.977	6	8.00	2.449
Overpopulation	32	6.56	3.689	11	8.00	2.966	18	6.11	3.924	13	5.31	3.772	6	7.00	3.098
Lack of Health Insurance	32	10.47	1.077	11	9.64	1.502	18	10.89	.323	13	10.15	1.463	6	9.83	1.602
Stress	32	5.06	2.462	11	4.45	2.979	18	5.33	2.326	13	5.85	2.703	6	5.83	1.722
Illicit Drugs	32	4.28	2.750	11	3.00	2.236	18	5.06	2.980	13	5.31	3.146	6	3.17	1.602
Smoking	32	3.91	2.557	11	3.00	1.612	18	4.56	2.727	13	5.23	2.619	6	3.50	3.146
Sleep	32	7.75	2.640	11	6.82	2.676	18	8.33	2.612	13	8.46	2.367	6	5.83	2.563
Genetically Engineered Food	32	7.59	2.298	11	8.45	2.155	18	6.72	2.218	13	5.31	3.250	6	10.33	.816

Appendix 4.5: Means and Standard Deviations for Items in the Threats to the Environment Rank Order - US Respondents

	United States														
Threats to Environment: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Global Warming	30	6.03	3.672	16	6.31	4.316	11	5.55	3.142	14	4.43	3.652	9	6.56	3.779
Consumerism	30	8.47	4.249	16	700	3.847	11	9.64	4.610	14	4.79	3.017	9	5.33	3.742
Genetic Engineering in Agriculture	30	11.17	2.627	16	12.63	.619	11	8.91	3.145	14	7.71	3.451	9	10.33	3.041
Air Pollution	30	4.43	2.967	16	4.63	2.754	11	5.09	3.177	14	.371	2.335	9	2.89	1.269
Water Pollution	30	4.73	3.051	16	5.69	3.114	11	4.09	2.879	14	4.00	3.258	9	3.67	3.162
Land Pollution	30	5.80	2.821	16	6.44	2.529	11	5.64	3.233	14	4.93	2.814	9	4.67	2.449
Ozone Depletion	30	6.30	3.164	16	6.38	3.074	11	6.09	3.780	14	8.00	4.455	9	6.22	1.986
Pesticides	30	7.93	3.016	16	8.31	3.049	11	8.18	3.060	14	4.50	2.849	9	8.00	3.317
Overharvesting of Species	30	7.70	3.395	16	7.69	3.790	11	7.91	3.330	14	8.29	3.667	9	6.33	4.153
Overpopulation	30	6.30	4.103	16	5.50	4.163	11	6.36	3.957	14	5.14	3.920	9	7.33	5.099
Development (housing/commercial)	30	6.73	3.610	16	6.00	3.483	11	7.55	3.959	14	6.14	3.134	9	6.78	4.116
Deforestation	30	6.00	3.195	16	6.13	3.403	11	5.27	2.796	14	6.00	3.942	9	5.56	2.789
Oil Drilling	30	9.40	2.966	16	8.31	3.341	11	10.73	2.102	14	8.64	3.608	9	8.89	2.205

Appendix 4.6: Means and Standard Deviation for Items in the Threats to the Environment Rank Order - NZ Respondents

	New Zealand														
Threats to the Environment: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Global Warming	32	5.00	3.707	11	5.09	2.844	18	4.61	4.118	13	3.31	2.898	6	8.00	4.290
Consumerism	32	8.91	4.511	11	10.00	4.583	18	8.44	4.718	13	8.46	4.255	6	6.67	3.882
Genetic Engineering in Agriculture	32	10.00	2.314	11	10.18	2.960	18	9.44	1.723	13	6.08	3.475	6	10.50	3.017
Air Pollution	32	4.31	2.507	11	2.64	1.859	18	5.00	2.114	13	5.62	2.931	6	5.17	2.639
Water Pollution	32	4.28	2.655	11	2.36	1.206	18	5.39	2.831	13	6.23	2.555	6	6.50	2.881
Land Pollution	32	5.44	2.552	11	4.09	2.300	18	6.00	2.301	13	7.23	2.386	6	6.50	2.665
Ozone Depletion	32	5.06	3.340	11	5.64	3.042	18	5.00	3.662	13	6.15	2.996	6	6.83	2.639
Pesticides	32	7.19	2.811	11	5.55	2.544	18	7.83	2.618	13	5.23	2.682	6	10.50	1.871
Overharvesting of Species	32	7.16	3.274	11	6.27	2.832	18	7.33	3.430	13	7.54	3.755	6	7.16	4.262
Overpopulation	32	6.75	4.064	11	7.45	4.367	18	6.78	3.874	13	5.69	4.479	6	6.75	4.665
Development (housing/commercial)	32	9.03	3.188	11	8.45	3.142	18	9.61	3.432	13	10.69	2.780	6	9.03	3.017
Deforestation	32	4.84	2.985	11	6.45	3.328	18	4.11	2.564	13	4.23	2.315	6	4.84	3.204
Oil Drilling	32	10.81	2.693	11	10.36	3.233	18	11.44	1.617	13	9.77	3.609	6	10.81	2.503

Appendix 4.7: Mean and Standard Deviation for Items in the Reasons for a Healthy Environment Rank Order - US Respondents

	United States														
Reasons for a Healthy Environment: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Moral Obligation to Future Human Generations	30	3.33	1.373	16	3.56	1.315	11	3.00	1.483	13	2.38	1.261	N/A	N/A	N/A
Moral Obligation to Other Living Creatures	30	3.10	1.447	16	2.88	1.455	11	3.18	1.537	13	2.31	1.377	N/A	N/A	N/A
Human Health	30	1.83	1.315	16	1.94	1.389	11	1.91	1.375	13	2.46	1.198	N/A	N/A	N/A
Maintenance of Food Chains	30	3.37	1.326	16	3.19	1.424	11	3.73	1.104	13	2.77	1.166	N/A	N/A	N/A
Provides Economic Resources	30	3.67	1.446	16	3.88	1.586	11	3.45	1.440	13	4.62	1.325	N/A	N/A	N/A
Aesthetic Quality	30	5.67	.758	16	5.56	.727	11	5.73	.905	13	5.38	.870	N/A	N/A	N/A

Note: N/A denotes table cells for which the "Reasons for a Healthy Environment Rank Order" was not administered to a sufficient number of research participants for statistical analysis as a result of time constraints in the interview process.

Appendix 4.8: Mean and Standard Deviation for Items in the Reasons for a Healthy Environment Rank Order - NZ Respondents

	New Zealand														
Reasons for a Healthy Environment: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Moral Obligation to Future Human Generations	32	3.13	1.157	11	2.91	1.044	18	3.11	1.132	12	1.83	1.193	6	3.00	1.673
Moral Obligation to Other Living Creatures	32	2.53	1.524	11	3.09	1.221	18	2.22	1.555	12	1.92	.900	6	4.50	1.225
Human Health	32	2.44	1.366	11	1.64	1.286	18	2.89	1.231	12	2.83	1.193	6	2.67	1.366
Maintenance of Food Chains	32	2.97	1.47	11	3.64	1.629	18	2.61	1.335	12	3.83	1.337	6	2.67	1.751
Provides Economic Resources	32	4.22	1.453	11	3.55	1.368	18	4.72	1.364	12	4.25	1.055	6	3.17	1.722
Aesthetic Quality	32	5.53	.842	11	5.64	.674	18	5.44	.984	12	5.58	.900	6	5.00	1.673

Appendix 4.9: Mean and Standard Deviation for the Benefits of GE Rank Order - US Respondents

	United States														
Benefits of GE: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Protection of the Environment	35	3.51	2.035	18	4.17	2.176	14	2.57	1.697	12	2.58	2.068	14	2.43	1.453
Reduced Chemical Use	35	4.14	2.328	18	4.22	2.340	14	3.93	2.336	12	2.75	1.215	14	2.36	1.598
Improved Nutritional Quality	35	4.06	2.578	18	3.83	2.640	14	4.57	2.409	12	5.17	2.517	14	5.62	2.022
Edible Vaccines and Drugs	35	5.71	2.906	18	6.17	3.258	14	5.36	2.590	12	6.67	2.270	14	6.85	2.410
Crop Defense Against Diseases/Pests/ Herbicides	35	5.03	2.294	18	5.11	2.676	14	5.07	1.979	12	3.75	1.765	14	3.86	2.070
Increase in Food Availability	35	3.86	2.290	18	3.44	2.064	14	4.07	2.269	12	3.92	2.353	14	5.46	2.259
Improved Taste	35	8.86	1.332	18	8.67	1.572	14	9.00	1.038	12	7.67	1.969	14	8.0	1.826
Increased Crop Yields	35	4.66	2.155	18	4.33	2.000	14	5.07	2.369	12	3.83	2.209	14	3.79	2.547
Improved Food Shelf-life	35	8.06	1.679	18	7.89	1.906	14	8.07	1.542	12	7.92	1.730	14	6.92	2.100
Wealth and Job Creation	35	6.94	2.950	18	6.83	2.728	14	7.29	3.268	12	7.33	2.309	14	7.00	3.038

Appendix 4.10: Mean and Standard Deviation for the Benefits of GE Rank Order - NZ Respondents

	New Zealand														
Benefits of GE: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Protection of the Environment	31	2.68	1.833	11	3.73	1.679	17	1.71	1.047	15	2.47	2.295	6	3.33	2.338
Reduced Chemical Use	31	3.84	2.051	11	4.27	2.328	17	3.59	1.938	15	2.60	2.165	6	3.50	2.074
Improved Nutritional Quality	31	3.84	1.934	11	3.64	2.111	17	4.06	1.952	15	5.07	2.154	6	5.00	2.683
Edible Vaccines and Drugs	31	4.77	3.170	11	4.82	3.459	17	4.88	2.804	15	5.33	2.690	6	3.33	2.582
Crop Defense Against Diseases/Pests/ Herbicides	31	4.42	2.292	11	3.18	1.888	17	4.94	2.304	15	4.20	2.274	6	3.83	2.639
Increase in Food Availability	31	4.77	2.376	11	4.91	2.914	17	4.88	2.118	15	5.67	1.839	6	3.67	2.338
Improved Taste	31	7.87	2.078	11	7.73	2.284	17	7.76	2.107	15	8.60	1.639	6	7.17	2.229
Increased Crop Yields	31	5.65	2.360	11	5.45	3.174	17	5.82	1.944	15	5.13	2.326	6	4.67	2.251
Improved Food Shelf-life	31	8.10	1.989	11	6.36	2.335	17	9.12	0.857	15	7.87	1.807	6	7.00	1.789
Wealth and Job Creation	31	8.10	1.972	11	8.18	2.359	17	8.24	1.562	15	8.07	1.486	6	8.00	2.757

Appendix 4.11: Mean and Standard Deviation for the Risks of GE Rank Order - US Respondents

	United States														
Risks of GE: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Toxicity of GE Foods	28	3.36	2.112	19	4.05	2.527	14	2.86	1.406	13	4.85	2.304	12	3.58	2.021
Human Antibiotic Resistance	28	3.00	1.846	19	3.32	2.056	14	2.29	1.204	13	3.85	1.625	12	3.25	2.340
Creation of New Viruses	28	2.21	1.792	19	2.32	1.916	14	1.86	1.351	13	3.77	2.488	12	2.50	1.508
A Lack of Labeling of GE Products	28	7.14	1.957	19	7.05	1.985	14	6.86	1.748	13	6.54	2.222	12	7.58	1.379
Negative Alteration in Nutritional Quality	28	5.79	2.250	19	5.63	2.114	14	5.71	2.268	13	6.08	2.691	12	5.17	1.337
Unintentional Gene Transfer to Wild Species	28	5.86	2.068	19	5.16	2.316	14	6.07	1.385	13	3.54	2.184	12	4.83	2.691
Threats to Crop Genetic Diversity	28	6.07	1.923	19	5.84	1.893	14	5.79	2.082	13	3.00	2.828	12	5.92	2.234
Limited Access to Seeds through Patenting of GE Crop Varieties	28	6.36	2.407	19	5.53	2.458	14	7.14	1.791	13	4.62	2.399	12	6.08	3.175
Allergies	28	5.21	2.043	19	5.07	2.269	14	5.73	1.954	13	5.00	2.309	12	4.75	2.050

Appendix 4.12: Mean and Standard Deviation for the Risks of GE Rank Order - NZ Respondents

	New Zealand														
Risks of GE: Rank Order Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Toxicity of GE Foods	32	3.91	2.131	11	3.73	1.794	18	3.89	2.246	16	5.19	2.834	5	3.20	2.168
Human Antibiotic Resistance	32	4.03	2.621	11	3.36	2.908	18	4.44	2.595	16	4.94	2.435	5	2.40	1.342
Creation of New Viruses	32	2.59	1.411	11	2.82	1.662	18	2.50	1.295	16	3.44	1.965	5	4.40	1.817
A Lack of Labeling of GE Products	32	7.06	2.327	11	5.36	2.873	18	7.89	1.410	16	6.56	3.010	5	8.00	2.236
Negative Alteration in Nutritional Quality	32	5.53	2.369	11	5.27	2.005	18	5.33	2.635	16	5.63	2.419	5	5.20	.837
Unintentional Gene Transfer to Wild Species	32	4.97	2.495	11	6.18	2.714	18	4.17	1.978	16	4.19	2.455	5	4.80	2.387
Threats to Crop Genetic Diversity	32	5.44	2.327	11	6.55	2.162	18	4.83	2.256	16	4.13	2.729	5	4.60	2.302
Limited Access to Seeds through Patenting of GE Crop Varieties	32	6.09	2.833	11	6.36	2.942	18	6.56	2.572	16	4.25	2.595	5	6.40	3.050
Introduction of Food Allergens	32	4.94	2.015	11	4.09	1.700	18	5.39	2.200	16	5.06	2.175	5	3.00	1.000

Appendix 4.13: Perceived Likelihood of GE Risks

Opponents of genetic engineering often cite the following as potential negative consequences. On a scale from 1 to 5 (1 being not at all likely to happen and 5 being very likely to happen), what do you think is the likelihood of the following consequences being caused by genetic engineering in agriculture within the next 20 years:

1. Human Antibiotic Resistance
   1 2 3 4 5

2. Creation of New Viruses
   1 2 3 4 5

3. Decrease in Crop Genetic Diversity
   1 2 3 4 5

4. Unintentional Gene Transfer to Wild Plants
   1 2 3 4 5

5. Toxicity in Genetically Engineered Foods
   1 2 3 4 5

6. A negative alteration in the nutritional quality of food
   1 2 3 4 5

7. Limited access to seeds through patenting of GM crop varieties
   1 2 3 4 5

8. A lack of labeling of genetically engineered ingredients in food
   1 2 3 4 5

9. Introduction of food allergens
   1 2 3 4 5

Appendix 4.14: Level of Trust in Groups Involved in GE Policy Formation

Listed below are interest groups involved in the debate surrounding genetically engineered food and crop technology. For each group please indicate the degree to which you trust each group involved in the debate to act in your best interests regarding genetic engineering policy.

1. Industry
   Strongly distrust Distrust Neutral Trust Strongly trust

. Medical Doctors
   Strongly distrust Distrust Neutral Trust Strongly trust

3. Ethics Committees
   Strongly distrust Distrust Neutral Trust Strongly trust

4. Consumer Organizations
   Strongly distrust Distrust Neutral Trust Strongly trust

5. The Church
   Strongly distrust Distrust Neutral Trust Strongly trust

6. Newspapers and Magazines
   Strongly distrust Distrust Neutral Trust Strongly trust

7. Farmers
   Strongly distrust Distrust Neutral Trust Strongly trust

8. Government
   Strongly distrust Distrust Neutral Trust Strongly trust

9. Environmental Groups
   Strongly distrust Distrust Neutral Trust Strongly trust

10. Grocery Stores
   Strongly distrust Distrust Neutral Trust Strongly trust

11. Scientists
   Strongly distrust Distrust Neutral Trust Strongly trust

12. Individual Citizen
   Strongly distrust Distrust Neutral Trust Strongly trust

Appendix 4.15: Ranking of Religiosity and Political Stance

On a scale of 1 to 10 (with 1 being not at all religious and 10 being very religious), how religious are you?

1 2 3 4 5 6 7 8 9 10

In political matters people talk of "the left" (liberal) and "the right" (conservative). How would you place your views on this scale? (1=extreme left, 10=extreme right).

1 2 3 4 5 6 7 8 9 10

Appendix 4.16: Engagement in the GE Debate

(Derived from Eurobarometer 58.0 2002)

1. Before today had you ever talked about modern genetic engineering with anyone?
   Frequently Occasionally Once or twice Never

2. If you have talked with someone before about genetic engineering, can you please tell me their relationship to you (family member, friend, co-worker, stranger).

3. I would take the time to read articles or watch TV programmes on the advantages and disadvantages of development of biotechnology.
   Strongly disagree Disagree Neutral Agree Strongly agree

4. I would be prepared to take part in public discussions or hearings about genetic engineering.
   Strongly disagree Disagree Neutral Agree Strongly agree

Appendix 4.17: Means and Standard Deviations for the Likelihood of GE Risks Likert Scale - US Respondents

	United States														
Likelihood of GE Risks: Likert Scale Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Human Antibiotic Resistance	32	3.84	1.081	17	3.53	1.179	11	4.18	0.874	14	3.64	1.216	14	2.25	1.422
Creation of New Viruses	32	3.78	1.099	17	3.47	1.231	11	4.18	0.874	14	3.64	1.216	14	2.17	1.274
Decrease in Crop Genetic Diversity	32	3.59	1.132	17	3.47	1.068	11	3.73	1.272	14	4.43	1.016	14	3.17	1.341
Unintentional Gene Transfer to Wild Plants	32	3.53	1.007	17	3.59	1.064	11	3.27	1.191	14	4.29	0.994	14	2.83	1.167
Toxicity in GE Foods	32	3.06	1.076	17	2.76	.970	11	3.36	1.206	14	3.93	0.997	14	2.46	1.250
A Negative Alteration in Nutrition Quality	32	3.13	1.157	17	2.76	1.091	11	3.64	1.206	14	3.93	0.997	14	2.00	1.180
Limited Access to Seeds Through Patenting of GE Crop Varieties	32	3.34	1.359	17	3.41	1.064	11	3.36	1.690	14	4.57	0.854	14	3.75	1.422
A Lack of Labeling of GE Food	32	3.75	1.270	17	3.65	1.320	11	4.00	1.414	14	4.71	1.069	14	2.50	1.251
Introduction of Food Allergens	32	3.63	1.008	17	3.29	1.105	11	4.00	0.775	14	4.50	0.760	14	2.17	1.167

Appendix 4.18: Means and Standard Deviations for the Likelihood of GE Risks Likert Scale - NZ Respondents

	New Zealand														
Likelihood of GE Risks : Likert Scale Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Human Antibiotic Resistance	32	3.05	1.194	11	2.95	1.491	18	3.11	1.079	16	3.88	1.147	6	2.00	0.894
Creation of New Viruses	32	3.31	1.120	11	2.73	1.421	18	3.72	0.826	16	3.88	0.957	6	2.00	1.265
Decrease in Crop Genetic Diversity	32	3.72	1.224	11	2.73	1.272	18	4.17	0.857	16	4.38	1.025	6	2.33	0.816
Unintentional Gene Transfer to Wild Plants	32	4.00	1.270	11	3.18	1.328	18	4.50	1.043	16	4.44	1.031	6	2.33	1.211
Toxicity in GE Foods	32	3.06	1.366	11	2.45	1.368	18	3.61	1.195	16	3.81	1.167	6	1.67	1.033
A Negative Alteration in Nutrition Quality	32	3.28	1.224	11	2.45	1.368	18	3.89	0.832	16	3.94	1.124	6	2.00	0.894
Limited Access to Seeds Through Patenting of GE Crop Varieties	32	3.83	1.311	11	3.45	1.508	18	3.89	1.231	16	4.69	0.602	6	3.33	1.633
A Lack of Labeling of GE Food	32	3.91	1.279	11	3.00	1732	18	4.50	0.514	16	4.31	1.078	6	2.50	0.837
Introduction of Food Allergens	32	3.66	1.153	11	2.82	1.079	18	4.28	0.826	16	4.13	1.088	6	1.83	0.983

Appendix 4.19: Means and Standard Deviations for the Trust Likert Scales - US and NZ Respondents

	United States						New Zealand					
Trust in the Groups Involved in GE Policy Formation Likert Scale	**Pro-GE US Consumer**			**Anti-GE US Consumer**			**Pro-GE NZ Consumer**			**Anti-GE NZ Consumer**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Industry	19	2.32	1.003	13	2.08	0.760	11	2.55	1.036	18	1.78	0.943
Medical Doctors	19	3.76	1.085	13	3.92	0.760	11	3.77	1.330	18	3.72	0.752
Ethics Committees	19	3.53	0.612	13	3.69	0.855	11	3.55	0.688	18	3.72	0.826
Consumer Organizations	19	3.50	0.687	13	3.62	0.870	11	3.36	0.809	18	3.44	1.097
The Church	19	2.79	0.918	13	3.38	1.325	11	2.36	1.027	18	3.17	0.618
Newspapers and Magazine Journalists	19	2.89	0.737	13	3.15	1.068	11	2.64	1.120	18	2.56	1.199
Farmers	19	3.26	0.653	13	3.31	0.947	11	3.00	0.632	18	2.33	0.767
The Government	19	2.68	0.946	13	2.54	0.967	11	3.23	1.252	18	2.83	0.985
Environmental Groups	19	3.84	0.688	13	4.00	0.707	11	3.32	1.189	18	3.89	0.583
Grocery Stores	19	2.74	0.733	13	2.92	0.641	11	2.27	0.786	18	2.56	0.922
Scientists	19	3.84	0.602	13	3.23	0.725	11	4.23	0.607	18	3.00	0.970
Individual Citizens	19	3.18	0.636	13	3.36	0.809	11	3.00	1.183	18	2.89	0.758

Appendix 4.20: Means and Standard Deviations for the Religion and Politics Likert Scales - US Respondents

	United States														
Religion and Politics Likert Scale Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Religion	36	5.49	2.392	19	5.18	2.577	13	5.92	2.253	15	5.00	3.224	12	7.71	1.959
Politics	36	4.67	1.669	19	4.50	1.496	13	4.69	2.016	15	3.27	1.450	12	7.29	1.499

Appendix 4.21: Means and Standard Deviations for the Religion and Politics Likert Scales - US Respondents

	New Zealand														
Religion and Politics Likert Scale Items	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Religion	32	3.45	2.374	11	3.55	2.505	18	3.36	2.208	14	2.36	1.692	6	3.50	2.168
Politics	32	4.06	1.459	11	4.55	1.293	18	3.88	1.616	14	3.50	1.160	6	6.50	1.049

Appendix 4.22: Means and Standard Deviations for the Engagement Likert Scale Items - US Respondents

	United States														
Engagement Question #	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Question 1	36	3.11	0.747	19	3.00	0.816	14	3.07	0.616	14	1.86	0.663	13	2.08	0.954
Question 3	36	4.19	0.856	19	4.37	0.597	14	4.00	1.177	14	4.64	0.497	13	3.54	0.967
Question 4	36	3.17	0.941	19	3.26	0.872	14	3.07	1.072	14	4.14	1.167	13	3.04	1.010

Appendix 4.23: Means and Standard Deviations for the Engagement Likert Scale Items - NZ Respondents

	New Zealand														
Engagement Question #	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Question 1	32	2.88	0.871	11	2.73	0.786	18	2.94	0.938	15	2.13	0.834	6	1.33	0.516
Question 3	32	4.08	1.063	11	3.86	1.380	18	4.28	0.895	15	3.80	1.207	6	3.83	0.753
Question 4	32	3.56	1.243	11	3.55	1.293	18	3.78	1.215	15	3.47	1.060	6	4.00	1.265

Appendix 4.24: US Knowledge Test

General Science Knowledge Assessment

(Taken from NSF Survey of Public Attitudes Towards and Understanding of Science and Technology, 2001)

The correct answers are in bold.

1. The center of the Earth is very hot.
   A. True
   B. False
2. Cigarette smoking is linked to lung cancer.
   A. True
   B. False
3. The earliest humans lived at the same time as the dinosaurs.
   A. True
   B. False
4. Radioactive milk can be made safe by boiling it.
   A. True
   B. False
5. Which travels faster: light or sound?
   A. Light
   B. Sound
6. Does the Earth go around the Sun, or does the Sun go around the Earth?
   A. Earth around Sun
   B. Sun around Earth
7. How long does it take for the Earth to go around the Sun or the Sun to go around the Earth?
   A. one day
   B. one month
   C. one year
8. The universe began with a huge explosion.
   A. True
   B. False
9. The continents on which we live have been moving their location for millions of years and will continue to move in the future.
   A. True
   B. False
10. Antibiotics kill viruses as well as bacteria.
    A. True
    B. False
11. Human beings, as we know them today, developed from earlier species of animals.
    A. True
    B. False
12. All radioactivity is man-made.
    A. True
    B. False

13. The oxygen we breathe comes from plants.
   A. True
   B. False
14. Lasers work by focusing sound waves.
   A. True
   B. False
15. Electrons are smaller than atoms.
   A. True
   B. False

Genetics Knowledge Assessment

(Taken from Eurobarometer 58.0, 2002)

16. There are bacteria, which survive on waste water.
   A. True
   B. False
17. Ordinary tomatoes do not contain genes, while genetically modified tomatoes do.
   A. True
   B. False
18. The cloning of living things produces genetically identical offspring.
   A. True
   B. False
19. By eating a genetically modified fruit, a person's genes could also become modified.
   A. True
   B. False
20. It is the father's genes that determine whether a child is a girl.
   A. True
   B. False
21. Yeast for brewing beer consists of living organisms
   A. True
   B. False
22. It is possible to find out in the first few months of pregnancy whether a child will have Down's Syndrome.
   A. True
   B. False
23. Genetically modified animals are always bigger than ordinary ones.
   A. True
   B. False
24. More than half of human genes are identical to those of chimpanzees.
   A. True
   B. False
25. It is impossible to transfer animal genes into plants
   A. True
   B. False

Environmental Knowledge Assessment

(Taken from National Environmental Education and Training Foundation website- www.neetf.org/roper/roper2001-b.htm (date accessed September 2006))

26. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea? Is it...
    A. multiplicity
    B. biodiversity
    C. socio-economics
    D. evolution
    E. don't know
27. Carbon monoxide is a major contributor to air pollution in the U.S. Which of the following is the biggest source of carbon monoxide? Is it...
    A. factories and businesses
    B. people breathing
    C. motor vehicles
    D. trees
    E. don't know
28. How is most of the electricity in the U.S. generated? It is...
    A. by burning oil, coal, and wood
    B. with nuclear power
    C. through solar energy
    D. at hydroelectric power plants
    E. don't know
29. What is the most common cause of pollution of streams, rivers, and oceans? Is it...
    A. dumping of garbage by cities
    B. surface water running off yards, city streets, paved lots, and farm fields
    C. trash washed into the ocean from beaches
    D. waste dumped by factories
    E. don't know
30. Which of the following is a renewable resource? Is it...
    A. oil
    B. iron ore
    C. trees
    D. coal
    E. don't know
31. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from? Is it...
    A. acid rain
    B. global warming
    C. sudden changes in temperature
    D. harmful, cancer causing sunlight
    E. don't know

32. Where does most of the garbage in the U.S. end up? Is it in...
    A. oceans
    B. incinerators
    C. recycling centers
    D. landfills
    E. don't know
33. What is the name of the primary federal agency that works to protect the environment? Is it the...
    A. Environmental protection agency (EPA)
    B. Department of Health, Environment and Safety (the DHES)
    C. National Environmental Agency (the NEA)
    D. Federal Pollution Control Agency (the FPCA)
    E. Don't know
34. Which of the following household wastes is considered hazardous waste? Is it...
    A. plastic packaging
    B. glass
    C. batteries
    D. spoiled food
    E. don't know
35. What is the most common reason that an animal species becomes extinct? Is it because...
    A. pesticides are killing them
    B. their habitats are being destroyed by humans
    C. there is too much hunting
    D. there are climate changes that affect them
    E. don't know
36. Scientists have not determined the best solution for disposing of nuclear waste. In the U.S., what do we do with it? Do we...
    A. use it as nuclear fuel
    B. sell it to other countries
    C. dump it in landfills
    D. store and monitor the waste
    E. don't know
37. What is the primary benefit of wetlands? Do they...
    A. promote flooding
    B. help clean the water before it enters lakes, streams, rivers, or oceans
    C. help keep the number of undesirable plants and animals low
    D. provide good sites for landfills
    E. don't know

Nutrition and Health Knowledge

(Questions 38-40 taken from Anderson (2001), Questions 41-49 taken from Papakonstantinow et al. (2002)).

38. In which of the groups below are **ALL** the foods a rich source of carbohydrates?
    A. bread, orange juice, soft drink, spaghetti
    B. avocado, beer, eggs, banana
    C. cheese, potato, rice, pineapple
    D. fish, dried apricots, fruit juice, peanuts
39. In which of the groups below are **ALL** the food high in fat?
    A. peanut butter, corn chips, banana, chocolate
    B. apple pie, cream, cheese, lollipops, eggs
    C. boiled potato, avocado, bacon, peanuts
    D. butter, margarine, sour cream, oil
40. In which of the groups below are **ALL** the foods high in protein?
    A. cheese, potato, spinach, egg
    B. avocado, beef steak, skim milk, chocolate
    C. fish, shrimp, lamb, tofu
    D. baked beans, egg whites, peas, orange juice
41. A calorie measures energy released from the body in the form of heat.
    A. True
    B. False
42. Fats yield more energy per gram than either carbohydrates or proteins
    A. True
    B. False
43. A product contains 15 percent saturated fat. Is this product a low, medium or high source of saturated fat?
    A. low
    B. medium
    C. high
44. A product contains 49 percent sodium. Is this product a low, medium, or high source of sodium?
    A. low
    B. medium
    C. high
45. Which of the following nutrients poses the greatest risk for heart disease?
    A. saturated fat
    B. cholesterol
    C. total sugar
    D. fiber
46. The nutrient that increases the risk for hypertension when consumed in excess is?
    A. vitamin A
    B. vitamin E
    C. sodium
    D. iron

47. Which nutrient deficiency is related to osteoporosis?
    A. iron
    B. calcium
    C. vitamin C
    D. zinc
48. Which of the following groups has the highest need for iron?
    A. elderly
    B. men
    C. women
    D. children
49. Which nutrient described on food labels decreases constipation?
    A. fat
    B. protein
    C. fiber
    D. vitamin C

Appendix 4.25: NZ Knowledge Test

General Science Knowledge

(Taken from National Science Foundation Survey of Public Attitudes Towards and Understanding of Science and Technology, 2001)

The correct answers are in bold.

1. The center of the Earth is very hot.
   A. True
   B. False
2. Cigarette smoking is linked to lung cancer.
   A. True
   B. False
3. The earliest humans lived at the same time as the dinosaurs.
   A. True
   B. False
4. Radioactive milk can be made safe by boiling it.
   A. True
   B. False
5. Which travels faster: light or sound?
   A. Light
   B. Sound
6. Does the Earth go around the Sun, or does the Sun go around the Earth?
   A. Earth around Sun
   B. Sun around Earth
7. How long does it take for the Earth to go around the Sun or the Sun to go around the Earth?
   A. one day
   B. one month
   C. one year
8. The universe began with a huge explosion.
   A. True
   B. False
9. The continents on which we live have been moving their location for millions of years and will continue to move in the future.
   A. True
   B. False
10. Antibiotics kill viruses as well as bacteria.
    A. True
    B. False
11. Human beings, as we know them today, developed from earlier species of animals.
    A. True
    B. False
12. All radioactivity is man-made.
    A. True
    B. False

13. The oxygen we breathe comes from plants.
   A. True
   B. False
14. Lasers work by focusing sound waves.
   A. True
   B. False
15. Electrons are smaller than atoms.
   A. True
   B. False

Genetics Knowledge Assessment

(Taken from Eurobarometer 58.0, 2002)

16. There are bacteria which survive on waste water.
   A. True
   B. False
17. Ordinary tomatoes do not contain genes, while genetically modified tomatoes do.
   A. True
   B. False
18. The cloning of living things produces genetically identical offspring.
   A. True
   B. False
19. By eating a genetically modified fruit, a person's genes could also become modified.
   A. True
   B. False
20. It is the father's genes that determine whether a child is a girl.
   A. True
   B. False
21. Yeast for brewing beer consists of living organisms
   A. True
   B. False
22. It is possible to find out in the first few months of pregnancy whether a child will have Down's Syndrome.
   A. True
   B. False
23. Genetically modified animals are always bigger than ordinary ones.
   A. True
   B. False
24. More than half of human genes are identical to those of chimpanzees.
   A. True
   B. False
25. It is impossible to transfer animal genes into plants
   A. True
   B. False

Environmental Knowledge Assessment

(Derived from National Environmental Education and Training Foundation website (modified to fit New Zealand)-www.neetf.org/roper/roper2001-b.htm (date accessed - September 2006))

26. There are many different kinds of animals and plants, and they live in many different types of environments. What is the word used to describe this idea? Is it...
    A. multiplicity
    B. biodiversity
    C. socio-economics
    D. evolution
    E. don't know
27. Carbon monoxide is a major contributor to air pollution in New Zealand. Which of the following is the biggest source of carbon monoxide? Is it...
    A. factories and businesses
    B. people breathing
    C. motor vehicles
    D. trees
    E. don't know
28. How is most of the electricity in New Zealand generated? It is...
    A. by burning oil, coal, and wood
    B. with nuclear power
    C. through solar energy
    D. at hydroelectric power plants
    E. don't know
29. What is the most common cause of pollution of streams, rivers, and oceans? Is it...
    A. dumping of garbage by cities
    B. surface water running off yards, city streets, paved lots, and farm fields
    C. trash washed into the ocean from beaches
    D. waste dumped by factories
    E. don't know
30. Which of the following is a renewable resource? Is it...
    A. oil
    B. iron ore
    C. trees
    D. coal
    E. don't know
31. Ozone forms a protective layer in the earth's upper atmosphere. What does ozone protect us from? Is it...
    A. acid rain
    B. global warming
    C. sudden changes in temperature
    D. harmful, cancer causing sunlight
    E. don't know

32. Where does most of the garbage in New Zealand end up? Is it in...
    A. oceans
    B. incinerators
    C. recycling centers
    D. landfills
    E. don't know
33. What is the name of the primary government agency that works to protect the environment? Is it the...
    A. Ministry for the Environment New Zealand
    B. Department of Health, Environment and Safety (the DHES)
    C. National Environmental Agency (the NEA)
    D. Federal Pollution Control Agency (the FPCA)
    E. Don't know
34. Which of the following household wastes is considered hazardous waste? Is it...
    A. plastic packaging
    B. glass
    C. batteries
    D. spoiled food
    E. don't know
35. What is the most common reason that an animal species becomes extinct? Is it because...
    A. pesticides are killing them
    B. their habitats are being destroyed by humans
    C. there is too much hunting
    D. there are climate changes that affect them
    E. don't know
36. Scientists have not determined the best solution for disposing of non-medical nuclear waste generated from nuclear power plants. In New Zealand, what do we do with it? Do we...
    A. nothing, NZ has no non-medical nuclear waste
    B. sell it to other countries
    C. dump it in landfills
    D. store and monitor the waste
    E. don't know
37. What is the primary benefit of wetlands? Do they...
    A. promote flooding
    B. help clean the water before it enters lakes, streams, rivers, or oceans
    C. help keep the number of undesirable plants and animals low
    D. provide good sites for landfills
    E. don't know

Nutrition and Health Knowledge Assessment

Questions 38-40 taken from Anderson (2001), questions 41-49 taken from Papakonstinow et al. (2002).

38. In which of the groups below are **ALL** the foods a rich source of carbohydrates?
A. bread, orange juice, soft drink, spaghetti
B. avocado, beer, eggs, banana
C. cheese, potato, rice, pineapple
D. fish, dried apricots, fruit juice, peanuts

39. In which of the groups below are **ALL** the food high in fat?
A. peanut butter, corn chips, banana, chocolate
B. apple pie, cream, cheese, lollipops, eggs
C. boiled potato, avocado, bacon, peanuts
D. butter, margarine, sour cream, oil

40. In which of the groups below are **ALL** the foods high in protein?
A. cheese, potato, spinach, egg
B. avocado, beef steak, skim milk, chocolate
C. fish, prawns, lamb, tofu
D. baked beans, egg whites, peas, orange juice

41. A calorie measures energy released from the body in the form of heat.
A. True
B. False

42. Fats yield more energy per gram than either carbohydrates or proteins
A. True
B. False

43. A product contains 15 percent saturated fat. Is this product a low, medium or high source of saturated fat?
A. low
B. medium
C. high

44. A product contains 49 percent sodium. Is this product a low, medium, or high source of sodium?
A. low
B. medium
C. high

45. Which of the following nutrients poses the greatest risk for heart disease?
A. saturated fat
B. cholesterol
C. total sugar
D. fiber

46. The nutrient that increases the risk for hypertension when consumed in excess is?
A. vitamin A
B. vitamin E
C. sodium
D. iron

47. Which nutrient deficiency is related to osteoporosis?
A. iron
B. calcium
C. vitamin C
D. zinc

48. Which of the following groups has the highest need for iron?
A. elderly
B. men
C. women
D. children

49. Which nutrient described on food labels decreases constipation?
A. fat
B. protein
C. fiber
D. vitamin C

Appendix 4.26: Means and Standard Deviations for the Knowledge Tests - US Respondents

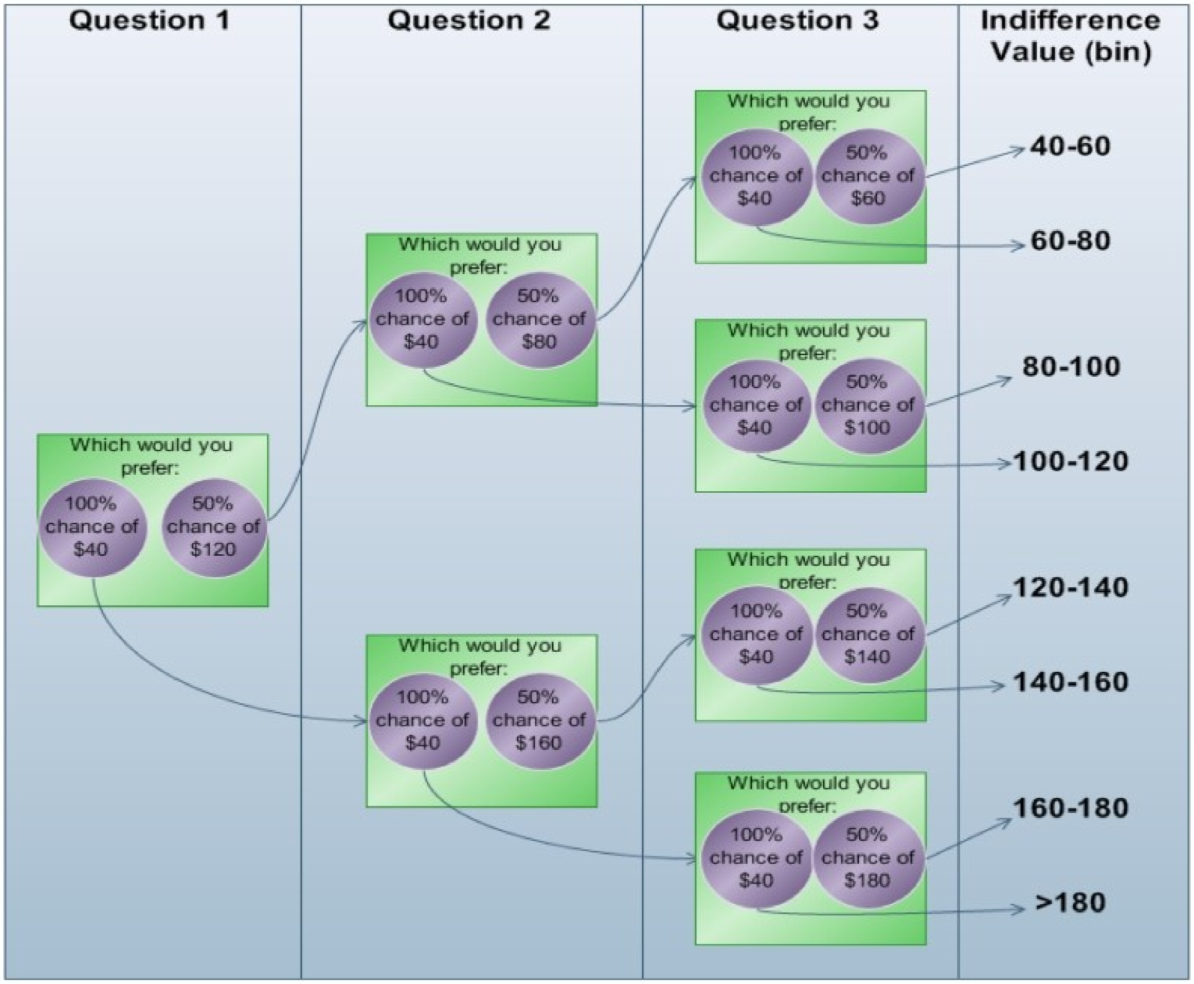
	United States														
Knowledge Test Item	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
General Science Knowledge	36	12.19	2.424	22	12.45	1.920	14	11.79	3.093	15	13.73	1.831	14	11.57	2.441
GE Knowledge	36	8.69	1.390	22	9.27	1.032	14	7.79	1.424	15	8.93	1.280	14	8.57	0.852
Environmental Knowledge	36	8.75	2.523	22	9.05	2.380	14	8.29	2.758	15	10.67	1.345	14	9.07	2.018
Health and Nutrition Knowledge	36	8.78	1.514	22	8.86	1.320	14	8.64	1.823	15	9.07	.884	14	7.93	1.900

Appendix 4.27: Means and Standard Deviations for the Knowledge Tests - NZ Respondents

	New Zealand														
Knowledge Test Item	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE-Amenable Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
General Science Knowledge	32	13	1.867	11	12.82	1.662	18	13.06	2.100	15	13.27	1.580	6	12.60	2.074
GE Knowledge	32	8.94	1.190	11	8.55	1.214	18	9.11	1.183	15	9	1	6	7.40	3.647
Environmental Knowledge	32	9.50	2.125	11	8.36	1.963	18	10.11	2.139	15	11.33	0.617	6	11.80	0.447
Health and Nutrition Knowledge	32	9.06	1.458	11	8.55	1.753	18	9.22	1.263	15	9.13	1.407	6	9.40	1.342

Appendix 4.28: General Risk Scenario

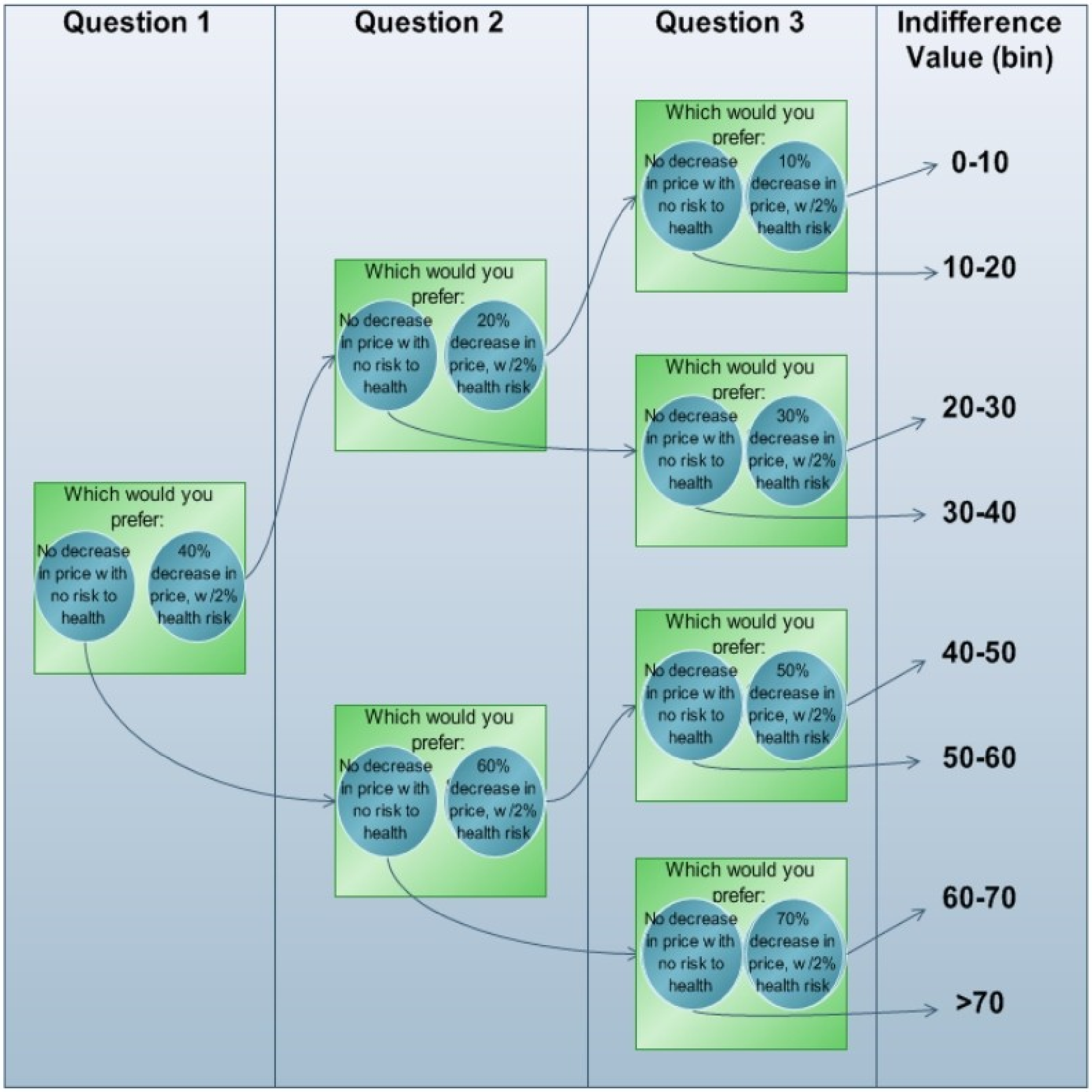
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of monetary values for which respondents would be indifferent choosing between an assured monetary return of $40 or a 50 percent chance of increasing their monetary return by at least one half - or losing it all.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 40-60: (1), IV 60-80: (2), IV 80-100: (3), IV 100-120: (4), IV 120-140: (5), IV 140-160: (6), IV 160-180: (7), IV >180: (8)

Appendix 4.29: Benefits Willing to Forego for No Risk to Health

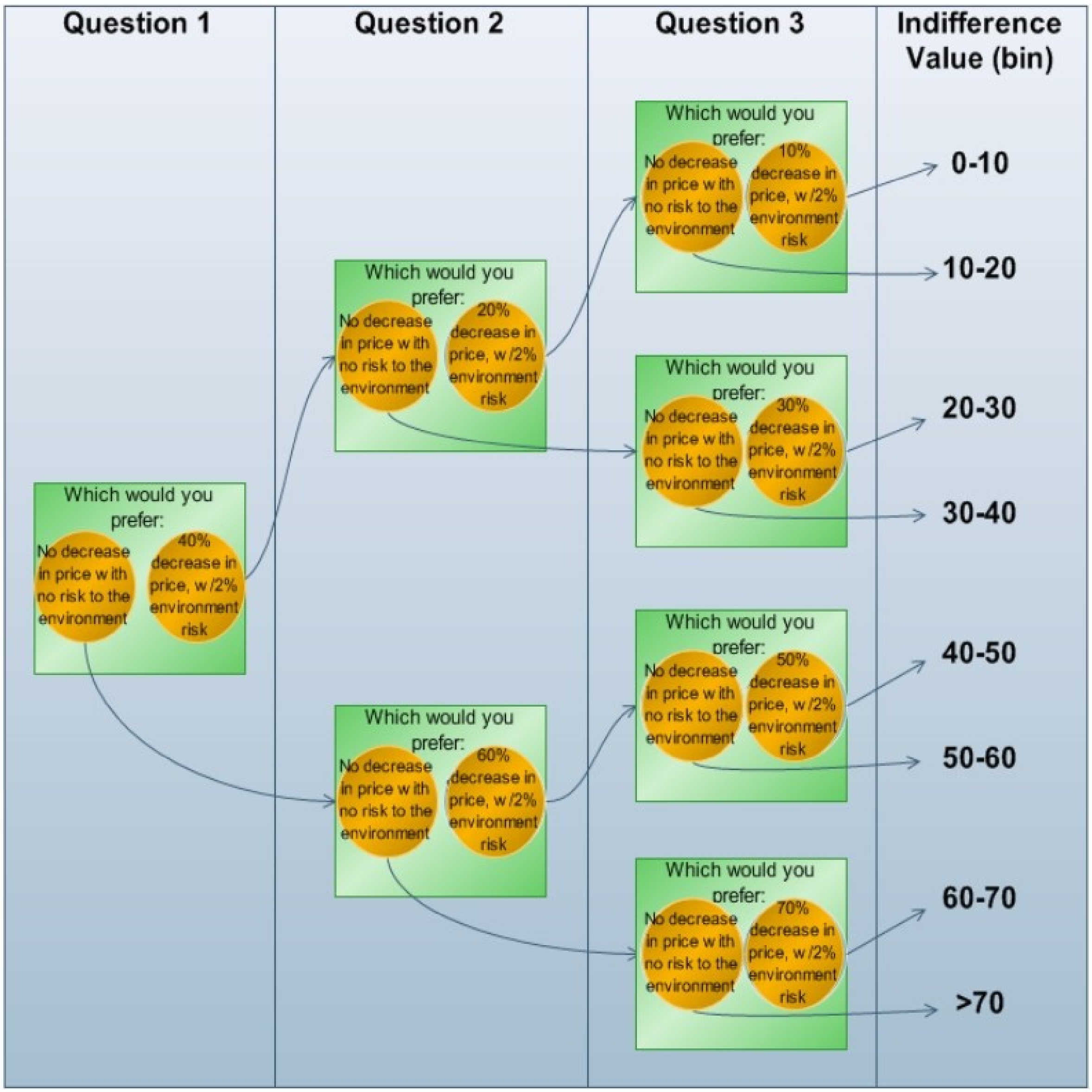
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of price discounts for which respondents would be indifferent choosing between no price discount and no risk to health and discounted food that poses a two percent risk to health.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-10: (1), IV 10-20: (2), IV 20-30: (3), IV 30-40: (4), IV 40-50: (5), IV 50-60: (6), IV 60-70: (7), IV >70: (8)

Appendix 4.30: Benefits Willing to Forego for No Risk to the Environment

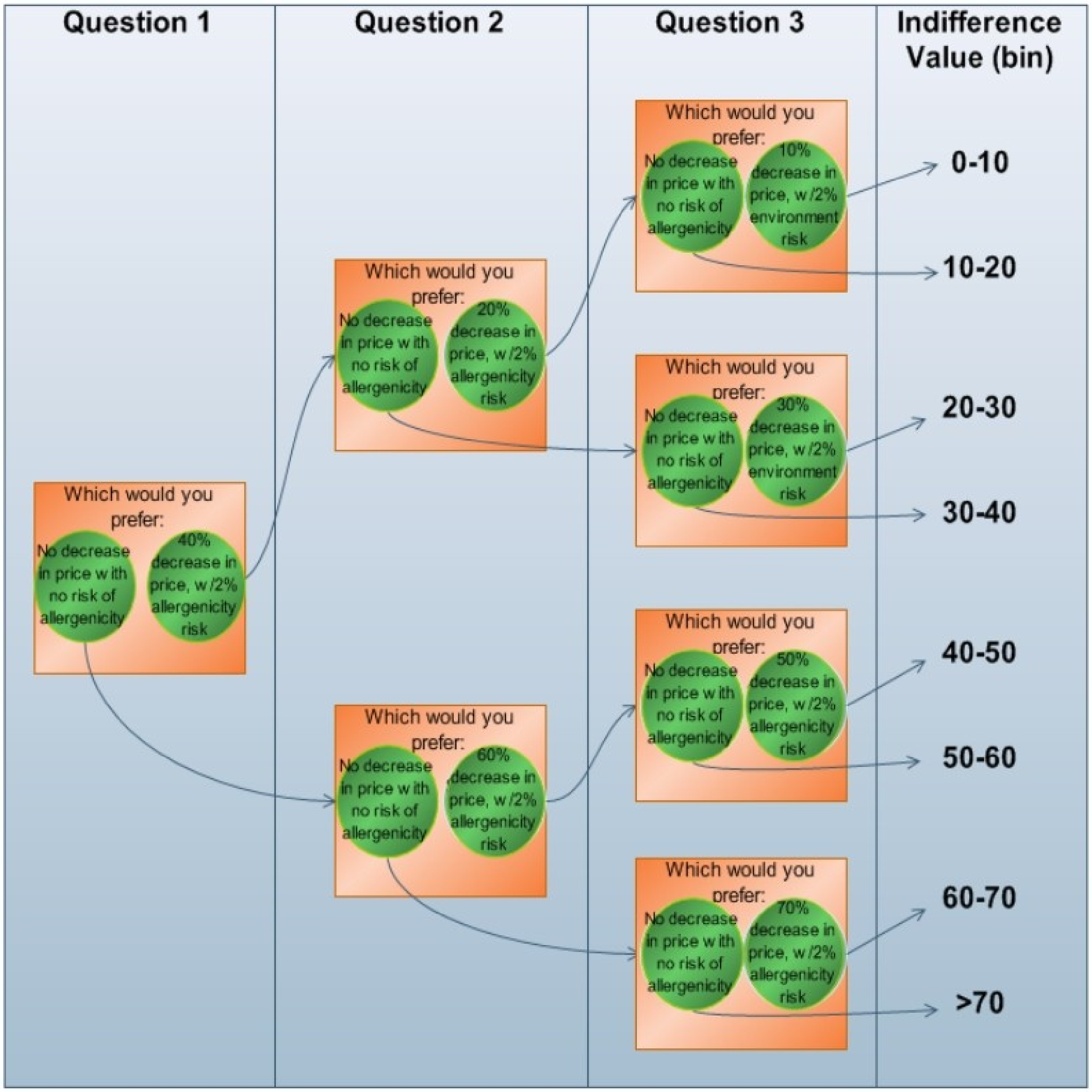
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of price discounts for which respondents would be indifferent choosing between no price discount and no risk or discounted prices with a two percent risk to the environment.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-10: (1), IV 10-20: (2), IV 20-30: (3), IV 30-40: (4), IV 40-50: (5), IV 50-60: (6), IV 60-70: (7), IV >70: (8)

Appendix 4.31: Benefits Willing to Forego for No Allergenicity Risk

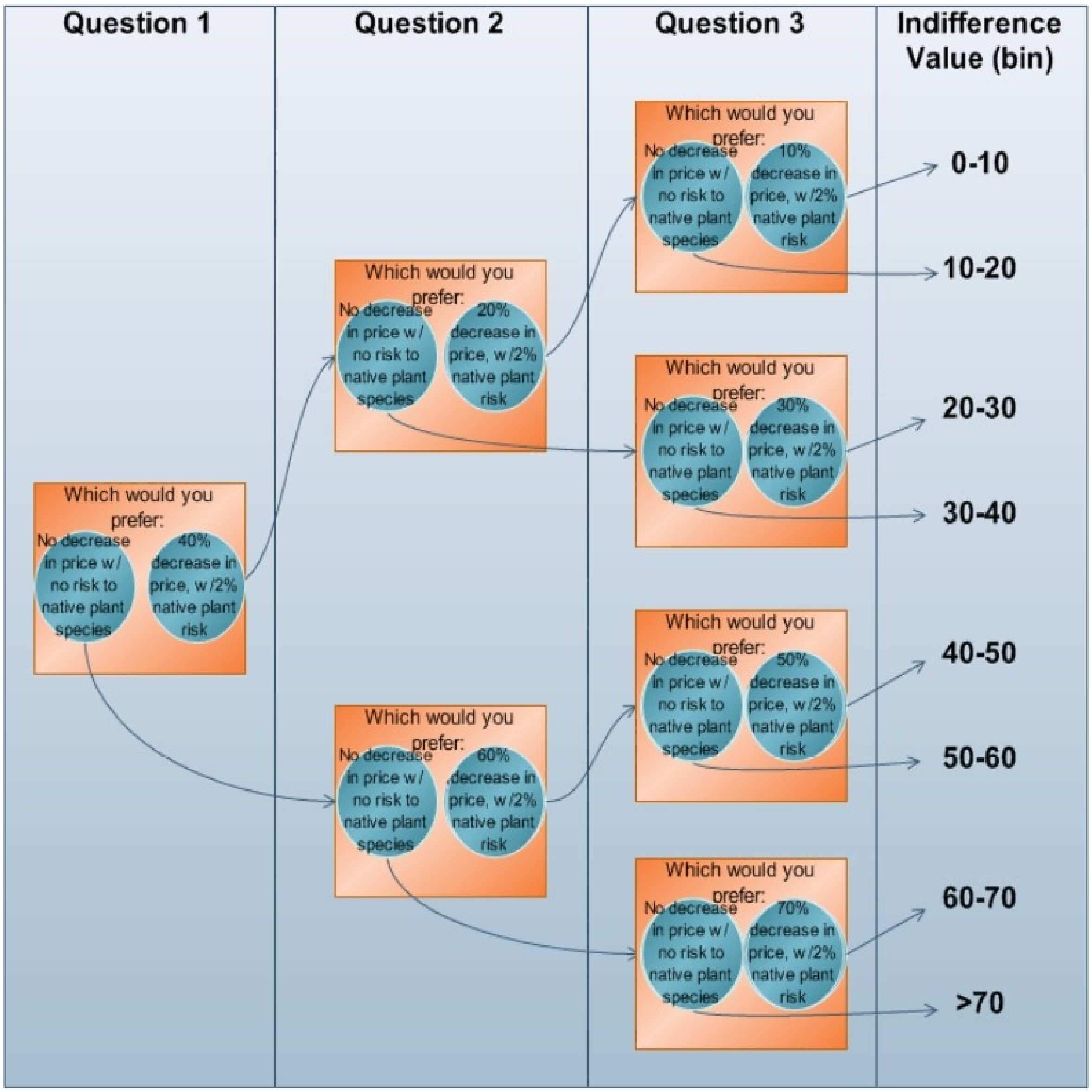
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of price discounts for which respondents would be indifferent choosing between no price discount and no risk of allergenicity or a price discount with a two percent risk of food allergenicity.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-10: (1), IV 10-20: (2), IV 20-30: (3), IV 30-40: (4), IV 40-50: (5), IV 50-60: (6), IV 60-70: (7), IV >70: (8)

Appendix 4.32: Benefits Willing to Forego for No Risk to Native Plants

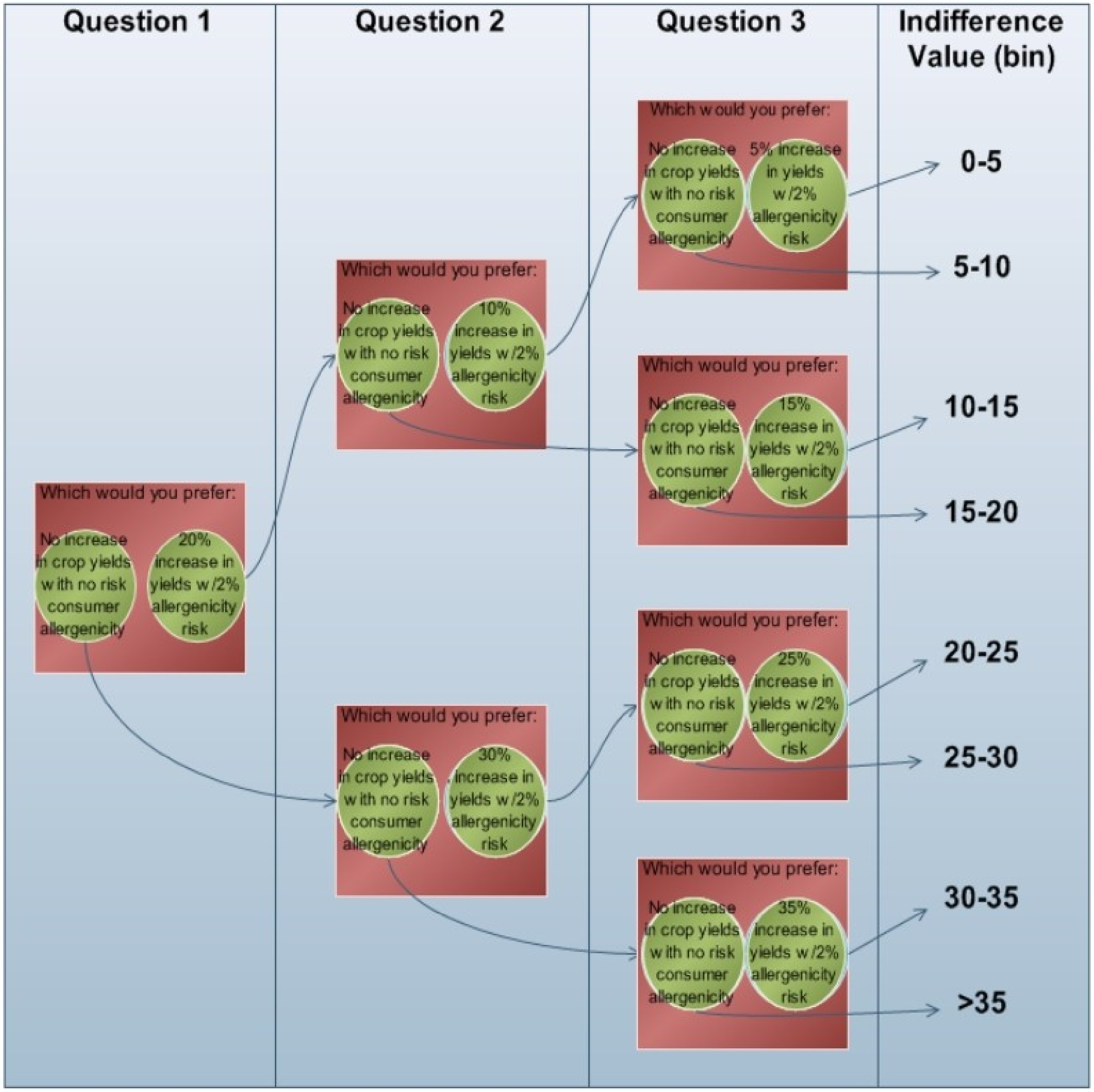
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of price discounts for which respondents would be indifferent choosing between no price discount and no risk to native plants or a price discount with a two percent risk to native plants.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-10: (1), IV 10-20: (2), IV 20-30: (3), IV 30-40: (4), IV 40-50: (5), IV 50-60: (6), IV 60-70: (7), IV >70: (8)

Appendix 4.33: Farmers – Benefits Willing to Forego for No Risk of Consumer Allergenicity

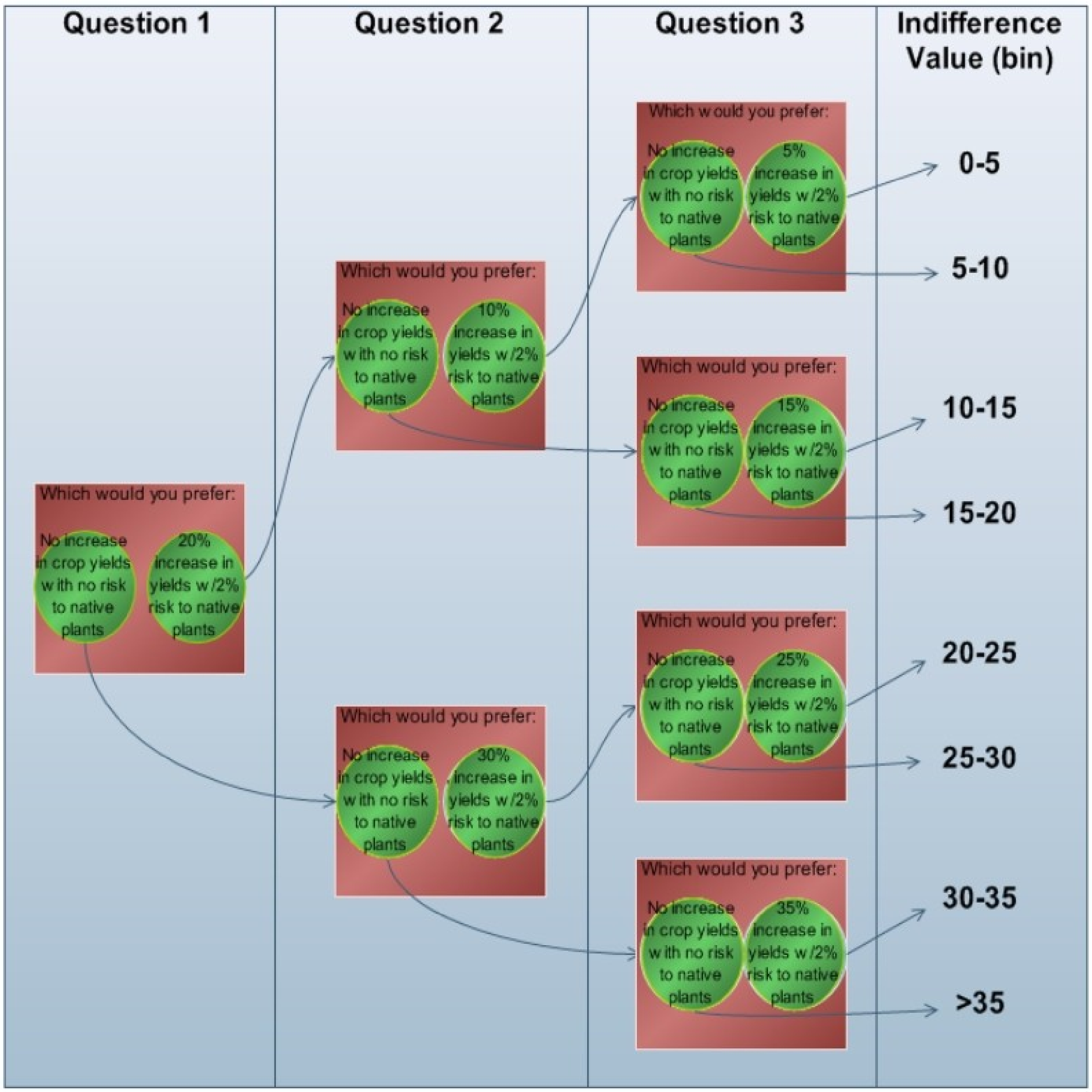
Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of percentage crop yield increases for which respondents would be indifferent choosing between no increase in crop yields and no risk of consumer allergenicity or increased crop yields with a two percent risk of consumer allergenicity.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-5: (1), IV 5-10: (2), IV 10-15: (3), IV 15-20: (4), IV 20-25: (5), IV 25-30: (6), IV 30-35: (7), IV >35: (8)

Appendix 4.34: Farmers - Benefits Willing to Forego for No Risk to Native Plant Species

Respondents were asked risk preference questions from Question Sets 1 through 3. The risk scenario presented to respondents was determined by answers given in prior question sets. The arrows in the figure below indicate the flow of questions posed to respondents. The resulting indifference value represents the range of percentage crop yield increases for which respondents would be indifferent choosing between no increase in crop yields with no risk to native plants or increased crop yields with a two percent risk to native plants.



Note: To compute mean values and to utilize the Mann Whitney U statistical test the indifference values (IV) were coded as follows-IV 0-5: (1), IV 5-10: (2), IV 10-15: (3), IV 15-20: (4), IV 20-25: (5), IV 25-30: (6), IV 30-35: (7), IV >35: (8)

Appendix 4.35: Means and Standard Deviations for Risk Scenario Items - US Respondents.

	United States														
Risk Scenario Item	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
General Risk Scenario	32	5.78	2.352	17	6.12	2.421	12	5.00	2.296	14	5.64	2.373	14	5.07	2.645
Benefits willing to forego for no risk to health	N/A	N/A	N/A	17	6.06	2.680	12	7.17	1.850	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk to the environment	N/A	N/A	N/A	17	6.41	2.181	12	5.67	2.309	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no allergenicity risk	N/A	N/A	N/A	17	5.71	2.974	12	6.42	2.610	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk to native plants	N/A	N/A	N/A	17	5.00	3.082	12	4.67	2.309	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk of consumer allergenicity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14	8.00	0.000	14	4.07	3.075
Benefits willing to forego for no risk to native plant species	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	14	7.71	1.069	14	2.69	2.428

Note: N/A denotes table cells for which the risk scenario exercise was not administered to the participant or, in the case of consumers, the participant group was divided into Pro-GE and Anti GE subgroups for purposes of statistical analysis.

Appendix 4.36: Means and Standard Deviations for Risk Scenario Items - NZ Respondents

	New Zealand														
Risk Scenario Item	**Consumers**			**Pro-GE Consumer**			**Anti-GE Consumer**			**Organic Farming Community**			**GE Farming Community**		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
General Risk Scenario	27	6.74	1.745	11	7.18	1.401	16	6.57	2.027	9	7.44	1.130	6	2.67	1.966
Benefits willing to forego for no risk to health	N/A	N/A	N/A	11	5.91	3.015	16	6.81	1.974	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk to the environment	N/A	N/A	N/A	11	4.36	3.075	16	6.81	2.428	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no allergenicity risk	N/A	N/A	N/A	11	5.00	2.933	16	7.56	1.094	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk to native plants	N/A	N/A	N/A	11	4.64	3.233	16	7.06	1.569	N/A	N/A	N/A	N/A	N/A	N/A
Benefits willing to forego for no risk of consumer allergenicity	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12	8.00	.000	6	4.83	3.488
Benefits willing to forego for no risk to native plant species	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	12	8.00	.000	6	3.33	1.211

Note: N/A denotes table cells for which the risk scenario exercise was not administered to the participant or, in the case of consumers, the participant group was divided into Pro-GE and Anti-GE subgroups for purposes of statistical analysis.

Appendix 7.1: Media Coding Frame Definitions

The following table represents coding frames defined in Botelho (2004). Items in bold indicate additions made to Botelho's definitions to fit this data set.

Coding Frame Definitions

1. Discovery: scientific breakthrough; new discovery; progress; paradigm shift; new direction for history

2. Economic Implications: economic potential; economic gain/loss; increase/decrease yield; investment opportunity

3. Ethical Issues: professional ethics; moral arguments; playing god; definition of risk; call for ethical involvement

4. Food **and Agricultural** Security Issues: contamination of food supply: having enough food; keeping up with rising food demand

5. Public Accountability: regulatory mechanisms; public involvement; transparency; trust in government; **protests**

6. Globalization: global perspective; creation of new feudalism due to patent rights; trade dispute before WTO; implications for lesser developed countries

7. Environmental Issues: actual/potential environmental impacts; unintended consequences; testing location safety; environmental testing

8. Health Implications: safety of human health; allergenicity; health trials; potential/ actual health impacts; nutrition

9. Labeling: EU required labeling; consumer awareness of GE products; labeling of ingredients

10. Public Opinion: consumer concern; public opinion on GE food; polls

11. Moratorium: EU moratorium on imports of GE food; **NZ moratorium on GE food**; ban on commercial growth

Appendix 7.2: Examples of Media Coding Frames

Examples of each of the eleven frames used in the media analysis are presented in this Appendix. Examples were collected from articles in the New Zealand Herald, The Press, The Atlanta Journal and Constitution and the Athens Banner Herald.

Discovery

> Genetic engineers are ready to say "let them eat cotton." Or, at least, cottonseed.
>
> Researchers at Texas A&M University have developed a strain of edible cottonseed that they say could, if widely adopted, feed millions of malnourished people. Assuming, of course, that they ever develop a taste for the stuff.
>
> Researchers say a decade or more of work will be needed to guide the technology out of the greenhouse and into commercial development, but they say the potential benefits are huge.
>
> "If cottonseed were safe for human consumption, the 44 million metric tons of cottonseed the world produces each year could provide the total protein requirement for a half-billion people" says plant geneticist Keerti Rathore, of the Texas Agricultural Experiment Station, whose team published its findings Monday in the Proceedings of the National Academy of Sciences. (November 21, 2006-The Atlanta Journal and Constitution)

Economic Implications

> AERU research officer, Dr Bill Kaye-Blake, said suggestions that a biopharming sector would have benefits in New Zealand should be treated with caution until more was known about the value of biopharmaceuticals. He said the unit had deliberately taken a "softly, softly" approach in assessing its economic benefits.
>
> The study had looked at the possible value of biopharming before the technology was available so better policy could be made, he said.
>
> "We looked at it from a dollar point of view, not from an ethical one or the sociology of genetic engineering or anything like that. This is a study on the economic impacts of biopharming."
>
> He said any forecast of its benefits was impossible to verify. Still unknown were impacts such as competing technologies and the effect on existing primary-sector industries and export markets.
>
> Kaye-Blake said the unit was almost ahead of itself in taking on the study and making an economic judGEent. "However, a lot of companies are making economic claims and saying this is the way of the future. We are saying (that), if you look at the whole picture, we are not sure if this is a good economic proposal for New Zealand."
>
> The global biopharmaceuticals industry is valued at around $41 billion, with an annual growth rate of 20 per cent. Biopharmaceuticals, which can cost $1000 a gram, are currently produced in expensive contained facilities. Previous research has estimated that

using biopharming to produce these compounds on farms could reduce the production costs to between a 10th and a 50th of current levels. (June 22, 2007-The Press)

Ethical Issues

There has been a lot of support for the idea. I think people see it as a way forward in the GE debate. It overcomes the big issue of public concern about ethics and how they feel uncomfortable about moving genes across the wide boundaries from animals to plants or bacteria to plants." (April 1, 2005-The Press)

Food and Agricultural Security Issues

Chinese farmers are apparently planting and marketing genetically modified rice without waiting for government approval of the crop for human consumption --- the second report of the illegal introduction of a transgenic crop into the world's food supply in the last month.

Only last Friday, the U.S. Department of Agriculture fined the Swiss biotech company Syngenta $375,000 for allowing an unapproved variety of genetically modified corn called Bt10 to enter the U.S. food supply over the last four years. The company acknowledged its "regrettable mistake," but maintained that the error posed no danger to consumers. (April 14, 2005-The Atlanta Journal and Constitution)

Public Accountability

State science company Crop & Food Research has been granted approval to field-test genetically engineered vegetables and forage brassicas, subject to strict conditions.

Crop & Food wants to assess the resistance of broccoli, cabbage, cauliflower and forage kale modified with genes derived from a soil bacterium to caterpillar pests, such as white butterfly and diamond-back moth.

The Environmental Risk Management Authority approved field testing on a 0.4 hectare plot at Lincoln, near Christchurch over 10 years. (May 29, 2007-The New Zealand Herald)

Globalization

A World Trade Organisation disputes panel has found in favour of the United States, Canada and Argentina in cases they have brought against the European Union over genetically modified crops.

They claimed it had a de facto moratorium on approving "biotech products" which was a breach of international trade rules.

US Trade Representative Robert Portman hailed the decision, saying agricultural biotechnology was a safe and beneficial technology that was improving food security and helping to reduce poverty worldwide.

At the other end of the spectrum, the decision will reinforce the conviction within the anti-globalisation movement that the WTO is the compliant tool of multinational corporations, a threat even to the safety of the food we eat.

Reality, of course, lies about equidistant between these two extremes. (February 16, 2006-The New Zealand Herald).

Environmental Issues

The ability of weeds and other pests to adapt to chemical controls has bedeviled farmers for a half-century, but in recent years, the explosive growth of Roundup and other glyphosate herbicides, which are sprayed on fields with herbicide-resistant crops, has fueled new concerns.

Last year, cotton farmers in Georgia and four other Southern states reported infestations of herbicide-resistant Palmer amaranth, a type of pigweed that grows to heights of 6 to 10 feet, making harvesting a field all but impossible. Researchers say the weeds, if they spread unchecked, are potentially a greater threat to cotton growers than the boll weevil. (January 20, 2007-The Atlanta Journal and Constitution)

Health Implications

But the Sustainability Council, chaired by Professor Cooper, and Canterbury University's Centre for Integrated Research in Biosafety, headed by Dr Heinemann, say the high levels of lysine in LY038 make it the first GE corn designed to be substantially different from conventional corn in its nutritional profile.

"While lysine is an essential amino acid, it is also highly reactive with common sugars and the heat of cooking accelerates the formation of advanced glycation end-products."

The latter are implicated in conditions including heart disease and chronic kidney failure. They are also what cause the "browning" of foods. (July 19, 2007-The New Zealand Herald)

Labeling

Victorian Agriculture Minister Joe Helper said federal labelling laws would guide shoppers who did not want to buy GE products. However, his spokesman later said he was not sure whether all products containing GE canola had to be labelled.

Gene Ethics spokesman Bob Phelps said consumers would have no choice.

"This so-called choice [for farmers] will take away everyone else's choice.” (November 28, 2007-The New Zealand Herald)

Public Opinion

"I wouldn't say it was just the greenies. It's about 5% to 7% of people who vote for the Greens, but there are a lot more people I know and talk to who don't vote for them who are against this.

"It is such a diverse range of people who are interested in this. Foodies are interested in this, and the common people of Europe are opposed to GE, That's why it's so hard for United States growers to get their food into the EU. The average Joe and Josephine may feel it is beyond their league, but they still want to know what they are eating.

"But," Dommisse continues, "there is still this feeling that, `as long as the scientists say this is safe, let's trust it'. For years we were told smoking was safe when obviously it wasn't. But you don't know what's in the corn you eat, especially if it's from the US. (June 9, 2007-The Press)

Moratorium

EU environmental ministers rejected an appeal Monday to force Austria to lift a ban on two biotech crop products, which the European Commission says violates international trade rules. Austria, keen to prevent genetically modified crops from being grown on its territory, had ignored 1999 and 2000 EU decisions approving two biotech corn products, made by St. Louis-based Monsanto Co. and Bayer CropScience AG, a German company with U.S. headquarters in Research Triangle Park, N.C. Austria invoked a so-called safeguard clause to prevent the crops from being used. The European Commission failed to muster enough backing for its third attempt to bring Austria in line. Of the 25 EU nations, only Britain, the Netherlands, Sweden and the Czech Republic backed its measure. (December 19, 2006-The Atlanta Journal and Constitution)

Appendix 7.3: Media Frame Search Terms

The following are a list of search terms identified by Botelho (2004) to help identify frames within articles and newscasts. Items in bold were added to suit the data set.

Discovery
- breakthrough
- development
- future
- progress

Globalization
- Africa
- biosafety
- global*
- national
- WTO

Labeling
- free
- ingredients
- label*

Economic Implications
- cost
- economic
- marketplace
- price
- profit
- yield

Food and **Agricultural Security**
- contamination
- food
- starlink
- supply

Environmental Issues
- biodiversity
- Bt
- gene transfer
- ecological
- environment*
- gene flow

Public Opinion
- concern
- consumer
- poll
- public

Ethical Issues
- ethic*
- God
- nature
- professional
- risk

Public Accountability
- accountability
- **Royal Commission on Genetic Modification**
- FDA
- EPA
- **ERMA**
- framework
- government
- regulatory
- transparency
- treaty
- **protests**

Health Implications
- allergens
- cancer
- health
- safety
- vitamin
- **biopharm***

Moratorium
- ban
- moratorium