ACCEPTABLE TRUST? THE PUBLIC PERCEPTION OF ORGANIZATIONS

INVOLVED IN GENETICALLY MODIFIED FOOD

by

JOHN THOMAS LANG

A Dissertation submitted to the

Graduate School-New Brunswick

Rutgers, The State University of New Jersey

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Graduate Program in Sociology

written under the direction of

Dr. Lee Clarke

and approved by

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New Brunswick, New Jersey

October, 2007

ABSTRACT OF THE DISSERTATION

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by JOHN THOMAS LANG

Dissertation Director: Dr. Lee Clarke

The amount, type, and quality of food we eat often seems to be a matter of personal taste, however, our system of food production circumscribes our choices. This system is neither accidental nor free of controversy. Estimates suggest that three-quarters of all processed foods on American shelves now contain some ingredients derived from genetically modified crops. Although American consumers are largely unaware of genetically modified food (GMF) and even lack clear impressionistic images and feelings about it, they are not without opinions. Debates about GMF have brought about reactions from artists, activists, ethicists and cultural theorists as well as from scientists, regulators, and industry representatives.

At one level, the controversies surrounding GMF are about whether genetic modification poses a risk to human health and the environment. At a deeper level, the discussions are about social and cultural values, political ideals, and the ability of corporations to gain consent from various public audiences. More to the point, sociological issues about the connections between organizations, power, the public, and trust when dealing with emerging technologies are at stake. Because perceptions are

dependent on social forms, the construction of trust may be as much about whether actors are trustworthy, as whether actors can induce us to trust.

I focus on the issues of institutional trustworthiness and examine the social implications of who trusts whom about GMF. Using data from a mail survey, I explore which organizations and experts the public trusts regarding GMF, connect those trust judgments to varying trust attributes, and establish determinants of trust. In doing this, I treat trust as an emergent property of a relationship. This allows me to observe the ways trustworthy social actors guide the public through the inherent uncertainty of emerging technologies. Because actors assume social and ethical responsibilities by creating and circulating knowledge about an emerging technology in an institutional competition for public trust, they are a central part of the context within which trust does or does not develop. I conclude by examining the "spiral of trust" that develops between the public and the (dis)trusted actors.

PREFACE

Tell me what you eat, and I will tell you what you are.
— Anthelme Brillat-Savarin

Man is what he eats.
— Ludwig Feuerbach

We are living in a world today where lemonade is made from artificial flavors and furniture polish is made from real lemons.
— Alfred E. Newman

Technology radically modifies the objects to which it is applied while being scarcely modified in its own features.
— Jacques Ellul

Trust, but verify.
— Ronald Regan

He who does not trust enough, will not be trusted.
— Lao Tzu

It's a vice to trust all, and equally a vice to trust none.
— Seneca

The people when rightly and fully trusted will return the trust.
— Abraham Lincoln

ACKNOWLEDGEMENT AND/OR DEDICATION

Earning my degree taught me many lessons, not always wanted or appreciated. While writing a dissertation can be lonely and isolating, finishing was not possible without the personal and practical support of numerous people. I only mention a few of those people here.

Lee “Chip” Clarke has been generous with his time and commitment as an advisor, friend, mentor, colleague and taskmaster. He deserves special praise for guiding me through this dissertation and my entire graduate school experience.

My dissertation research was supported by a grant provided to the Rutgers Food Policy Institute by the U.S. Department of Agriculture (USDA), under the Initiative for the Future of Agricultural Food Systems (IFAFS), grant #2002-52100-11203 “Evaluating Consumer Acceptance of Food Biotechnology in the United States,” Dr. William K. Hallman, Principal Investigator. My research would not have been possible without Bill’s assistance.

I am also grateful to the rest of my exceptional doctoral committee and wish to thank Caron Chess, Branden Johnson, Paul McLean, and Patricia Roos for their continual support and encouragement.

I would like to thank Hans Peter Peters, Magdalena Sawicka and everyone else at the Programme Group Humans, Environment, Technology (MUT) of the Research Centre Jülich - Helmholtz Gemeinschaft in Jülich, Germany, for generous hospitality during my brief visit.

I owe a special note of gratitude to Dianne Yarnell for helping me navigate the Rutgers University bureaucracy. Tamara Crawford, Jeanie Danner, Shan Harewood, Lisa Iorillo, and Sheila Roth all provided invaluable assistance at one time or another.

I owe my colleagues and friends many thanks and drinks, especially Colleen Bloom, Dmitry Khodyakov, Vanina Leschziner, and Benjamin Onyango. Stacey Greathouse keeps me laughing. Alyssa Krill makes me incredibly happy.

Finally, I would like to thank my family. My mother is a source of unquestioned support and endless amounts of food. My sisters are both constant sources of encouragement and enthusiasm. My nephews and nieces help me keep my life in proper perspective and balance. My dog, Samantha, is a never-ending source of amusement.

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CHAPTER 1: INTRODUCTION

> With all that biotechnology has to offer, it is nothing if it's not accepted. This boils down to a matter of trust–trust in the science behind the process, but particularly trust in the regulatory process that ensures thorough review–including complete and open public involvement.
>
> — U.S. Secretary of Agriculture Dan Glickman (1999)

> On the basis of what we have seen so far, we don't appear to need it at all. The benefits, such as there are, seem to be limited to the people who own the technology and the people who farm on an industrialised scale. We are constantly told that this technology may have huge benefits for the future. Well, perhaps. But we have all heard claims like that before and they don't always come true in the long run.
>
> — HRH The Prince of Wales, Prince Charles (1999)

In a world rapidly transformed by science and technology, experiments in genetic engineering are altering our conception of what it is natural. As Alfred E. Neuman, the fictional mascot of *Mad* magazine once remarked, “we are living in a world today where lemonade is made from artificial flavors and furniture polish is made from real lemons.” Including the introduction of Dolly the cloned Sheep in 1996 and the announcement of the mapping of the human genome in 2001, the field of biotechnology has undergone many phases of transformation. Cross-species cloning, weaponized anthrax, stem-cell research, genetic profiling, and the genetic manipulation of embryos and key crops in our food system are but a few of the ways in which advances in biotechnology influence our lives. Despite prosaic and profound progress, when asked to recall the first image or thought that came to mind when thinking of biotechnology, genetic modification or genetic engineering, nearly one-third of respondents could not produce a single thought or image related to these words (Hallman, Hebden, Aquino, Cuite, and Lang 2003).

Although they do not have a sophisticated understanding, or even a clear impressionistic image and feeling associated with these advances in biotechnology, Americans are not without opinions. The introduction of genetically modified food (GMF) brought about reactions from artists, activists, ethicists and cultural theorists as well as from scientists, regulators, and industry representatives. At one level, the controversies surrounding GMF are about whether genetic modification poses a risk to human health and the environment. This perspective is at the heart of traditional regulatory approaches, and this is how biotechnology producers and users prefer to frame the debate (Falkner 2007). Critics have raised several environmental and human health safety concerns. However, a high degree of uncertainty surrounds these concerns. Although there has been no serious environmental damage and no conclusive evidence of harm to human health because of GMF, firm conclusions about the safety of GMF would be hard to come by given that long-term threats to biological diversity and ecosystems are difficult to assess. It is not least for this reason that many environmentalists call for the precautionary regulation of GMF, to limit long-term and potentially irreversible harm.

At a deeper level, the discussions surround GMF touch on wider issues relating to social and political power, cultural values, and corporate responsibility. How and who should regulate GMF are two questions made difficult by myriad competing interests. Another, somewhat related question, concerns the types of risks and benefits that stakeholders take into account when assessing and managing GMF-related hazards. Given the globalization of GMF, food production, and agricultural trade, no individual or organization can hope to deal with these complex questions in isolation. Social actors need to trust each other to create and support regulatory frameworks, and to resolve social, economic, and political conflicts. In examining perceptions of trust regarding the organizations and experts involved in GMF, this dissertation contributes to the growing body of research on the role of trust in scientific matters.

Specifically, I focus on the issues of institutional trustworthiness and examine the social implications of who trusts whom about genetically modified food. This tangible and prosaic example of an emerging technology illuminates the social problems and highlights the social and cultural assumptions inherent in American agriculture. Using data from a mail survey, I explore which organizations and experts the public trusts regarding GMF, connect those trust judgments to varying trust attributes, and establish determinants of trust for each actor. In doing this, I see public perceptions of trustworthiness in a unique way. By viewing trust as an emergent property of a relationship between social actors, I direct attention toward the ways competent and caring social actors guide the public through the uncertainty inherent in emerging technologies. Actors assume social and ethical responsibilities by creating and circulating knowledge about an emerging technology in an institutional competition for public trust. These actors, then, are a central part of the context within which trust does or does not develop. I conclude by examining the “spiral of trust” that develops between the public and the (dis)trusted actors.

Genetic modification is the technical process by which scientists modify plant and animal genes to improve resistance to pests and disease, increase fertility, reduce damage to the soil, increase nutritional value, or change other characteristics to make the organism more useful to humans. Although corporations have only applied this process to large-scale agriculture within the last twenty-five years, roughly three-fourths of all processed foods on American shelves now contain some ingredients derived from genetically modified crops (GEO-PIE 2003).

Though GMF is a detailed technical process, this is not a scientific study of the microbiology and genetics that lie at the base of genetic modification. In addition to its primary sociological focus, this dissertation covers only the United States, reserving the international reach and scope of the technology for future studies. Furthermore, I focus on genetically modified food and not on other pharmacological, medical, or scientific advances based on genetic modification, which are being profoundly shaped by many of the same forces. Similarly, though environmental issues are at stake, I do not primarily undertake an environmental assessment.

Most existing studies of GMF have focused on broad issues such as public awareness and perceptions of the safety of this technology (e.g., Hamstra 1998; Hallman, Hebden, Aquino, Cuite, and Lang 2004). Yet, by placing public perception of the organizations involved in GMF in context, we are better able to appraise the technology's current place and likely future in society. Similarly, by placing the problem of trust within this specific context, it is possible to recognize the important social factors and interests that shape public trust judgments about the organizations involved in GMF. As my review of the literature specifies, the negotiations and interactions that help build trust relationships take a variety of forms. Exactly who and what compose this ecology of trust relationships depends on the context and specific problem under study. Rather than examining trust in a generalized sense, in this dissertation I take a case-driven approach similar to scholars who have begun to explore the effects of trust as a prerequisite for risk communication about GMF (e.g., Poortinga and Pidgeon 2003a; Siegrist 2000).

Investigating the context surrounding GMF will better enable me to understand the relationships between relevant actors.

As currently practiced, this case-based method is not without its limitations. If I were to emphasize trust solely as a means to help reduce decision-making complexity, I would run the risk of obscuring the inherent power relationships between key actors. This is a limitation of most of the scholarship that explores trust relationships regarding genetically modified food. Many existing analyses are incomplete because they ignore the complex system of experts, authorities, and organizations that contribute to and benefit from trust. Moreover, traditional risk analysis obscures the possibility that GMF represents a risk imposed by self-interested organizations.

While scholars debate whether the public accepts GMF, everyone ignores alternative agricultural practices and systems. The possibility that trust helps those who control the technology–complex, elaborate organizational structures, including the regulatory and legal system–deepens the public's reliance on the trustworthiness of experts. This "spiral of trust" further reifies the existing power relationships between technological expertise and the public. By emphasizing the full social context of GMF, I go beyond existing work to examine these possibilities.

In sum, this dissertation examines how social and institutional factors interact to structure trust relations in the context of GMF in the United States. The multi-layered research design of this project allows me to contribute to sociological theory building at a micro and institutional level. The dissertation also promises broader social contributions by facilitating understandings of policy formation and public response to genetically modified foods in the United States. GMF is a highly contested issue that holds immense implications for the future of the global food supply system and humans' relationship to the environment. I believe that insights from this inquiry will prove valuable to scholars, policy makers, and the general public.

In the remainder of this chapter, I give a brief history of genetically modified food, the surrounding controversies, and the key stakeholders. This context is essential to help us understand the organizational relationships that surround this emerging technology. In this summary, it becomes clear that science is only a first step in the introduction of this technology. Challenges to expertise and authority emerge as a key strategy for stakeholders including academia, independent scientists, industry, government, and advocacy groups.

What is Genetic Modification?

Here, and in the phone and mail survey, I define biotechnology as the intentional alteration of an organism's genetic material by means that could not occur naturally through mating or recombination. This process, also commonly referred to as "genetic engineering" or "genetic modification," often involves the isolation, manipulation, and reintroduction of DNA into an organism. Scientists select specific genes from one organism and introduce them into another to pass along a desired trait. Scientists alter genetic material by transferring genes from one organism to another; moving, deleting, modifying, or multiplying genes within a living organism; and modifying existing genes or constructing new ones, and incorporating them into a new organism. The resulting organism is said to be "genetically modified." The goal of this process is to introduce new genetic characteristics to an organism to increase its usefulness.

There are three common methods of genetic modification–plasmid, vector, and biolistic. Scientists generally use the plasmid method to alter microorganisms such as bacteria. The vector method is similar to the plasmid method, but scientists insert its products directly into a genome via a viral vector. In the biolistic method, also known as the “gene gun” method, scientists introduce DNA into target tissues by accelerating a DNA-particle complex (made up of the desired DNA and an inert metal particle) in a partial vacuum and placing the target tissue within the acceleration path. Scientists use each of these methods to produce new varieties of plants or animals more quickly than conventional breeding methods and to introduce traits not possible through traditional techniques. In agriculture, scientists might try to increase the yield of a crop, introduce a novel characteristic, or produce a new protein or enzyme. Scientists could also give crops increased resistance to environmental and biological stresses such as heat, drought, nutrient deficiencies, insects, and diseases. The principal agricultural biotechnology products marketed to date have been GM crops modified to tolerate particular herbicides and resist specific pests. The best-known example of this is the use of *Bacillus thuringiensis* (Bt) genes in corn and other crops. Bt is a naturally occurring bacterium that produces crystal proteins that are lethal to insect larvae. Bt crystal protein genes have been transferred into corn, enabling the corn to produce its own pesticides against insects such as the European corn borer.

History

During the 1980s and 1990s, biotechnology became a boom industry, moving from the laboratory onto farms. At the end of the 1980s, the first genetically modified foods made it through the United States regulatory process to become a commercial reality. The first product approved by the U.S. Food and Drug Administration was chymosin (rennet), a genetically modified enzyme used to make cheese (U.S. Food and Drug Administration 1990). Bovine somatotropin, a growth hormone given to cows to increase milk production, followed Chymosin in 1993 by. In 1994, Calgene introduced the “Flavr Savr” tomato with the benefits of genetic modification marketed directly to consumers (Martineau 2001). Initially bearing a voluntary label, the Flavr Savr tomato eventually failed commercially for lack of sales and production difficulty. Although there was some initial fanfare, and little public concern, it never sold well and was off the market by 1997. But Monsanto’s introduction of commodity crops, including soybeans and corn, that could resist the toxic effects of specific herbicides made GMF widely available (Lambrecht 2001; Charles 2002). More than one quarter of the world’s cultivated farm land consists of GM crops (Pew Initiative on Food and Biotechnology 2004; James 2004). Furthermore, more than one quarter of all soy, corn, canola and cotton grown worldwide was genetically modified (James 2004; Brookes and Barfoot 2006). As a result, many estimates suggest that roughly three-quarters of all processed foods in the U.S. currently contain a GM ingredient (GEO-PIE 2003).

GM ingredients are so common because farmers quickly adopted GM commodity crops. In 1996, the first year GM seeds were commercially available, U.S. farmers planted almost 4 million acres of GM crops (James 2004). By 2006, U.S. farmers planted almost 135 million acres of GM crops, which represents more than half of the worldwide total (James 2006). An overwhelming majority of the genetically modified content in food currently comes from just four major crops–soybeans, corn, canola, and cotton (as cottonseed oil). Although not often consumed as whole foods, food manufacturers use these commodity crops as ingredients in a vast array of processed foods. Just a few examples include such common corn-based ingredients as cornstarch, corn flour, corn oil, and corn-based sweeteners like high-fructose corn syrup. Common soy-based ingredients include soybean oil, soy flour, soy lecithin, and soy protein extracts. Similarly, food manufacturers use canola and cottonseed oils in many products including salad dressings, margarines, processed cheese, potato chips, cookies, and pastries.

Though this is changing, farmers and grain handlers often do not keep GM and conventional varieties separate as they move from the farm to the grain processor (Elbeheri 2007). This means that foods made with ingredients derived from these four major crops may have some GM content. Many of the ingredients derived from these crops are so highly processed or refined that it could be difficult to determine whether they came from GM, non-GM, or mixtures of both kinds of crops. Industry fills packaged goods in the United States with GM ingredients, though they most often do not, and regulators do not require them to, label them as such. Even when farmers and grain handlers attempt to keep them separate, accidental mixtures can occur as consumers discovered during the Starlink controversy (on which more later).

Although there is currently little diversity among available GM products, the United States Department of Agriculture (USDA) lists several products “in the pipeline” for future production. Among these are varieties of insect-resistant fruits and vegetables, naturally decaffeinated coffee beans, nicotine-free tobacco, and grains with radically enhanced nutritional properties and vitamin content (Economic Research Service 2001; Fernandez-Cornejo and Caswell 2006). As these GM products arrive on shelves with benefits marketed directly to consumers, Americans may become more aware of agricultural biotechnology. However, consumers will continue to trust the judgments of the countless experts and organizations that ensure the safety of their food because they still will not have the scientific knowledge to evaluate risks on their own (Hallman, Adelaja, Schilling, and Lang 2002; Hallman, Hebden, Aquino, Cuite, and Lang 2003; Hallman, Hebden, Aquino, Cuite, and Lang 2004; Lang and Hallman 2005).

Public Reaction

Public opinion regarding GMF continues to be varied around the world. In the U.S., the public remains unsure (Hallman, Hebden, Aquino, Cuite, and Lang 2004). In Europe, public opinion remains generally negative (Gaskell, Allum, and Stares 2003). Policymakers and industry executives have struggled to understand the reasons why the public has not greeted these foods with more enthusiasm. For years, scholars have criticized the scientific community for its tendency to assume that public resistance to the products of science and technology stems from ignorance. This common assumption, known to social scientists as the “deficit model,” is a largely unsupported notion that the rejection of scientific and technological “progress” begins with a poor grasp of scientific and technological facts. This is simply not the case. Analyses of the relationship between attitudes toward biotechnology, including GMF, and knowledge of the underlying science have continued to show remarkably weak statistical relationships between the two (Priest, Bonfadelli, and Rusanen 2003; Sturgis and Allum 2004).

Though it took some years to begin to overcome “deficit model” thinking, stakeholders have slowly realized that consumer resistance to a variety of forms of biotechnology is not a function of ignorance. Rather belatedly, industry has noticed that GMF delivers little or no tangible consumer benefits. In turn, economic research has begun to respond to the “no consumer benefit” observation. Rather than addressing the revolutionary science, industry has learned to promote the social promise of the technology, touting perceived social benefits like the prospect of easing world hunger. Industry executives also note other public goods, including contributions to the environment via reduced pesticide use and the potential health advantages of nutritionally enhanced products.

Economic factors alone do not drive all decisions, even consumer decisions. If they can afford them, people will pay for things they need or want, and sometimes industry can persuade consumers that they need or want things they have never heard of before. Marketers and advertisers sell goods ranging from soup to nuts based on social values–the products’ advertised contributions to quality of life, variously defined for various demographic audiences. However, the potential benefits that might be selling points for GMF are just that–potential. Products with consumer benefits available to today’s consumer are limited or nonexistent. In other words, questions about what people are willing to pay for are largely hypothetical because GM products with special benefits simply are not on hand.

Though experts may accuse the public of having “irrational” fear about GMF, the public is quite “rational” in its own way. Ordinary people do not necessarily try to evaluate scientific evidence directly; they often lack the necessary background knowledge, time, and inclination. Most of us are not in a position to judge the scientific evidence pertaining to the value and risk of GMF. Instead, the public turns to those they trust and whose values they feel they share. Trust becomes the major issue in controversies involving science and technology, especially radical new science and technology, the ultimate impact of which is not–and perhaps cannot be–settled in advance. Listening, therefore, to those we trust and that we perceive to have relevant expertise is a perfectly “rational” thing to do; listening to those we trust on technical matters when we recognize the limits of our own knowledge is a wise thing to do. In this sense, trust in the stakeholders–the abstract systems, authoritative experts, and institutions involved in GMF–is an essential component of the public acceptance of this technology.

There are several reasons for consumers’ tenuous acceptance and, in some cases, explicit opposition to GMF. First, some consumers are concerned about the health and safety risks associated with GMFs, such as possible increased exposure to toxins, severe allergic reactions, and increased antibiotic resistance. Second, some consumers are concerned about the environmental impacts, such as the threat to biodiversity from the contamination of conventional crops by GM varieties. Third, some consumers are concerned about the impact of GM agriculture on the food production system as a whole in that it may encourage large-scale monoculture agriculture rather than more sustainable methods. Fourth, some consumers worry about the moral and ethical implications of scientifically tampering with the perceived naturalness of food.

The next decade will see exponential progress in GM product development as researchers gain increasing and unprecedented access to genomic resources that are applicable to multiple organisms. More controversy will come with this scientific advancement. Current controversies surrounding GM foods and crops commonly focus on human and environmental safety, labeling and consumer choice, intellectual property rights, ethics, food security, poverty reduction, and environmental conservation. As these products become more commonplace, the struggle over these issues will only intensify. Past concerns may help us anticipate future issues.

Major Controversies

Though not the first controversy, one of the more public scientific debates about GM food took place in England during 1998. At the center of the controversy was Dr. Arpad Pusztai, author of more than 270 research articles on food safety and member of the Rowett Institute, one of the United Kingdom's leading food safety research labs. He sparked the controversy when he expressed doubts about the safety of GM foods on the BBC's "World in Action" program. To illustrate his concern he mentioned his ongoing research on GM versions of pesticidal proteins. The research involved feeding two sets of rats a protein (lectin). He fed one set of rats using potatoes that were genetically modified to produce more lectin; he fed the other set of rats potatoes that had lectin added by non-GM methods. According to the findings, the rats fed on GM potatoes suffered a number of harmful effects on growth, organ development and immune responses; the other group of rats did not suffer the same ill effects. Pusztai speculated that the GM device used to carry the new gene into the potatoes might be the source of the problem.

Following his television appearance, politicians, scientists and the biotechnology industry vigorously attacked Pusztai and his research. In a letter to the Royal Society, the UK's national academy of sciences, he wrote, "I have suffered allegations concerning my personal honesty and motivation; those concerned preferring to attack me rather than treat my work and findings to an informed and balanced appraisal" (Pusztai 1999a). Neither his eminence in the field nor his careful documentation and scientific defense of his statements were enough to save his career. Pusztai was suspended after 36 years work at the Rowett Institute, and his employment contract was subsequently not renewed at the end of 1998, notwithstanding that one to two years of work remained on each of the six research programs for which he was responsible (Pusztai 1999b).

Following Pusztai's dismissal, he detailed his scholarship in the "Research Letter" section of *The Lancet*, and the editors wrote a lengthy explanation explaining their decision to publish the findings (Ewen and Pusztai 1999; Horton 1999). The article carefully maintained that the data were preliminary and not generalizable, and the conclusions were weak and tentative. Many of the scientific reviewers had concerns about the design and execution of this particular research. However, as the editor noted, the debate was no longer about the merit of the research itself, but on the framing of science and dissemination of information to the public (Horton 1999). Pulled into the debate were academics, scientific journals, various media outlets, government officials, industry executives and numerous advocacy groups.

A year later, a similar controversy emerged over preliminary research conducted at another prestigious research center, this time in the United States. In 1999, researchers from Cornell University published a letter in *Nature* stating that pollen from Bt corn (a type of genetically modified corn) had toxic effects on Monarch butterfly larvae (Losey, Raynor, and Carter 1999). Caterpillars, the larval stage of Monarch butterflies, feed on milkweed plants. Because some milkweed grows next to cornfields, Losey and his Cornell colleagues suggested that Bt corn pollen may drift onto milkweed and inadvertently harm the Monarch larvae. Although not a full scientific paper, the research garnered a tremendous amount of media coverage and gave anti-biotechnology advocates a poster species. Though there were some initial attempts to discredit the research, a second study confirmed some of the initial scientific findings (Shelton and Roush 1999). In the following year, the EPA, biotechnology industry, and university researchers studied the potential impact of Bt corn pollen on the Monarch butterfly and related species and found that Bt poses little risk of harm to their larvae (Pleasants, Hellmich, Dively, Sears, Stanley-Horn, Mattila, Foster, Clark, and Jones 2001; Oberhauser, Prysby, Mattila, Stanley-Horn, Sears, Dively, Olson, Pleasants, Wai-Ki, and Hellmich 2001).

Despite attacks on Losey and his scholarship from industry, Losey himself called for more study and a measured approach to the issue. Perhaps as a result, Losey did not face the same fate as Pusztai. Again, the fight was not only about the science, but it was about framing of the debates. As a marker of the initial scientific debates, Monarch butterflies have come to symbolize the *potential* risks of GM crops. Until then, the official risk assessment had managed to avoid considering the effect of the Bt toxin on non-target insects. In this context, the criticism about the methodological limitations of the study reinforced its message that serious consequences can come from unintended interactions with the broader environment. This study did not prove that Bt corn kills Monarch butterflies, but it raised the question of why such experiments were not performed earlier.

In 2001, Ignacio Chapela, along with his postdoctoral student David Quist, published a paper in *Nature* contending that pollen from GM corn (maize) had spread into non-GM corn in Mexico (Quist and Chapela 2001). Just how the contamination occurred remains a puzzle, especially since Mexico had a moratorium on the planting of GM crops in force for three years by the time the contaminated samples were collected. Agricultural experts and proponents of GM crops maintain that corn pollen is characteristically heavy, so winds do not carry it far from cornfields. The closest region where farmers and industry had ever officially planted GM corn was sixty miles away and therefore wind-assisted contamination was impossible. Chapela suggested that contamination might have occurred due to fresh hybridization events with illegally cultivated GM crops, or as the result of “escaped” GM genes that had persisted in traditional corn since the government imposed moratorium. This second possibility was controversial.

In the spring of 2002, *Nature* published letters by well-known scientists who questioned the validity of Quist and Chapela's research. With criticism and pressure coming from many sides, *Nature* took an unprecedented step. For the first time in the journal’s history, the editor announced that it should not have published the article in the first place, despite the original peer review, due to insufficient evidence (Metz and Futterer 2002; Kaplinsky, Braun, Lisch, Hay, Hake, and Freeling 2002). Even more irregular was that the major finding of that paper–that GM contamination had occurred–was never in dispute (Quist and Chapela 2002). Detractors directed their technical criticisms at a secondary finding suggested by the data–that the transgenic constructs were fragmenting and scattering in the maize genome. The possibility that inserted transgene is capable of moving around a genome, either intact or in fragments, is controversial. Many within the scientific community agree that the claim of transgene reassortment in the genome is unsupported by evidence at this point.

Whether or not parts of Quist and Chapela's study were technically flawed, they focused attention on an important concern deserving careful analysis and evaluation. Some of the controversy occurred because maize is a staple, historic crop with immense cultural significance in Mexico. Furthermore, Mexico is the world's repository of maize genetic diversity so this threat gave a vibrant, real-world example to match previously hypothetical concerns that GM crops could unintentionally spread and take over traditional forms of agriculture. Moreover, corn is the species that companies use for much of their research into further uses of biotechnology, including "growing" pharmaceutical compounds using crops. As such, the concern that genetically modified strains could accidentally spread to non-genetically modified crops and contaminate them with a pharmaceutical compound has even more potentially serious health and safety issues involved.

The controversy also gathered momentum because Chapela had been leading a fight against a controversial research partnership between the biotechnology firm Novartis (now Syngenta) and the University of California at Berkeley, which gave the company privileged access to the university's plant scientists. Novartis agreed to provide up to $25 million over five years in return for a role in handing out the money and rights to the research findings. Chapela's struggles became a symbol of the erosion of academic independence from corporate influence. This even extended to his tenure case (Smallwood 2005). Chapela came up for review in September 2001, and received overwhelming support from his colleagues. The college's acting dean approved their decision, and then a campus-wide tenure-review committee voted unanimously in Chapela's favor; eighteen-months later the campus budget committee and the chancellor of the university voted to deny tenure. But the process continued. After international protest, several grievances and lawsuits, in May 2005, a new chancellor of the university approved tenure (Smallwood 2005).

Again, the scientific conclusions were only part of the story. The ecological and agricultural consequences of the contamination that Chapela and Quist reported are worrisome for some. The concern that GM crops could surreptitiously find their way into conventional crops raises concerns about environmental contamination, genetic drift, and agricultural sovereignty. For many, industry has yet to establish the environmental impact of GM crops. Another concern, that industry has yet to demonstrate the safety of GM food for human consumption, played out during the StarLink controversy.

StarLink is a GM variety of corn that produces the Cry9C protein. Government agencies only approved the corn for use in animal feed, and not for the human food supply, because of concerns it might trigger allergic reactions. In 2000, food manufacturers accidentally introduced StarLink corn into several food products that found their way to grocery store shelves. This triggered a recall of 300 brands of taco shells, chips and other U.S. foods. The controversy forced Kellogg and ConAgra to shut down production lines for almost two weeks to make sure there was no StarLink in their systems. Tyson Foods Inc., the world's largest poultry producer, even refused to buy StarLink as feed as the controversy grew. But beyond the immediate financial issues, some believed the StarLink case was simply a harbinger of more troubles to come. Not only were the varieties of corn not separated, it took a third-party consumer group (Friends of the Earth) to test the products to discover they had been tainted. This was an example of how government regulations and industry procedures had failed to keep a GM product from the food supply.

These scientific controversies, involving researchers doing work in the United States (Losey, Raynor, and Carter 1999), England (Ewen and Pusztai 1999), and Mexico

(Quist and Chapela 2002), makes it is evident that a multitude of stakeholders are influencing discussions about genetic modification. Some people criticized these researchers for using questionable science to advance personal agendas. Food manufacturers, government agencies, environmental groups and other social actors hijacked scientific arguments about GM food to serve other agendas. In this case, as with other controversies, contested interests and symbolic battles characterize scientific judgments and evaluations over claims of expertise (Clarke 1999). Multinational biotechnology corporations use their power to challenge the scientific authority of those who question their products (Freudenburg 2005; Kleinman and Kloppenburg Jr 1991). In turn, opponents of these corporations, of the industrialization of agriculture, of U.S. policy and of globalization have found a common rallying point with environmental and consumer advocacy groups.

Entities on both sides of these debates attempt to use science to discredit the opposition at some risk to their own credibility, a potentially expensive proposition in terms of the spending of social capital. Under these circumstances, as with other controversial or emerging technologies, even minor risks matter to the public. Moreover, the risks of GMF are not necessarily minor. Understanding the public reactions to science and surrounding controversies raises epistemological questions as well as socio-political ones about the authority of science in the U.S.

It would be wrong to assert that the controversies posed by GM food can be easily resolved through scientific education or better public understanding. The general public may not possess “expert” knowledge, as traditionally defined, but this does not mean that they have nothing to contribute to decisions about science and technology. In particular, GM food brings a moral debate to the forefront. Not only do scientists tamper with nature in a way that many believe was previously reserved for a divine force, they also do so with the assistance and protection of government regulation. This moral tinge, this fundamental question of what is "natural" brings forward profound questions that science is ill equipped to handle. To understand these issues requires an examination of the food ecology–the key stakeholders including industry and its related organizations, academia, government, advocacy groups, and various interested publics.

The GMF controversy has become largely symbolic in content. Rather than trying to address the challenges and opportunities of GMF, stakeholders appropriate public trust. In this context, I view public trust as a resource, like money and political power. Differences in public perceptions, interest group dynamics, political systems, and industrial structure have driven European and U.S. agricultural biotechnology policy in opposing directions (Jasanoff 2005; Bernauer and Aerni 2007). In the United States, technology firms and large farmers have pushed for and obtained comparatively permissive regulatory standards; in the European Union, advocacy groups have urged highly precautionary regulation of GMF (Bernauer and Aerni 2007).

Trust in the Food Ecology

According to organizational sociology, organizations do not exist in a vacuum, but operate in the context of much larger networks of organizations, relationships, social structures, and meanings which collectively serve to shape their operating and cognitive environments and performance (DiMaggio and Powell 1983; Scott 2001). Though often overlooked by casual observers, there is a complex institutional ecology involved in the production and distribution of food within the United States (Schlosser 2001). Because

American regulators treat GM foods as equivalent to those produced through conventional means, food manufacturers rarely handle them differently (U.S. Food and Drug Administration 1992). As such, the commodity chain of industry-related firms is the same for GM and non-GM crops.

Before we put food on our plates, it goes through several stages of production and distribution, starting with the companies who patent their commercial GM crop seeds and lease seeds to farmers on an annual basis. In the United States, where GM crops are widely used (as noted earlier), farmers sign legally binding agreements that forbid them to save and replant the seed. In the developing world, where norms of saving and exchanging seeds, especially in times of hardship, are common traditions, this new model of agricultural practice creates a potentially destructive relationship. As multinational firms continue to consolidate their presence in the international market, real choice for farmers may evaporate.

In the mid-1970s, agricultural chemical companies began acquiring seed companies, perhaps anticipating a time when biology would replace their agricultural chemicals. Sandoz, later to become a part of Syngenta, acquired Rogers seeds; Monsanto acquired Jacob Hart; and DuPont acquired Pioneer, then one of the world's largest seed companies (Herdt 2006). Bayer, Advanta, and Limagrain also acquired companies, and by 2005, these six owned almost half the commercial seed sales capacity in the world (Oehmke and Wolf 2003; Schimmelpfennig, Pray, and Brennan 2004). In addition, the six plus the multi-national chemicals manufacturing corporation, BASF, accounted for over 80 percent of genetically modified crop field trials and controlled over 40 percent of private-sector agricultural biotechnology patents issued in the United States (King and Schimmelpfennig 2005)

The concentration of crop seed production in the hands of a few multinational companies has generated vocal opposition by advocacy organizations. They seize on issues such as the possible accidental transmission of transgenes into Mexican maize or toxic effects on Monarch butterflies and mingle them with information about seed industry concentration, farmers' rights, and gene patenting with the terms "biopiracy, Frankenfoods, genetic pollution, and corn grenade" in a virtual war against GM crops (Miller and Conko 2005). One fear is that the largest companies will control the supply of seeds and food and may eventually control the fundamental rights of access to food, similar to industry's control of the price of pharmaceuticals (Lang and Priest 2007).

The consolidation of seed and agri-chemical production, combined with intellectual property practices that favor industrial concerns, may lock farmers into a system in which they have little or no choice over what to grow, with which chemicals, whom to sell to, and at what price. The regulatory infrastructure created by patent law gives the biochemical and biotechnology companies that control the technology a uniquely privileged position and great influence over farming practice in developing nations (DePalma 2000; Pinstrup-Andersen and Schioler 2000). A consequence of the enforcement of intellectual property rights in this area is the fear that adoption of GM crops will transfer resources from the public sphere to private ownership in the form of multinational corporations protected by patents. As a result, the World Trade Organization's controversial Trade Related Aspects of Intellectual Property Rights

(TRIPs) agreement, which requires nations to establish some form of protection for plant varieties, has become the focus of international scrutiny.

Such considerations are not limited to the developing world. Prohibitions on replanting or reselling seed have taken some U.S. farmers by surprise, and some find this an economic hardship and an intrusion into what they see as their historic privilege—not as extreme an economic hardship as would be experienced by subsistence farmers worldwide, but an economic hardship nevertheless (Shinkle 2003). The assumption is that subsistence farmers are the most vulnerable to new patent restrictions. Nevertheless, wherever this kind of complex impact on the economic system may occur, its significance—just like the significance of the science and technology that produced GM alternatives in the first place—is difficult even for experts to evaluate. I am not saying such an evaluation is impossible, but I am suggesting this is not a simple or straightforward problem with a single solution.

Farmers could produce their own seeds for most crops as they did in the past. Farmers sell into competitive markets; seed companies sell to farmers, also a competitive market (Lence, Hayes, McCunn, Smith, and Niebur 2005). Although there is public apprehension over the economic power of the big seed companies, the available evidence suggests that the technology benefits farmers and consumers as well as the companies (Herdt 2006). That is, the evidence suggests that genetic modification is a shared, though not necessarily equal, benefit if we agree on the use of economic risk-benefit analysis as the measuring stick (Brookes and Barfoot 2006). The more difficult, but often un-asked, questions are whether continued production of GMF reflects people’s cultural values and ethical standards and whose ethical standards should be used to shape the ecology of food (Pinstrup-Andersen 2005).

Social scientists who study public discourse and the effect of media in relation to social controversies like GMF have identified “agenda setting” (defining particular problems as significant) and “framing” (defining and delimiting the salient aspects of those problems) as among the most powerful shapers of public opinion (Nisbet and Huge 2006). To the extent that various factions see the impact of GMF on the world food supply as an important issue, there remain competing “frames” influencing its interpretation, one in which GMF is seen as the solution, and another in which it is seen as the problem.

How this technology affects farmers in the developing world is only one example of competing frames among many. Other concerns and perceived risks are not directly economic in character at all (Thompson 2000). Some people may object to GM foods for religious reasons, feeling it is inherently wrong to tamper with God’s work. Environmentalists may argue in very similar terms, claiming that it is intrinsically wrong to change nature, or they may point to the risks associated with altering the ecosystem, citing the long history of damage that has been done by “harmless” pesticides and the elimination of “useless” species. The imminent introduction of biopharming—where scientists genetically introduce potentially toxic medicines and chemicals into ordinary-looking crops that could be mistaken for food, both before and after harvest—makes the potential dangers of this contamination more tangible (Caruso 2007). Some are worried about the “Frankenfood” monster that may be unleashed by GMF where the uncertainties introduced by complex interactions of science, technology and ecology are difficult for even experts to evaluate. Many people will probably continue to worry about the health effects of eating “unnatural” foods, especially if they perceive the regulatory oversight for novel foods to be weak. Yet others may not want to accelerate the shift to larger-scale corporate agriculture that they associate with “artificial” farming practices.

Outside of the U.S. there is the additional factor of not wanting to be ordered around by American multinationals. This resistance against American industry is a reaction to the perception of extreme rationalization as a substitute for tradition, that some have referred to as McDonaldization (Ritzer 1996; 1998). This term recognizes that traditions and interconnectedness of food, mealtimes, and quality of life in many European cultures brings about resistance to American-style fast food and its rationality (Stille 2001). Food production and distribution in the U.S. is a highly organized and rational endeavor.

In basic outline, the food production and distribution chain begins when firms (such as Monsanto or Dupont) sell their crop seeds to farmers, who plant and grow them. Farmers, in turn, sell their crops to grain elevators or handlers (such as Archer Daniels Midland or Cargill), who sell the grain to food processors; food and grain processors (such as ConAgra Foods and Nabisco) transform grain into a range of products from bread to cooking oil to snack foods (Schurman 2004). Processors then sell these goods to food retailers, including grocery stores and restaurants. It is from these retail outlets that most people in the United States obtain their food. Consequently, the final consumers of GM foods are not the direct customers of the agricultural biotechnology firms.

In terms of regulations, American government agencies treat GM foods as equivalent to those produced through traditional means if the GM variety does not introduce allergens or substantially alter the nutritional value of the food (U.S.Food and Drug Administration 1992). The 1986 "Coordinated Framework for Regulation of Biotechnology," outlined the division of the responsibilities for GM organisms among the U.S. Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and the U.S. Environmental Protection Agency (EPA) (Office of Science Technology Policy 1986). Depending on its characteristics, a product may be subject to review by one or more of these agencies; their responsibilities are usually complementary but in some cases, their responsibilities overlap. Before humans or animals can consume a new GM crop variety, the FDA must evaluate its safety. The USDA monitors field trials and evaluates the potential impact of widespread environmental release of the plant. The EPA investigates the pesticide levels in GM crops. This jurisdiction extends to both human health and environmental impacts of the pesticide.

We all depend on food with adequate nutrition and relatively free of harmful substances and pathogens to live. Our food system largely governs what foods we have available and their amounts and qualities. Such systems are neither accidental nor free of controversy. By exploring the social context of food, we begin to see the socio-cultural, political, economic, and philosophical factors that influence food production, consumption, and the attendant risks.

As such, attempts to frame the debates in terms of traditional risk analysis and risk communication would miss the broader point. Stated bluntly, opponents of GM crops do not want to debate acceptable levels of risk. Though often framed in scientific terms, the debate is as much (if not more) about ideological, social, and political ideals. The controversies are as much about the power of multi-national corporations and their ability to gain consent from various public audiences for their emerging technologies. More to the point, there are sociological issues at stake about the connections between power, trust, and the public when dealing with emerging technologies. In the remainder of the dissertation, I explore whether the construction of trust may be as much about whether stakeholders are trustworthy, as whether stakeholders can induce us to trust.

Outlining the Structure of the Dissertation

Each of the subsequent chapters contains an introductory section to describe the relevant literature, followed by brief methodological remarks and results. I conclude with a discussion of the findings, discussing the importance and implications for the overall topic. I use connecting language to bridge each chapter to the next. In total, the dissertation is a unified work about trust and GMF, with a comprehensive review of the unifying scholarly framework and literature. As the first study to use overall, attribute and importance measures for trust in the context of GMF, my results will be more exploratory than definitive, but may provide initial insights and a partial model for future research.

I begin my analysis in Chapter 2 by giving some attention to theoretical understandings of trust in general and perceptions of trust more specifically. I describe the gaps in current social science trust scholarship, thus introducing the major topics that I will address in later chapters. In Chapter 3, I give an overview of variations in perceptions of trust in the social actors involved with GMF, reporting which of six organizational actors the public trusts regarding GMF. In Chapter 4, I go into further statistical detail to determine which characteristics the public considers most important when determining stakeholder trustworthiness. In Chapter 5, having completed my main empirical analysis, I reflect on how social and institutional factors interact to structure trust relations. While investigating the power relations inherent in the social and organizational context of trust, I speculate on the ways in which “spirals of trust” and “institutional ecologies” delimit, structure, and are structured by individual perceptions of trust. By treating trust as an emergent property of a relationship between social actors, I direct attention toward the ways competent and caring social actors help the public navigate the uncertainty inherent in emerging technologies.

CHAPTER 2: TRUST AND EMERGING TECHNOLOGY

There continues to be a lack of agreement on the key conceptualizations of trust, despite continuing research that spans work on individual, group, and organizational decision-making, to studies of specific technologies, political movements, and environmental controversies. The range of trust scholarship across myriad disciplines, including economics, computer science, political science, and sociology, compounds the problem. These disciplinary approaches address trust in different ways and for different purposes that rarely converge. The debates over how to measure trust can leave scholars impatient with ever-changing definitions and questions about the actual meaning of trust. As such, the conceptual development of trust is uneven and underdeveloped.

In one sense, researchers view this as a methodological debate, a technical issue of measurement problems. The assessment of trust encompasses problems of definition and measurement that vary case-by-case. If scholars generate trust measures from the nuances of a particular case–and there are often good reasons for doing so–they are bound to wind up with dozens of competing measures. That is indeed the case. This situation leaves scholars asking anew for each study, how to best assess trust in any given situation.

Despite extensive empirical and theoretical considerations, many measures of trust remain simplistic. For example, authors sometimes treat the relative contribution of trust attributes to aggregated trust judgments as equally important for all groups. It is likely, however, that certain trust attributes will be more beneficial for some organizations than others will; some traditionally conceived trust attributes may actually be detrimental to trust for some organizations. If a corporation were to acknowledge accidental contamination of traditional food supplies with genetically modified ingredients, people might rate the corporation as highly honest. Those same people might also lower their trust judgment of that corporation. Additionally, some trust attributes might be more relevant for some groups than others. Not only is it possible that trust in religious organizations regarding genetically modified food will have little to do with scientific expertise, it is likely that trust in industry will have little to do with industry's desire to contribute to the well-being of society.

Finally, there might be patterns of influence to consider. Perceived trust of one actor might influence a person's trust judgment of another actor. For example, trust in environmental groups is likely to exacerbate societal distrust of corporations and interfere with industry's attempts to solicit public trust. Such efforts could also reduce general levels of trust, thereby undermining overall trust in major societal institutions. The field's frequently narrow emphasis on simple trust measures may explain why existing studies are limited in the extent to which they can explain how the public knows which groups to trust regarding GMF. Unsophisticated views of trust overlook the likelihood of multiple and complex influences of trust attributes on trust judgments.

More than a measurement and methodology issue, researchers could view this as problematic for the trust literature as a whole. The concept of trust need not be so irregular and idiosyncratic. What has, to this point, remained under-developed is an organizational perspective. This omission is significant because it potentially bridges the long-standing gap between individual conceptions (e.g., Rotter 1971), cultural determinations (e.g., Fukuyama 1995), and abstract theories (e.g., Luhmann 1979) of trust.

Uncertainty about Emerging Technology

Unintended and unexpected consequences, failures and disaster, stemming from and in spite of technical innovations, abound (Clarke 2006). Experts can identify some consequences with laboratory research, field trials, or systems analysis in various forms. The full spectrum of health, environmental, and social consequences, however, becomes visible only after the implementation, sometimes with tragic results (Erikson 1994; Krimsky and Plough 1988). The public becomes aware of the successes and failures of an emerging technology only after widespread use. Innovations thus create uncertainty; decisions about them are risky. This uncertainty and these risky decisions give scholars opportunities to learn things about society that organizations usually obscure.

Trustworthy experts–those who are competent and act with concern for others–help the public navigate the uncertainty inherent in new technologies. People base their opinions on mediated information coming from a variety of expert sources. Perhaps these sources will tell the truth about the technology; perhaps these sources are biased, deceitful, or are themselves misled. Very often, people will lack the competence to deal with detailed first-hand information about the technology and will have to rely on expert assurances that a technology is safe. In that case, the public substitutes trust for the lack of general knowledge or competence to engage in an in-depth assessment of the technology (Luhmann 1979).

People accept that technology is not perfect. Most technologies have a potential to cause damage and are safe only to the degree that experts carefully develop, implement, operate, monitor, and regulate them. Technologies are unsafe insofar as that is not the case. Experts would choose to continue the development of GMF if they believe they could contain or prevent the potential, multiple, and cascading chain of consequences of a

GMF-related accident. Alternatively, if experts believed that catastrophe were unavoidable, they could stop producing GMF seeds and crops. Experts may need to make this decision regarding production of GM grasses. Because grass is a perennial crop, once people plant and release GM grass the environment, eradication would be incredibly difficult. The public would make those choices if they were theirs to make. But they are not. Others–experts and organizations–will make these choices for the public. Calls to differentiate between the objective, measurable risk of genetically modified food and confused public perceptions of possible risk miss this point.

Because of their key status, these primary decisions and decision-makers have influence well beyond their direct authority. As such, the human ability to limit catastrophe or encourage potential is greatest at the point in time when societies are choosing whether to embrace a technology (Perrow 1999). The efforts of the non-expert public are largely limited to fine-tuning and damage control once these chief stakeholders have chosen to move forward with a technology like GMF. The search for new ways for the voices of a variety of lay "publics" to have influence on how these societal resources are allocated itself recognizes that those decisions take place within particular organizations and not directly through public debate.

Claims that the public are irrational are partly responsible for contentious debate about emerging technologies. The public are "rational" in their skepticism about this emerging technology about which they have little information, and are rather cautious in deciding whom to trust regarding these technologies (Lang and Priest 2007). Even if the public were more aware of GMF and its potential risks and benefits, decisions to accept or reject it would still be difficult. Competing institutional groups can gain from fear mongering within this atmosphere of ignorance and fragile trust (Abbott 1988; Starr 1982). Furthermore, the media have a difficult job of presenting varying viewpoints on technical issues (Priest 2001a). Myriad structural and organizational barriers would make it all but impossible for the ideal-typical rational person to decide whom to trust.

Public assessment of a technology includes an implicit or explicit assessment of the organizations and social institutions legitimated to make decisions about and regulate that technology. If the industries involved in the production and manufacturing of genetically modified food were involved in a scandal or an event that caused the public to re-think their trust, what would happen? Not much. Recall the discussion of the various controversies from the previous chapter. In the end, even if a controversy becomes public knowledge, the public is often without recourse. The public must continue to trust, even if experience has shown that organizations can sometimes violate that trust. This is because power is unevenly distributed. The public remains dependent upon numerous manufacturers to provide them with something as mundane as food. Thus, it becomes reasonable for the stakeholders of a technology to believe that governments and regulatory agencies will protect their interests even if public trust in them breaks down (Metlay 1999).

From the point of view of the public, emerging technologies do not necessarily reduce uncertainties but add new ones. People wonder if the innovation process really reflects their values and interests. They are concerned that the technology developers, users, and regulators might not be competent enough to make the right decisions and that the wrong decisions will cause harm. Perhaps the key stakeholders will communicate overly biased information about potential risks and benefits. These are just a few of the unknowns that make the public vulnerable to the uncertainties surrounding new technologies. For the general population, therefore, part of the uncertainty related to technical innovation stems is uncertainty about the behavior of social systems, organizations, and experts. Trust is one important strategy people use to deal with situations characterized by "uncertainty and vulnerability" (Heimer 2001).

Defining Trust

Most trust researchers lament the lack of an agreed upon definition. This lack of conceptual clarity leads scholars to spend much of their intellectual effort in the generation or critique of various conceptions of trust (Metlay 1999). Given the contextual nature of trust, however, it is altogether likely that a general definition would not be sufficient for all purposes. Rather than delving into the individual and idiosyncratic definitions in the literature, I use the following definition (Gambetta 1988, p.217) as the starting point for discussion:

> …trust (or, symmetrically, distrust) is a particular level of the subjective probability with which an agent will perform a particular action, both before [we] can monitor such action (or independently of [our] capacity of ever to be able to monitor it) and in a context in which it affects [our] own action.

This definition is useful for the purposes of a general review because it includes the majority of propositions that are evident in other definitions of trust. First, trust may be partially subjective. Though trust does not always spring solely from an objective assessment of facts, I may choose to trust based partly on experience and observation. Second, I cannot monitor all actions that affect trust. If I had perfect knowledge of a situation and could monitor all actions, then I would know the outcome and, therefore, have no need to trust. Third, the actions of others influence my own level of trust. When you act according to expectations, I have further evidence that you are trustworthy.

Fourth, trust exists in a specific context. While I may have a generalized sense of confidence in a system, I do not necessarily transfer this trust to all tasks. For example, I may generally believe the government will protect us from harm, though I may not believe that it can or will protect us from environmental pollution. Finally, and perhaps most salient for analyses of emerging technologies, is that outcomes are uncertain. That is, trust can only exist in some acceptable range between an absolute known quantity and truly random occurrence. The uncertainty of the outcome is what distinguishes trust from other related constructs. The possibility of a negative outcome constitutes the risk involved in the chosen action.

Not all conceptual, theoretical or empirical contributions to trust scholarship contain each of these propositions. Indeed, I would not argue that each proposition is relevant in every situation. However, these propositions exist in the debates surrounding trust. As such, it is important that we pay attention to them, to consider whether each of these issues is important for the particular area under study.

It is altogether possible that a broad or generalized definition would not fit all possible contexts. Trust is subject to specific situations, the context of the interaction and the actors involved (Barber 1983; Gambetta 1988; Hardin 2002). To say that one trusts another without further qualification of that statement is ambiguous. When evaluating a trust relationship, the question to ask is not whether A trusts B but does A trust B under condition X. For example, I may trust scientists to conduct research on genetically modified food, but not to apply that knowledge ethically. Or, a more specific formulation of the example I gave above, I may trust our government to protect our food supply but not necessarily to protect the environment.

I should not overstate the contextual nature of trust. There are useful conceptions that treat trustworthiness and the corresponding existence of trust as part of the social capital of society (Putnam 2004), as the default assumption of a benign social environment leading to ontological security (Giddens 1990), and as part of the political culture (Almond and Verba 1965). Both ideals, specific trust and general trust, may be complementary rather than contradictory; they may represent different though related phenomena.

Frequent experiences of trust in specific situations may be an important source of general trust because people may generalize their disposition to place trust in other people, organizations, and institutions across different situations, trustees, and issues. It is very likely that a person's particular experiences will lead to more trusting general expectations ranging over a class of actions and actors. A person's specific experiences of justified and/or disappointed trust may feed a sense of general trust. An observer might simply have an unreflective faith in the system. A person's confidence in a system of experts and organizations responsible for managing hazards may alleviate one's general concerns. It may be possible that in a particular situation, a person will make a decision based on a generalized trust in the system rather than an assumption that someone is trustworthy or that the situation has negligible risk. If scholars start with the assumption that context does not matter, however, we miss the opportunity to study the social and structural patterns that exist in trust relationships.

Furthermore, as Cvetkovich and Lofstedt (1999) have written, we may want to create individual definitions of trust for each area under study. Scholars create the definitions within bodies of work that have their own scopes and goals that may not be compatible with other people's work. Some of these definitions arise from particular assumptions about the internal mechanisms of trust, which may not be equal to other people's assumptions on how trust works. In this sense, when researchers operationalize trust they are asserting some sort of localized and contextual definition of trust.

Measuring Trust

The assessment of trust encompasses not only problems of definition, but also problems of measurement. Although some might lament the absence of an integrated theoretical basis to inform methods and to make sense of results, attempts to measure trust are a necessary step. Rather than trying to fit a general definition of trust to a specific case, researchers have often started with a case study to discover which parts of trust are most salient. Scholars derive these data-driven definitions from the area under study.

By using statistical techniques, researchers contribute to the body of evidence that trust is an easy enough concept to grasp in common sense terms. It is, however, much more difficult to operationalize because there are any number of particular aspects to trust that could be relevant in any given social context. Researchers have conducted a number of factor analytic studies to empirically test the dimensionality of trust in a variety of risk issues (e.g., Covello 1993; Frewer, Howard, Hedderley, and Shepherd 1996; Metlay 1999; Renn and Levine 1991; Lang and Hallman 2005; Poortinga and Pidgeon 2003a). Each of these studies asks respondents to provide detailed, numerically rated assessments of their trust in stakeholders for a particular hazard. Although the labels these studies assign their resulting factors do not necessarily correspond with one another, the theoretical justification for, and subsequent empirical confirmation of, trust as a multi-dimensional concept is consistent.

As an alternative to detailed appraisals of institutions, Earle and Cvetkovich (1995) claim that people base trust on "salient value similarity." This is a "groundless" trust, needing no justification. Rather than deducing trustworthiness from direct evidence, people infer it from information shortcuts, available images, schema, and the like. This yields a general basis for trust only to the extent that people perceive situations as being similar. The key point is that people do not confer trust based on a detailed appraisal of the likely competence and fiduciary responsibility of the actor but on the perception of shared values. This means that measurements of trust must include some measure of values or value similarity. Michael Siegrist and colleagues have made attempts to operationalize these concepts and quantitatively test them in relation to the perception of risks (Siegrist 2000; Siegrist, Earle, and Gutscher 2000). In general, these results suggest that an individual expresses more trust and confidence in those managing risky situations if they posses shared values. People are also most likely to trust those that express similar worldviews in the presentation of risk narratives.

Despite sophisticated quantitative analyses and impressive data, these studies lack a measure of external validity. Scholars cannot be certain that their expert interpretations of trust are the same interpretations that the public intends when answering questionnaires. This is uncertain because the vast majority of work on trust either explores the subject theoretically or assumes criteria without having based those ideas on what "the public" considers important. This problem is further compounded by an unclear definition of "the public" as if its members were a unified group rather than thinking in terms of multiple "publics" (Priest 2006). As such, it is increasingly difficult to make valid statements about what the "general public" believes within (Priest 2006) and across (Peters, Lang, Sawicka, and Hallman 2007) societies.

The Role of Trusted Experts

Granovetter (1985) has stressed that social relations are mainly responsible for the production of trust in economic life and that people generate trust when agreements are "embedded" within a larger structure of personal relations and social networks. Social structure is important not only for the formation of social capital (e.g., Fukuyama 1995; Putnam 1993) but also for the generation of trust itself. It allows for more rapid proliferation of obligations and expectations, imposes sanctions on the failure to meet an obligation, and helps to generate reputation (Coleman 1990). In addition, familiar and stable relationships can relieve members of a given social structure of the uncertainty about other people's motivations and anxiety about others' actions not meeting their expectations. By treating trust as a social mechanism that is embedded in structures of social relations (Granovetter 1985; Mizruchi, Stearns, and Marquis 2006), we can place our focus on the institutional and organizational contexts. Because emerging technologies are embedded in an economic and social context, an assessment of that technology must include an assessment of the technology's producers and users, as well as the organizations and social institutions legitimated to make decisions about the technology (Poortinga and Pidgeon 2003b).

A research agenda that emphasizes the decision processes in powerful organizations and among experts will need to come to terms with problems of institutional legitimacy and trust. The debates between the United States and the

European Union (E.U.) regarding the use of the “precautionary principle” in the adoption of technological solutions to social problems reflects similar considerations. The precautionary stance taken by the E.U. is reminiscent of Perrow’s (1999) argument that the human ability to limit catastrophic potential is greatest at the point in time when societies are choosing whether to implement the system. The “menu of choice” available to citizens/consumers is usually—and predominantly—constructed by experts, scientists, industries and governments (Purcell, Clarke, and Renzulli 2000). Once stakeholders have chosen to move forward with GMF, the efforts of the public (that is, of non-expert “publics”) are largely limited to fine-tuning and damage control. If we are not already at that point for GMF, we are rapidly approaching it. Calls for more “upstream” engagement of the public in decision-making regarding GMF are directly reflective of this tension.

The increasing complexity in scientific systems, exemplified by GMF, amplifies public need for trustworthy systems. Due to the interdependencies of our ever more complex social systems, and our increasing reliance on expert knowledge, we have less ability to monitor or control technology. While the division of labor and specialization of knowledge in society has substantially decreased many traditional forms of risk, it has increased our vulnerability to the very interdependencies that make our socio-technical systems work. Continued social and technical complexity elevates the uncertainty involved in emerging technologies. Because there is an increased division of labor and interdependence of complex social and technical systems, we must trust others. This potential for recreancy, organizational failure resulting from lack of either competence and/or fiduciary responsibility, is exactly the condition that increases our reliance on trust

(Freudenburg 1993). More to the point, the potential for recreancy puts social and political issues at the core of debates surrounding the consequences of emerging technologies.

In particular, experts and organizations are an increasingly important nexus between science and society, but remain under-examined entities in trust scholarship. As organizations take an increasing role in scientific and technological research, they maintain a crucial position in the link between trust and risk. This happens as organizations take a more prominent role in framing social problems by defining risks and responses. These organizations also help decide which research questions to ask and answer. In their risk communication messages, the organizations take on social and ethical responsibilities by acting as experts, creating and circulating knowledge about technology. Trust allows these experts to maintain their advisory positions in society. The public accepts the risks of unknown technologies because these trusted experts endorse, promote, and regulate them.

Although trust is a fundamental mechanism underlying all perceived social reality, it is also a risky engagement. Although trust diffuses uncertainty and complexity, trust simultaneously produces risk. Risk is inevitable because people make decisions with limited information about the future. Trust would be unnecessary without risk.

Because of its obvious theoretical importance, scholars have focused on the role of trust in explaining risk perceptions across a range of technological hazards. Wynne (1980) was one of the first to make the link between differences in lay and expert perceptions of risk and differences in the extent of trust in regulatory and scientific institutions. Since then, the relationship between trust, confidence, and risk perception has been widely investigated (e.g., Frewer 1999; Frewer, Howard, Hedderley, and Shepherd 1996; Peters, Covello, and McCallum 1997; Slovic 1993; Slovic, Flynn, and Layman 1991). Most results show that people who trust the people who manage risk believe technology poses a lower risk; people who express no trust in the managers of risk believe technology poses a greater risk (Johnson 1999; Metlay 1999). While trust reduces perceived risk, it may not reduce actual risk inherent in the relationship. Nevertheless, as a positive expectation about others, trust does lead to a perception of lowered risk in a relationship. In this sense, trust reduces (or lowers) perceived risk.

Luhmann (1979) has further suggested that, from a functionalist perspective, social trust enables societies to tolerate increasing uncertainty due to progressive technological complexity. An “internally guaranteed security” from “generalizing expectations of behavior” (Luhmann 1979, p. 93) fosters a greater tolerance for uncertainty. Barber (1983) shares Luhmann’s perspective on trust concerning its function–the reduction of complexity–and offers ‘competence’ and ‘fiduciary responsibility’ as explanatory concepts. Regardless of the specific mechanism, trust helps individuals reduce uncertainty and therefore helps with the coordination of social expectations and interactions by allowing specific, rather than arbitrary, assumptions about future behavior. For some theorists (i.e., Giddens 1990; Seligman 2000), trust is fundamental to the emergence and prominence of organizations and institutions in daily life. As personal interactions decline in importance and practicality, it becomes necessary for people to develop trust in societal institutions.

Scholars have several reasons to relate public perceptions of complex technologies to trust. Difficulties arise when determining the object of trust. Oftentimes, government agencies, scientists, and sponsoring corporations are the only studied social actors. These groups of stakeholders regulate, monitor, and promote new technologies and are clearly worthy of scholarly attention. What is not clear, however, is whether there are other relevant social actors. Perhaps scholars believe this limited set of actors is the most important; perhaps scholars simply do not have room to explore other relationships within the context of their research programs. Still, several additional organizations may influence public opinion. The public has more contact with their local merchants than their local government officials. The media and various advocacy groups, not scientists who speak in technical language, are likely first official sources of information for many who seek additional information. Friends and Internet sites are likely first unofficial sources of information. Academics may be stereotypically seen as more honest, and have less reason to provide biased information than industry. By narrowly defining the organizational ecology, the range of stakeholders who influence public perceptions and opinions of a technology, scholars neglect potential objects of public trust (or distrust) regarding GMF.

Research Considerations

To understand public trust in emerging technologies adequately we need to consider two basic questions. First, we need to determine which experts, authorities, and groups make up the organizational ecology. In a short span of time biotechnology has moved from experiment for scientists in the laboratory, to seeds available to farmers on the farm, and finally to the food on consumers' forks. These stakeholders and others in the commodity chain provide a logical starting place. How researchers narrow or expand that list of relationships to explore hypotheses within the context of their research programs then becomes a question of methodological convenience and tradeoffs. Second, we need to determine how we can assess the public’s trust in these organizations. Building on the research findings that may be multi-dimensional and encompasses concepts of competence and fiduciary responsibility is a good start. Exploring which criteria the public considers important when making trust judgments would be a novel and worthwhile expansion of existing research. How, specifically, scholars measure what the public considers important then becomes, again, a question of methodological convenience and tradeoffs within a particular research program.

To understand how organizations make choices about the potential risks of GMF, we need to give more attention to the structural forces that impinge on the decision makers. Some of these forces originate in the organizations in which the stakeholders are involved, and some originate in the environment of these organizations. These structures and processes coalesce to constrain decision makers to make tradeoffs between organizational resources and public interests, and vice versa. My case study of GMF allows us to examine some of the processes whereby organizations choose alternatives and some of the mechanisms that organizations use to guide their behavior in circumstances that provide few clues about the proper response.

Results of this research will add significantly to the existing literature on emerging technologies, organizations, and representations of expertise as well as deepen our body of knowledge on such topics as definition and theory of trust, merits and limitations of trust in organizations, and trust-power relationship between organizations and the public. By analyzing how stakeholders promote GMF and interact with, educate, and inform the public, this research will explore how organizations create, develop, and maintain trust. In sum, this research will examine how social and institutional factors interact to structure trust relations in the context of GMF in the United States.

In the next section, I describe the data source and research design used in the empirical chapters that follow. The purpose of this section is primarily to introduce the relevant methodological considerations and details so that I can focus the text in later chapters more on substantive issues. More detailed explanations and rationale for the research questions, hypotheses and analyses are contained within each of the empirical chapters.

Research Design

The data presented are from a mail survey that was the follow-up to a comprehensive, nationally representative study initially conducted by telephone (Hallman, Hebden, Aquino, Cuite, and Lang 2004). Extensively trained employees at Shulman, Ronca, and Bucuvalas, Inc (SRBI) conducted the telephone interviews between May 4, 2004 and June 14, 2004. Potential respondents were selected using national random digit dialing across all 50 states. U.S. Census Bureau population estimates determined the distribution necessary for proportionate geographic coverage. The computer assisted telephone interviewing (CATI) program guided a random but balanced selection process to help ensure that interviewers talked to representative numbers of men and women.

Choice of Survey Mode

Cost and value for money considerations motivated me to use a mail survey methodology. Despite being part of a larger research effort, getting access to a reasonably representative sample of the U.S. population was only possible via a self-completed postal or internet survey. The financial cost of increasing the length of a telephone survey was too high to be able to include more than a few questions in total. The decision between postal or internet survey rested on trade-offs between cost, labor intensiveness, and data quality. The main advantage of a postal survey would be the opportunity to use a properly drawn random sample of respondents. This sample would further allow me to match up data collected during the phone survey with the mail survey questions, in effect greatly expanding the potential dataset. Given postage, printing and administration costs, and anticipated response rate, I anticipated a sample size of roughly 400 people. Although not ideal, I considered this a superior option to the non-probability sample of a web-based alternative.

The Food Policy Institute at Rutgers University contracted SRBI to conduct the telephone and mail surveys. SRBI is a member of the National Council on Published Polls (NCCP) and the Council of American Survey Research Organizations (CASRO). They are a full-service global strategy and research organization specializing in public policy and opinion surveys, among other things. Clients include major financial institutions, Fortune 500 companies, federal, state and local governments, foundations and universities. Moreover, SRBI has an established relationship with the Food Policy Institute and a record of accomplishment, providing high quality, timely and cost effective interviewing.

Response Rate

Interviewers at SRBI conducted 1,201 CATI guided telephone interviews using national random digit dialing across all 50 states. Interviewers excluded many of the telephone numbers originally selected as part of the sampling frame as nonresidential or non-working numbers. Only 25 percent of the numbers selected at random yielded completed interviews. However, calls to 66 percent of the working residential numbers resulted in completed interviews. The respondents to this telephone survey are the sampled population for my follow-up mail questionnaire.

After completing the telephone survey, interviewers asked the 1,201 respondents if they would be willing to complete a mail questionnaire for a $5.00 incentive. Slightly less than half (47 percent, 559) of the respondents agreed and gave a valid mailing address. For the 440 respondents who did not complete and return a questionnaire within 14 days, interviewers sent a second questionnaire without the gratuity. Of the 559 who originally agreed, 363 (65 percent) returned a completed mail survey. SRBI edited, keypunched with 100 percent verification and compiled all returned mail questionnaires were into an SPSS dataset. The final sample size of 363 from a population of 1,201 yields a completion rate of 30 percent and allows a sampling error rate of ±5.5 percent. The somewhat low completion rate and moderately sized sample dictate some caution when interpreting the results. While it is important to stress that this is an exploratory analysis, the results allow me to make rough judgments about perceptions of trust in the organizations and experts involved in GMF in the United States.

Summary

The general paradigm of trust has focused upon unexamined and unarticulated assumptions about who is communicating what, to whom, and in what context, resulting in an overly simplistic or overly abstract approach to trust. Traditional trust efforts have failed to recognize the social and contextual complexities associated with trust and its management. In the next chapter, I attempt to remedy gaps in our knowledge by exploring which organizations and experts the public trusts regarding GMF, connecting those trust judgments to varying trust attributes, and establishing determinants of trust for each actor.

CHAPTER 3: ORGANIZATIONS INVOLVED IN GMF

Building on the description of the organizational ecology of GMF I presented in Chapter 1, and applying the data described in Chapter 2, I turn to the organizational features and characteristics that may be important for assessing trust in the organizations involved in GMF in the U.S. I place trust within a broader organizational context to gain a more realistic understanding of the social factors and interests that shape definitions of acceptable trust. Accordingly, I place trust in specific organizations as the object of analysis to help understand public reactions to this emerging technology.

The production of genetically modified food is taking place in the context of three related societal trends: (1) a highly developed division of labor, (2) increasing scientific and technical complexity, and (3) increasing organizational complexity. These conditions are characteristic of a “risk society” in which the public requires a burgeoning pool of trust to function adequately (Beck 1992). The continued differentiation and specialization of roles, functions, occupations, and expertise has created complex interdependencies based on cooperation, competition, and trust. These conditions bring the expectation that those who have a specific task or responsibility will perform their duty in a way that others can count on. As a result, the public relies on experts even though experts will sometimes fail, and even though it is increasingly difficult to know who the right expert for the job is. This potential for recreancy puts social and political issues at the core of debates surrounding the risk of technology in modern life and is exactly the condition that increases our reliance on trust (Freudenburg 1993).

Current accounts of trust center on individuals (e.g., Hardin 2002; Cook 2001; Seligman 2000), with special reference to the conditions or processes that induce people to trust certain others (Tilly 2005). Trust is subject to specific situations, the context of the interaction and the actors involved (Barber 1983; Gambetta 1988; Hardin 2002). As I noted in Chapter 2, to say that one trusts another without further qualification is an imprecise measure. When evaluating a trust relationship, it is more accurate to ask whether one is trusted in a particular context.

Trustworthy experts and organizations are competent, act with concern for others, and help the public navigate the uncertainty inherent in new technologies such as GMF. Experts and organizations are obviously key stakeholders in how science proceeds, occupying a crucial position between acceptance and uncertainty. One way that organizations assume social and ethical responsibility is by creating and circulating knowledge about GMF. Organizations, then, are a central part of the context within which institutional trust does or does not develop. These groups, however, have not received sufficiently close or detailed attention in debates about how trust shapes technical controversies. Moreover, when authors examine trust at an organizational level, appropriate and complete measures of trust are rarely used. To address these gaps in understanding, in this chapter I use GMF as a case study to draw general insights about the determinants of trust for new technologies.

Given the general recognition of the importance of trust in the acceptance of technology, my objective is to establish which attributes determine trust in the organizations and experts involved in GMF. My analysis departs from previous work by challenging two fundamental assumptions in the trust literature: that scholars know how to measure trust and that the measurement of trust is formulaic. I find important ways in which these assumptions are questionable, leading to important gaps in our understanding of trust.

Background: Perceptions of GMF

To recap what I noted in Chapter 1, GMF has progressed from experimental science to a commonplace foodstuff in only twenty years. At the end of the 1980s, the first genetically modified foods made it to market. Currently, more than one quarter of the world's cultivated farmland consisted of GM crops and more than one quarter of all soy, corn, canola and cotton grown worldwide is genetically modified (Brookes and Barfoot 2006; James 2004; Pew Initiative on Food and Biotechnology 2004). Food manufacturers use these commodity crops as ingredients in a vast array of processed foods such as high-fructose corn syrup, soy lecithin, as well as canola and cottonseed oils. As a result, many estimates suggest that roughly three-quarters of all processed foods in the US currently contain a GM ingredient (GEO-PIE 2003; Lambrecht 2001). Despite the massive and rapid shift in agriculture, the American public has scarcely noticed (Hallman, Hebden, Aquino, Cuite, and Lang 2004).

In the last decade, public perceptions of genetically modified food (GMF) have been intensively studied (e.g., Hamstra 1998; Hallman, Hebden, Aquino, Cuite, and Lang 2004; Gaskell, Allum, and Stares 2003; Hallman, Hebden, Aquino, Cuite, and Lang 2004; Hamstra 1998). Scholars have investigated the relationship between various socio-demographic variables and attitudes towards GM food (e.g., Puduri, Govindasamy, Lang, and Onyango 2005; Puduri, Govindasamy, Lang, and Onyango 2005; Siegrist, Earle, and Gutscher 2000), the importance of perceived risks and benefits (e.g., Frewer, Hedderley, Howard, and Shepherd 1997; Frewer, Hedderley, Howard, and Shepherd 1997; Onyango, Nayga Jr., and Schilling 2004), media attention (McInerney, Bird, and Nucci 2004; McInerney, Bird, and Nucci 2004; Nisbet and Lewenstein 2002), and knowledge (e.g., Sturgis and Allum 2004). Because of this scholarship, we know that public opinion regarding GMF remains divided. In the US, the public remains unsure or unaware (Hallman, Hebden, Aquino, Cuite, and Lang 2004); in Europe, public opinion leans toward the negative (Gaskell, Allum, and Stares 2003). While opposition may be more vigorous in Europe, consumer enthusiasm for these foods is limited on both sides of the Atlantic.

Supportive policymakers and industry executives have struggled to understand why consumers have not greeted these foods more positively. Social activism and political-cultural context may help explain the efficacy of anti-GMF strategies in some locations (Schurman 2004). Regardless of whether the opposition to GMF is successful, the anti-GMF strategies illustrate that the GMF controversy is also, in many ways, a proxy debate for broader issues of social and political power, democratic practice, and corporate responsibility (Lang and Priest 2007; Jasanoff 2005). Although scholarship has contributed to a better understanding of the individual basis of public perceptions, the wide-ranging organizational context of GMF has received relatively little attention. A focus on individual risk perception easily neglects the organizational ecologies within which individual perceptions are shaped (Clarke and Short 1993). Because existing scholarship explores the trustworthiness of only a limited set of actors, research implies that only a few actors influence public opinion. Yet ongoing debates about appropriate public engagement strategies and the role of moral, ethical, and social considerations in scientific decision-making bring forward a wide-range of actors that are likely to increase trust and reduce public uncertainty.

Trust helps people cope with uncertainty (Beck 1992; Giddens 1990; Luhmann 1979). Following Durkheim's (1984) classic work on the division of labor, Freudenburg (1993) stressed the essential role of trust in modern society. Building on this, Clarke and Short (1993, p. 384) write that "[t]he division of labor, though a source of riches, increases vulnerability to others' failures to fulfill their responsibilities." Scientific and technological developments produce benefits, but they also produce uncertainty, potentially disastrous failures, and harmful side effects (Erikson 1994). Even when experts and organizations take great care, failures have resulted in severe consequences (Clarke 2006; Weick and Sutcliffe 2001). Furthermore, the complexity of institutions, organizations, and technological systems, and the increasingly global scope of their operations make them impenetrable to ordinary people, but often also to the professional experts (Perrow 1999; Sztompka 1999).

Sample Demographics

Ideally, survey participants have the same demographic characteristics as the population they represent. Unfortunately, many large-scale survey samples under-represent groups that are difficult to contact or to interview, such as the elderly or those with less than a high school education. Because the sample in this dissertation cannot truly said to be representative of U.S. population, I have decided to report marginal distributions using non-weighted data. I intend the following demographic information to characterize the sample as well as introduce several variables that will find their way into analyses in subsequent chapters.

To obtain demographic information, I merged the mail and telephone survey data via an anonymous respondent identification number. I present detailed socio-demographic characteristics of respondents in Table 3.1. Note that this sample over-represents women, the highly educated, and those with high household incomes. As such, readers should take caution when attempting to generalize results.

[TABLE 3.1 HERE]

I coded sex as dichotomous with female equal to 0 and male equal to 1 (36.4 percent). I report age as an ordinal level measure with 6 categories that range from 18 to 24 years (coded 1) to 65 and older (coded 6) (mode = 4). I coded education as an ordinal level measure with 4 categories that ranged from less than a high school degree (coded 1) to more than a 4-year college degree (coded 4) (mode = 4). I report household income (in dollars) as an ordinal level measure with 7 categories that range from less than $25,000 (coded 1) to more than $125,000 (coded 7) (mode = 4). Finally, I measure religiosity dichotomously with attending church less than once per month equal to 0 and at least once per month equal to 1 (58.3 percent). The socio-demographic characteristics of the non-weighted mail and telephone surveys are similar and largely reflect typical survey responses biases (Krosnick 1999) though I cannot discount the possibility of self-selection bias from the original population.

Description of Survey Instrument

I conducted a follow-up mail survey to keep the telephone survey less than 30 minutes long and to allow for a more thorough understanding of specific topics. By covering these topics in written form, respondents were able to give more detailed information than would have been possible, given time constraints or respondent fatigue, on the telephone. Among other questions about food preferences, the self-administered mail questionnaire contained 78 questions about trust, with closed-ended response alternatives of mainly Likert-type scales. Although the wording for each question in the survey remained constant, to minimize response-order effects respondents were randomly assigned one of six versions of the trust questionnaire; each version of the questionnaire presented the questions in a different order. I have reproduced one full questionnaire in Appendix B. I present a full description of the topics below.

Trust

The survey asked respondents about their trust in each of six organizations with regard to GMF. I intended this question to measure the respondents' level of trust in the various groups in the specific context of decision-making regarding GMF (A trusts B to do X). The survey instructions asked respondents to explicitly rate, "How much do you trust the following groups to make appropriate decisions about genetically modified food? (from 1 no trust to 7 complete trust)" These groups–environmental organizations, farmers, food manufacturers, government agencies, grocers and grocery stores, and university scientists–reflect important stakeholders in the organizational field. Moreover, these groups reflect the commodity chain for GMF.

Ideally, to get a complete picture of organizational ecology I would have asked about friends and family. I chose to omit these groups for two related reasons. First, I had limited space on the survey. Second, given that the public has limited awareness of GMF and rarely discusses it (Hallman, Hebden, Aquino, Cuite, and Lang 2003; Hallman, Hebden, Aquino, Cuite, and Lang 2004), I felt that friends and family were least likely to be a relevant source of trust in this particular instance. These final six stakeholders were selected both because of their importance in the organizational field, and because other surveys, such as the Eurobarometer, have also included basic trust measures for some of them, permitting cross-cultural comparisons in future research. Though this list of stakeholders is a more limited than I would ideally prefer, these groups will allow me to test some detailed hypotheses about the nature of trust and GMF. No existing surveys provide robust measures of trust and trust attributes for such a wide-array of experts and organizations involved in genetically modified food.

Attributes

Studies of trust in institutions primarily focus on identifying which factors influence trust judgments. From a theoretical point of view, Barber's (1983) socio-historical thesis on trust remains persuasive. In some respects, researchers have continued to elaborate and amend his main thesis that trust is a multi-dimensional concept. In large part, however, the empirical evidence that has accumulated since the early 1980s has done little to disconfirm his assertions.

Following from Barber's (1983) description of trust, I selected six trust-related attributes–honesty, unselfishness, shared values, ability to predict effect, knowledge, and ability to determine importance–that are frequently discussed in previous work on trust (e.g., Barber 1983; Earle and Cvetkovich 1995; Frewer, Howard, Hedderley, and Shepherd 1996; Lang and Hallman 2005; Metlay 1999; Poortinga and Pidgeon 2003a; Renn and Levine 1991; White and Eiser 2005). Although there is overlap in the attribute descriptions and apparent equivalence to some degree, no two studies to date have used the same measures. Furthermore, most studies treat the trust attributes as components of an aggregated trust measure rather than a focus of analysis. I intend the six questions I designed, and tested in a series of preliminary studies, to evaluate six distinct trust-related attributes. Explicit ratings of the attributes were measured on a scale that ranged from 1 (not at all) to 7 (completely); respondents were also given an explicit "unsure" option. Specifically, respondents were asked the following block of questions "When thinking about genetically modified food, how would you rate [environmental organizations] on each of these items?"

1. [Honest] How honest they are
2. [Unselfish] How much they pursue their own interests versus the public interest
3. [Share Values] How much they share my values
4. [Predict Effects] How well they can predict potential effects
5. [Knowledge] How knowledgeable they are
6. [Determine Importance] How well they can tell which potential effects are important

After responding to this block of questions, the survey instructions asked respondents to answer the same questions about another group. The survey repeated this sequence until respondents had rated each of the six groups on each of these six attributes.

In the final dataset, the measure of unselfishness was reverse coded so that a higher rating would signal a positive attribute, acting more in the public interest. After my initial analyses, however, I determined that my measure of unselfishness was seriously flawed. For example, internal validity checks on the question made no sense (e.g., environmentalists were rated as more self-interested than corporations and university scientists). The wording of the full question "how would you rate [environmental organizations] on how much they pursue their own interests versus the public interest, on a scale ranging from 1 (not at all) to 7 (completely)" is difficult to comprehend and even more difficult to interpret. While the notion of fiduciary responsibility that it seems to reflect as a factor in trust has been argued by some (e.g., Barber 1983), some theorists do not mention it at all, positively or negatively. The empirical work on this variable is slim, but recent analysis (Johnson 2007) of similar items found it neither a washout nor critically important. Because my analysis and interpretations of this particular measure would be unreliable and wildly speculative, I decided to remove the unselfish measure from my analyses and do not report on it.

Results

I pursued three discrete objectives in this chapter. First, I investigated public perceptions of trust toward the experts and organizations involved in GMF. Second, I determined the extent to which public judgments and determinants of trust in social actors vary. Third, I explored how the determinants of trust vary by actor.

Perceptions of Trust in Organizations

My first objective was to examine public perceptions of trust toward the experts and organizations involved in GMF. As such, I computed mean scores and standard deviations for the explicit trust measure. Respondents rated each organization on a seven-point scale, ranging from 1 (no trust) to 7 (complete trust); a rating of 4 represents a neutral score.

[TABLE 3.2 HERE]

Substantively, the highest trust rating (4.73) is only a little better than neutral (4.0) and the lowest rating (3.21) is only a little worse than neutral. Statistically, three groups have mean trust scores that are significantly above a neutral rating: respondents rated university scientists, farmers, and environmental organizations as relatively trusted regarding genetically modified food. Statistically, three groups have mean trust scores significantly below a neutral rating: respondents rated government agencies, grocers and grocery stores, and food manufacturers as relatively untrustworthy regarding genetically modified foods.

These ratings are roughly consistent with results reported from other American (Lang and Hallman 2005), European (Gaskell, Allum, and Stares 2003), and comparative (Priest, Bonfadelli, and Rusanen 2003) quantitative surveys; the trusted sources in Europe are often the same as in the United States. The main stakeholders in GM food (government agencies and food manufacturers) as well as those that are most likely to have public contact (grocers and grocery stores) are less trusted than others. Conventional wisdom says that that effective communication should come from trusted experts. If true, these stakeholders may not alleviate the public's uncertainty about GMF. Although respondents trusted some more than others, no group was overwhelmingly trusted. Without trust in experts, the exaggerated claims of supporters or detractors of the technology may continue to create public uncertainty. Viewed institutionally, power and money await those who tap into our insecurities and supply us with substitutes (Glassner 1999).

Perceptions of Trust Attributes

My second objective was to determine the extent to which public judgments and determinants of trust in these six actors vary. As such, I computed mean scores and standard deviations for each of the five attributes of trust measured (Table 3.3) for each organization. Respondents rated each organization on a seven-point scale, ranging from 1 (no trust) to 7 (complete trust); a rating of 4 represents a neutral score.

[TABLE 3.3 HERE]

Considering the mean values for the five trust attributes for each organizational actor, the general hierarchy of trusted organizations is not entirely consistent with Table 3.2. For comparison, I distinguish between those that rise above and those that fall below neutral (4.0) for each trust attribute. For the measure of shared values, predicting effects, and determining importance, three actors have scores above the attribute's neutral rating; respondents rated university scientists, farmers, and environmental organizations relatively high on these attributes. Three groups have scores below neutral; respondents rated government agencies, grocers and grocery stores, and food manufacturers relatively low on these attributes. The pattern for these three measures is identical to the overall measure of trust.

For the measures of honesty and knowledge, four actors have ratings above neutral. In addition to university scientists, farmers, and environmental organizations, respondents also rated grocers and grocery stores above neutral for honesty. Regarding knowledge, respondents only rated grocers and grocery stores relatively low. While respondents did not rate any actor below neutral for every attribute, they only rated government agencies, grocers and grocery stores as well as food manufacturers above neutral on one attribute each.

In sum, public perceptions of trust attributes vary for these organizational actors in minor ways. Three trust attribute measures displayed the same patterns of trustworthiness and untrustworthiness as the general measures of trust. Respondents rated organizations differently, however, for three of the measures. I should point out a few commonalities. First, university scientists, farmers and environmental organizations rated high on all measures. In contrast, government agencies, grocers and grocery stores as well as food manufacturers rated low on four of five measures.

As a next step in determining the extent to which public judgments and determinants of trust in these groups vary, I calculated the bivariate correlations of the explicit trust ratings. As shown in Table 3.4, all correlations were positive and statistically significant ($p \leq 0.01$).

[TABLE 3.4 HERE]

The strongest correlation (0.60, $p \leq 0.01$) was between the food manufacturers and grocery stores. Trust in food manufacturers was also moderately correlated with trust in farmers (0.51) and government agencies (0.49). The weakest, but still statistically significant (0.15, $p \leq 0.01$), relationship exists between trust in environmental organizations and trust in food manufacturers. These results indicate that public judgments of trust in these groups regarding GMF are related.

To determine if the reported trust attributes were always interrelated, I repeated the bivariate correlation calculations of trust attribute ratings for each of the six objects of trust. Given that scholars mention these attributes as essential components of trust, I would anticipate that the attributes would be related. As shown in Table 3.5, all correlations were moderately strong, positive, and statistically significant ($p \leq 0.01$).

[TABLE 3.5 HERE]

Though the pairwise correlations generally confirm my expectations, they also indicate that collinearity problems may exist. I calculated variance inflation factor (VIF) statistics to examine the possibility of multicollinearity. Most VIF statistics were in a normal range (< 4). However, four of the six models had one or two variables with VIF values greater than 4; the largest VIF value in any model was 5.761. Readers should interpret the influence of specific independent variable with caution.

Determinants of Trust in Organizations

My third objective was to find out how determinants of trust vary by actor. I used bivariate correlations to uncover the relationship between respondents' trust in each of the organizations. As shown in Table 3.6, I correlated explicit trust ratings with the five trust attributes and demographic variables.

[TABLE 3.6 HERE]

In general, the same patterns emerged for all six actors. However, for the sake of simplicity and given that I previously found the weakest correlations between trust in environmental organizations and trust in food manufacturers, I focus my discussion on these two actors. Given their dissimilarities, the contrasts between these actors highlight the potential range of differences in trust judgments. Furthermore, previous research indicates that the public perceives food manufacturers as more closely aligned with pro-GM sentiments and perceives environmental organizations as more closely aligned with anti-GM sentiments (Lang and Hallman 2005).

For the trust attributes, the same general pattern emerged for food manufacturers as for environmental organizations. All items were moderately and positively correlated (between .370 and .702, $p \leq 0.01$) for both groups. There were, however, differences in correlations with the demographic variables. Education (-.144, $p \leq 0.05$) and income (-.152, $p \leq 0.05$) were negatively correlated with trust in food manufacturers. In contrast, only age (-.192, $p \leq 0.01$) was negatively correlated with trust in environmental organizations. Though this analysis does hint at the possible relationships, regression models are more appropriate for testing predictions of trust.

To determine the extent to which trust attributes predict public judgments of trust in each set of organizations, I calculated the linear regression effects of the five trust attributes on explicit trust judgments. I use measures of sex, age group, educational level, household income, and religiosity to control the possible mediating influences of socio-demographic factors.

[TABLE 3.7 HERE]

As noted in Table 3.7, at worst, the model accounts for less than one-third (30.0 percent) of the variance in trust in food manufacturers and, at best, slightly more than one-half (53.2 percent) of the variance in trust in environmental organizations. The predictive ability of the model ranged between those two extremes for the remaining organizations. Whether this is adequate is unclear. However, much of the variability in an individual's trust in organizations and experts remains outside of this standard way of measuring trust. Moreover, this measurement of trust is more effective for some experts and organizations than others.

I observed distinct patterns of significance for the trust attributes in each model. For all groups, an increase in public perceptions of honesty resulted in a larger increase in the overall perception of trust than any other variable under consideration. The results were mixed for the other trust attributes. That is, a varying set of trust attributes predicts public perceptions of trust. For example, trust in food manufacturers is less predictable by demographic variables than trust in environmental organizations. Second, perceived knowledge about GM food is significant for environmental organizations, but not important in explaining trust in food manufacturers. Just as important are variables that do not help predict trust. Three trust attributes–sharing values, determining importance, and predicting effects–did not significantly help explain trust for either group. Similarly, three demographic variables–sex, household income, and religiosity–did not significantly help explain trust for either group.

Discussion & Conclusions

I pursued three discrete objectives in this chapter. First, I explored which organizations and experts the public trusts regarding GMF. Respondents considered university scientists, farmers, and environmental organizations relatively trustworthy. Respondents considered the traditional stakeholders–government agencies, grocers and grocery stores, and food manufacturers–less trustworthy. Considering support and opposition to GMF in a broad institutional competition for public trust, there is no reason to believe that these organizational actors will coordinate their actions to reassure the public.

This does not mean, however, that the actions of those involved with GMF are unstructured. As discussed, in uncertain situations, trust often functions as a means to help reduce decision-making complexity. Analyses focused solely on levels of public trust may run the risk of obscuring the inherent power relationships among key actors and between these actors and others (e.g., "ordinary" people or "the public"). Competition for control of expert knowledge and public trust is a hallmark of professionalization (Abbott 1988). Yet the stakeholders in this dissertation lack a coordinating institutional and professional framework. Moreover, the lack of a unified, hierarchical command structure to delineate authority and power among organizations likely means that the public will sometimes perceive these groups as competing actors, other times the public may see them acting in unison. Exactly how the public perceives them, however, is not entirely within their control.

Scientists and their related institutions enjoy a jurisdictional claim to the extent that the public considers controversies surrounding GMF a scientific issue. As such, public perceptions of science related actors should vary together. Scholars have analyzed science as a societal institution at length in peer-reviewed journals such as Science, Technology, and Human Values and Social Studies of Science. These journals, and others, find that the American public defers to scientific authority and the power of science to resolve disputes. However, my emphasis on deference to scientific authority does not mean that other values do not play a role in shaping American views of science, or agricultural biotechnology specifically. These other values might include an appreciation of nature (Peters, Lang, Sawicka, and Hallman 2007) or politically institutionalized opposition to GMF. Though American political leaders and governmental agencies have been uniform in their support for GMF, this is not true in other countries, including England and Germany (Gaskell, Einsiedel, Priest, Ten Eyck, Allum, and Torgersen 2001; Jasanoff 2005). Moreover, while the issue has been a priority for some environmental and consumer advocacy groups, GMF has never been a central issue for the larger and more influential environmental organizations such as the Sierra Club or Nature Conservancy (Brossard and Nisbet 2007). It is not surprising that American public opinion toward GMF is more positive than in Europe given the lack of competing jurisdictional challenges, relative to the strong institutional and cultural authority of science.

My second objective was to determine the extent to which public judgments of trust attributes vary in these organizational actors. In this particular context, the public generally trusts some actors like university scientists and generally distrusts others like food manufacturers. Actors like government agencies are (dis)trusted more narrowly. Perhaps the variation lies in social role expectations and public beliefs about the scope of organizational authority. The results suggest that the public entrusts experts and organizations within a narrow range. General measures of trust do not capture the ways that public judgments of an actor vacillate from trustworthy to untrustworthy depending on the attribute measured.

Moving beyond individual perceptions and trust attributes is important. Closer examination in the GMF case of the basis for trust falsifies the predominant analytical tendency to treat these attributes as reflecting, accurately and completely, public perceptions of trust. My analysis suggests instead that trust itself is an analytical artifact. This case shows that unacknowledged assumptions about public trust are unfounded. Moreover, trust perceptions are dependent on social forms. Thus, it becomes evident that organizational actors are not interchangeable stakeholders in debates about trust. As such, they should be essential subjects of critical social and cultural evaluation.

In the U.S., the dominance of scientific authority creates a situation whereby future challengers start in a weakened position. This is similar to Noelle-Neumann's (Noelle-Neumann 1974; 1984; 1991) widely cited public opinion theory of the "spiral of silence" that explains how majority opinions become dominant over time and minority opinions weaken. This theory describes the increasing pressure to conceal dissenting views, fearing that they will be socially isolated if their opinions are out of favor. In this manner, public opinions become forms of social control, forcing individual behaviors to conform to prevailing attitudes about what is acceptable. The spiral of silence emphasizes the horizontal pressures that the threat of isolation and corresponding fear of isolation exert to keep people from being open and honest about their opinions.

I propose a similarly themed “spiral of trust” whereby individual belief that particular organizations and experts are trustworthy, may lead to a virtuous spiral. Alternatively, when an individual believes that the public distrusts particular social actors, this may lead to a degrading spiral. Eventually, dissenting voices disappear from the public opinion landscape, save the voices of the “hard-core” who continue to support a minority viewpoint despite becoming more socially isolated (Noelle-Neumann 1991). In practice, the only dissenting voices that the public might heed would be those that are already trusted. This, again, means that competing claims must come from social actors who can establish or maintain jurisdictional legitimacy. This inability to express personal trustworthiness fully because of a negative climate of opinion toward a social actor might impair social cohesion, inhibit social exchange, and lead to jurisdictional competition. Social pressures and fear of social isolation, more than public perceptions, govern trust judgments. In this manner, micro-level trust judgments help us derive more generalized forms of trust.

My third objective was to establish determinants of trust for each expert and organization. The determinants of trust show a degree of diversity across organizational actors. The strength, significance, and variance explained by each determinant differed in each equation. Trust attributes do not uniformly predict trust judgments across organizations; attributes vary in the amount they contribute to trust judgments for a particular organization. Understanding which trust attributes the public considers important when assessing the actions of these actors is a necessary first step in a research agenda that emphasizes the decision processes in powerful organizations and among experts.

If we assume that people base trust on social relationships, not personal attitudes, scholars might find explanations for change and variation in organizational forms or networks of trust. In these relationships, if organizational actors do not meet their obligations or our expectations, we are often without recourse and remain dependent upon the stakeholders. While an unexamined, unreflexive commitment may provide a degree of ontological security (Giddens 1990), this “as-if trust” (Wynne 1996) reflects the fact that people are often compelled to act as if they trust experts and institutions because they feel they have no other choice, keeping any significant doubts to themselves. In this sense, trust helps elaborate organizational structures, including the regulatory and legal system, let those who have control over the development of GMF promote the technology while deepening the public’s reliance on the trustworthiness of experts. This spiral of trust further reifies the existing power relationships between technological expertise and the public.

There are, of course, extra variables and additional objects of trust that deserve further attention. While I controlled for several socio-demographic variables, measures of political orientation may also be salient (Nisbet and Lewenstein 2002). Furthermore, interpersonal networks of friends and family might be an important source of trust. This survey instrument, however, does not allow me to assess the importance of these factors. To demonstrate that individuals base their trust judgments on varying sets of organizations and experts, scholars must continue to innovate and devise new ways to measure trust reliably across these groups. I have not exhausted the explanatory potential of trust attributes in this exploratory analysis. As such, the results are more suggestive than definitive, yielding more questions than answers. Future analysis of trust attributes using nationally representative data and based on a qualitative analysis of the semantic meanings that respondents attribute to measures of trust would provide a more complete explanation of why people trust some actors and do not trust others.

Accounts of trust that center solely on individuals, cannot (1) identify possible causes for organization-specific differentiation and/or relevance of trust or (2) explain why these models leave as much variance unexplained as they explain, leaving much of the variance unaccounted for in a trust attribute model. It would be tempting to create individual definitions of trust for each studied area, as proposed by Cvetkovich and Lofstedt (1999). Scholars currently create the definitions within bodies of work that have their own scopes and goals that may not be compatible with other people’s work. As Wynne (1992; 1996) reminds us, trust is mutable and discursively contested. Yet, if scholars generate measures or trust from the nuances of a particular case, we will create dozens of competing measures. Moreover, this Babel-like account of trust would force scholars to ask, for each new case, how to best assess and completely measure trust. Accounts of organizational features and processes, however, make it possible to see new relationships and may provide a more coherent explanation of patterns of trust than the approaches pursued up until now by others.

This analysis considers the possible contributions of socio-cultural variables that impact perceptions of trust in organizations involved in GMF. The results have implications for understanding public trust in organizational actors involved with new technologies. In particular, the results highlight concerns about measures of trust attributes adequately explaining public perceptions of trust. Though organizations represent an increasingly important nexus between science and society, they remain under-examined in trust scholarship. How trust may allow these organizations to maintain their advisory positions is worthy of continued exploration, if only because it is trust that allows the public to accept the risks of unknown technologies these organizations endorse.

Perhaps different levels and types of experience with each organization result in different assumptions about which characteristics of trust are important for different organizations. To demonstrate that individuals based their trust judgments on varying sets of organizations and experts, scholars must devise ways to measure trust reliably across groups of experts and organizations.

TABLE 3.1: DEMOGRAPHIC CHARACTERISTICS

Variable	Variable Label (Code)	Valid %
Sex	Female (0)	63.6
	Male (1)	36.4
Age Group (in years)	18-24 (1)	8.5
	25-34 (2)	13.8
	35-44 (3)	20.4
	45-54 (4)	24.5
	55-64 (5)	14.9
	65 and older (6)	17.9
Level of Education	< High School Degree (1)	6.9
	High School Graduate (2)	26.2
	Some College (3)	31.5
	>= 4-Yr College Degree (4)	35.4
Household Income ($)	< $25,000 (1)	19.0
	$25,000-$34,999 (2)	14.6
	$35,000-$49,999 (3)	16.0
	$50,000-$74,999 (4)	23.6
	$75,000-$99,999 (5)	14.9
	$100,000-$124,999 (6)	5.5
	> $125,000 (7)	6.4
Attend Church	< once per month (0)	41.7
	At least once per month (1)	58.3

Note: N = 363.

TABLE 3.2: MEANS AND STANDARD DEVIATIONS OF TRUST RATINGS

	N	Mean	Standard Deviation	t
University scientists	355	4.73	1.68	8.20**
Farmers	355	4.37	1.63	4.25**
Environmental organizations	355	4.19	1.77	2.03*
Government agencies	356	3.36	1.81	-6.70**
Grocers & grocery stores	351	3.27	1.53	-8.92**
Food manufacturers	352	3.21	1.57	-9.46**

Note: scales range from ‘no trust’ (1) to ‘complete trust’ (7), t-test value = 4; * t-values significant from neutral (4) at the $p \leq .05$ level (2-tailed); ** significant at the $p \leq .001$ level (2-tailed).

TABLE 3.3: MEANS, STANDARD DEVIATIONS, AND RANKINGS OF ATTRIBUTES BY ACTOR

	Environmental Organizations N = 255			Farmers N = 279			Food Manufacturers N = 285			Government Agencies N = 287			Grocers and Stores N = 279			University Scientists N = 284		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
Honest	4.81	1.80	2	5.10	1.52	1	3.74	1.85	4	3.69	1.88	4	4.38	1.67	1	5.39	1.52	2
Share Values	4.20	1.87	5	4.43	1.67	3	3.24	1.75	5	3.29	1.79	5	3.52	1.68	3	4.26	1.75	5
Predict Effects	4.41	1.84	4	3.93	1.89	5	3.89	1.84	2	3.89	1.89	3	3.20	1.77	5	5.29	1.53	4
Knowledge	5.18	1.56	1	4.96	1.50	2	4.61	1.70	1	4.39	1.79	1	3.92	1.66	2	5.89	1.26	1
Determine Importance	4.47	1.92	3	4.10	1.87	4	3.88	1.85	3	3.91	1.89	2	3.27	1.85	4	5.31	1.56	3

TABLE 3.4: SIGNIFICANT BIVARIATE CORRELATIONS OF TRUST RATINGS

	1	2	3	4	5
1. Environmental Organizations	--				
2. Farmers	0.18	--			
3. Food Manufacturers	0.15	0.51	--		
4. Government Agencies	0.19	0.19	0.49	--	
5. Grocers & Grocery Stores	0.17	0.49	0.60	0.35	--
6. University Scientists	0.39	0.32	0.31	0.45	0.21

Note: Listwise N = 344. All correlations significant at the $p \leq .01$ level (2-tailed).

TABLE 3.5: SIGNIFICANT BIVARIATE CORRELATIONS OF TRUST ATTRIBUTES

		1	2	3	4	5
Environmental Organizations Listwise N = 255	1. Honest	--				
	2. Share Values	.68	--			
	3. Predict Effects	.73	.59	--		
	4. Knowledge	.73	.63	.71	--	
	5. Determine Importance	.80	.66	.83	.74	--
Farmers Listwise N = 279	1. Honest	--				
	2. Share Values	.62	--			
	3. Predict Effects	.60	.57	--		
	4. Knowledge	.62	.54	.69	--	
	5. Determine Importance	.58	.58	.83	.65	--
Food Manufacturers Listwise N = 285	1. Honest	--				
	2. Share Values	.69	--			
	3. Predict Effects	.65	.63	--		
	4. Knowledge	.56	.54	.78	--	
	5. Determine Importance	.68	.65	.85	.73	--
Government Agencies Listwise N = 287	1. Honest	--				
	2. Share Values	.79	--			
	3. Predict Effects	.63	.66	--		
	4. Knowledge	.64	.65	.81	--	
	5. Determine Importance	.64	.66	.88	.77	--
Grocers & Grocery Stores Listwise N = 279	1. Honest	--				
	2. Share Values	.58	--			
	3. Predict Effects	.61	.68	--		
	4. Knowledge	.63	.60	.76	--	
	5. Determine Importance	.59	.63	.85	.75	--
University Scientists Listwise N = 284	1. Honest	--				
	2. Share Values	.60	--			
	3. Predict Effects	.50	.43	--		
	4. Knowledge	.64	.44	.67	--	
	5. Determine Importance	.56	.50	.82	.66	--

Note: All correlations significant at the $p \leq .01$ level (2-tailed).

TABLE 3.6: BIVARIATE CORRELATIONS OF TRUST ATTRIBUTES AND DEMOGRAPHIC VARIABLES WITH TRUST RATINGS

	Food Manufacturers (N = 277)	Environmental Organizations (N = 250)	Farmers (N = 273)	Government Agencies (N = 283)	Grocers & Stores (N = 270)	University Scientists (N = 279)
Honest	.544**	.702**	.537**	.618**	.498**	.597**
Knowledgeable	.370**	.610**	.445**	.422**	.451**	.490**
Predict Effects	.433**	.539**	.456**	.430**	.487**	.356**
Share Values	.456**	.545**	.443**	.530**	.489**	.409**
Determine Importance	.435**	.585**	.446**	.445**	.408**	.447**
Sex (F=0; M=1)	-.068	-.067	.054	.051	-.026	.048
Level of Education	-.144*	.071	-.196**	.009	-.137*	.060
Age Group	-.039	-.192**	.011	-.129*	.019	-.013
Household Income	-.152*	-.020	-.051	.048	-.133*	.102
Attend Church	.076	-.004	.051	.066	.142*	.008

Note: Significance level: * $p \leq 0.05$, ** $p \leq 0.01$.

TABLE 3.7: REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES AND DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Food Manufacturers	Environmental Organizations	Farmers	Government Agencies	Grocers & Stores	University Scientists
Honest	.389***	.528**	.323***	.557***	.264***	.415***
Knowledgeable	.007	.177*	.076	-.035	.087	.177*
Predict Effects	.094	-.035	.077	-.037	.238*	-.160
Share Values	.123	.079	.108	.044	.217**	.049
Determine Importance	-.006	.016	.072	.115	-.159	.218*
Sex (M=1; F=0)	-.003	-.002	.079	.012	.036	.029
Level of Education	-.034	.118*	-.113	-.041	-.082	-.022
Age Group	-.074	-.150**	-.016	-.147**	.054	-.029
Household Income	-.043	-.017	.062	.062	.002	.129*
Attend Church	.029	.030	.045	.019	.083	.049
Total df	276	249	272	282	269	278
F	12.820***	29.256***	13.964***	18.997***	13.978***	18.581***
R^2	.325	.550	.348	.411	.351	.409
Adjusted R^2	.300	.532	.323	.390	.325	.387

Note: Significance level: * $p \leq 0.05$, ** $p \leq 0.01$, ***$p \leq 0.001$.

CHAPTER 4: THE IMPORTANCE OF TRUST ATTRIBUTES

In this chapter, I explore the possibility that people assign differential levels of importance for each trust attribute and for each organization. I do this in relation to the five trust attributes and six social actors I presented in Chapter 3. Additionally, I empirically investigate the relationship between respondents' trust ratings and the respondent-assigned importance of the trust attributes..

As noted in earlier chapters, trust plays a pervasive role in social affairs (Cook 2001) and questions about its nature have once again stimulated sociological interest (e.g., Khodyakov 2007; Sztompka 2006; Tilly 2005). Recent work (e.g., Mizrachi, Drori, and Anspach 2007) emphasizes the ability of social actors to choose and apply strategies of trust. Rather than focusing on the structural, political or cultural constraints, the emphasis is on individuals as active agents applying appropriate trusting strategies depending upon the context. If we believe that people have an available repertoire (Mizrachi, Drori, and Anspach 2007) or tool kit (Swidler 1986) of trusting strategies, the importance of a particular trust attribute, then, depends on the specific context in which it is used and applied.

Scholars do not fully understand how people form trust judgments. This is partly because few studies have explicitly tested alternative hypotheses, partly because determining how to assess trust judgments properly is difficult (Johnson 1999). Despite the conceptual and methodological difficulties, understanding the bases of trust is critical for understanding public perceptions of the risks involved with emerging technologies. Measurements of trust can vary in at least three ways. Scholars generally believe that overall trust is subject to specific situations, the context of the interaction, and the actors involved (Barber 1983; Gambetta 1988; Hardin 2002). It is also possible that various attributes of trust judgments are more or less important depending upon the specific situations, the context of the interaction, and the actors involved.

Attribute Ratings

Attribute ratings are the most common approach that scholars use to study the bases of trust (Johnson 2007). Researchers ask respondents to rate a single organization or expert on a series of trust attributes derived from competing theories of trust. These ratings are factor analyzed, and then trust ratings are regressed on the attributes. The methodological assumption behind this analysis is that people who believe the trust target has positive attributes will rate it as more trustworthy, while those who believe it is low on positive attributes or high on negative ones will express less trust (Johnson 2007). Readers can easily find these analyses in the trust literature. For example, a study of trust in sources of information about food risks found two factors (Frewer, Howard, Hedderley, and Shepherd 1996). The first factor combined aspects of competence and caring, while the authors did not clearly interpret the second factor. A study of trust in the U.S. Department of Energy also describes trust as two-dimensional, though the author labeled these factors as general trustworthiness and competence (Metlay 1999). Most recently, Poortinga and Pidgeon (2003a) found two factors common to the trustworthiness of the British government across five risk issues, including GM food. They combined elements of competence and caring for their first factor, while the second included elements of credibility, reliability and vested interest. Although the labels these studies give their two factors do not precisely correspond with one another, the presence of two factors is consistent.

Importance Ratings

Using importance ratings to explore sources of trust has not often appeared in scholarly literature. To date, Johnson (2007) is the first scholar to focus on the relative importance of particular trust attribute to respondents. This intriguing work focused on the results of a survey conducted in New Jersey in 2003 on local officials' views of wetlands and wetlands management. In turn, Johnson (2007) expanded the work of Frewer and colleagues (1996), where respondents generated their own reasons for trusting various actors that could provide information on food risks. Given the paucity of research in this area, the question remains whether scholars can seriously treat importance ratings as indicators of trust.

My analysis is similar to Johnson's (2007), although I focus on GMF. In this chapter, I investigate the relative degree of importance assigned to trust attributes by survey respondents. I expand the scope by focusing on the perceived importance of trust attributes for the determination of trust regarding genetically modified food in the United States. I expand the sample of respondents by focusing on the general public rather than local officials. By using measures of importance, it becomes possible to appraise the extent to which public judgments of importance match scholarly distinctions.

When scholars ask people to rate social actors on various attributes, there is the assumption that these attributes are relevant to trust judgments, and that statistical analysis will reveal the relationship between criteria and trust. In this chapter, I explore whether these attributes are consciously relevant to trust judgments. Ratings of importance are a reflection of an individual's agency in a particular context. People direct attention or select salient factors by assigning importance to a particular trust attribute. By testing how importance varies, I explore a potential indicator of individual agency.

Further, this analysis is unique in that I have included measures of trust attributes as well as ratings of the relative importance of those. As the first study to examine trust under these conditions, my results will not be definitive, but will provide initial insights and perhaps a partial model for future research. This novel method allows me to make comparisons between “conventional” methodology and Johnson’s (2007) innovative approach.

This work is important for conceptual and methodological reasons. Conceptually, importance has a lower cognitive burden compared to measuring trust attributes. Measures of trust attributes presuppose that the respondent has a degree of familiarity with the phenomenon under study. Measures of importance have a lower cognitive threshold, only requiring that the respondent could imagine which attributes would be more or less important when trying to understand the phenomenon. In the abstract, this removes familiarity with the social actors and phenomenon from the equation.

Methodologically, scholars are not sure if their expert interpretations of trust are the same interpretations that the public intends when answering questionnaires. This is an unknown because surveys present trust attributes to respondents as if they each represent an equal portion of trust. Though not necessarily explicit, researchers assign equal weight to each attribute when determining a respondent’s trust judgment. If these attributes are equally salient, however, scholars potentially face contradictory measures. For example, if an institution had publicly admitted mistakes, this would likely lead to lower competence ratings. This same admission, however, would likely lead to higher honesty ratings. Given that competence and honesty are both considered attributes of trust, this presents a quandary. Alternatives are not readily available to researchers, however, because they cannot be sure what weight respondents would assign to each attribute. Furthermore, if people use different criteria in different circumstances, the attributes of trust are not equal and not interchangeable.

Examining respondents' ratings of importance lets scholars empirically examine Wynne's (1992, p. 299) assertion that trust represents "underlying tacit processes of social identity negotiation, involving senses of involuntary dependency on some groups, and provisional or conditional identification with others in an endemically fluid and incomplete historical process." The examination of this unacknowledged assumption about public trust perceptions emphasizes the conditions under which trust attributes are important. In other words, given that I hold the context and situation constant, I can test the implicit null hypothesis that trust attributes are equally important, regardless of the organizational actor. If trust judgments are heuristic, as Earle and Cvetkovich (1995) believe, importance ratings would have no patterned relationship with trust ratings. If, however, there is a pattern of importance ratings, these patterns may stem from social desirability (Johnson 1999; 2007).

I inspect respondents' ratings of importance in relation to several attributes that experts generally agree constitute trust. Specifically, I test my assertion that which attributes are most important depends on the organizational actor. This is plausible, if, *ceteris paribus*, the public relies on social actors for a specific attribute of trust. Insofar as an individual's repertoire or tool kit of available trust strategies differ, then an individual's selection of relative importance for each social actor will also differ.

My exploration occurs in several stages. First, I report which of five trust attributes the public considers most important when deciding who to trust regarding

GMF. Second, I explore how importance varies by actor. Third, by treating trust as the dependent variable, I begin to explore the conditions under which importance can explain trust judgments.

Methods

I completely describe my methods and measures in Chapter 3. I also have reproduced one full questionnaire in Appendix B. As in Chapter 3, I measured respondents' trust in six actors–environmental organizations, farmers, food manufacturers, government agencies, grocers and grocery stores, and university scientists. Responses ranged from 1 (no trust) to 7 (complete trust) when asked, "How much do you trust the following groups to make appropriate decisions about genetically modified food?" Respondents, again, rated all the actors on each of five trust-related attributes–honesty, shared values, ability to predict effects, knowledge, and ability to determine importance. Responses ranged from 1 (not at all) to 7 (completely) when asked, "When thinking about genetically modified food, how would you rate [environmental organizations] on each of these items?"

Importance

New to this chapter, respondents explicitly rated the importance of each of the six attributes concerning GMF on a scale ranging from 1 (not at all) to 7 (completely important). Specifically, the survey instructions asked respondents to answer the following question. "When thinking about genetically modified food, how important is each of the following items when deciding how much you trust [environmental organizations]?"

1. [Honest] How honest they are

2. [Unselfish] How much they pursue their own interests versus the public interest

3. [Share Values] How much they share my values

4. [Predict Effects] How well they can predict potential effects

5. [Knowledge] How knowledgeable they are

6. [Determine Importance] How well they can tell which potential effects are important

After responding to this block of questions, the survey instructions asked respondents to answer the same questions about another group. The survey repeated this sequence until respondents had rated each of the six groups on each of these six measures of importance. Consistent with my decision regarding the attribute measure of unselfishness, I decided to remove the importance measure of unselfishness from my analyses and do not report on it.

Results

I pursued two discrete objectives in this chapter. First, I investigated possible differential level of importance assigned to trust attributes by survey respondents. Second, I examined the relationship between respondents' trust ratings and the respondent-assigned importance of the trust attributes.

Perceptions of Trust in Organizations

To put these results in context, recall Table 3.2, where I computed mean scores and standard deviations for the explicit trust measure. Although respondents trusted some more than others, ratings for all actors were within a moderately narrow range. Respondents rated university scientists, farmers, and environmental organizations as somewhat trusted; they rated government agencies, grocers and grocery stores, and food manufacturers as somewhat untrustworthy regarding genetically modified foods.

[TABLE 4.1 HERE]

Spearman's rank correlations (Table 4.1) show that respondents generally agreed on relative rankings of trust in these actors, with all correlations significant at $p \leq 0.01$ except for food manufacturers and environmental organizations ($r = .13$, $p \leq 0.05$).

Perceptions of Trust Attributes and Importance

My first objective is to investigate possible differential level of importance assigned to trust attributes by survey respondents. To put these results in context, recall Table 3.3, where I calculated the mean, standard deviation, and ranking of the five attributes for each organizational actor. Respondents rated university scientists, farmers, and environmental organizations relatively high on measures of shared values, predicting effects, and determining importance; they rated government agencies, grocers and grocery stores, and food manufacturers as relatively low on these attributes. Respondents perceived university scientists, farmers, and environmental organizations, and grocers and grocery stores as honest; they thought every actor except grocers and grocery stores were knowledgeable. In sum, public perceptions of trust attributes varied in minor ways for each actor. Two major patterns emerged. First, respondents rated university scientists, farmers and environmental organizations as trustworthy according to all measures. Second, respondents rated government agencies, grocers and grocery stores as well as food manufacturers as untrustworthy on four of five measures.

It became apparent in Table 3.3 that the rank order of trust attributes depends on the social actor. For some (e.g., environmental organizations), knowledge is most highly rated and sharing values is the lowest. For others (e.g., farmers), honesty is the highest rated and the ability to predict effects is lowest. Yet, Spearman's rank correlations (Table 4.2) show that respondents agreed on relative rankings of trust attributes for each actor, with all correlations significant at $p \leq 0.01$.

[TABLE 4.2 ABOUT HERE]

My second step was to compute the mean, standard deviation, and ranking of importance (Table 4.3) for each organizational actor. Respondents rated each organization on a seven-point scale, ranging from 1 (no trust) to 7 (complete trust); a rating of 4 represents a neutral score. I applied the rank (1 to 6) to indicate the relative ranking of mean attribute scores for each actor.

[TABLE 4.3 ABOUT HERE]

The general hierarchy of mean values for the five importance ratings for each organizational actor is not entirely consistent with the attribute ratings from Table 3.3. In comparison, the ranks for importance are relatively stable. Honesty and knowledge are consistently top-rated across actors. Respondents always assign the lowest mean importance to sharing values. In fact, for each actor, the order of importance is topped by honesty or knowledge, then followed by the ability to determine importance, the ability to predict effects and, lastly, sharing values.

For comparison, I again distinguish between those that rise above and those that fall below neutral (4.0) for each measure of importance. In contrast to Table 3.3, where some actors rated above or below a neutral rating for some attributes, all ratings of importance for all actors were above neutral. The mean scores ranged from a value of 6.38 for rating the importance of university scientist's knowledge, to a low value of 4.64

for the importance of sharing values with grocers and grocery stores. Across actors, respondents consistently rated honesty or knowledge the most important, followed by the ability to determine importance, the ability to predict future effects, lastly, sharing values with the respondents. Spearman's rank correlations (Table 4.4) show that respondents agreed on relative rankings of importance for each actor, with all correlations significant at $p \leq 0.01$.

[TABLE 4.4 ABOUT HERE]

In sum, public perceptions of importance vary for these social actors in minor ways. Respondents rated all of the trust attributes as relatively important. These ratings of importance were consistent across the six social actors.

Using Importance to Determine of Trust in Organizations

Principal axis factoring for each social actor helps me classify the measures of importance. Table 4.5 illustrates that four of the five measures of importance—honest, predict effects, knowledge, and determine importance—generally load onto a single factor, suggesting that these items measure a single concept.

[TABLE 4.5 ABOUT HERE]

The results were consistent for each organization. The variance explained by importance ranges from a low of 63.4 percent for farmers to a high of 72.6 percent for government agencies. To provide a measure of internal reliability, I computed the Cronbach's alpha for each social actor, with and without shared values measures. When I included all five measures of importance, standardized alpha scores ranged from a low of .84 for farmers to a high of .89 for government agencies as well as grocers and grocery stores. When I removed shared values from the calculations, standardized alpha scores were slightly higher, ranging from a low of .87 for farmers to a high of .94 for university scientists. The high internal reliability (with four or five items) and the substantial explained variance for each social actor support the use of an overall importance measure. Although Table 4.5 shows impressive alphas even with shared values included, the substantially lower loadings for it in most of the factoring results suggest something is going on with shared values that is not quite the same as everything else.

Because of this result, I decided to force a two-factor solution to see if I could make the shared values results clearer. Moreover, recall that previous factor analytic studies of trust attributes found two factor solutions.

[TABLE 4.6 HERE]

As such, I would also anticipate finding that a two-factor solution best fits the importance data. However, as noted in Table 4.6, specifying a two-factor model did not explain more variance or make interpretations easier. As such, the single-factor (4 item) models seems to best fit the data.

My second objective was to examine the relationship between respondents' trust ratings and the respondent-assigned importance of the trust attributes. I regressed trust ratings on four classes of independent variables: demographic variables, importance ratings, attribute ratings, and the interaction effects of importance and attribute ratings. For each social actor, a first regression analysis (Table 4.7) included only demographic variables. A second regression analysis (Table 4.8) included only importance ratings. A third regression analysis (Table 4.9) included only attribute ratings. A fourth regression analysis (Table 4.10) included on interaction effects.

[TABLE 4.7 HERE]

[TABLE 4.8 HERE]

[TABLE 4.9 HERE]

[TABLE 4.10 HERE]

As noted in Table 4.7 and 4.8, the first two models are poor predictors of trust. At best, the model accounts for less than 8 percent of the variance in trust judgments for university scientists; at worst, the model was not a significant predictor of the variance in trust judgments. Given the low predictive ability, discussions of which particular variables contributed most are almost meaningless. Importance measures do not adequately predict trust. As noted in Table 4.9, attributes are fair predictors of trust, accounting for half of the variance in trust judgments in environmental organizations at best and 30 percent of the variance in trust judgments in food manufacturers at worst. Attribute ratings are better predictors of trust than interaction effects. As noted in Table 4.10, interaction effects accounted for less than half (44 percent) of the variance is trust judgments in environmental organizations at best and less than one-quarter (22 percent) of the variance in trust judgments in farmers at worst.

It remains possible that the measures of importance, in combination with demographic variables, would combine to produce a robust predictor of trust. I present those results in Table 4.11. Although a slight improvement over the results in Table 4.7 and Table 4.8, the model is still not a significant predictor of the variance in trust judgments for government agencies and, at best, the model accounts for less than 8 percent of the variance in trust judgments for environmental organizations.

[TABLE 4.11 HERE]

Alternatively, perhaps the combination of demographics and interaction effects would combine to produce a robust predictor of trust. I present those results in Table 4.12. This model is a slight improvement over the results in Table 4.10. The addition of demographic variables increased the prediction by less than 3 percent for environmental organizations and by less than 2 percent for farmers.

In Table 4.13, I regressed trust ratings on the three main classes of independent variables. For each social actor, the regression model included demographic variables, attribute ratings and importance ratings.

[TABLE 4.13 HERE]

The overall predictive ability is similar to that noted in Table 4.9. Although a slight improvement over the results for attributes alone, the same general description applies. The full model accounts for a bit more than one-half (51.6 percent) of the variance in trust judgments in environmental organizations at best and a bit less than one-third (31.3 percent) of the variance in trust judgments in food manufacturers at worst.

In Table 4.14, I regressed trust ratings on all four classes of independent variables. For each social actor a complete regression analysis included demographic variables, attribute ratings, importance ratings, and the interaction effects of attribute and importance ratings.

[TABLE 4.14 HERE]

The overall predictive ability is similar to that noted in Table 4.13. Although a slight improvement over the results for the main classes of independent variables, the same general description applies when interaction effects are included. The full model accounts for a bit more than one-half (53.5 percent) of the variance in trust judgments in environmental organizations at best and a bit less than one-third (32.2 percent) of the variance in trust judgments in farmers at worst.

To see if some subset of demographic variables, attribute ratings, and importance ratings was a significant predictor I performed a forward stepwise regression (Table 4.15) on the main effects model. Similar to the model in Table 4.13, this stepwise accounts for a bit more than one-half (53.4 percent) of the variance in trust judgments in environmental organizations at best and a bit less than one-third (31.0 percent) of the variance in trust judgments in food manufacturers at worst. This model was more parsimonious, however, with a maximum of four variables.

[TABLE 4.15 HERE]

All importance ratings were consistently excluded for all social actors. Attribute ratings were significant predictors of trust. Honesty was consistently included as the most significant variable in all models. Sharing values and predicting effects were significant for half of the actors. Knowledge was only significant for environmental organizations and determining importance was only significant for university scientists. Demographic variables were of mixed significance. Sex and religiosity were consistently excluded for all social actors. Age group had a significant, negative impact for environmental organizations and government agencies. Education had a minor impact on trust for environmental organizations and household income had a minor impact on trust for university scientists.

Finally, to see if some subset of the fully saturated model, including demographic variables, attribute ratings, importance ratings, and interaction effects, was a significant predictor I performed a forward stepwise regression (Table 4.16). Identical to the model in Table 4.15, this stepwise accounts for a bit more than one-half (53.4 percent) of the variance in trust judgments in environmental organizations at best and a bit less than one-third (31.0 percent) of the variance in trust judgments in food manufacturers at worst.

[TABLE 4.16 HERE]

In fact, Table 4.15 and Table 4.16 are identical for 5 of the 6 social actors. Attribute ratings were significant predictors of trust, demographic variables were of mixed significance, and importance ratings were never significant predictors of trust. The only noted difference between Table 4.15 and Table 4.16 is in the model that describes trust judgments in grocers and grocery stores. When including interaction effects, the ability to predict the effects of GMF was no longer a significant predictor of trust judgments. Instead, the interaction effects for sharing values and determining importance were included in the model. This change, however, only resulted in a 0.7 percent increase in the predictive ability of the model. Given this meager result, I can only conclude that interaction effects do not effect trust judgments in any meaningful way.

Discussion & Conclusions

In this chapter, I investigated the relative degree of importance assigned to trust attributes by survey respondents. My exploration took several steps to addressing gaps in our knowledge. First, I reported which of five trust attributes the public considers most important when deciding who to trust regarding GMF. Respondents rated honesty and knowledge the most important. They rated an actor's ability to determine the importance of potential effects of GMF as moderately important. The ability to predict future effects and sharing values with the respondents were rated the least important. The valuations are relative; respondents rated each of these variables above neutral importance. Second, I explored how importance varies by actor. While public perceptions of importance vary for each organizational actor, the valuations were largely consistent. Third, by treating trust as the dependent variable, I tested whether measures of importance could explain trust judgments. The results were clear; importance measures do not adequately predict trust.

The data do not support my assertion that the order of the importance for trust attributes is dependent upon the organizational actor. I expected that ratings of importance would vary across actors. However, I found a general trend for considering honesty or knowledge to be most important, followed (in order) by the ability to determine importance, the ability to predict effects, and sharing values. Overall, there was less variation in the ratings of importance than in the actual attribute ratings for each of the actors. Moreover, importance was a weak predictor of trust judgments.

I find no easy and conclusive explanation for these results but I distinguish between two plausible, though not definitive, explanations. First, as I noted earlier, there may be shared cultural repertoires (Mizrachi, Drori, and Anspach 2007) or took kits (Swidler 1986) for determining the attributes that are important for forming trust judgments. I hypothesized that an individual's selection of relative importance for each social actor would vary insofar as an individuals' available repertoire or tool kit of trust strategies differed. Given the limited variation in importance ratings, it is possible that evaluative associations by the media, the public, and social and cultural institutions have shaped prevailing knowledge, norms, values and generalized interpretation schemes.

Second, and possibly in combination with the first explanation, there may be a social desirability aspect to requests for importance judgments (Johnson 2007). If we believe, as Earle and Cvetkovich (1995) claim, that trust is primarily based upon a sense of shared values, then respondents may imply that any attribute scholars ask about must be somewhat important. Respondents could justify their trust in an actor because of competence, because other reasonable people would use competence as a criterion. As such, my explicit request for importance ratings might privilege (and reveal) normatively legitimate criteria rather than helping scholars understand sources of trust. The factor analysis and reliability testing provide some support for that theory. Respondents, however, paradoxically report that sharing values is relatively unimportant when making trust judgments. Whether this is true or not, future research might productively include measures of social-desirability bias or use other techniques that reduce or eliminate desirability effects.

Given the exploratory nature of my measures, I have clearly not exhausted the explanatory potential of importance ratings. Though my results generally did not support the continued use of measures of importance, many important theoretical and empirical questions remain. The still sparse research into this suggests that there might be a wide divergence on how to evaluate trust across actors and risks. By continuing to account for the possibility that importance matters, scholars may be able to reach a more definitive conclusion. Future analysis of importance using respondent-derived criteria, across a broad range of hazards, across a broader range of actors, and using a more varied pool of respondents, may help give a more complete explanation of why people trust some actors and do not trust others.

My analysis in this chapter considered the ability of demographic variable, as well as ratings of trust attributes and their importance to trust judges, to predict perceptions of trust. The results highlight concerns that, by themselves, measures of importance cannot explain public perceptions of trust. Moreover, in combination with measures of trust attributes, measures of importance cannot explain trust parsimoniously. Instead, a more conventional methodology was better able to predict trust. If individuals are expressing agency, then it is not readily apparent. In the next and final chapter, I direct attention to the relationships between the social actors and organizational structures that lets those who have control over the development of GMF promote the technology while deepening the public's dependence on the trustworthiness of experts. This spiral of trust further reifies the existing power relationships between technological expertise and the public.

TABLE 4.1: SPEARMAN'S RANK CORRELATIONS OF EXPLICIT TRUST RATINGS

	1	2	3	4	5
1. University scientists	--				
2. Farmers	.30	--			
3. Environmental organizations	.34	.17	--		
4. Government agencies	.42	.19	.19	--	
5. Grocers & grocery stores	.19	.49	.17	.34	--
6. Food manufacturers	.28	.50	.13[@]	.48	.59

Note: n = 344; All correlations significant at the $p \leq .01$ level (2-tailed), except [@] correlations significant at the $p \leq .05$ level (2-tailed).

TABLE 4.2: SPEARMAN'S RANK CORRELATIONS OF ATTRIBUTES BY ACTOR

		1	2	3	4	5
Environmental Organizations Listwise N = 255	1. Honest	--				
	2. Share Values	.67	--			
	3. Predict Effects	.74	.60	--		
	4. Knowledge	.73	.61	.74	--	
	5. Determine Importance	.80	.65	.85	.75	--
Farmers Listwise N = 279	1. Honest	--				
	2. Share Values	.60	--			
	3. Predict Effects	.59	.57	--		
	4. Knowledge	.62	.53	.68	--	
	5. Determine Importance	.57	.59	.83	.64	--
Food Manufacturers Listwise N = 285	1. Honest	--				
	2. Share Values	.67	--			
	3. Predict Effects	.62	.61	--		
	4. Knowledge	.53	.49	.77	--	
	5. Determine Importance	.66	.63	.84	.72	--
Government Agencies Listwise N = 287	1. Honest	--				
	2. Share Values	.77	--			
	3. Predict Effects	.61	.63	--		
	4. Knowledge	.62	.62	.81	--	
	5. Determine Importance	.62	.64	.87	.76	--
Grocers & Grocery Stores Listwise N = 279	1. Honest	--				
	2. Share Values	.57	--			
	3. Predict Effects	.58	.64	--		
	4. Knowledge	.59	.57	.74	--	
	5. Determine Importance	.58	.62	.84	.72	--
University Scientists Listwise N = 284	1. Honest	--				
	2. Share Values	.59	--			
	3. Predict Effects	.53	.40	--		
	4. Knowledge	.64	.42	.65	--	
	5. Determine Importance	.58	.47	.81	.66	--

Note: All correlations significant at the $p \leq .01$ level (2-tailed).

TABLE 4.3: MEANS, STANDARD DEVIATIONS, AND RANKINGS OF IMPORTANCE BY ACTOR

	Environmental Organizations N = 352			Farmers N = 349			Food Manufacturers N = 352			Government Agencies N = 352			Grocers and Stores N = 349			University Scientists N = 352		
	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank	Mean	SD	Rank
Honest	6.03	1.44	2	6.13	1.31	1	6.24	1.34	1	6.24	1.42	1	6.01	1.47	1	6.32	1.30	2
Share Values	4.81	1.92	5	4.91	1.93	5	4.87	1.99	5	5.12	1.98	5	4.64	1.99	5	4.91	1.97	5
Predict Effects	5.70	1.51	4	5.49	1.69	4	5.79	1.58	4	5.95	1.54	4	5.15	1.83	4	6.19	1.31	4
Knowledge	6.08	1.32	1	5.85	1.41	2	6.03	1.38	2	6.13	1.40	2	5.58	1.64	2	6.38	1.41	1
Determine Importance	5.76	1.53	3	5.56	1.72	3	5.85	1.51	3	6.06	1.48	3	5.31	1.84	3	6.24	1.29	3

TABLE 4.4: SPEARMAN'S RANK CORRELATIONS OF IMPORTANCE BY ACTOR

		1	2	3	4	5
Environmental Organizations Listwise N = 352	1. Honest	--				
	2. Share Values	.34	--			
	3. Predict Effects	.62	.43	--		
	4. Knowledge	.69	.33	.70	--	
	5. Determine Importance	.61	.46	.78	.70	--
Farmers Listwise N = 349	1. Honest	--				
	2. Share Values	.35	--			
	3. Predict Effects	.59	.51	--		
	4. Knowledge	.61	.41	.78	--	
	5. Determine Importance	.53	.48	.80	.70	--
Food Manufacturers Listwise N = 352	1. Honest	--				
	2. Share Values	.41	--			
	3. Predict Effects	.63	.52	--		
	4. Knowledge	.64	.47	.78	--	
	5. Determine Importance	.63	.55	.84	.77	--
Government Agencies Listwise N = 352	1. Honest	--				
	2. Share Values	.45	--			
	3. Predict Effects	.69	.50	--		
	4. Knowledge	.75	.46	.82	--	
	5. Determine Importance	.67	.49	.87	.77	--
Grocers & Grocery Stores Listwise N = 349	1. Honest	--				
	2. Share Values	.41	--			
	3. Predict Effects	.53	.58	--		
	4. Knowledge	.66	.51	.79	--	
	5. Determine Importance	.54	.57	.87	.76	--
University Scientists Listwise N = 352	1. Honest	--				
	2. Share Values	.37	--			
	3. Predict Effects	.70	.35	--		
	4. Knowledge	.76	.35	.80	--	
	5. Determine Importance	.66	.39	.85	.75	--

Note: All correlations significant at the $p \leq .01$ level (2-tailed).

TABLE 4.5: PRINCIPAL AXIS FACTORING OF TRUST ATTRIBUTES BY ACTOR

	Environmental Organizations N=352	Farmers N=349	Food Manufacturers N=352	Government Agencies N=352	Grocers and Stores N=349	University Scientists N=352
Honest	**.551**	.348	**.459**	**.633**	**.481**	**.682**
Share Values	.178	.218	.285	.253	.353	.162
Predict Effects	**.668**	**.727**	**.728**	**.819**	**.787**	**.777**
Knowledge	**.647**	**.623**	**.615**	**.741**	**.704**	**.802**
Determine Importance	**.695**	**.626**	**.706**	**.782**	**.772**	**.752**
Explained Variance	65.4	63.4	68.2	72.6	70.1	71.4
Cronbach's alpha						
All variables	.842	.840	.866	.885	.887	.856
Without Share Values	.892	.869	.898	.931	.900	.937

Note: Extraction method: Principal axis factoring. Only one factor was extracted for each actor; solutions cannot be rotated.

TABLE 4.6: PRINCIPAL AXIS FACTORING OF IMPORTANCE BY ACTOR–2 FORCED FACTORS

	Environmental Organizations N=352		Farmers N=349		Food Manufacturers N=352		Government Agencies N=352		Grocers and Stores N=349		University Scientists N=352	
	1	2	1	2	1	2	1	2	1	2	1	2
Honest	**.428**	**.638**	.297	**.632**	**.469**	**.528**	**.415**	**.770**	.310	**.783**	**.425**	**.853**
Share Values	**.411**	.169	**.558**	**.630**	**.491**	.275	.387	.336	**.514**	.314	.278	.279
Predict Effects	**.744**	**.462**	**.781**	**.486**	**.664**	**.595**	**.793**	**.508**	**.879**	.352	**.755**	**.505**
Knowledge	.377	**.866**	.390	.285	**.421**	**.788**	**.547**	**.714**	**.608**	**.628**	**.687**	**.604**
Determine Importance	**.763**	**.476**	**.789**	**.350**	**.792**	**.475**	**.821**	**.447**	**.842**	.375	**.847**	.398
Explained Variance	32.6	32.5	35.7	24.7	34.1	31.1	38.5	33.5	44.2	27.4	40.4	31.6

Note: Extraction method: Principal axis factoring; Rotation method: Varimax with Kaiser normalization. 2 factor model specified for each actor; rotations all converged in 3 iterations.

TABLE 4.7: REGRESSION MODELS OF TRUST RATINGS ON DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Demographics						
Sex (F=0; M=1)	-.077	.054	-.052	.061	.008	.050
Level of Education	.128*	-.214***	-.110	-.049	-.107	.055
Age Group	-.079	-.001	-.038	-.069	.032	-.008
Household Income	-.074	-.003	-.048	.031	-.105	.058
Attend Church	-.078	.063	.098	.094	.085	-.065
Total df	353	353	350	354	349	353
F	2.407*	3.697**	2.206	1.234	2.680*	1.111
R^2	.033	.050	.031	.017	.037	.016
Adjusted R^2	.020	.037	.017	.003	.023	.002

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001.

TABLE 4.8: REGRESSION MODELS OF TRUST RATINGS ON IMPORTANCE (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Importance						
Honest	.251**	.046	-.099	.019	-.049	.088
Share Values	.080	.199***	.111	-.058	.131*	-.211***
Predict Effects	.094	-.210*	-.006	.090	.043	-.017
Knowledge	-.071	.173*	.182*	-.115	.023	.150
Determine Importance	-.053	.024	-.001	.112	.033	.110
Total df	345	342	342	346	339	345
F	5.337***	4.100***	2.799*	1.019	2.151	6.683***
R^2	.073	.057	.040	.015	.031	.089
Adjusted R^2	.059	.043	.026	.000	.017	.076

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001.

TABLE 4.9: REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Attribute						
Honest	.538***	.319***	.396***	.507***	.258***	.429***
Share Values	.082	.104	.123	.094	.219**	.041
Predict Effects	-.027	.093	.099	-.003	.249*	-.170
Knowledge	.207**	.086	.009	-.014	.082	.166*
Determine Importance	-.030	.067	-.005	.076	-.142	.215*
Total df	250	273	277	283	270	279
F	52.335***	25.971***	25.127***	35.564***	26.787***	35.078***
R^2	.516	.326	.316	.390	.336	.390
Adjusted R^2	.507	.314	.303	.379	.323	.379

Note: $*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$.

TABLE 4.10: REGRESSION MODELS OF TRUST RATINGS ON THE INTERACTION EFFECTS OF ATTRIBUTES AND IMPORTANCE (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Interaction Effects						
Honest	.539***	.270***	.369***	.568***	.290***	.417***
Share Values	.127*	.154*	.153*	-.004	.216**	-.036
Predict Effects	-.049	.001	.041	.086	.317*	-.210*
Knowledge	.181*	.073	.084	-.116	-.050	.168*
Determine Importance	-.080	.079	-.048	.071	-.163	.256**
Total df	246	267	272	276	265	271
F	39.104***	16.364***	32.219***	29.791***	22.182***	26.773***
R^2	.448	.238	.285	.355	.299	.335
Adjusted R^2	.436	.223	.272	.343	.286	.322

Note: *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

TABLE 4.11: REGRESSION MODELS OF THE EFFECT OF IMPORTANCE AND DEMOGRAPHIC VARIABLES ON TRUST RATINGS (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Importance						
Honest	.242**	.062	-.094	.009	-.052	.078
Share Values	.111	.163**	.088	-.067	.102	-.199***
Predict Effects	.085	-.177	-.018	.092	.061	-.014
Knowledge	-.080	.155	.190*	-.087	.037	.151
Determine importance	-.054	.011	.008	.103	.029	.109
Demographics						
Sex (F=0; M=1)	-.038	.068	-.038	.067	.028	.042
Level of Education	.123*	-.197***	-.077	-.056	-.004	.001
Age Group	-.092	-.020	-.076	-.062	.018	.000
Household Income	-.091	.002	-.050	.035	-.120*	.040
Attend Church	-.075	.054	.092	.094	.081	-.027
Total df	344	341	341	346	338	344
F	3.893***	3.752***	2.331*	1.124	2.124*	3.447***
R^2	.104	.102	.066	.032	.061	.094
Adjusted R^2	.078	.075	.038	.004	.032	.066

Note: *$p \leq 0.05$; **$p \leq 0.01$; ***$p \leq 0.001$.

TABLE 4.12: REGRESSION MODELS OF THE EFFECT OF INTERACTION EFFECTS AND DEMOGRAPHIC VARIABLES ON TRUST RATINGS (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Interaction Effects						
Honest	.515***	.272***	.363***	.586***	.281***	.399***
Share Values	.142*	.157*	.156*	-.025	.196**	-.024
Predict Effects	-.077	-.020	.040	.050	.325*	-.209*
Knowledge	.152	.074	.077	-.124	-.039	.177*
Determine importance	-.007	.080	-.049	.100	-.170	.264**
Demographics						
Sex (F=0; M=1)	.006	.090	.005	.033	.042	.034
Level of Education	.132*	-.125*	.000	-.037	-.035	-.016
Age Group	-.162***	-.016	-.072	-.140**	.056	-.022
Household Income	-.042	.043	-.069	.054	-.039	.103
Attend Church	.031	.049	.040	.027	.090	.020
Total df	245	266	271	275	264	270
F	22.319***	9.312***	10.985***	15.956***	11.621***	13.798***
R^2	.487	.267	.296	.376	.314	.347
Adjusted R^2	.465	.238	.269	.352	.287	.322

Note: $*p \leq 0.05$; $**p \leq 0.01$; $***p \leq 0.001$.

TABLE 4.13: BLOCK ENTRY REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES, IMPORTANCE, AND DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Attribute						
Honest	.541***	.336***	.396***	.560***	.288***	.393***
Share Values	.069	.117	.111	.062	.214**	.119
Predict Effects	-.043	.068	.033	-.011	.265*	-.135
Knowledge	.170*	.108	-.023	-.053	.095	.163*
Determine Importance	.013	.040	.033	.088	-.218*	.188*
Importance						
Honest	.021	-.059	-.082	.032	-.008	-.093
Share Values	.013	.059	.050	-.063	.012	-.102
Predict Effects	.016	-.129	-.029	.042	.168	.046
Knowledge	-.024	.030	.218*	-.073	-.097	.075
Determine Importance	-.003	.035	-.105	.042	-.054	.022
Demographics						
Sex (F=0; M=1)	-.001	.058	.006	.009	.042	.033
Level of Education	.114*	-.134*	.009	-.036	-.059	-.025
Age Group	-.153***	-.023	-.112*	-.147**	.045	-.025
Household Income	-.021	.091	-.052	.062	-.008	.121*
Attend Church	.028	.029	.016	.014	.075	.052
Total df	245	266	271	275	264	270
F	18.423***	9.577***	9.249***	12.942***	9.618***	13.908***
R^2	.546	.364	.351	.427	.367	.450
Adjusted R^2	.516	.326	.313	.394	.329	.418

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001.

TABLE 4.14: BLOCK ENTRY REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES, IMPORTANCE, INTERACTION EFFECTS, AND DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Attribute						
Honest	.835**	.107	.085	.433	.076	.699**
Share Values	-.173	.054	.431*	.376	.090	.295*
Predict Effects	.295	.110	.009	-.548	.235	.472
Knowledge	-.470	.202	-.336	.175	.445	-.443
Determine Importance	.521	.391	-.176	.330	-.126	.060
Importance						
Honest	.199	-.208	-.176	-.012	-.143	.088
Share Values	-.136	-.001	.176	.093	-.074	.076
Predict Effects	.202	-.125	-.041	-.224	.139	.433
Knowledge	-.475*	.113	.038	-.047	.134	-.426
Determine Importance	.261	.217	.148	.177	-.007	-.063
Interaction Effects						
Honest	-.317	.321	.365	.141	.285	-.336
Share Values	.327	.111	-.393	-.395	.194	-.289
Predict Effects	-.460	-.039	.096	.661	.037	-.799
Knowledge	.853*	-.131	.396	-.244	-.483	.886*
Determine Importance	-.717*	-.476	-.818*	-.319	-.121	.151

TABLE 4.14: CONTINUED

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Demographics						
Sex (F=0; M=1)	-.016	.057	-.004	.010	.041	.032
Level of Education	.106*	-.134*	.001	-.040	-.048	-.036
Age Group	-.151***	-.031	-.105*	-.131**	.038	-.008
Household Income	-.017	.098	-.055	.069	-.011	.131*
Attend Church	.024	.027	-.003	.011	.073	.032
Total df	245	266	271	275	264	270
F	15.096***	7.310***	7.504***	9.912***	7.325***	11.244***
R^2	.573	.373	.374	.437	.375	.474
Adjusted R^2	.535	.322	.324	.393	.324	.431

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001.

TABLE 4.15: STEPWISE REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES, IMPORTANCE, AND DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Attribute						
Honest	.567***	.358***	.435***	.629***	.286***	.507***
Share Values	--	.146*	.161*	--	.211**	--
Predict Effects	--	.149*	--	--	.177*	--
Knowledge	.180**	--	--	--	--	--
Determine Importance	--	--	--	--	--	.199***
Importance						
Honest	--	--	--	--	--	--
Share Values	--	--	--	--	--	--
Predict Effects	--	--	--	--	--	--
Knowledge	--	--	--	--	--	--
Determine Importance	--	--	--	--	--	--
Demographics						
Sex (F=0; M=1)	--	--	--	--	--	--
Level of Education	.108*	--	--	--	--	--
Age Group	-.151***	--	--	-.153***	--	--
Household Income	--	--	--	--	--	.118*
Attend Church	--	--	--	--	--	--
Total df	245	266	271	275	264	270
F	71.009***	42.699***	61.962*	96.607***	44.181***	64.163***
R^2	.541	.328	.315	.414	.337	.419
Adjusted R^2	.534	.320	.310	.410	.329	.412

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001; Forward Stepwise regression of all variables (Criteria: Probability of F to enter <=.050, Probability of F to remove >=.100); Excluded variables noted with --.

TABLE 4.16: STEPWISE REGRESSION MODELS OF TRUST RATINGS ON TRUST ATTRIBUTES, IMPORTANCE, INTERACTION EFFECTS, AND DEMOGRAPHIC VARIABLES (STANDARDIZED COEFFICIENTS)

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Attribute						
Honest	.567***	.358***	.453***	.629***	.322***	.507***
Share Values	--	.146*	.161*	--	--	--
Predict Effects	--	.149*	--	--	.299**	--
Knowledge	.180**	--	--	--	--	--
Determine Importance	--	--	--	--	--	.199***
Importance						
Honest	--	--	--	--	--	--
Share Values	--	--	--	--	--	--
Predict Effects	--	--	--	--	--	--
Knowledge	--	--	--	--	--	--
Determine Importance	--	--	--	--	--	--
Interaction Effects						
Honest	--	--	--	--		--
Share Values	--	--	--	--	.229***	--
Predict Effects	--	--	--	--	--	--
Knowledge	--	--	--	--	--	--
Determine Importance	--	--	--	--	-.182*	--

TABLE 4.16: CONTINUED

	Environmental Organizations	Farmers	Food Manufacturers	Government Agencies	Grocers and Stores	University Scientists
Demographics						
Sex (F=0; M=1)	--	--	--	--	--	--
Level of Education	.108*	--	--		--	--
Age Group	-.151***	--	--	-.153***	--	--
Household Income	--	--	--	--	--	.118*
Attend Church	--	--	--	--	--	--
Total df	245	266	271	275	264	270
F	71.109***	42.699***	61.962***	96.607***	34.434***	64.163***
R^2	.541	.328	.315	.414	.346	.419
Adjusted R^2	.534	.320	.310	.410	.336	.412

Note: *p ≤ 0.05; **p ≤ 0.01; ***p ≤ 0.001; Forward Stepwise regression of all variables (Criteria: Probability of F to enter <=.050, Probability of F to remove >=.100); Excluded variables noted with --.

CHAPTER 5: INSTITUTIONAL & ORGANIZATIONAL ECOLOGY OF TRUST

In previous chapters, I explored which organizations and experts the public trusts regarding GMF, connected those trust judgments to varying trust attributes, and established determinants of trust for each organizational actor. Those results, however, lead to as many questions as answers. The individual level exploration of public perceptions of trust falls short in several respects. I address some of these shortcomings by examining public uncertainty about GMF in the context of institutional competition for public trust.

Rather than judging trust interpersonally, people can judge the trustworthiness of organizational actors and organizational actions. Experts analyze the risks of products like GMF. Organizations employ and embed expert knowledge in their actions and routines. As such, experts and organizations are the driving force behind public uncertainty and dissent. Without trust in these actors, the uncertainty and vulnerability of social interactions become paramount (Heimer 2001). Sociologists have repeatedly recognized this problem (e.g., Simmel 1955; Lewis and Weigert 1985; Misztal 1996; Mollering 2006). However, a systematic treatment of what makes organizations trustworthy, how individuals perceive and thereby trust organizations, remains elusive. In this final chapter, I propose a new, more coherent explanation of trust patterns, one that makes it possible to see how individual perceptions interact with social and institutional features to influence the structure of trust relations. Specifically, I speculate on the ways in which “spirals of trust” and “institutional ecologies” delimit, structure, and are structured by individual perceptions of trust.

As I noted earlier, it is methodologically convenient to create individual definitions of trust for each area we study, as proposed by Cvetkovich and Lofstedt (1999). Scholars currently create the definitions within bodies of work that have their own scope and goals. This means that authors must assert that their new or proposed measure will be semantically equivalent to previous measures so that their work has some empirical foundation. Yet, as Wynne (1992; 1996) reminds us, trust is mutable and discursively contested. This Babel-like account of trust forces scholars to ask, for each new case, how to best assess and completely measure trust. Scholars typically measure and explore trust at the level of an individual's perceptions or attitude. A more sociological treatment contextualizes individual trust perceptions and associates them with the usual array of social characteristics such as education, income, class, race, age, or gender. Still, this misses the relational aspect of trust. Instead of trying to contextualize individual opinions of trust, I propose an exploration of trust as an emergent property of on-going relationships between social actors.

To undertake an analysis of trust in GMF that accounts for complex relations, I maintain that it is best to examine the trust relationships between the key actors involved in the institutional ecology of the food system. I consider four sets of actors particularly important, because they are directly involved with public perceptions of GMF. Merchants such as farmers, food manufacturers, and grocers grow, produce, and supply food. Regulators such as government agencies ensure the safety of the food supply. Watchdogs such as environmental organizations and university scientists function as public advocates. In combination, these organizational actors are, conceptually, the key groups that assume social and ethical responsibility for creating and circulating knowledge about

GMF. As such, public trust in GMF emanates from public relationships among these actors. Above all, I am concerned with the extent to which consumers (the fourth social actor) find these various actors trustworthy.

While scholars do not always think of trust in these terms, in any given context, trust is comprised of a set of overlapping, patterned relationships that can be isolated from the heterogeneous content of individual relations (Simmel 1955). For example, in the case of GMF, a multitude of stakeholders along the commodity chain is vying for public trust and each individual may have a unique perception of those stakeholders. Individuals trust the food supply system and the actors in that system. When people buy food, they interact most directly with the merchants in that system, and indirectly with food regulators, experts, and watchdogs. In addition to the risk of malfeasance in that situation (Tilly 2004), even a weekly trip to the grocery store relies on a relationship with norms and expectations. The relations that people have with a producer or a retailer will be different from those they have with government bodies. People want safe, nutritious, inexpensive, and delicious food. In this context, I could say that trust is an expectation that other relevant actors in the food system will help meet some or all of these objectives. Social actors, then, are a central part of the context within which trust does or does not develop. Trust depends on who the actors are, what they do, and the interactions they have with one another.

This account, then, presumes an understanding of the perceptions and organization of the relationship between actors, introducing elements of control and power, knowledge and information. This relational and conditional description of the trust relationship between individuals and stakeholders is similar to ecological (Hannan and Freeman 1977) and institutional (Berger and Luckmann 1967) theories of organizational development. These theories highlight supra-individual properties of systems without attributing actions to aggregations of individual motives or attributes. In this chapter, however, I propose a few key differences. Chiefly, in the usual ecological accounts, only one part of the social world is conceived as subject to the constraints we call ‘‘ecological’’ while the rest is fixed. Instead of envisioning a particular ecology as having a set of fixed boundaries, I assume each set of actors exist in a series of linked ecologies with permeable boundaries and structural holes (Abbott 2005; Burt 2004). In combination, these linked ecologies describe trust relations regarding genetically modified food. Though I describe the trust relationship as my central theme, I do not presuppose that this particular relationship is always central for GMF. Nevertheless, it is easiest to see how this approach works by extending my argument along a single dimension.

To declare that trust is social and relational means understanding the earlier statement that A trusts B regarding X. This does not necessarily imply an individual, rational decision-making process. Instead, I am chiefly interested in the variations in institutional relationships. Where A and B can represent social actors, from individuals to institutions, I have generally let X represent the context or specific example of GMF. Here, I expand X to represent the food ecology. I concentrate on macro-level relationships between four actors-merchants, regulators, watchdogs and consumers. In doing this, I view acceptance of GMF in a particular way, where “spirals of trust” is a key concept that directs attention towards distinctive patterns of how the acceptance an emerging technology is organized and normatively founded.

My approach fills the gaps left by other sociological approaches and, of course, by trust theories that do not take organizations and institutions into account. In studies of risk and emerging technologies in particular, the focus has been on individual cognition or interpersonal social-psychological processes, merely acknowledging some influence of the environment or context without further theorization (c.f., Frewer, Howard, Hedderley, and Shepherd 1996; Kramer and Tyler 1996). More sociological studies of trust, on the other hand, have tended to focus on the role of managers, systems and institutions in mediating risk (c.f, Cvetkovich and Lofstedt 1999; Kasperson and Kasperson 2001; Krimsky and Plough 1988), attributing an almost marginal role to the trusting actors (Misztal 1996). However, individuals interpret and question organizations and institutions and do not merely reproduce them passively (DiMaggio and Powell 1983). Individuals and organizations are increasingly able to reflect consciously on the premises of their own and others' knowledge claims (Beck 1992; Giddens 1990).

Deference to Scientific Authority

Americans defer to scientific authority. This value is deeply held and as a result, during scientific controversy, Americans are prone to taking a pro-science or pro-technology stance (Brossard and Nisbet 2007). Popular discourse and rhetorical strategies indisputably link science and scientists' assertions to observable characteristics of the natural world (Hilgartner 1990). Such strategies imply that the public cannot call experts' claims into question, even when the issue involves risks that are hard to quantify and for which even experts disagree (Clarke 1999). Regulators routinely appeal to scientific authority to help maintain public confidence in their decision-making (Jasanoff 1990). For example, the scope of the risks and benefits surrounding GMF remains unclear (Lang and Priest 2007) and issues like allergencity (Bernstein, Bernstein, Bucchini, Goldman, Rubin, and Sampson 2003) and environmental benefits (Johnson and Hope 2000) continue to generate scientific controversy. However, the USDA asserts that food biotechnology "is safe based on all available science," and invokes faith in the authority of science to assure consumers about the safety of their food supply (Juanillo, Jr. 2001). Scholars have even argued that this continued deference to scientific authority has been the strongest total influence on support for GMF (Brossard and Nisbet 2007).

Ordinary people do not necessarily try to evaluate scientific evidence directly; they often lack the necessary background knowledge, time, and inclination—and they know this. Rather, they turn to guidance from those they trust, and whose values they share (Earle and Cvetkovich 1995). The fact that citizens may be relatively uninformed about an emerging technological debate does not mean that they are unable to make relevant decisions or judgments (Lang and Priest 2007). Given that most of us are not really in a position to judge the scientific evidence pertaining to the value and risk of GMF, listening to those we trust and perceive to have relevant expertise (whether that expertise is scientific, social, or ethical) is reasonable.

Scientists behave exactly the same way when operating outside their own areas of expertise. Moreover, listening to those we trust on technical matters when we recognize the limits of our own knowledge is a preeminently wise thing to do. The outcome of such processes, however, might not always be what the scientific and engineering communities (and their commercial promoters) might like—or what they imagine is the "correct" thing to do. One of the more interesting elements is that the professional careers of certain actors, particularly scientists, cross back and forth between types of stakeholders acting, in Abbott's (2005) terms as hinges and avatars. Hinges are issues or strategies that "work" in both ecologies at once; avatars are attempts to institutionalize in one ecology a copy or colony of an actor in another.

Avatars from scientific fields have been able to maintain important jurisdictional claims as merchants, regulators, watchdogs and consumers. Deference to scientific authority is the hinge by which scientists continue to have freedom to move between different professional and practice-oriented ecologies. As the social actors in the ecology of GMF link to one another through their various avatars, we end up with an ecology of organizations that has participants–in this case, merchants, regulators, watchdogs and consumers–that are far more typical, typified and typifiable than the people who work for them. For example, regardless of individual characteristics, and generally regardless of context, regulators impose standards, rules, and values on merchants while watchdogs and consumers reinforce normative expectations.

Although consumers may have differing role expectations for each of the actors, all of the actors defer to scientific expertise. The resulting normative isomorphism (DiMaggio and Powell 1983) gives great power to science as a profession and epistemology within the ecology. Scientists–as participants in each of the social ecologies–establish standards, adjudicate disputes and implement reforms. Though scientists move between ecologies, this does not imply that science is neutral to questions of power.

Scientists and decision makers widely believe that scientific literacy—understanding the facts behind the science in a debate—is the key factor shaping public views about science. The popular assumption is that increasing science literacy boosts public acceptance of the scientific worldview. In other words, if the public knew more about science, they would give scientists more influence over important policy decisions, and controversies would likely go away (Bauer, Allum, and Miller 2007). When asked their opinions about GMF, however, few people want detailed information about how farmers and industry produce the crop. Instead, people want to know who is creating GMF, people want to know if GMF is a good thing, and if so, who is making sure it remains a good thing (Hallman, Hebden, Aquino, Cuite, and Lang 2004). While some evidence supports the idea that people who are more knowledgeable perceive less risk in the technology, the impact of knowledge is likely to be weaker in its effects than other competing influences (Brossard and Shanahan 2003).

The Food Ecology: Trust as Social and Relational

Though Americans purchase and consume GMF every day, they do not understand the science behind GMF. Moreover, given that manufacturers do not label GMF foods as such in the U.S., people do not make reasoned or explicitly thought-out decisions to purchase or avoid GMF. While a person's role as a consumer in a grocery store highlights individual, economic interactions, within this exchange are social and cultural expectations about safety, quality, taste, nutrition, and ethical aspects of food production and distribution. To understand trust associated with GMF, therefore, it is important to consider the supra-individual aspects of buying food. Trust judgments are not simple aggregations or results of a person's demographic characteristics and motives. While trust may be viewed as inherently embedded in the gradual establishment of personal relations and networks (Granovetter 1985), trust is also present in impersonal and anonymous, relations. With a highly differentiated division of labor, where social exchange takes place over long physical and social distances, people delegate the responsibility for meeting our needs to others, often to organizations represented by a chain of strangers (Luhmann 1979) and agents with expertise (Shapiro 1987). These organizations and experts produce, process, and distribute food; they also provide knowledge and information about our food. The public relies on these actors because most people simply cannot collect, process, and interpret all relevant data themselves, but have to rely on the representations and assessments of experts (Shapiro 1987).

We have several reasons to trust our food supply, including past experience with specific brands and shops, quality, traceability and regulatory assurances of all kinds. Still, in part because of the generally anonymous character of the exchange, there is an institutional opportunity for actors to secure their self-interests, despite possible negative consequences for consumers. In these situations, guardians and watchdogs of public interest may relieve some of this uncertainty. While government agencies often fulfill this function, the media, public advocacy and consumer protection organizations on the one hand, and experts and scientific institutions on the other hand, also take this role on occasion. This system of checks-and-balances, while safeguarding consumer interests, can complicate trust judgments for consumers (Shapiro 1987). The indeterminate nature of scientific knowledge and inquiry produces uncertainty and unintended consequences (Wynne 1996). This complex and dynamic set of relationships constitute an ecology of food provisioning, made up by long chains of impersonal, often unknown, and highly institutionalized actors.

The process of creating, constructing, and maintaining relationships constitutes and delimits both actors and the institutional ecology. As part of this relational process, these stakeholders compete against one another, making claims over jurisdictions. These claims—whether rhetorical, scientific, political, social, and so forth—are actions and reactions to a variety of internal and external forces that represent a potential gain or loss of public trust. I do not mean to produce an overly rational model of social behavior that over-emphasizes instrumental social motives and atomizing individuals from the contextualized nature of social action (Granovetter 1985; Wrong 1994).

My concern alludes to the intricate relationship between trust and power. Trust, as noted in Chapter 2, refers to the notion that A trusts B regarding X. Power has to do with the ability of A to reach its goals, despite the B's opposing interests (Wrong 1995; Lukes 2004). Structural holes are the weak connections between clusters of densely connected individuals (Burt 1995). Actors who have these connections can act as brokers between the clusters or groups. As such, people with contact networks rich in structural holes are the individuals who know about, have a hand in, and exercise control over more rewarding opportunities (Burt 1999). If I extend this logic to social actors like industry and government, because they exist in multiple organizational ecologies and span structural holes, they can exercise power over the interests of consumers and advocacy organizations. Though, as famously noted, it is difficult to posit the existence of highly concentrated forms of power without sounding paranoid (Dahl 1958), I explore this tension along institutional lines using Lukes' (2004) three dimensions of power.

In the first dimension of power, there is equal access to decision-makers, but A has more resources or skills than B. So A beats B. In the second dimension, power generates decisions and causes "nondecisions." A beats B by controlling issues on the agenda. For example, even a "decidedly ambiguous" trade agreement on the process by which countries can refuse to accept GMF products may be viewed as an impressive step in the “right” direction (Helmuth 2000). The significant nondecisons—like whether GMF should be in the food supply at all—are ignored. Finally, in the third dimension, B cannot even conceptualize something beyond the false consensus that serves A’s interests. By now, B views the previous defeats as unremarkable and normal.

Recall my observation in Chapter 1 that most critics of GMF do not propose an end to large-scale agriculture; rather they concentrate on whether GMF is a technology that will benefit the public. Outwardly, competing paradigms such as sustainable agriculture and organic agriculture, do not imply the end of large-scale farming (Rigby and Cáceres 2001). If these alternatives tried to produce food on the same scale as the current agricultural paradigm, they would need to address the same problems of scale, geographical distribution, regulation and market control as the conventional food system. This serves to reinforce the power of the incumbent systems of large-scale corporate agribusiness that have already addressed these issues, albeit imperfectly. For example, once Walmart—the largest American grocery retailer—decided to embrace organic products, food manufacturers like the Kellogg Company, PepsiCo Incorporated, and General Mills made plans to introduce organic products, necessitating large-scale production and distribution (Warner 2006).

The general problem remains, as Lukes (2004) contends, that the relations between power, and the interests and responsibility of actors, are not easily detected or even visible. In other words, patterned relationships within an ecology may be so imbalanced that issue identification may not develop. Distrusted and weak social actors may have their aspirations manipulated by the trusted and powerful. In other words, because merchants and food manufacturers are already powerful when it comes to agricultural issues, they make the initial decisions, set the initial agenda, and define the “appropriate” frames for emerging food-related technologies like GMF. In this position, they can manipulate debates to their benefit, even if at the cost of others. For example, food manufacturers might benefit from debates about the best way to label GMF because that assumes everyone has already agreed to sell GMF. If consumers and advocacy groups, for example, spend their social capital debating the best way to label GM food, they cannot debate whether farmers should grow GMF at all. Alternatively, if debates center on the cost-efficiency and production yields of GMF crops versus conventional farming practices, then debates about the ethics of patenting staple food crops is lost.

Recent research examining public views of science and technology highlights the strong heuristic role played by value predispositions and media content in shaping general views about science in general (Nisbet, Scheufele, Shanahan, Moy, Brossard, and Lewenstein 2002) and about agricultural biotechnology specifically (Besley and Shanahan 2005). For these people, media coverage likely plays a key role relative to knowledge. The media attention may directly shape views about agricultural biotechnology through interpretation or framing (Besley and Shanahan 2005; Nisbet and Lewenstein 2002). The media attention may also indirectly shape views about agricultural biotechnology as an important source of informal learning about the topic (Nisbet, Scheufele, Shanahan, Moy, Brossard, and Lewenstein 2002). The more people pay attention to agricultural biotechnology in the press, the more knowledgeable they are about the issue.

Alongside this symbolic constituting of tasks into construed, identified jurisdictions, the various structural apparatuses of technologies and scientific authority as a whole provide a structural anchoring for the stakeholders (Abbott 2005). The ecological, contingent character of successful emerging technologies provides a theoretical exposition of why a technology succeeds relative to other possible solutions. (Abbott 2005). Despite controversy, such as those mentioned in Chapter 1, public ambivalence toward GMF has not reached a crisis. This also means that actors do not introduce alternative frames, because existing interpretations and debates remain unresolved. One could argue that a crisis or catastrophe would cause stakeholders to reconsider, and end, their commitment to GMF. Perhaps an actor's response to a crisis would cause others to gain or lose trust. It is hard to demonstrate trust absolutely unless an opportunity for betrayal is clearly available. Because the dangers of GMF remain uncertain, and debated by stakeholders, trust remains uncertain.

The potential for gained or lost trust presupposes an external criterion of success. Various publics, including regulators, trade partners, competitors, and the public adjudicate actors' claims for control. These external judgments ratify actors' claims, thereby making them effective against competitors. However, these external referees of jurisdiction draw their own legitimacy, in part, from outside the particular ecology. Scientists gain legitimacy from consumers, in part, because of their value to industry. A series of linked ecologies with permeable boundaries and structural holes socially condition our perceptions of risk and trust.

Although experience and knowledge may shape our perceptions, they are not necessary. Various social actors filter and mediate knowledge and opportunities.

Therefore, the ability to meet and influence decision-makers has an effect on perceptions of trust. I do not have to know how scientists work, for example, to trust science. But when I meet with scientists I will have additional insight as to whether I will trust them. Moreover, scientists also have an opportunity to judge how much I can be trusted as a consumer. Our access to, and experiences with, each other will influence both of our appraisals. Though the ability to influence each of these groups will vary along any number of dimensions, I can safely make some general statements about the four social actors under study—merchants, regulators, watchdogs and consumers.

Merchants should be able, without much difficulty, to meet with regulators and their representatives. Watchdogs, like large, multinational consumer and environmental groups, have good access to policy-makers, partly because these groups are likely to employ former government officials to help them gain access to decision-makers. Watchdogs like scientists play a variety of roles for all stakeholders in the GM debate. In addition to their role in research and testing new GM seed varieties, government agencies employ scientists to evaluate research. Meanwhile, all stakeholder groups employ scientists in an advisory role, for example, to advise on the risks to human health and the environment from GM technology. Groups such as professional academies of science later employ former government scientists, which helps these bodies have good access to government agencies.

The official government framework for decision-making varies according to specific political, economic, agricultural and environmental contexts. Opinions (even among common interest groups) are not homogenous across the world. For example, Zambia’s farmers have rejected GM crops; Brazil’s agri-business groups are enthusiastic about them; and Thailand's organic farmers are concerned that commercialization of GM agriculture may affect their exports to the E.U. (Masood, Warnock, Silvani, and Hanley 2005). Despite these differences, it is possible to draw some broad conclusions about how governments make decisions and who has access to decision-makers in the U.S. Government agencies, including the USDA, FDA, and EPA, regulate GMF and related technology. Through their legislative authority, Congress has a large role in deciding the content of new laws.

Different groups of citizens vary in their access to different parts of the policy-making process. Scientists, international advocacy groups, the biotechnology industry and groups representing commercial farmers tend to have good access to government agencies. Scientists are involved in most stages of the decision-making process and tend to have good access to decision-makers across all policy areas. They advise decision-makers on the regulation of GMF. In addition, different stakeholders in the GM debate call upon scientists to play a variety of roles. For example, governments and biotechnology companies employ scientists to develop new seed varieties; advocacy groups employ scientists to advise them on the potential risks to human health and the environment; and professional scientific bodies employ ex-government scientists to help lobby for their profession in government. However, scientific opinion on GMF is not uniform–scientists' views have been used to support decisions both to accept and to reject GMF.

As an alternative or supplement to their expert authority, scientific institutions are partly drawing on developments in the sub-discipline of public understanding of science. Decision-making was once the privilege of experts. This meant that any outside, community involvement required that multiple publics be educated in scientific matters. Governments and various regulatory bodies emphasize the usefulness of the public's knowledge, incorporating it into the decision-making process using new techniques such as the consensus conferences, public participation exercises, science shops and, most notably, the language and rhetoric of transparency. There is even, albeit to a somewhat lesser extent, an acknowledgement of the contingency of scientific knowledge itself.

Unlike the European situation, where scientists are more likely to view themselves as servants to the state, and subject to regulation (Jasanoff 2005), American scientists believe they should be mostly free from direct regulation and political control (Bimber and Guston 1995). In the United States, science is depicted as a socially and politically neutral institution that produces objective knowledge about the natural world (Irwin 2001). GMF and the related scientific controversies, like those noted in earlier chapters, are not extensively covered in the media (Nisbet and Lewenstein 2002) nor are they easily recalled by the public (Hallman, Hebden, Aquino, Cuite, and Lang 2004).

Perhaps this is a problem with the synchronic measurements in most social science research. Public opinion surveys tap into those judgments at a fixed point in time. If we uncritically recognize that external power, we mistakenly conceive of theses ecologies of the various publics as fixed and unproblematic entities in a position to judge claims of trust. If we were to monitor the fluctuations of trust judgments from the introduction of an emerging technology and continuously monitor those judgments over time, we might have a less static view of trust.

Public opinion surveys on trust can reveal, for example, variations between individuals and social groups and across countries (Peters, Lang, Sawicka, and Hallman

2007). However, consumer trust in the organizations and experts involved with GMF is something more than just individual risk perception or uncertainty. As a critique of individualistic approaches, I see trust as a property of the collective organization of social relations, as part of processes of institutionalization (Mollering 2005). These relations indicate the establishment of formal institutional relationships, like government regulations. They also indicate the presence of stable, informal relationships like individual shopping preferences. The structure of these social relationships provides taken-for-granted organizational and normative frameworks and procedures that strongly influence consumers and their expectations. These relationships also provide a macro-level vantage point from which to account for the regularities of collective opinion reflected in public opinion surveys.

In trying to understand current issues of trust in food, expressions of public opinion are only part of the story. Other actors in the ecology, besides consumers, are involved, interact directly with consumers, and have the power to influence conditions. The study of institutional actors would direct attention toward the relations between those actors and the consuming public. An important point is how institutional actors relate to, and interrelate with, ordinary people as consumers, individually and collectively. Regulators and industry executives have begun to recognize the value of the public's trust in recent years (Brown and Michael 2002; MacGillivray 2002). When speaking at the National Press Club, former U.S. Secretary of Agriculture Dan Glickman (1999) said:

> With all that biotechnology has to offer, it is nothing if it's not accepted. This boils down to a matter of trust, trust in the science behind the process, but particularly trust in the regulatory process that ensures thorough review–including complete and open public involvement.

Monsanto CEO, Hendrik Verfaillie, describes Monsanto's corporate misjudgments and failure to acknowledge the public desire for uncensored access to information:

> The shift that started 40 years ago is approaching maturity. It is a movement from a 'trust me' society to a 'show me' society. We don't trust government … and thus government rulemaking and regulation is suspect. We don't trust companies … or the new technologies they introduce into the market place. We were still in the 'trust me' mode when the expectation was 'show me' (As quoted in Vidal 2000).

Similarly, in his 2001 address to the Advertising Association, the Chairman of Unilever, Neil Fitzgerald, said:

> Whether we're selling a political message or a packet of cereal, everyone … is now faced with a fundamental decline in trust ... You can have all the facts and figures, all the supporting evidence, all the endorsement that you want, but if you don't command trust, you won't get anywhere (as quoted in Duffy, Downing, and Skinner 2003).

Anecdotal evidence strongly suggests that while some actors believe public engagement is an inherent good, many within the scientific and policy communities see it primarily as a way of informing the public and deflecting criticism, rather than as a way of incorporating public values and preferences into the policy process. While these alternative conceptualizations can and do co-exist, they represent conflicting views of the role of the public. From the rhetoric, it would seem that industry has realized (even if belatedly) the value and importance of trust. However, it is difficult to be enthusiastic about cultural developments and institutional innovations that fail to emphasize the decision processes in powerful organizations and among experts.

Risk, Trust & Power Ecologies

As a substitute for information about a vast array of possible threats in everyday life, the public relies on the endorsement of regulators, officials, industry, scientists, and other experts. Instead of arriving at probabilistic accounts of which risks they should fear, people make choices about which institutions to trust (Priest, Bonfadelli, and Rusanen 2003). Moral entrepreneurs can take advantage of this and skew what the public fears (Glassner 1999). Scholars of risk report that if trust in the sponsors of biotechnology is high, then people are less likely to worry about unforeseen risks and costs (Freudenburg 1992; Freudenburg 1993; Slovic 1999). Even experts tend to under-estimate organizational amplifications of risks (Freudenburg 1992). In short, the public and experts rely on social criteria such as trust to evaluate risk (Freudenburg 1993).

Trust increases the tolerance of ambiguity, reduces the resources required to monitor others, and opens up new possibilities for action (Luhmann 1979). Hardin (2001) argues that trust leads to a willingness to "delegate" problems. Trust may be a factor contributing to deference to authorities (Tyler 1997; Tyler 2001). People do not necessarily defer based on formal hierarchies or power but on accepted authority (Luhmann 1979). For example, if I wanted to plant a tree, I might implicitly trust and follow the recommendations of the agricultural extension specialist from Rutgers University's Cook College even though that position has little formal power. The specialist, by virtue of specialized training, can be trusted in this context.

On the micro-level, people assign trust in a specific situation of uncertainty to a specific actor. By generalizing the expectation of trustworthiness to classes of actors and to the meso- and macro-level of society, we can derive generalized forms of trust from this basic definition of situation-specific trust. A person may generalize trust in a specific politician, for example, to trust in government as an institution. Important examples of such generalizations at the societal macro-level are interpersonal trust as the "default expectations of the trustworthiness of others" (Yamagishi 2001) and institutional trust as the level of confidence in social institutions. The social effects of trust have led a number of scholars to consider general trust as a kind of "social capital" (Coleman 1990; Fukuyama 1995; Putnam 2004) and as an important element of political culture (Inglehart 1999).

Several groups of researchers have detailed differences in trust between the U.S. and Europe as reasons for divergent public views about agricultural biotechnology, with Americans more trusting in regulators, scientists, and industry, and less trustful of consumer and environmental organizations than Europeans (Bonny 2003; Priest, Bonfadelli, and Rusanen 2003). Using data specific to the U.S., other researchers have shown that trust in institutions directly influences risk perception and fear, which in turn affects acceptance of biotechnology (Brossard and Shanahan 2003; Siegrist 2000). The research is clear on two counts: institutional trust varies nationally and institutional trust is related to acceptance of biotechnology.

While citizens protest or advocate, academics debate, and media outlets report, governments and industry continue to produce and the U.S. government continues to allow GMF in the food supply. Institutional actors continue to make decisions, ranging from whether to import or export GMF, whether to require or volunteer to label GMF, and whether to further research and promote GMF. Given the controversy, the polarized positions of the U.S. and the E.U., social actors have responded in a number of different ways (Gaskell, Bauer, Durant, and Allum 1999; Gaskell, Einsiedel, Priest, Ten Eyck, Allum, and Torgersen 2001). Although such efforts could have provided the opportunity for exchange of information and opinions, they failed if we measure success in public understanding. As I reported, Americans are generally uninformed about GMF, unaware of its presence in the food system and their own diets, and have heard or read little about GMF (Hallman, Adelaja, Schilling, and Lang 2002; Hallman, Hebden, Aquino, Cuite, and Lang 2003; Hallman, Hebden, Aquino, Cuite, and Lang 2004).

Conclusions & Discussion

This dissertation allowed me to theorize about the environment, decision-making, culture, acceptability, organizations, risk and social action in the context of food biotechnology. I have been fascinated with the controversy surrounding GMF because it is a proxy debate for broader issues of social and political power, cultural values, and corporate responsibility. Though I have focused on GMF, the analysis may also prove relevant to other emerging technologies. Understanding trust judgments remains a challenge. Conceived narrowly, the process behind GMF belongs to the modern field of biotechnology, from which advances in cloning, stem cell therapy, genetic testing, pharmaceutical production, and DNA sequencing have arisen. Conceived broadly, these emerging and revolutionary technologies belong to a class of organizational processes and expert skills that represent projected aspiration and promise. As such, the GMF case study belongs to the broader class of events that I dub the social uncertainties of emerging technologies.

Some people believe that the emerging technologies that governments and industry might introduce to the public in the future—whether they are biotechnology, nanotechnology, information technology, cognitive science, robotics or genetics related—will have wide-ranging impact on our daily lives. Institutional hope is clearly high, when judged by the willingness to put capital (in terms of knowledge, people, money, research and so forth) behind them. Nevertheless, how these developments eventually turn out is uncertain. How institutions organize themselves to "sell the science" (Nelkin 1987), as well as how experts package scientific developments, how the media tell stories, and who the public eventually begins to trust with these developments will continue to be common themes across each of these advances. Organizations and experts will assume, once again, social and ethical responsibilities by creating and circulating knowledge about the new technology, whether it is an innovation in medicine, energy production, or other applications of biotechnology.

In a simple and generally assumed formulation, organizations and experts will attempt to create, develop, manage and maintain trust. After these deliberate and successful attempts to influence trust judgments, various publics will determine what level of trust is acceptable and who is trustworthy. But not all attempts and activities are deliberate and not all are successful. To the extent that a powerful actor could successfully manipulate the public's trust, the public and the social actor would jointly determine what an acceptable and necessary level of trust is. Furthermore, manipulations would only be salient to the extent that the issue mattered to the respondent and the respondent had recourse. Therefore, individual judgments about the acceptability of trust could occur and those judgments could make a difference. Neither is necessary. Judging by the variance explained by the traditional methodology (trust attributes, in Chapter 3) and a novel methodology (importance ratings, in Chapter 4), it remains clear that a number of unexplored and incidental effects of trust need to be investigated further.

How organizations and experts help the public navigate the uncertainty inherent in these technologies at the same time as they seek to develop or influence both public policy and markets remains opaque. If the public does not trust these groups and their messages, the public will not fully embrace either the technology as consumers or the policy that promotes it as citizens. This possibility represents significant risks from the perspective of elite actors. As such, individual perceptions and value-driven choices may have significant cultural, social, and political implications. In the end, spirals of trust and institutional ecologies delimit, structure, and are structured by individual perceptions of trust. How trust allows particular social actors to maintain their advisory positions in society is worthy of continued exploration, if only because it is trust that allows the public to accept the risks of unknown technologies these actors endorse.

Directions for Future Research

My bottom-line recommendation of this research is not a call for intensified organizational promotion. Trust is important, but experts cannot market it like soap. Moreover, there is no universal recipe or set of levers for organizations and experts to align to create the necessary conditions for trust. Socio-demographic variables, perceived honesty, and perceived organizational knowledge matter. However, how much they matter and for which groups remain variable. Though organizations may take this news with pessimism, consumers should take some solace is the knowledge that experts cannot easily manipulate their trust. That there is no recipe suggests a broader conclusion. Competition between stakeholders and individuals' ever-changing relationships—with science as an institution and stakeholders as actors—preclude a fixed, permanent formula. Moreover, a universal formula for creating trust judgments presupposes that stakeholders themselves do not change. Because the social actors involved in a trust relationship are constantly changing, so too will the necessary and acceptable conditions for trust.

These results of my dissertation bear on efforts within organizations that manage and promote emerging technology. I believe this work thus holds promise for improving awareness and sensitivity to the social values of trust. Though bounded within an organizational ecology, trust judgments are not something that others can easily manipulate. There are seemingly limitless varieties of potential determinants of trust that scholars should explore because it helps structure our social reality and renders risk bearable. Trust captures how individual actors use their agency to deal with irreducible social vulnerability and uncertainty brought about by the actions of experts, organizations and institutions.

APPENDIX A: RECRUITING LETTER

July 31, 2007

Dear **NAME**,

Thank you for your recent participation in a telephone interview conducted by the Food Policy Institute at Rutgers University. You may recall that you were asked a series of questions about your food preferences and issues related to food biotechnology. During the interview, you agreed to participate in this follow-up mail survey. In appreciation of this commitment, I am enclosing five dollars.

This survey is part of a national study of American food preferences being conducted by researchers at the Food Policy Institute. We have sent out fewer than 1000 surveys, so your participation, while completely voluntary, is very important to the success of the study.

This survey focuses on your food preferences as a consumer. There are no “right” or “wrong” answers, I only ask that you carefully read and think about each question. There are three parts to this survey please read the directions for each section carefully. It is important that you use an ink pen to mark your answers.

University regulations governing research prohibits the unauthorized use of any personal information that you provide. Please be assured that your responses will be completely confidential.

I thank you in advance for completing the enclosed survey. Please return the completed survey to us using the stamped and addressed envelope. You can drop the envelope in any U.S. postal mailbox within the next 14 days. If you have any questions about the survey, please feel free to contact me at (732)932-1966 x3102 or aquino@aesop.rutgers.edu.

Sincerely,

Professor William K. Hallman

“This informed consent form was approved by the Rutgers Institutional Review Board for the Protection of Human Subjects on 12/13/02”

APPENDIX B: SAMPLE QUESTIONNAIRE[1]

FOOD POLICY INSTITUTE

Survey on Food and Technology

2004

[1] I changed the formatting for this sample questionnaire from portrait to landscape to meet the margin requirements of the dissertation. All wording remains identical to the version sent to respondents. In general, however, respondents answered two questions per page rather than the one presented here.

Survey Part 2

In this section you will be asked how you feel about some groups involved with various aspects of genetically modified food. Even if you haven't thought much about this sort of thing before, try to give your 'gut' feelings. There are no "right" or "wrong" answers; these are simply your opinions. Read the full list of items in each question before starting to answer; give identical scores only for items that are equally important to you. *Please make a mark in one box for each item.*

When thinking about genetically modified food, how would you **rate *environmental organizations*** on each of these items?

	Not At All 1	**2**	**3**	**4**	**5**	**6**	**Completely** 7	**Unsure**
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, how would you **rate *farmers*** on each of these items?

	Not At All 1	2	3	4	5	6	Completely 7	Unsure
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, how would you **rate *food manufacturers*** on each of these items?

	Not At All **1**	**2**	**3**	**4**	**5**	**6**	**Completely** **7**	**Unsure**
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, how would you **rate *grocers and grocery stores*** on each of these items?

	Not At All 1	2	3	4	5	6	Completely 7	Unsure
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, how would you **rate *university scientists*** on each of these items?

	Not At All 1	2	3	4	5	6	Completely 7	Unsure
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, how would you **rate *government agencies*** on each of these items?

	Not At All 1	2	3	4	5	6	Completely 7	Unsure
How honest they are	☐	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***environmental organizations***? Read the full list before starting to answer; give identical scores only for items that are equally important to you. Please make a mark in one box for each item.

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***farmers***?

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***food manufacturers***?

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

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When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***grocers and grocery stores***?

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

➔➔ **Continued on next page**

When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***university scientists***?

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

➔➔ **Continued on next page**

When thinking about genetically modified food, **how important** is each of the following items when deciding how much you trust ***government agencies***?

	Not Important 1	2	3	4	5	6	Completely Important 7
How honest they are	☐	☐	☐	☐	☐	☐	☐
How much they pursue their own interests versus the public interest	☐	☐	☐	☐	☐	☐	☐
How knowledgeable they are	☐	☐	☐	☐	☐	☐	☐
How well they can predict potential effects	☐	☐	☐	☐	☐	☐	☐
How much they share my values	☐	☐	☐	☐	☐	☐	☐
How well they can tell which potential effects are important	☐	☐	☐	☐	☐	☐	☐

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How much do you trust the following groups to make appropriate decisions about genetically modified food?

	No Trust 1	2	3	4	5	6	Complete Trust 7
Environmental organizations	☐	☐	☐	☐	☐	☐	☐
Farmers	☐	☐	☐	☐	☐	☐	☐
Food manufacturers	☐	☐	☐	☐	☐	☐	☐
Grocers and grocery stores	☐	☐	☐	☐	☐	☐	☐
University scientists	☐	☐	☐	☐	☐	☐	☐
Government agencies	☐	☐	☐	☐	☐	☐	☐

➔➔ **Continued on next page**

Please make sure you marked only one box for each question.

****

Thank you for taking the time to complete this survey!

Please return the survey promptly in the postage paid envelope provided to the following address:

ATTN: 3177
Schulman, Ronca, and Bucuvalas, Inc.
145 E 32nd St., Floor 5
New York, NY 10016

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CURRICULUM VITA

John Thomas Lang

Education

2007 Ph.D. in Sociology, Rutgers University
2003 M.A. in Sociology, Rutgers University
1993 B.A. in Sociology, Rutgers University

Publications

2007 Understanding Receptivity to Genetically Modified Foods: Looking at the Broader Context. *Gastronomica* 7(3):88-92 (John T. Lang and Susanna Priest).

2007 Culture and Technological Innovation: Impact of Institutional Trust and Appreciation of Nature on Attitudes towards Food Biotechnology in the U.S. and Germany. *International Journal of Public Opinion Research* 19(2):191-220 (Hans Peter Peters, John T. Lang, Magdalena Sawicka, and William K. Hallman).

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