NUCLEAR POWER PLANT PERCEPTIONS AMONG COLLEGE STUDENTS AT TEXAS STATE UNIVERSITY-SAN MARCOS

THESIS

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CHAPTER I

INTRODUCTION

Fossil fuels are the world's largest source of energy. Unfortunately, their combustion produces a variety of pollutants, such as nitrogen oxide and sulphur dioxide, as well as carbon dioxide and other greenhouse gases (Dresselhaus and Thomas 2001). In 2007, the Intergovernmental Panel on Climate Change (IPCC 2007) concluded that humans have caused the climate to change and that the United States is one of the largest emitters of the gases that contribute to a warming global climate. Moreover, "we are able to confirm our original conclusion that climate change represents a major threat to terrestrial species (Thomas et al. 2004, 2719)." Since concerns over the changing climate are growing, alternative, low-emission energy sources have become an important topic of conversation (T. Hansen 2006).

Hydroelectric, solar, wind, and geothermal energy are proposed alternative energy sources. The opportunities to produce these forms of energy are geographically restricted and most require large tracts of land (Dresselhaus and Thomas 2001). Nuclear power is an alternative source of energy that does not produce greenhouse gases (K. Hansen 2006). However, nuclear energy is not without its own risks to humans. These risks result in a unique cost-benefit relationship for nuclear power that has polarized public perception and political debates in the United States for decades (Siegrist, Cvetkovich,

and Roth 2000). Given the growing number of newly permitted and proposed nuclear power plants in the United States (U.S. Nuclear Regulatory Commission [NRC] 2009b), an opportunity currently exists to investigate the popular opinions of young decision-makers, most of whom have not been asked to participate in the decision to build new plants in their lifetimes. A review of the available literature reveals that there is a lack of systematic, up-to-date information on the perceptions of young people toward the use of nuclear power plants to solve our nation's greenhouse gas management goals. Therefore, the purpose of this research is to acquire and analyze college students' (Texas State University-San Marcos) perceptions of the risks and benefits associated with large-scale nuclear power plants as an energy source. A classroom survey was conducted in the spring of 2010 to assess college students' perceptions toward nuclear power and to analyze the degree to which political preference and personal experience play a role in defining those perceptions.

CHAPTER II

BACKGROUND

Because it is fueled by enriched uranium, nuclear power is a form of energy that does not directly emit carbon into the atmosphere. About 17% of the world's electricity comes from nuclear power (Corradini 2007). In the United States, 19% of the electricity consumed comes from nuclear power, and overall, the U.S. produces more nuclear power than any other country in the world (U.S. Energy Information Administration 2009).

In 2006, natural gas was the largest source of electricity in Texas, with coal and nuclear power ranking as second and third, respectively. Natural gas accounted for almost half of the electricity used in Texas, while nuclear power accounted for 10%. In 2006, prior to the upgrade of Reactor Number 2 at the Palo Verde Nuclear Power Plant in Arizona, the two reactors at the South Texas Nuclear Project were the largest nuclear reactors in the U.S. In terms of plant size, the South Texas Nuclear Project ranks 16th on a list by the U.S. Energy Information Administration of the 100 largest utility plants in the United States (U.S. Energy Information Administration 2006). Nuclear power production in Texas is substantial, and with two of the largest reactors in the country, as well as new proposed reactors (U.S. NRC 2009b), Texas is an important player in the future of the nuclear industry.

Commercial nuclear power began providing electricity to American homes in 1954 (K. Hansen 2006). Initially, the cost of electricity from nuclear power was considered cheap, and the new energy source gained popularity. Beginning in the 1950s, the use of nuclear energy increased rapidly in the United States. Nuclear energy production continued to grow until the late 1970s (K. Hansen 2006). In 1979, an accident occurred at the Three Mile Island Nuclear Power Plant in Pennsylvania. The core of the plant overheated, causing a partial meltdown of Reactor 2 at the plant (U.S. NRC 2009a). This accident prompted changes that included emergency planning and radiation protection procedures for nuclear power plants, and the accident caused operator training and engineering problems to be more readily addressed (U.S. NRC 2009a). In 1986, Reactor 4 at the Chernobyl Nuclear Power Plant in the Ukraine experienced a complete meltdown due to operator error (World Nuclear Association 2008). This explosion, and the fires that erupted immediately after it, released large amounts of radioactive material into the atmosphere, covering much of the Ukraine, Belarus, Russia, and parts of Eastern Europe (World Nuclear Association 2008).

The accident at Three Mile Island halted nuclear power plant construction in the United States, and no new plants were permitted after 1971 (K. Hansen 2006). Public opposition to nuclear power existed before the accident at the Three Mile Island plant, but this accident brought new concerns into the forum for debate (Whitfield et al. 2009). Many citizens became fearful of nuclear power and opposed the creation of more nuclear power facilities. Van der Pligt, Eiser, and Spears (1984) suggested that nuclear power faced public opposition and no longer depended on the economy or technology alone for

acceptance as an energy source. For this reason, public opinion and perception are a key factor in nuclear power's future (Whitfield et al. 2009).

One hundred previously planned reactors were cancelled after the Three Mile Island accident (Flynn 1992). Among the plants shut down due to public opposition was California's Rancho Seco (Flynn 1992). Public concerns include plant safety and radioactive waste transportation and disposal. Strupczewski (2003) states that nuclear power plants pose a smaller risk for accidents than the possible risk of accidents associated with oil, gas, or coal power plants. The specific risk refers to the minimal risk of a technological failure and a smaller number of deaths attributed to nuclear power plant accidents. In comparison to the number of deaths associated with multiple forms of energy production, the number of deaths associated with nuclear power is less than other sources (Strupczewski 2003).

The technological failure of a nuclear power plant is a low frequency/high impact event. The occurrence may be infrequent, but the losses associated with the event may be extreme. Research shows that people feel the same about low frequency/high impact events as they do about high frequency/low impact events (Kasperson et al. 1988). However, if a common accident occurs within a familiar setting, regardless of its frequency and magnitude, people are less disturbed and disrupted by the impacts (Slovic, Fischhoff, and Lichtenstein 1982). Most of the environmental hazards associated with fossil fuel production are high frequency, low impact events (spills, emissions, air pollution). Many Americans have come to tolerate, or perhaps even ignore, high frequency events with which they are familiar (Slovic, Fischhoff, and Lichtenstein 1982),

such as the chronic degradation of physical and human environments affected by fossil fuel extraction and energy production. Our awareness of global warming, and the apparent difficulties associated with management of the phenomenon, is changing our perspective on the costs of traditional fossil fuel production (Sailor et al. 2000). This in turn has reinvigorated public discourse and government support for nuclear power.

One solution to the costs of nuclear power production that remains elusive is the long-term management of high-level radioactive wastes generated by the industry. For highly radioactive waste, the United States declared that Yucca Mountain in Nevada would be the site for a permanent nuclear waste repository or storage facility (Whipple 1996). Currently, the NRC is reviewing the application for the Yucca Mountain storage facility, but the White House may cut funds for this project (Eureka County, Nevada-Nuclear Waste Office 2009a). The Eureka County, Nevada Nuclear Waste Office (2009b) has identified a multitude of problems associated with the waste repository, including the potential for water contamination, life expectancy of waste containment vessels, and the seismic activity of the site. These concerns continue to be addressed while the repository application is under review (Eureka County, Nevada-Nuclear Waste Office 2009b).

After the accident at Three Mile Island, the United States halted construction of nuclear power plants. According to the U.S. NRC (2009b), companies began submitting applications for nuclear power plant licenses again in 2007. Between 1971 and 2007, there were no new orders for construction of nuclear power plants, partly because of concerns about their safety and partly because studies show the public did not want more

plants (Cutter 1993). Now, there are new reactor sites in the application review process, and many existing sites are applying to expand their facilities by adding additional reactors to their sites (U.S. NRC 2009b).

Nuclear power is a controversial energy source because it could reduce climate change through low carbon dioxide emissions, but it can also negatively impact the environment through its production of radioactive waste. While U.S. college students may not possess the same degree of personal experience with nuclear power as nuclear industry experts, for nuclear power plants sited in the near future, their generation will serve as the stewards for those plants over their operational lifetime. Therefore this research surveyed Texas State University-San Marcos undergraduate college students to obtain their perceptions of nuclear power plants as a source of electricity. These perceptions were analyzed for any patterns in the relationships between student demographics, life experiences, political/social attitudes, and the level of risks and benefits perceived from nuclear power production.

CHAPTER III

LITERATURE REVIEW

Risk

The purpose of this literature review is to define and discuss previous research conducted on risk perception of nuclear power. Ogden (2008) defined risk as the possibility or likelihood that something bad will happen. Ogden acknowledged that the term risk is hard to explain because the possibility or likelihood of something happening does not mean that something will actually happen. However, this idea is frequently understood as a real occurrence rather than the threat of an occurrence (Ogden 2008). Risk can be categorized using dread and unfamiliarity (Cutter 1993). A risk with unknown consequences is dreaded more than risks of which people are aware. People usually fear things with which they are not familiar because they do not understand them (Cutter 1993).

Douglas and Wildavsky (1982) defined risk with their cultural theory of risk perception. This theory explained that people's assessments of risk are based on their own personal knowledge and understanding (Douglas and Wildavsky 1982). According to Kasperson et al. (1988), risk is technically defined as the probability that an event will occur combined with the magnitude of the event. Previously, risk was determined by multiplying probability by magnitude to get the risk associated with an event. However,

this definition has become obsolete (Kasperson et al. 1988). These researchers have found that most people are aware of what risk means, but "clearly, other aspects of the risk such as voluntariness, personal ability to influence the risk, familiarity with the hazard, and the catastrophic potential shape public response" (Kasperson et al. 1988, 112). Slovic (1987) explains that different people define risk in different ways, and the way risk is defined will determine how people feel about certain hazards. He explains that the experts define risk as the number of people killed by the hazard each year. The general public defines risk by including other factors, such as voluntariness, dread, knowledge, and controllability of the hazard (Slovic 1987).

Humans have the ability to alter the environment as they need (Slovic 1987). This ability often reduces risk, but many times, this ability creates new risks for humans. Often, human advancements in technology create new risks (Slovic 1987). When humans developed nuclear power to help improve their lives, they created a new set of risks (Slovic 1987). Covello and Mumpower (1985) stated that when people create new technologies to reduce or remove a risk, these technologies often create new risks. More recently, people interact with many new experiences, including the hazards people face. People feared natural disasters and diseases as the major risks in their lives until new risks appeared (Covello and Mumpower 1985). These new risks come from technology: nuclear power plants, chemicals and pollution, among other risks. Many people fear these technologies because they do not understand them and are unfamiliar with their effects (Covello and Mumpower 1985). Sometimes, the amount of risk associated with a specific technology is not really the issue; instead, the problem is a social or ideological

problem, and declaring the technology as a risk is a better justification for disapproval (Slovic 1987).

Since the future of many technologies, including nuclear power, depends on public opinion and acceptance (Van der Pligt, Eiser, and Spears 1984), it is important to study risk perception. Many researchers have studied and are currently studying risk perception (Slovic, Lichtenstein, and Bischhoff 1979; Wiegman, Gutteling, and Cadet 1995; Siegrist, Cvetkovich, and Roth 2000; Peters, Burraston, and Mertz 2004; Whitfield et al. 2009). The literature indicates that there are multiple ways to define risk, particularly when referring to environmental risk. The definition of risk that best explains this research is the probability or likelihood that something bad will happen (Ogden 2008).

Risk Perception

From a geographer's perspective, Cutter defines perception as "the actual receipt of environmental stimuli by one of our five sensory preceptors-sight, smell, hearing, taste, touch" (Cutter 1993, 13). Cognition is the way in which these stimuli are processed within the brain (Cutter 1993). These stimuli are passed through a person's mind and are categorized or organized by the brain based on that person's experiences and personal knowledge. This information is then stored in the brain as a memory (Cutter 1993). Cognition is a product of perception, or ways of thinking about an idea or object (Peters, Burrasont, and Mertz 2004). Cognition happens more often than people realize, and they are not aware that it is happening. While cognition is the technical term for this action, perception is the more common term and perception is the acceptable reference (Cutter

1993), so this study will also refer to this action as perception. Douglas and Wildavsky (1982) believe that many perceptions of risk are influenced by politics (Douglas and Wildavsky 1982), which was tested and proved by Costa-Font, Rudisill, and Mossialos (2008) when they tested political party ties and strength of these political party ties.

Governments are interested in public perceptions of risk (Peters, Burraston, and Mertz 2004). What people think about a certain idea and why they form those perspectives determines their actions and behavior toward the idea (Slovic 1987). Emotions and affections determine a person's risk perceptions (Peters, Burraston, and Mertz 2004). The term affection can be described as personal opinions, whether good or bad, about an idea or object. Cognition is a product of perception, or ways of thinking about that idea or object. If a person thinks about something long enough, a connection is built between affection and this object (Peters, Burraston, and Mertz 2004).

Alhakami and Slovic (1984) explain that risk perception is often connected to benefit analysis in many cases. When these two concepts are connected, the relationship depends on attitudes toward the object in question. If attitudes are positive toward the object, benefits are perceived as high and the associated risk is low. The opposite applies if people have a negative attitude toward something (Alhakami and Slovic 1994).

Cutter (1993) explains that psychologists usually study perception, but geographers have a place in risk perception research as well. Psychologists generally focus on the process of forming a perception. A geographer's focus is not to determine how perceptions form but rather to determine human responses to a stimuli. Geographers study how perceptions can change public policy and impact choices about stimuli (Cutter

1993). Cutter states, "Geographers by studying hazard perception seek to understand why people take action in response to environmental threats and how they form their perceptions of the range of actions available to them" (Cutter 1993, 14). Therefore, geographers focus on what reactions people have after their initial perceptions form, and why, out of all the options available to them, do they chose to react the way that they do.

Risk perception is important to study and much research focuses on risks associated with technology (Lomax 2000). This paper focuses on risk perceptions of the technology, nuclear power.

Risk Perceptions of Nuclear Power

Various studies have been conducted on risk perceptions of nuclear power (Slovic, Lichtenstein, and Bischhoff 1979; Van der Pligt, Eiser, and Spears 1984; Wiegman, Gutteling, and Cadet 1995; Horska et al. 1996). Van der Pligt, Eiser, and Spears (1984) studied perceptions of nuclear power in both the U.S. and in parts of Europe. These researchers did not survey respondents but instead gathered information about general perceptions from previous research. These researchers determined that the accident at Three Mile Island damaged public opinions of nuclear energy. They also determined that people are not generally opposed to a plant as long as it is not built too close to their home or their neighborhood (Van der Pligt, Eiser, and Spears 1984). Gregory (2006) and Flynn (1992) did not survey local residents either, but instead combined existing research into consensus articles. Gregory (2006) determined that the experts, those who have experience with and who have studied within the realm of nuclear power, have different opinions than the lay public, those who have not studied

nor have experience within the field of nuclear energy. Flynn (1992) researched how the public's distrust of the government and nuclear manufacturers can impact their perceptions of nuclear power. People have expressed concerns over plant safety, public health, and nuclear waste management and disposal. People also distrusted the government and the nuclear industry. The article concluded that the future of the nuclear industry would depend heavily on public acceptance, which is dependent on trust of information sources (Flynn 1992).

Another method of determining perceptions was to look at previous surveys and to use this information as the basis for research. Costa-Font, Rudisill, and Mossialos (2008) conducted a study based on a previous survey conducted by the European Commission of the European Union public. Of these respondents, only United Kingdom residents' responses were used. The original hypothesis of these researchers was that political affiliation and public knowledge about nuclear waste would determine attitudes toward nuclear power. The European Commission (EC) asked survey participants questions about how much they support nuclear power. The EC also inquired about respondents' knowledge of nuclear waste, choice of political parties, and trust in the sources of information telling them about nuclear waste. The results showed that knowledge is important in determining support and those who did not know as much about nuclear waste tended to support nuclear power. When the researchers removed perceived consequences of nuclear power's use from the model, knowledge of waste became unimportant in determining overall attitudes toward nuclear power, showing that knowledge of nuclear power depends on a person's understanding of how nuclear power is used. However, the general findings show that people who are less knowledgeable of

nuclear power will support it, regardless of the consequences of use. Additional findings show that people who had a strong political affiliation to a particular party did not support nuclear power as much as those without strong ties to a party (Costa-Font, Rudisill, and Mossialos 2008).

Trust of information sources appears to be an important indicator in the perception of risk associated with nuclear power (Viklund 2003; Costa-Font, Rudisill, and Mossialos 2008; Whitfield et al. 2009). Viklund (2003) found that the more trusted the source, the more positive the attitudes toward nuclear power, and the perceived risk decreased. Source of the information proved important as well in the research conducted by Costa-Font, Rudisill, and Mossialos (2008), and the results showed that people are more willing to trust the nuclear power industry than UK government agencies or the European Union. Another study by Whitfield et al. (2009) tested trust of the nuclear industry. Respondents were asked to indicate how much trust they had in various organizations within the United States. The results showed that most people surveyed had more trust in the nuclear industry, and its governing agency the NRC, than they had in other agencies such as the Environmental Protection Agency. The study also showed that while some people were in favor of nuclear power as a source of energy, some who were against the energy source were willing to pay additional taxes to prevent the use of nuclear power (Whitfield et al. 2009).

Other studies about nuclear power have been conducted in France and the Netherlands (Wiegman, Gutteling, and Cadet 1995) and in the Czech Republic (Horska et al. 1996). Wiegman, Gutteling, and Cadet's (1995) study showed that there was a

negative relationship between risk perception and perception of benefits. Horska et al. (1996) determined perceptions of environmental changes around a nuclear power plant compared to the environment before plant construction, including both the natural and social environments. The target group in this study was the local population and local government officials. While the sample size was very small, only 27 respondents, the results showed that people feel that plant construction had a negative effect on both the social and natural environment of the area (Horska et al. 1996).

Nuclear Power and Risk Perceptions of College Students

There have been many studies conducted on the risk perceptions of college students (DeJoy 1992; Spigner, Hawkins, and Loren 1993; Maswanya et al. 1999; Siegrist, Cvetkovich, and Roth 2000; Parsons et al. 2002). However, few studies exist on college students' perceptions of nuclear power plants (Slovic, Lichtenstein, and Bischhoff 1979; Peters, Burraston, and Mertz 2004; Siegrist, Carmen, and Cousin 2006). These researchers surveyed college students about their perceptions of nuclear power, but not all surveys were strictly for college students (Slovic, Lichtenstein, and Bischhoff 1979), and not all were strictly about nuclear power (Siegrist, Carmen, and Cousin 2006).

Slovic, Lichtenstein, and Bischhoff (1979) surveyed two groups, the League of Women Voters in Oregon and a sample of students from the University of Oregon, to determine their perception of risk and perception of benefits. Nuclear power had a relatively low benefit compared with the other items listed, including vaccinations, hunting, and handguns, while the perceived risk was higher than the other listed items. The researchers noted that there is a disconnect between what the public thinks and what

experts think. The experts feel nuclear power is safe, but the general public, which includes both groups studied, feels that nuclear power is a risky source of power. However, in this article, a statement was included in the journal submission that the survey was conducted prior to the Three Mile Island accident, and opinions are likely to have changed after this event; this study does not tell how students' risk perceptions were impacted by this accident (Slovic, Lichtenstein, and Bischhoff 1979).

Siegrist, Carmen, and Cousin (2006) studied attitudes toward nuclear power with the hypothesis that college students have negative attitudes toward nuclear power, whether they approve of its use or not. The results showed that more college students had negative attitudes toward nuclear power than they did to hydroelectric power and that most students approve of hydroelectric over nuclear power. While these researchers performed an interesting study, the research was conducted in Europe, not in the U.S., and studied perceptions of nuclear power and mobile phone stations, not specifically nuclear power perceptions (Siegrist, Carmen, and Cousin 2006). Peters, Burraston, and Mertz (2004) studied multiple sources of radiation, including nuclear power, to determine if emotions impact risk perception. The study used topics that students generally have opinions about, usually opinions formed by outside influences based on a stigma and not necessarily personal experience. The results showed that, in general, if a person has a lasting impression or emotional scar about a topic, whether it was formed through experience or stigma, this would affect their emotions related to the topic, including their impressions of nuclear power. This study on risk perception based on emotions was not specifically geared toward perceptions of nuclear power so much as it was to radiation sources in general (Peters, Burraston, and Mertz 2004).

The research discussed in this section is not a final consensus of perceptions among all current college students. The attempt of the current research is to add to nuclear power risk perception research by investigating the current perceptions of students in Texas. The research in this literature review is either dated or conducted in conjunction with other technologies and is not explanatory of what students in Texas, or the United States, feel about nuclear power.

CHAPTER IV

METHODOLOGY

The purpose of this research is to determine the risk perceptions of college students pertaining to nuclear power plants. Previous research has employed different methods for obtaining human perceptions of nuclear power (see for example Slovic, Lichtenstein, and Bischhoff 1979; Peters, Burraston, and Mertz 2004; Siegrist, Cvetkovich, and Roth 2006). In this study, we administered a structured, scantron-based survey to college students taking undergraduate classes in the Department of Geography at Texas State University-San Marcos, Texas.

Study Area

San Marcos, Texas is located along Interstate 35, between San Antonio and Austin, the state capital of Texas. San Marcos's population is around 50,000. This moderately sized town is home to Texas State University-San Marcos. As of 2009, Texas State had a population of 30,803 students (Texas State University-San Marcos 2010). San Marcos is located about 150 miles northwest of the South Texas Nuclear Project near Bay City, Texas and about 200 miles south of the Comanche Peak Nuclear Power Plant near Glen Rose, Texas.

The survey (Appendix 3) was administered directly to students in the classroom in undergraduate courses being offered in the 2010 spring semester through the Department

of Geography at Texas State University-San Marcos. The surveys were administered to students in February and March of 2010. These undergraduate courses included meteorology, physical geology, historical geology, and world regional geography. These classes are offered in either the late morning or afternoon hours. Undergraduate students of any major are able to take these classes, so the enrollment is not restricted to geography majors only. These courses are required for certain majors by Texas State University-San Marcos, and these courses count for science or social science credits. The population of students at Texas State enrolled in courses offered by the Geography department was between 1000-1200 students during the Spring 2010 semester.

Survey Design

The survey was designed according to previous research. This survey questioned students about their risk perceptions of nuclear power, using questions measured on a Likert Scale with the following options: strongly agree, agree, neutral, disagree, and strongly disagree. This study also assessed students' perceptions of the benefits associated with nuclear power. Wiegman, Gurreling, and Cadet (1995) found that people in France find nuclear power to be risky, but they are more willing to accept nuclear power plants because they perceive the benefits to outweigh the costs. Based on previous research, the following categories, listed in Table 1 below, were explored.

Table 1: Conceptual research variables and related studies.

Category	Previous Research
Risk perception	Siegrist, Carmen, and Cousin 2006; Costa-Font, Rudisill, and Mossialos 2008; Viklund 2003; Whitfield et al. 2009; Van der Pligt, Eiser, and Spears 1984; Gregory 2006; Flynn 1992; Wiegman, Gutteling, and Cadet 1995; Slovic, Lichtenstein, and Bischhoff 1979; Peters, Burraston, and Mertz 2004
Personal knowledge	Costa-Font, Rudisill, and Mossialos 2008
Trust in various institutions	Siegrist, Carmen, and Cousin 2006; Viklund 2003; Costa-Font, Rudisill, and Mossialos 2008; Whitfield et al. 2009
Benefits perception	Slovic, Lichtenstein, and Bischhoff 1979; Siegrist, Cvetkovich, and Roth 2000; Wiegman, Gutteling, and Cadet 1995
Political ties	Costa-Font, Rudisill, and Mossialos 2008

Some researchers (Viklund 2003; Siegrist, Carmen, and Cousin 2006; Costa-Font, Rudisill, and Mossialos 2008; Whitfield et al. 2009) have tested trust as a factor influencing overall perceptions of nuclear power. These researchers have tested trust in institutions regulating the nuclear industry or trust in the source supplying information about the nuclear power plant. Like Whitfield et al. (2009), a list of government agencies and private groups was created, with the statement saying, "Information about nuclear power given to the public by the institutions listed below can be trusted." Students were asked to indicate their level of trust in each institution using a 5-point Likert Scale from strongly agree to strongly disagree.

The trust factor was divided into several different categories, including federal government, the Texas Commission on Environmental Quality (TCEQ), scientists, environmental groups, and energy corporations, to test a broader range of trust issues. These categories were chosen due to their connection to nuclear power. The federal government agencies listed are agencies that are either environmental agencies and response agencies (Environmental Protection Agency, Federal Emergency Management Agency) or they are energy regulating agencies (Department Of Energy, Nuclear Regulatory Commission). The Texas Commission on Environmental Quality was chosen for both its environmental protection duties (Texas Commission on Environmental Quality 2010) and because of its authority over nuclear waste disposal, both high- and low-level waste, in Texas (Texas Commission on Environmental Quality 2009). Scientists were chosen for their role in researching and reporting pertinent information to the public. Environmental groups were added because of their interest in the

environment. Energy corporations were included because of their role as private suppliers of energy, whether nuclear or other types of energy.

In addition to trust, respondents were also asked about their personal knowledge of nuclear power. Previous research has shown that the more knowledgeable a person is about nuclear waste, the less likely they are to support nuclear power (Costa-Font, Rudisill, and Mossialos 2008). This idea of personal knowledge was tested in this study, and the hypothesis is that the more knowledgeable a person is about nuclear power, the higher their risk perceptions of the technology will be. However, the current study not only tested knowledge of nuclear waste, but it also questioned students about other aspects of nuclear power, including knowledge of nuclear power plant emissions and number of nuclear plants in Texas and the U.S.

Costa-Font, Rudisill, and Mossialos (2008) found that political ties toward certain parties could influence perceptions. These researchers also found that those with strong ties to any political party did not support nuclear power as much as people without strong ties to a political party (Costa-Font, Rudisill, and Mossialos 2008). The Costa-Font, Rudisill, and Mossialos (2008) study was conducted in the United Kingdom, and while this country has a different political system than in the United States, this idea may still prove to be a significant factor in risk perception of nuclear power plants. Therefore, the association of political affiliation and strength of affiliation was tested.

In an effort to advance our understanding of current risk perceptions of nuclear power among college students, exploratory questions were included in this survey that, to the author's knowledge, have not been analyzed by previous researchers. Students were

asked if they knew anyone who had previously worked in the energy industry, or if they themselves had ever worked in the energy industry. Either of these associations might influence students' perceptions of nuclear power by giving them extra insight into the energy industry. Students were asked to indicate on a scale from strongly agree to strongly disagree if they think it is likely that the U.S. will experience a major nuclear power plant accident in their lifetime. If students think a disaster is likely to occur in their lifetime, they may feel more negatively about the use of nuclear power as an energy source. The stipulation of an "accident in my lifetime" was added to this question because it put a longer timeframe on the questions than asking about "in five years", as this would likely decrease a students' perception of this chance. Most students feel that they have many years left to live, so to ask them about this chance in their lifetime is giving them a longer timeframe. It also puts this chance into perspective by giving them less boundaries than to specify a specific timeframe. This question was included as a question to assess risk perception. Another exploratory question asked students if they vote in every election. This question was meant to assess voting behavior of the student and may influence their risk perceptions.

Although a full exemption was granted for this study (see Appendix 1 & 2), nuclear power might be considered a controversial and potentially upsetting subject, the Institutional Review Board (IRB) of Texas State University-San Marcos had suggested that the survey include a consent statement. This statement informed respondents that their participation in the survey was voluntary and that they could withdraw from the survey at any time if they felt uncomfortable with the study questions. In order to retain

the respondents' anonymity, the survey did not include any information that could tie a specific survey to an individual student.

Hypotheses

For the categories tested in this thesis (risk perception, benefit perception, knowledge, trust in institutions, and political ties), hypotheses were made from the results of previous research. Texas State University-San Marcos college students have negative perceptions of nuclear power resulting in high perceptions of risk. Since risk perception and benefit perception generally have an inverse relationship with each other, students have low assessments of benefits from nuclear power. Another hypothesis is that if students are knowledgeable about nuclear power, they know the actual risks associated with the technology, and have a higher risk perception. If students trust the institution supplying information about nuclear power plants, they have a more positive opinion of nuclear power, which will result in a lower risk assessment. Finally, a student's political philosophy, party affiliation, strength of affiliation, and voting behavior will influence risk perception of nuclear power. It is hypothesized that students who associate with conservative politics will assess risk from nuclear power lower than liberal philosophies. Republicans will differ from Democrats or Independents in their perception of nuclear power plant risk. Students with strong ties to their preferred political party have higher risk perceptions of nuclear power. In terms of voting behavior, those who vote more often are more caring citizens and differ from those who do not vote in every election in their assessment of risks associated with nuclear power. These hypotheses are summarized into Table 2.

Table 2: Hypotheses of research results.

Category	Hypotheses
Risk perception	Students who have high perception of risks of nuclear power have negative opinions of nuclear power.
Benefits perception	Students who have high perception of risks of nuclear power have lower perception of benefits of nuclear power.
Personal knowledge	The more knowledgeable about nuclear power, the higher the perception of risks.
Trust in institutions	The more trusted the source of information (regardless of the institution), the more accepting the students will be of nuclear power, and the lower their risk perceptions.
Trust in federal government	The more trusted the source, the lower the risk perceptions of nuclear power. The students have more trust in the NRC than they do in the EPA or in private companies.
Political ties	Students with stronger ties to a political party have higher risk perceptions of nuclear power. Alignment with the Republican party and conservative politics has lower risk perceptions of nuclear power.

Data Analysis

Survey responses were coded for analysis and entered into SPSS (2001). The main intention of this research is to determine which characteristic(s) have the strongest influence on Texas State students' perceptions of nuclear power. Descriptive statistics and frequencies were rendered, and correlations and chi-square used to test for relationships as specified in the hypotheses.

First, correlations were run for each of the responses assessing similar ideas. For example, the four risk perception statements were correlated with each other. Since each of these items were significantly related to each other, they can be combined into an index variable. These same correlations were done for each category, and each one proved to be significantly related. Therefore, all of the questions assessing a specific idea were combined into indexes.

To create these indexes, each answer choice for each question on the survey was coded with a numerical value. Answers of strongly agree received a value of 5, answers of agree received a value of 4, neutral responses received a value of 3, and disagree and strongly disagree were given values of 2 and 1, respectively. For each category, these numerical values were averaged to create an index or score for that category. The reason the index variables were calculated in this manner was so that the responses could be compared with other variables that are only one question where the total value could only be 5, such as the TCEQ variable. An index was calculated for risk perception, benefit perception, trust in federal institutions, trust in scientists, and trust in environmental

groups. Survey statements for knowledge, trust in TCEQ,trust in energy corporations, and political party affiliation, political philosophy, strength of party affiliation, and voting behavior were used as individual items to test independently against the risk perception index. An example of how the indexes were created, and which statements were used to calculate each new variable, is illustrated in Figure 1-5.

1) Overall, nuclear power plants are risky.

A	B	C	D	E	
5	4	3	2	1	Value: 4

2) The operation of a nuclear power plants poses a high risk to the environment.

A	B	C	D	E	
5	4	3	2	1	Value: 3

3) The operation of a nuclear power plants poses a high risk to local communities.

A	B	C	D	E	
5	4	3	2	1	Value: 5

7) It is likely that the U.S. will experience a major nuclear power plant accident in my lifetime.

A	B	C	D	E	
5	4	3	2	1	Value: 2

Total Risk Perception Score: 14

Risk Perception Index Value: 3.5

Figure 1: Statements in and creation of risk variable index.

4) Nuclear power plants are good for the environment.
A B C D E

5) Nuclear power plants are better for the environment than fossil fueled plants.
A B C D E

6) Nuclear power plants are better for the environment than renewable energy alternatives (wind, solar, etc.)
A B C D E

8) More nuclear power plants should be built to help reduce greenhouse gas emissions in the United States.
A B C D E

9) It is better to build new nuclear power plants than to build new fossil fueled plants.
A B C D E

Figure 2: Statements in benefit variable index.

10) U.S. Environmental Protection Agency (EPA)
A B C D E

11) U.S. Nuclear Regulatory Commission (NRC)
A B C D E

12) U.S. Department of Energy (DOE)
A B C D E

13) Federal Emergency Management Agency (FEMA)
A B C D E

Figure 3: Statements in trust in federal government variable index.

15) University Scientists				
A	B	C	D	E
16) Government Scientists				
A	B	C	D	E

Figure 4: Statements in trust in scientists variable index.

17) Sierra Club				
A	B	C	D	E
18) Green Peace				
A	B	C	D	E

Figure 5: Statements in trust in environmental groups variable index.

A knowledge index was not created, though. Instead, values were given to responses based on whether the student answered the question correctly. For a correct answer, the response got a value of 1. For incorrect answers or responses of "I don' know", responses were given a value of 0. Rather than combine these values into one index, we decided to run correlations for each individual question against the risk perception index to determine which of the knowledge survey items have the strongest influence on risk perception. The same type of analysis was conducted for the political questions as well. For each of the four questions assessing students' political affiliation, a value was assigned to each response, and each of these questions were tested against the risk perception index.

Once the indexes were created, correlations were run between the risk perception index and each of these composite variable indexes or individual survey items. If these items were significantly related to the risk index, the item was put into the regression model. The questions that could not be correlated, i.e. those statements with nominal values, were analyzed using a chi-square analysis and a cross tabulation. The chi-square analysis determined if the items were significantly related to each other, and those that were, were added into the regression model.

After relationships were established, those composite variables or individual questions that had a statistically significant relationship to risk perception were added to the regression model. The distributions of the individual survey items and composite variables were not normal distributions. Also, the variables were not mutually exclusive of each other and were instead interrelated. Therefore, a parametric stepwise regression

could not be run. Instead, a nonparametric analysis was chosen and factors were entered into a stepwise, multinomial logistic regression model based on their significance from the most significant to the least significant relationship to the risk perception composite variable, with a cut off at a significance level of 0.05. All variables with a significance of >0.05 were excluded from the regression model.

CHAPTER V

RESULTS

The survey for this thesis was administered in classes at Texas State University-San Marcos during the spring 2010 semester using a scantron for students to record their responses. In these courses, 239 students voluntarily took the survey. Two students did not complete the survey for personal reasons that the researcher is unaware of, but the survey did include a statement that students were able to withdraw from the survey at any time and for any reason if they were not comfortable with the questions. In another case, one of these students was a graduate student, and these responses were not used for the statistical analysis since the study focused on undergraduate students. Therefore, the results of this research and statistical analyses are based on the opinions and perceptions of 236 Texas State undergraduate students of various ages and from various Texas State majors.

These scantrons were then run and recorded by the Texas State Testing Center, and results were sent to the researcher for analysis. Most students completed all questions, but a few students left some questions blank. These surveys were still used, but any questions left blank by any students were reported in the Frequencies subsection. The responses left blank were not included in the statistical calculations of this research.

Frequency of Survey Responses

Frequencies were calculated for the 38 questions in the survey questionnaire. These frequencies are shown in Tables 3-11. Since the risk perception questions in this survey were negatively worded questions, a response of "strongly agree" means a negative opinion of nuclear power and a response of "strongly disagree" means a positive opinion of nuclear power. The frequencies shown in Table 3 indicate that a majority of students have a negative opinion of nuclear power plants. For each statement assessing risk perception, less than 10% of the students answered "strongly disagree", showing that many students feel nuclear power is a risk. For the question about the potential for a major nuclear power plant accident, 36.9% of respondents felt that this was a possibility, showing a majority of students think a nuclear power plant accident might occur during their lifetime. Another 31.8% were neutral about the potential for a major accident, showing they were unsure of this possibility. Only 10.2% felt that a major nuclear power plant accident was imminent in their lifetime, and less than 10% felt that this possibility was unlikely. However, the responses for the remaining three risk perception questions had at least half of the respondents answering either "strongly agree" or "agree". For the question about overall nuclear power plant risk, almost 55% of students answered "agree" or "strongly agree". For the questions about nuclear power plants' risk to the environment and to local communities, 64% and 62.3% of respondents answered either "agree" or "strongly agree", respectively.

Table 3: Frequency table showing the risk perception of nuclear power plants.*

Scale	Overall Risk of Nuclear Power Plants		Nuclear Power Plant Risk to Environment		Nuclear Power Plant Risk to Local Communities		Nuclear Power Plant Major Accident Potential	
Strongly Agree	49	20.8%	56	23.7%	51	21.6%	24	10.2%
Agree	80	33.9%	95	40.3%	96	40.7%	63	26.7%
Neutral	57	24.2%	46	19.5%	49	20.8%	75	31.8%
Disagree	35	14.8%	30	12.7%	29	12.3%	51	21.6%
Strongly Disagree	15	6.4%	9	3.8%	11	4.7%	23	9.7%
	N=236		N=236		N=236		N=236	

*Survey questions 1-3, and 7

For the questions regarding benefits, the results are summarized in Table 4. For the statement about the benefits of nuclear power plants' to the environment, 40.3% responded with "disagree", and 27.5% answered "strongly disagree" to the statement, showing that most students do not feel that nuclear power is good for the environment. For the statement about nuclear power being better than fossil fuels, 36.4% either agreed or strongly agreed, and 36.9% of respondents answered "neutral". A small percentage, 26.6% do not feel that nuclear power is better than fossil fuels.

The next question compared the benefits of nuclear power to alternative energy, making the statement that nuclear power was better for the environment than alternative energy sources such as wind and solar power. Less than 8% agreed with this statement while more than half (51.3%) strongly disagreed with this statement and another 28.4% disagreed with this statement. Only 7.7% of students either agreed or strongly disagreed that nuclear power is better than alternative energy sources.

41.9% of students felt neutral about the statement that nuclear power plants should be built to help reduce greenhouse gasses. 20.8% disagreed and 7.2% strongly disagreed with this statement, leaving 29.2% who responded with either agreed or strongly agreed.

The last question to assess student perceptions of the benefits associated with nuclear power plants was a statement that said that it was better to build-nuclear power plants than fossil-fueled plants. For this statement, 44.9% remained neutral on this subject. Combined, responses of "strongly agree" and "agree" accumulated 37.3% of the

responses with individual percentages at 10.6% and 26.7%, respectively. The remaining 16.5% of the responses chose responses of "disagree" and "strongly disagree".

Table 4: Frequency table showing the perception of benefits from nuclear power plants.*

Scale	Nuclear Power Plants are good for the Environment		Nuclear Power Plants are better than Fossil Fueled Plants		Nuclear Power Plants are better than Alternative Energy		Nuclear Power Plants reduce Greenhouse Gases		Better to Build Nuclear Power Plants than Fossil Fuel Plants	
Strongly Agree	9	3.8%	34	14.4%	7	3.0%	25	10.6%	25	10.6%
Agree	15	6.4%	52	22.0%	11	4.7%	44	18.6%	63	26.7%
Neutral	52	22.0%	87	36.9%	30	12.7%	99	41.9%	106	44.9%
Disagree	95	40.3%	40	16.9%	67	28.4%	49	20.8%	21	8.9%
Strongly Disagree	65	27.5%	23	9.7%	121	51.3%	17	7.2%	18	7.6%
	n=236		n= 236		n=236		n=234		n=233	

*Survey questions 4-6, and 8-9

The next set of statements was intended to determine students' trust in information from various government and private institutions. The statement that preceded these institutions read, "Information about nuclear power given to the public by the institutions listed below can be trusted." The institutions were than listed asking students to respond on a scale from strongly agree to strongly disagree. Each institution listed was grouped into similar categories, and the following trust categories were developed: federal institutions, TCEQ, scientists, environmental groups, and energy corporations. The results for federal institutions are listed in Table 5.

In general, more people agreed than disagreed with the statement that they trust information supplied by these institutions about nuclear power. Over 40% of the students agreed that they trust the Environmental Protection Agency (EPA), and 31% were neutral as to their trust of them. Only 10.1% of the students responded with either "disagree" or "strongly disagree", showing that a large portion of the students trust or are neutral about their trust in the EPA. Of the respondents, 11 students skipped this question, so the above percentages were calculated with those 11 students omitted.

In responses of trust in the Nuclear Regulatory Commission (NRC), 44.5% of students felt neutral about their trust in this source. 33.9% agreed that they trust NRC information, and 8.9% strongly agreed in their trust of information from the NRC. Less than 12% of students disagreed or strongly disagreed that they can trust NRC information.

Table 5: Frequency distributions of student trust in nuclear power information from federal institutions.*

Scale	Environmental Protection Agency (EPA)		Nuclear Regulatory Commission (NRC)		Department of Energy (DOE)		Federal Emergency Management Agency (FEMA)	
Strongly Agree	31	13.3%	21	8.9%	19	8.1%	10	4.2%
Agree	96	40.7%	80	33.9%	79	33.5%	59	25%
Neutral	74	31.4%	105	44.5%	108	45.8%	114	48.3%
Disagree	14	5.9%	26	11%	25	10.6%	38	16.1%
Strongly Disagree	10	4.2%	4	1.7%	5	2.1%	15	6.4%
	n=225		n=236		n=236		n=236	

*Survey questions 10-13

For the Department of Energy (DOE), the majority of responses, 45.8%, were neutral about whether they trust DOE information on nuclear power. 33.5% agreed that they can trust the DOE, and only 8.1% felt strongly that they agreed to trusting the DOE. However, 12.7% of students disagreed or strongly disagreed in trusting DOE information.

In trusting the Federal Emergency Management Agency information, 48.3% were neutral about their trust in this federal government agency. 25% agreed that they can trust FEMA, and 4.2% strongly agreed that they trust nuclear power information from FEMA. On the flip side, 22.5% of students either disagreed or strongly disagreed with the statement that they can trust FEMA for nuclear power information.

Of the four federal government-regulating agencies listed in this survey, the students trusted the EPA more than any other agency listed, and they trusted FEMA the least out of the agencies listed on the questionnaire form. More students were neutral of their trust in FEMA than any other source, and more students answered "disagree" and "strongly disagree" for trust in FEMA than for any other source. These results also show that these students trusted an environmental agency (EPA) for nuclear power information more than they trust the government agency that regulates nuclear power operations in the United States.

The results for the remaining trust questions appear in Table 6 on the following page.

Table 6: Frequency distributions of student trust in nuclear power information from a Texas government institution, scientists, environmental organizations, and energy corporations.*

	TCEQ		University Scientists		Government Scientists		Sierra Club		Green Peace		Energy Corporations	
Strongly Agree	23	9.7%	27	11.4%	10	4.2%	10	4.2%	19	8.1%	7	3.0%
Agree	83	35.2%	86	36.4%	51	21.6%	38	16.1%	48	20.3%	48	20.3%
Neutral	110	46.6%	93	39.4%	119	50.4%	126	53.4%	87	36.9%	101	42.8%
Disagree	14	5.9%	23	9.7%	47	19.9%	43	18.2%	51	21.6%	45	19.1%
Strongly Disagree	6	2.5%	7	3.0%	9	3.8%	19	8.1%	31	13.1%	34	14.4%
	n=236		n=236		n=236		n=236		n=236		n=235	

*Survey questions 14-19

One Texas agency was listed, the Texas Commission on Environmental Quality (TCEQ), as they are an environmental agency in Texas and oversee waste disposal in Texas. For this agency, the majority (46.6%) of students were neutral about whether or not they trust the TCEQ. Of those students that trust the TCEQ, 35.2% answered "agree", and 9.7% "strongly agreed" that they trust the TCEQ. Only 8.4% of students did not trust the TCEQ.

In terms of trusting university scientists, 11.4% of those surveyed strongly agreed that they trust information from university scientists, and 36.4% agreed that they trust university scientists' information. Only 12.7% of respondents either disagreed or strongly disagreed that they trust nuclear power information given to them by university scientists and 39.4% were neutral.

For government scientists, the responses were quite different. Over half of the respondents, 50.4%, were neutral about whether they trust nuclear power information from government scientists, and combined, 25.8% agreed or strongly agreed that they trust government scientists. Combined, 23.7% of respondents either disagreed or strongly disagreed with the statement that they trust government scientists.

Two environmental groups were listed in this survey, Sierra Club and Green Peace, for students to express their trust in information given by these groups. For the Sierra Club, 53.4% of students were neutral about their trust in this organization's information. Of the remaining responses, 20.3% either agreed or strongly agreed that they trust the Sierra Club, while the remaining 26.3% disagreed or strongly disagreed that they trust the Sierra Club. Students are surer of their distrust for Green Peace. 36.9%

were neutral about their trust in Green Peace information about nuclear power, but 34.7% disagreed or strongly disagreed that they trust their information. Of those that trust Green Peace, 20.3% agreed that they trust their information group, while 8.1% strongly agreed that they trust Green Peace information.

As with Green Peace, many students are either unsure or did not trust energy corporations such as TXU Energy or Centerpoint Energy. For this variable, 42.8% of students are neutral of their trust for energy corporations, and only 23.3% trust them. The remaining 33.5% do not trust energy corporations, with 19.1% answering "disagree" and 14.4% answering "strongly disagreed" to this question. One person did not respond to the question of whether they trust energy corporations, so the above percentages are based on results without this student's response.

The next questions assessed students' knowledge of nuclear power. The results of these survey items are summarized in Table 7 and 8. The first two questions in the knowledge section asked students if they currently do or previous had worked in any sector of the energy industry. Ten students, 4.2% of all respondents, responded that they currently do or previously had worked in the energy industry. Most of the students, 211 students or 89.4%, have no experience in the energy industry. The remaining 15 students either did not answer this question and left it blank (10 students) or they responded by filling in a scantron answer that was not a choice on the survey. The next question assessing knowledge asked students if anyone they know works or worked in the energy industry. Ninety-eight students (41.5%) know someone who currently works or previous worked in the energy industry. Again, a majority, 134 or 56.8% students, do not know

anyone in the energy industry. Either the remaining four students (1.7%) responded with an answer that was not a survey choice or they left the question unanswered.

In evaluating knowledge, multiple-choice questions were given asking specific questions about nuclear power plants and things related to nuclear power. For the first six questions, students were asked questions in which they were to answer yes or no. In the instance that they did not know, they were also given the option to respond, "I don't know". The other two knowledge questions asked students to determine how many commercial nuclear power plants were in Texas and in the United States. The answer choices were a range of numbers, and students either answered or guessed at the correct one. For these two questions, a correct answer shows either knowledge or a lucky guess. The results of student knowledge of nuclear power are shown in Table 8.

Table 7: Frequency of students with experiential knowledge of nuclear power.*

	Yes		No		No Response	
Students working in energy industry	10	4.2%	211	89.4%	15	6.3%
Know anyone working in energy industry	98	41.5%	134	56.8%	4	1.7%

*Survey questions 20-21

Table 8: Students' knowledge of nuclear power.*

	Emit Radiation?		Emit GHG?			Is Nuclear Waste Hazardous?		Storage at Yucca Mountain?		Total Plants in Texas?		Total Plants in U.S.?		Building New Plants?	
Correct	68	28.8%	138	77	32.6%	192	81.4%	30	12.7%	86	36.4%	63	26.7%	95	40.3%
Incorrect	168	58.8%	98	159	67.4%	44	18.6%	206	87.2%	150	63.5%	173	73.3%	141	59.8%
	n=236														

*Survey questions 22-23, and 25 ~~24~~-29

The first question asked if normally operating nuclear power plants emit radiation into the local environment. The correct answer, no, was given by 28.8% of students. 30.5% answered yes, and the remaining 40.3% responded, "I don't know." One student answered this question with an option that was not an answer choice, so this answer was combined with the incorrect responses.

The next question asked students if nuclear power plants emit greenhouse gases (GHG). Of the three answer choices, 32.6% gave the correct answer of no. 22.9% responded yes, an incorrect answer, and 44.5% did not know.

Students were then asked to evaluate whether radiation, regardless of its source poses a high risk to humans. This question, however, was a poorly worded question, as radiation is present in the atmosphere daily but is not a high risk to humans. Therefore, the results of this question were discarded and were not used in assessing risk perceptions of nuclear power.

The next question, about nuclear waste, asked if waste from nuclear power plants is hazardous to humans. The correct answer, yes, was given by 81.4% of the students, while the incorrect answer, no, was given by only 3.8%. 14% responded that they did not know, showing that many students understand that nuclear waste is a hazard to people. Two respondents, however, did not respond to this question. Whether students know that nuclear waste is a source of radiation was not assessed by this survey. The survey, also, did not assess whether students understand the exact hazards associated with nuclear waste, as these questions were beyond the scope of this study.

The following question also asked about knowledge of nuclear waste, and the question asked if all waste from U.S. nuclear power plants was stored at one site near Yucca Mountain in Nevada. While this site has yet to be approved as a long-term storage repository, most students did not know this. 70.3% responded that they did not know, and 16.1% said yes, giving the incorrect answer. Only 12.7% know that nuclear waste is not currently stored at Yucca Mountain. One student left this question blank. Even though the focus of this study is not about nuclear waste, nuclear waste hazard and storage is considered nuclear power knowledge. If students know about nuclear waste, they likely have some knowledge of nuclear power in general.

The next two questions did not give students the option "I don't know" so students were forced to guess if they did not already know. For the question about the total number of plants in Texas, 36.4% of students gave the answer with the correct range, 0-5. There are currently two operating, commercial nuclear power plants in Texas: the South Texas Nuclear Project and the Comanche Peak Nuclear Power Plant. Of the incorrect answers, 27.5% said 6-10 plants, 21.6% said 11-20, 6.4% answered 21-30, and 4.1% answered 31+. These results show that a third of respondents know about how many nuclear power plants are located in Texas, but these answers could have been a lucky guess. Nine students did not respond to this question.

The next question asked about the total number of commercial nuclear power plants in the United States. The correct range is 51-75, because there are 65 operating nuclear power plants in the United States that produce electricity for public consumption. Only 26.7% answered this question correctly, adding up to 63 students. Of the incorrect

answers, 15.7% answered 0-25, 18.2% answered 26-50, 16.1 responded with 76-100, and 19.1% said that there were 100+ plants in the U.S. The results of this question showed that most students do not know how many plants are in the United States. Of those that did answer correctly, the response may have been from knowledge or it could have been a lucky guess.

Next respondents were asked if companies in the U.S. were currently building or planning to build new nuclear power plants. This issue was addressed in the "Introduction" section of this paper, and multiple companies are submitting requests for permits to build nuclear power plants. 40.3% of students answered yes, while only 6.4% answered incorrectly that companies are not currently nor are they planning to build new nuclear power plants. 53% of respondents did not know, and one student responded with an answer that was not an option on the survey.

The next set of questions asked students to identify their political affiliation. The results of the political questions are summarized in Tables 9-10.

Table 9 shows student responses about their personal political philosophy. The choices given for this question were: conservative, moderate, liberal, other and none. 25% of students were conservative, 28% were moderate, and 27.1% describe themselves as having a liberal political philosophy. 9.7% answered either other or none, meaning their personal philosophy is not aligned with one of those listed or they do not define themselves as having a political philosophy.

Table 9: Students' personal political philosophy and party affiliation.*

Political Philosophy	Number	Percent	Political Party	Number	Percent
Conservative	59	25.0%	Republican	72	30.5%
Moderate	66	28.0%	Democrat	51	21.6%
Liberal	64	27.1%	Independent	50	21.2%
Other	23	9.7%	Other	19	8.1%
None	24	10.2%	None	42	17.8%
	n=236			n=234	

*Survey questions 30-31

The next question asked students about their political party affiliation. Students were asked to state their political party affiliation. The choices given are as follows: Republican, Democrat, Independent, other, and none. Table 9 shows the percentages and number of students who define their party affiliation based on these categories. The majority of students, 30.5%, defined themselves as Republicans, 21.6% defined themselves as Democrats, and 21.2% align with the Independent party. An additional 8.1% defined themselves as aligning with some other party not listed, and the remaining 17.8%, claim to not align with any particular political party. Two of the student surveyed did not respond to this question, leaving 0.8% of the sample unknown.

A follow-up question stated, "I am very strongly connected with this political party." For this question, some responses were removed. If a person answered the previous question about political party affiliation with a response of "None", then their response to strength of political party would be moot. If they do not have a political party, then their strength of political party connection cannot be measured if a party does not exist. Therefore, those who answered the previous question with "None" were removed from this question and the results are summarized in Table 10. 9.7% were strongly connected to their party, and another 16.1% agreed they are connected to their particular party. 35.6% were neutral in response, and 19.9% either disagreed or strongly disagreed to having a strong connection to their political party.

Students were also given the following statement: "I vote in every election" and were asked to use the answer choices from strongly agree to strongly disagree. The results of this question are also summarized in Table 10.

Table 10: Student political party strength and response to "I vote in every election".*

	Strongly connected to political party?		"I vote in every election"	
Strongly Agree	23	9.7%	38	16.1%
Agree	38	16.1%	57	24.2%
Neutral	84	35.6%	66	28.0%
Disagree	31	13.1%	47	19.9%
Strongly Disagree	16	6.8%	26	10.6%
	n=192		n=234	

*Survey questions 32-33

From the table, one can determine that not many students vote in every election. It appears that more students do vote than do not vote. The results show that 40.3% of students either agreed or strongly agreed with the statement. Twenty-eight percent of students chose neutral for some reason. Those who chose "disagree" or "strongly disagree", 30.5% of students, disagreed or strongly disagreed that they vote in every election. Their specific reasons for not voting, however, were not assessed in this survey.

The remaining questions were about participant demographics. Almost half (48.7%) of the participants were in the "20 and under" age group. Another 36.4% of were classified as 21-25. According to the results, over 85% of the respondents in this survey were 25 years old or younger. 13.5% fell into the 26-50 age groups, which was divided into two intervals for this study, 25-30 and 31-50. The final category was 51 and older, but no one in this study was over the age of 50. However, three students did not fill in their age, and it is impossible to determine what age group these three students fell into.

The next question asked students to identify themselves as either male or female. The results show that more males (121) participated in this study than females (108). For this question, five students chose scantron responses which were not an option on the survey itself. Two students did not answer this question, so there are seven students for which we do not know their sex.

Students were asked for their classification in the university system as freshman, sophomore, junior, senior, or graduate. Table 11 shows that there were more juniors in these classes, followed closely by sophomores. These two groups were only separated by

a very small margin. Seniors and freshman had the smallest number of students represented. One graduate student was surveyed because of their enrollment in one of the surveyed courses. This student's responses, however, were removed from the data for the statistical analysis, as this survey was specifically about undergraduate students at Texas State.

Students were also asked to indicate their major at Texas State as defined by which college on campus hosts their department. The questions were worded and answers were set up in a format that would allow use of the scantron. Since a scantron only has five answer choices and the university has eight colleges, the majors were broken up into two questions. Students were asked to choose their major from the list given, and if their major was not listed in the first set of majors, they were to go on to the next question to find the remaining majors. Some students answered both questions, indicating that they had a major in two different colleges. A majority of students either appeared to be Liberal Art majors or were still undecided. However, since it appears that not everyone answered the question correctly, it is difficult to determine which majors the respondents of the survey appropriately represented.

Table 11: Number of students from each classification group.*

	Number	Percent
Freshman	52	22.0%
Sophomore	63	26.7%
Junior	66	28.0%
Senior	50	21.2%
Not stated or graduate	5	2.1%
	n=236	

*Survey question 36

Bivariate Correlations

Before creating the variable indexes, connections between the individual statements for the variable had to be established to show that the indexes were appropriate and that the statements were similar enough to be combined. For the risk perception variable, the survey items were put into a correlation matrix shown below as Table 12. Since each of the questions has a distribution that is skewed, the variables are nonparametric. Therefore, the Spearman's Rho is the correlation used for the questions assessing risk perception. As the table shows, most of the relationships are strong or very strong relationships, except for the relationship between the potential for a nuclear power plant accident and the other three variables. This one statement is only moderately correlated with the other variables for this index, but since the relationship is still statistically significant, this survey item will still be factored into the risk perception index value.

For perception of benefits, a correlation matrix was also created to determine if the variables were alike enough to be added together to form an index value. The benefit correlation matrix is shown below in Table 13. As with the risk perception variable, a Spearman's Rho correlation was used because not all of the questions had a normal distribution.

Many of the associations in the benefits survey items were weak to moderate associations, with only two strong associations. However, each of the associations is statistically significant at the 0.01 level, and therefore, all of these statements will be used to form the benefit index.

Table 12: Correlation matrix for risk perception questions.*

	Overall Risk of Nuclear Power Plants	Nuclear Power Plant Risk to Environment	Nuclear Power Plant Risk to Local Communities	Nuclear Power Plant Major Accident Potential
Overall Risk of Nuclear Power Plants	1.000	0.765*	0.770*	0.445*
Nuclear Power Plant Risk to Environment	0.765*	1.000	0.800*	0.449*
Nuclear Power Plant Risk to Local Communities	0.770*	0.800*	1.000	0.489*
Nuclear power Plant Major Accident Potential	0.445*	0.449*	0.489*	1.000
	n=236	n=236	n=236	n=236

*Statistically significant at the 0.01 level.

*Survey questions 1-3, and 7

Table 13: Correlation matrix for benefit perception questions.*

	Nuclear Power Plants are good for the Environment	Nuclear Power Plants are better than Fossil-Fueled Plants	Nuclear Power Plants are better than Alternative Energy	Nuclear Power Plants Reduce Greenhouse Gases	Better to build Nuclear Power Plants than Fossil-Fueled Plants
Nuclear Power Plants are good for the Environment	1.000	0.509*	0.400*	0.439*	0.458*
Nuclear Power Plants are better than Fossil-Fueled Plants	0.509*	1.000	0.264*	0.531*	0.746*
Nuclear Power Plants are better than Alternative Energy	0.400*	0.264*	1.000	0.329*	0.303*
Nuclear Power Plants Reduce Greenhouse Gases	0.439*	0.531*	0.329*	1.000	0.617*
Better to build Nuclear Power Plants than Fossil-Fueled Plants	0.458*	0.746*	0.303*	0.617*	1.000
	n=236	n=236	n=236	n=234	n=233

*Statistically significant at the 0.01 level.

*Survey questions 4-6, and 8-9

A correlation matrix is also shown as Table 14 for the variable of trust in federal institutions. Each of the four questions that went into this index variable were tested for relationships to determine if the questions were related to each other and if they could be included in the index variable. The Spearman's Rho correlation was used because these variables were nonparametric. The table shows that trust in these agencies are all related to each other. While most of the correlations are moderate, the correlations between FEMA and the remaining three agencies are weak. However, these relationships are significant with a p-value <0.01 and can therefore be added into the trust in federal agencies index.

In order to determine if university scientists and government scientists were related enough to combine into an index, the correlation matrix in Table 15 shows the associations between these two variables. Again, since these survey items were not normally distributed, they are nonparametric and were tested using the Spearman's Rho. The association between these two factors is a weak one, but the association is significant at the 0.01 level, so these two questions were combined to form one variable to test against risk perception.

Table 14: Correlation matrix for trust in federal institutions questions.*

	EPA	NRC	DOE	FEMA
EPA	1.000	0.599*	0.483*	0.445*
NRC	0.599*	1.000	0.495*	0.288*
DOE	0.483*	0.495*	1.000	0.361*
FEMA	0.257*	0.288*	0.361*	1.000
	n=225	n=236	n=236	n=236

*Statistically significant at the 0.01 level.
*Survey questions 10-13

Table 15: Correlation matrix for trust in scientists.*

	University Scientists	Government Scientists
University Scientists	1.000	0.356*
Government Scientists	0.356*	1.000
	n=236	n=236

*Statistically significant at the 0.01 level.
*Survey questions 15-16

For environmental groups, the same correlation matrix was created and the results are shown in Table 16 below. The results from the nonparametric Spearman's correlation between Sierra Club trust and Green Peace trust are moderately correlated. This correlation is significant, so these two variables were combined into one index variable.

Once the questions were determined to be related with each other, they were combined into one, composite variable determining one specific assessment. These variables were formulated by creating a mean value, such that the responses were added together and divided by the number of responses for that variable. The value was a variable of was the mean of the questions meant to assess that category. The knowledge questions were calculated so that each correct answer received a point value of 1 and every incorrect answer or "I don't know" response received a point value of 0.

In order to test the relative importance of variables in prediction of risk, simple bivariate correlations were first conducted to establish associations to determine which variables should be included in the regression equation. The composite variable index for risk perception was run against the following composite variables: benefit perception, trust in federal institutions, trust in environmental groups, and trust in scientists. The composite variable index for risk perception was also run against the following individual items: trust in Texas Commission on Environmental Quality (TCEQ), trust in energy corporations, each of the nine knowledge questions, the voting behavior question, the strength of political party connection, and the demographics variables: age, sex and classification.

Table 16: Correlation matrix for trust in environmental groups.*

	Sierra Club	Green Peace
Sierra Club	1.000	0.555*
Green Peace	0.555*	1.000
	n=236	n=236

*Statistically Significant at the 0.01 level.

*Survey questions 17-18

The important aspects of the politics questions was not to determine if politics in general had an impact on risk perceptions but to determine if specific political philosophy, political party affiliation, strength of party affiliation, or if voting behavior had an impact on risk perceptions of nuclear power. Therefore, each of these separate questions was correlated individually with the composite risk perception variable to determine if a relationship existed. The only political affiliation question that was significantly related to the risk perception index was voting behavior.

Also included in the correlations was an assessment of the relationship between risk perception and the three demographics questions: age, sex, and classification. Since the results of the question assessing students' major was not answered appropriately by a number of students, this question was not used. All three of these variables were significantly related to the risk perception variable.

To clarify the association between sex and risk perception, the relationship was a negative one. The coding for this question classified females as a one and males as a two. The negative correlation means that females have a higher risk perception of nuclear power than males do.

Those questions that had a correlation to risk perception and had a significance value of <0.05 were added to the stepwise regression for risk perception. The following variables, summarized in Table 17 with their correlation values, were included in the stepwise regression. All of these variables had a significance level of <0.05.

Table 17: Simple correlations for the nine variables included in the stepwise regression.

Variable	Risk Perception Index	n values
Benefit Index	-0.634**	236
Trust in Environmental Groups	-0.253**	236
Knowledge: Nuclear power plants emit radiation.	-0.433**	236
Knowledge: Nuclear power plants emit greenhouse gases.	-0.391**	236
Knowledge: How many nuclear power plants are located in Texas?	-0.301**	227
I vote in every election.	0.203**	234
Sex	-0.353**	229
Age	-0.152*	233
Classification	-0.154*	231

**Statistically significant at the 0.01 level.

*Statistically significant at the 0.05 level.

Chi-square Analysis

To determine significance between the nominal variables and the risk perception variable, chi-square values and cross tabulations were conducted. To meet test requirements, the composite risk perception values for "strongly disagree" and "disagree" were combined. As only a small percentage of students thought that nuclear power was not very risky. The responses for "disagree" and "strongly disagree" were combined into one value, making our risk perception scale from strongly agree to disagree. Also, values in the risk perception mean were rounded so that all values ending in .50 and .75 were rounded up to the nearest whole number and those ending in .25 were rounded down to the nearest whole number. We then ran crosstabs and chi-square tests on the remaining variables, those measured as nominal data.

The first variable, political philosophy was considered nominal because the responses were: conservative, moderate, liberal, other and none. The association with risk perception proved to be statistically significant. In order to normalize the data from nominal to ordinal, the responses for political philosophy of other and none were removed from the analysis. This left the three major political philosophies on the political philosophy spectrum: conservative, moderate, and liberal. A correlation was run between the political philosophy variable and the newly calculated risk perception mean, but the association was not statistically significant.

The next test was to look for relationships between risk perception and political party affiliation. In terms of risk perception, the three parties listed on the survey: Republican, Democrat, and Independent, felt that nuclear power was a risk. In the other

and none responses, the majority also agreed that nuclear power was risky. However, the results of this crosstab and chi-square analysis were not significant, so the variable was not included in into the regression equation. Therefore, neither of these two political questions were entered into the regression equation.

For the demographics questions, correlation tests and chi-square analysis were run on the three demographics questions: age, sex, and classification. The results show significant associations between all three of these factors and the risk perception variable.

Multinomial Logistic Regression

The variables listed in Table 17 above were statistically significant in determining risk perceptions of nuclear power plants among college students at Texas State. The variables did not meet the assumptions for a parametric regression analysis, so a nonparametric analysis was performed instead.

Upon examination of these nine variables, we determined that classification was not a strong variable. In some instances, students may fall into a situation where they are short of one classification by only one or two credit hours. Also, a person does not have to enter college at a certain age. A person may enter college immediately upon graduation from high school, at age 18 or they may enter college at a later date. While there is a connection between age and classification, as most people do enter college immediately after high school graduation, the more appropriate measure of maturity and life experience is age; therefore, age, and not classification, was used in this regression model. The results of the regression analysis are summarized in Table 18.

These eight variables were added into a stepwise, multinomial logistic regression to determine which factors have the greatest influence on risk perceptions. For this regression model, the first variable to enter into the model was a persons' knowledge on whether normally operating nuclear power plants emit radiation into the atmosphere. This variable was the most significant in determining risk perception. The second variable to enter into the model was a students' knowledge of whether nuclear power plants emit greenhouse gases. The third variable to enter into the regression model was the student's sex. The final variable that went into the logistic regression model was the student's voting behavior.

These four factors were the only factors that were significant in explaining students' risk perceptions of nuclear power plants. The remaining four variables: perception of nuclear power benefits; trust in information from environmental groups; knowledge of the number of nuclear power plants in Texas; and age did not meet the set significant level of .05 needed to enter the equation.

The pseudo r-squared value gives a predicted value for what r-squared would be. The value for this analysis, using the Cox and Snell pseudo r-squared value, is 0.635. This value means that we can predict 63.5% of students' risk perceptions using the four variables that proved statistically significant in our stepwise regression analysis.

Table 18: Regression analysis of significant results for variables entered into multinomial logistic regression for risk perception.

Variable	Step entered into the model	Significance value
Benefit Index	Not entered	Not statistically significant
Trust in Environmental Groups	Not entered	Not statistically significant
Knowledge: Nuclear power plants emit radiation.	1st step	<0.00
Knowledge: Nuclear power plants emit greenhouse gases.	2nd step	<0.00
Knowledge: How many nuclear power plants are located in Texas?	Not entered	Not statistically significant
I vote in every election.	4th step	0.04
Sex	3rd step	0.04
Age	Not entered	Not statistically significant
Classification	Not entered	Not statistically significant

CHAPTER VI

CONCLUSIONS

A majority of Texas State students surveyed perceive a high degree of risk associated with nuclear power. Many students have limited knowledge of nuclear power. Since people fear the unknown, with little knowledge about something, students might be fearful of something that is not known to them and rate its risk as high. Many people are aware of previous accidents associated with nuclear power plants and might think that nuclear power is dangerous and rate it as a risk because of these accidents.

Most students did not perceive a high degree of benefits to nuclear power. Two of the questions had a majority of study participants (over 60%) responding with a negative assessment of nuclear power benefits. The remaining three questions had a large number of responses as neutral. From these three questions, it can be seen that students are torn about the benefits of nuclear power versus the benefits of fossil fuels. The two questions that assessed nuclear power versus fossil fuels received a majority of neutral responses, but students were still more in favor of nuclear power than they were against it. These results could be because they did not know or were unsure of whether or not nuclear power truly is better for the environment than fossil fuels. The problem could also be the difficulty of weighing out the costs versus the benefits of nuclear power and the costs and benefits of fossil fuels.

It appears that college students believe that nuclear power has low benefits. A study by past researchers (Alhakami and Slovic 1994) has shown that risks and benefits are indirectly related. If perceptions of one are high, perceptions of the other are low. The same relationship can be seen in this research. Nuclear power plant risks were seen as high, and the benefits were seen as low. While these two variables were related in a simple bivariate correlation, the benefits of nuclear power was not significant in the stepwise regression results explaining risk perceptions.

One aspect that was tested in this research was to compare nuclear power to other forms of energy. Against alternative energy sources, nuclear power was not seen as the better choice. However, compared to fossil fuels, nuclear power was the preferred choice. The feelings of preferring nuclear power to fossil fuels could be a result of concerns for global warming and climate change. These results might also just be a result of the risk perceptions of nuclear power. Regardless of the reason, the indirect relationship between risk and benefit found by previous researchers (Slovic, Lichtenstein, and Bischhoff 1979; Wiegman, Gutteling, and Cadet 1995; Siegrist, Cvetkovich, and Roth 2000) remained true in this research as well.

In terms of trust, the highest response was neutral for the federal government agencies listed (EPA, NRC, DOE, and FEMA). More students trust the EPA than they do any other federal government source. While the majority of students responded neutral to their trust in federal institutions, more students trust the federal government information than do not trust it. Therefore, one can conclude that students trust federal government institutions more than they distrust these sources.

In terms of trust in environmental groups, trust for these two groups, the Sierra Club and Green Peace, the majority of students were neutral. While the percentages were not very high, students tend to distrust environmental groups more than trust them. This is, possibly, why trust in environmental groups and risk perception had a significant relationship in the bivariate correlations. This association between risk perception and trust in environmental groups was an exploratory variable that proved to be an important one. However, this trust variable did not meet the significance level needed to enter into the stepwise regression as a variable to explain risk perceptions.

Viklund (2003) found that the more trusted the source of information, the lower the risk perception of nuclear power. This association did not hold true in this research, and for the current study, while there was a relationship between risk perception and trust in environmental groups, this trust variable did not explain any students' perceptions of risk toward nuclear power in the regression model. The one association found in this study was that as trust in environmental groups increased, student risk perception of nuclear power decreased. This indirect relationship might not be the same as previous findings because of the type of groups listed in the survey instrument. From this research, however, one can conclude that these environmental groups may be presenting positive aspects of nuclear power, so that if students trust these groups, they are more willing to believe that nuclear power is not as risky and have a lower perception of its risks.

For trust of government scientists, over half of the students gave a neutral response, while nearly 40% were neutral on university scientists. A neutral response

could have two potential meanings: students could feel unsure of their actual level of trust or they are unfamiliar with the groups listed and are therefore unable to form an opinion about the trust they feel for this institution. A neutral response might also mean that students are unsure of where they should be getting their information. If students are unsure of where they should get their information, they are likely to have limited trust in any information source. Regardless of the reason for these neutral responses, many students are unsure of their trust in various sources of information, leading them to either trust everyone or trust no one.

Trust in the Texas Commission on Environmental Quality was a variable tested because of the location of the research, their oversight of nuclear waste disposal, and because of their mission to protect the quality of water and air. This association, however, did not have a significant relationship with risk perceptions.

An association that was not found in the present study was that more people trusted the NRC than they did the EPA (Whitfield et al. 2009). In the current study, more people trusted the EPA than they did the NRC. Some reasons for this reversal of trust in these institutions could be that students are unfamiliar with the NRC and do not know what this agency does.

Based on the percentages in the "Results" section, it can also be concluded that students are not very knowledgeable about nuclear power. From the knowledge questions asked, more students responded with incorrect answers or with "I don't know", for six of the seven questions asked. More students know that nuclear power plant waste is hazardous to humans. However, most students are not very knowledgeable about

storage of nuclear waste, nuclear power plant emissions of radiation or greenhouse gases, the total numbers of plants in Texas or in the U.S., and about whether new nuclear plants are being planned or built.

In assessing risk perceptions as a result of knowledge, only three questions were correlated with the risk perception index, knowledge of nuclear power plants emitting radiation, knowledge of nuclear power plant emission of greenhouse gases, and knowledge of the number of plants in Texas. Of these three questions, two proved to be significant in risk perception. The two knowledge questions about emissions of radiation and of greenhouse gases were both statistically significant in the regression analysis, showing that knowledge of these aspects had an impact on risk perceptions of nuclear power. The results showed that if a student got these questions correct, they do not perceive nuclear power to be as risky as those who answered these questions incorrectly or with "I don't know".

The results from this study do not match the results from the Costa-Font et al. (2008) study. Even though the study questions were not about the same topic, since the current study was not limited to knowledge of nuclear waste but included questions about general knowledge of nuclear power, the results here differed. The current study found that, for the two questions about emissions by nuclear power plants, students who knew about what nuclear power plants emitted saw them as less risky than those who were not aware of plant emissions. In the previous study Costa-Font et al. (2008) study, the researchers found that less knowledgeable people support nuclear power. The difference in associations between the current and the previous study could stem from the fact that

the previous study was limited to knowledge of nuclear waste while the current study used a more comprehensive assessment of knowledge, including nuclear power plant emissions. Had the questions impacting risk perceptions been waste related questions, the results might have matched those of the previous study (Costa-Font et al. 2008).

For the politics questions, many of the results were unexpected. Not everyone who called themselves a Republican said they were conservative in their political philosophy. The same is true of Democrats and liberal views, but there was a moderate association between political party and political philosophy that was statistically significant. More students in the study were Republican than any other political party but more students were moderate or liberal in their philosophy than other groups, although there was a fairly even spread among conservatives, liberals, and moderates.

Costa-Font et al. (2008) found that strong political ties to any political party did not support nuclear power. The results from the previous study (Costa-Font et al. 2008) found that strength of connection to any political party was a major contributor to risk perception of nuclear power. While in the current study, there proved to be no relationship between political party, political philosophy or strength of connection to political party and risk perceptions, the one association that did exist was between risk perceptions and voting behavior. Even though the correlation was weak (0.203), it was statistically significant and was one of the four variables that went into the stepwise regression model to explain the risk perceptions of nuclear power among students.

These political results could be related to the area of study. The research by Costa-Font et al. (2008) was conducted in the United Kingdom and the current research

was conducted in Texas. The political parties in these two countries are not the same, so strength of connection to a party might not show the same results in terms of risk perception of nuclear power.

Some explanation for political involvement affecting risk perception of nuclear power can be suggested. These differences may be because those who vote in every election are more informed and are therefore more aware of topics in political debate. With nuclear power gaining attention in the political forum, those who are politically informed about important and emerging topics should be aware of the debates following nuclear power. Those who vote in every election care about the future of their country and care about the people who live in it.

Students in the current survey appeared to have great concern for the environment. In the knowledge questions assessing knowledge of nuclear power plant emissions, the relationship was a negative one, showing that those with knowledge perceived a lower risk. This relationship may show that students are concerned about the environment, and that they think nuclear power is less of a risk if it is not a threat to air quality, as fossil-fueled plants are. Students' concern for the environment was also apparent in the results of the correlation matrix for the benefit questions. The concern for the environment, in this study, is equal to student concerns for local communities. In the correlations between overall risk and risk to local communities versus overall risk and risk to the environment, the correlations were very similar. Both relationships were strong and significant relationships, and the concern for local communities was only a slight margin above the concern for the environment. These associations show that

students are just as concerned about the environment as they are about people being negatively impacted by nuclear power plant risks.

CHAPTER VII

DISCUSSION

The purpose of this section is to discuss what the results mean and to discuss possible changes to the Methodology section of this study that might produce new or different results. Given the results found in this study, there are many things that can be said of the future of nuclear power.

As the results of this study show, college students find nuclear power to be a risky source of electricity. Previous research (Slovic, Lichtenstein, and Bischhoff 1979; Van der Pligt, Eiser, and Spears 1984; Flynn 1992; Wiegman, Gutteling, and Cadet 1995; Peters, Burraston, and Mertz 2004; Gregory 2006; Siegrist, Carmen, and Cousin 2006; Whitfield et al. 2009) shows that the general public and college students have disliked and still dislike nuclear power. While the general public fears that nuclear power may be too risky, the experts still feel that nuclear power is safe, and that the associated risks are low. One can conclude that the general public is not informed on the associated risks or the experts are not taking enough factors into consideration when calculating risk. To bridge this knowledge gap, there should be an open forum to allow the public to explain their risk assessments and ask questions of the experts about their professional risk assessment.

If the government plans to allow the building of new nuclear power plants, they should consult with the public about their concerns. The public should also be kept informed of decisions that could affect them, and they should also be informed about the

potential dangers of nuclear power. This will allow people to make informed decisions about nuclear power.In conducting this research, many students appeared to be uninformed about nuclear power, and did not have much experience with or knowledge of it. Since college students are the future leaders and decision makers in this country, they should be more informed about topics that will affect their future. Students should not only learn the history of this country and the world, they should also know about the future of the U.S. and the world. Since nuclear power is a growing energy source that is seen as a reliable alternative to the main source of energy in the U.S., fossil fuels, it is inevitably in our future. The role that nuclear power will play in the future depends on these decision makers, who should be informed about it before making a major decision about it.

The research in the present study has important implications for future research. Nuclear power plant perceptions are important to the future of nuclear power, so additional research is needed in this field of study. Future studies could be done at a different university to determine if risk perceptions differ based on location or proximity of the school to a nuclear power plant. Studies could be done in another state, perhaps a state with no nuclear power plants, to determine if risk perceptions differ based on the fact that nuclear power is not a direct threat in their area. A study could also be done in a region with a higher density of nuclear power plants, such as in the Northeastern portion of the U.S. to see if perceptions change with exposure to power plants and to determine if living with the risk on a daily basis affects people. Since perceptions may differ based on the area of the U.S. that the study is performed in, research conducted in a Northeastern state may have results different than those found in this study. It might be of interest to

compare these perceptions with those found of people in Texas or in the Southwest region of the U.S.

Research could also compare the risk perceptions of college students versus other age groups. For example, keeping the variables used in this study the same, it might be worthwhile to perform this study on a different age group, say a middle-aged group or an older aged group of citizens. These groups of people might have a stronger trust of the government or a higher perception of benefits, negating their risk perceptions of nuclear power. If an older group of citizens was surveyed, maybe those who lived through the Cold War era, their risk perceptions of nuclear power might be very different than the perceptions of those who did not live through that era.

Studies done in another region of Texas or the U.S., whether it is done on college students or not, may produce different results than the ones gathered in this study.

Results might differ if students were surveyed in a class that studies nuclear power plants, such as an energy class. It might be interesting to compare such a group to a group of those who have not had formal study of nuclear power to determine if their risk perceptions differ. Risk perceptions might also differ if the study had been performed in different classes, such as in business classes or technology classes.

Testing different variables might also produce different results. As this research showed, not all of the variables tested in this study were of significance in determining risk perception. Instead of retesting the variables that did not help explain risk perception, researchers could try new variables on the same age group.

Nuclear power is regaining popularity in the U.S., but this popularity does not spread through all people. With new pushes to control climate change and to move away

from a dependence on foreign fossil fuels, each day, nuclear power appears to be a more competitive source of energy. With the proposal of new nuclear power plants in the review process, the growth of the nuclear industry is looming in the near future. However, it cannot be denied that people fear nuclear power, and many people see it as a risk that may not be necessary. If the government and the nuclear industry intend for nuclear power to be the wave of the future, something must be done to reinvent the opinions of the general public, so that nuclear power does not reach its end before it even really begins.

APPENDIX A

IRB EXEMPTION

Sent: Tuesday, October 27, 2009 10:39 AM

DO NOT REPLY TO THIS MESSAGE. This email message is generated by the IRB online application program.

Based on the information in IRB Exemption Request EXP2009T5786 which you submitted on 10/26/09 15:57:12, your project is exempt from full or expedited review by the Texas State Institutional Review Board.

If you have questions, please submit an IRB Inquiry form:

http://www.txstate.edu/research/irb/irb_inquiry.html

Comments:
No comments.

==========

Institutional Review Board
Office of Research Compliance
Texas State University-San Marcos
(ph) 512/245-2314 / (fax) 512/245-3847 / ospirb@txstate.edu / JCK 489
601 University Drive, San Marcos, TX 78666

APPENDIX B

IRB EXEMPTION CONFIRMATION

Sent: Monday, December 07, 2009 12:10 PM

Dr. Hagelman-

I understand there was some issue with whether Barbara Grahmann's thesis project qualified for exemption from IRB approval.

Ms. Grahmann called me last week and after reviewing the application again, I can assure you it clearly qualifies for Exempt status under Category 2 of the allowable exemptions.

If you need assistance or further information, please contact me.

Thank you.

Becky Northcut
Director, Research Compliance
Office of the Associate Vice-President for Research
Texas State University-San Marcos
512-245-2314

APPENDIX C

SURVEY INSTRUMENT

This survey is a research study for a Master's thesis project. Participation in this survey is completely voluntary. You may withdraw from the survey at any time if you feel uncomfortable with the study questions.

All statements in this survey are related to commercial, electricity-producing nuclear power plants. Please use the scantron provided to answer the following questions.

I. For the following statements, please indicate your personal feelings using the following scale:

(A) strongly agree (B) agree (C) neutral (D) disagree (E) strongly disagree

1) Overall, nuclear power plants are risky.
A B C D E

2) The operation of a nuclear power plants poses a high risk to the environment.
A B C D E

3) The operation of a nuclear power plants poses a high risk to local communities.
A B C D E

4) Nuclear power plants are good for the environment.
A B C D E

5) Nuclear power plants are better for the environment than fossil fueled plants.
A B C D E

6) Nuclear power plants are better for the environment than renewable energy alternatives (wind, solar, etc.)
A B C D E

7) It is likely that the U.S. will experience a major nuclear power plant accident in my lifetime.

A B C D E

8) More nuclear power plants should be built to help reduce greenhouse gas emissions in the United States.

A B C D E

9) It is better to build new nuclear power plants than to build new fossil fueled plants.

A B C D E

II. Using the same scale as above, please indicate your personal feeling about the following statement:
(A) strongly agree (B) agree (C) neutral (D) disagree (E) strongly disagree

Information about nuclear power given to the public by the institutions listed below can be trusted:

10) U.S. Environmental Protection Agency (EPA)

A B C D E

11) U.S. Nuclear Regulatory Commission (NRC)

A B C D E

12) U.S. Department of Energy (DOE)

A B C D E

13) Federal Emergency Management Agency (FEMA)

A B C D E

14) Texas Commission on Environmental Quality (TCEQ)

A B C D E

15) University Scientists

A B C D E

16) Government Scientists

A B C D E

17) Sierra Club

A B C D E

18) Green Peace
A B C D E

19) Energy Corporations (e.g. TXU Energy, Centerpoint Energy)
A B C D E

III. For the following questions, please answer to the best of your ability.

20) Do you or have you ever worked in the energy industry?
Yes No

21) Do you know anyone who works or has previously worked in the energy industry?
Yes No

22) Normally operating nuclear power plants emit radiation into the local environment.
A) Yes B) No C) I don't know

23) Nuclear power plants emit greenhouse gases.
A) Yes B) No C) I don't know

24) Radiation from any source poses a high risk to humans.
A) Yes B) No C) I don't know

25) Waste from nuclear power plants is hazardous to humans.
A) Yes B) No C) I don't know

26) Waste from all U.S. nuclear power plants is currently stored at one site near Yucca Mountain in Nevada.
A) Yes B) No C) I don't know

27) How many commercial nuclear power plants are located in Texas?
A) 0-5 B) 6-10 C) 11-20 D) 21-30 E) 31 +

28) How many commercial nuclear power plants are located in the United States?
A) 0-25 B) 26-50 C) 51-75 D) 76-100 E) 100 +

29) Are companies in United States currently building or planning to build any new nuclear power plants?
A) Yes B) No C) I don't know

30) Which term best describes your personal political philosophy?
A) Conservative B) Moderate C) Liberal D) Other E) None

31) Which best describes your political party affiliation?
A) Republican B) Democrat C) Independent D) Other E) None

32) I am very strongly connected with this political party.
A) Strongly Agree B) Agree C) Neutral D) Disagree E) Strongly Disagree

33) I vote in every election.
A) Strongly Agree B) Agree C) Neutral D) Disagree E) Strongly Disagree

34) How old are you?
a) under 20 b) 21-25 c) 26-30 d)31-50 e) 51 or older

35) Sex
a) Female b) Male

36) What is your classification in school?
A) Freshman B) Sophomore C) Junior D) Senior E) Graduate

If you have already declared your major with the university, please indicate your major. If you have not declared your major with the university, but you know what major you want to choose, please indicate that major. Otherwise, please choose "Undecided".

37) Which of the following Texas State colleges is your major in? If your college is not on this list, please go to question 38.
A) College of Education
B) College of Liberal Arts
C) College of Science
D) McCoy College of Business Administration

38) Which of the following Texas State colleges is your major in?
A) College of Applied Arts
B) College of Fine Arts and Communication
C) College of Health Professions
D) Undecided or Other

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