DEVELOPMENT OF A REFLEXIVE MODERNIZATION THEORETICAL PERSPECTIVE TO PREDICT INDIANA RESIDENTS' PERCEPTIONS OF EMERGENT SCIENCE AND TECHNOLOGY

by

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To my family in all its entirety

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

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Emergent science and technology elicit widely differing perceptions from consumers. Despite the potential benefits that emergent technologies offer to society, research shows that the public consistently expresses concerns about their adoption and regulation. Understanding consumer response to emergent technologies is particularly important today, when emergent science and innovations are being introduced to the public at an exceedingly fast pace.

The current research uses mail survey methodology to measure Indiana residents' perceived optimism that emergent science and technologies will be beneficial to them and their families. A structured questionnaire was developed specifically for use in this study. After field-testing, the questionnaire was mailed to 4,500 Indiana households through a stratified random sampling design. Up to three contacts were made with subjects, resulting in receipt of usable responses from 1,003 households, or a 26% response rate. The dependent variable was a scale measure composed of seven areas of emergent science and technology: nanotechnology, unmanned aerial vehicles, autonomous cars, artificial intelligence, big data technologies, synthetic biology, and plant genetic research. Subjects were asked to indicate their level of optimism that these technologies would be beneficial to themselves or their families' way of life. Descriptive results revealed slight to moderate levels of optimism for most of the technologies. Nanotechnology and plant genetics research were rated most favorably among the items assessed, while artificial intelligence and autonomous cars were rated least favorably.

A theoretical model developed from reflexive modernity literature was used to identify variables predictive of public perceptions of emergent science and technology. Multiple linear regression was performed using the SPSS Complex Samples module to test the model's performance. Results showed that the model was somewhat successful, explaining about 33 percent of the variance in the dependent variable. Subjects expressing increased optimism toward

emergent science and technology tend to express higher levels of confidence in science (scientism), greater faith in government to regulate emergent science and technology, increased interest in science, and higher levels of media system dependency. These subjects also tend to have higher levels of education compared to those who were less optimistic about emergent science and technology.

Findings from this research are discussed in the context of improving public engagement efforts focused on emergent science and technology.

CHAPTER 1. INTRODUCTION

1.1 Introduction

Emergent science and technology are a defining feature of modern industrial societies. Such topics are in the daily news and touch consumers' lives in a variety of ways, from communication to medicine. Americans have come to expect science-based innovations to bring about positive change in society (Kennedy & Funk, 2016). "New" technologies have in fact transformed human society throughout much of recorded history.

As an example, one can look into the sky at nearly any moment to see exhaust gases from jet aircraft carrying passengers and cargo from destination to farther global destination. In the U.S., the first plane took flight in the early 1900s and the innovation of commercial air travel would become an indispensable part of life within decades, contributing significantly to World War II efforts and to business and civilian life thereafter. Commercial air travel is an example of a revolutionary modern technology-based innovation that was adopted rapidly. In the U.S., the growing popularity of air travel in the mid-20th century occurred alongside other hugely successful innovations in engineering, communication, and medicine.

However, for every successful technological innovation, countless others do not succeed. Commercial air travel again provides a classic example of a famous yet failed innovation; supersonic transport. In the late 20th century the United Kingdom and France jointly sponsored the introduction of the Concorde plane, a supersonic luxury jet widely described as an engineering marvel (Butwin, 1983). The aircraft was capable of traveling at nearly twice the speed of sound (more than 1,300 miles per hour) and could cruise from New York to London in less than four hours. Despite its virtues, the Concorde was noisy and expensive to operate. In

2000, the Concorde was temporarily grounded after a fiery crash in France that killed all on the aircraft and four on the ground. All Concorde aircraft were retired from service in 2003. Today, there are no commercial supersonic commercial flights despite their distinct speed advantage.

This aviation example suggests that would-be technological innovators and entrepreneurs must be willing to sacrifice significant time and capital to launch new innovations with no assurance of success. Society, on the other hand, must accept that while emergent science and technologies may offer benefits over established ways of doing things, they often also pose risk and uncertainty to various industries or groups in society. Affected groups often have questions about emergent technologies and possible consequences on their ways of life. For example, what unanticipated consequences might emergent technology have in the short or long term? What industries could be affected? Might the emergent technology alter or disrupt current lifestyles or ways of making a living? Will all groups in society share equally in both the benefits and risks? In some cases, resistance to emergent technologies can lead to social conflict and, quite often, into delayed or non-adoption of innovations.

Research is needed to develop a more complete understanding of social factors associated with public perception of emergent science and technology. The current research addresses this need through the development of a theoretical model to predict perceptions that emergent technologies will be beneficial to an individual's well-being and way of life. Following a brief historical overview of emergent science and technology, this chapter discusses the social process associated with public acceptance of emergent science and technology. The chapter then provides a statement of the problem, study objectives and justification. Finally, the chapter concludes with a list of limitations, assumptions underpinning this research, and a glossary of key terms used throughout the document.

1.2 Emergent Science and Technology through the Centuries

Casual consideration of emergent science and technology might well bring to mind such historic developments as the introduction of x-rays (1895 by Wilhelm Conrad Roentgen), the telephone (1849 by Alexander Graham Bell), or automobile (1885 by Karl Benz). These and countless other innovations have become indispensable in everyday modern society, and their use is seldom examined critically today. However, literature on diffusion of innovations reveals that many new innovations go through a difficult and sometimes contested trial period in which their use is ultimately accepted, rejected or deferred by society.

Majumdar et al. (2015) states that "innovation is a social process, in which social factors, needs and wants determine technological development" (p. 127). The social processes triggered by an innovation may vary depending on the culture and region (World Bank, 2010). Regardless of location, societal factors, including individuals' needs, wants and fears, can play a significant role in determining whether innovations are rapidly accepted, postponed in their debut, or rejected and discarded.

Juma (2016) provides a historical perspective on the role of social factors in determining acceptability and adoption of new innovations and technologies. Many of today's common household items and familiar amenities were initially contested by particular industries or the public. The first historical example used to discuss the role of social factors in technology adoption decisions is the beverage coffee. USA Today reports that as of 2013, 83 percent of adults in the U.S. consume coffee regularly; global demand for coffee is projected to increase 25 percent by 2020, (Toppa, 2015). Though coffee is largely seen as a convenience of modern life, coffee and coffeehouses did not avoid controversy when first introduced. In fact, coffee and coffeehouses were once an extreme social controversy among society and those in power

because they initiated social change, which was feared by political leaders. Coffeehouses provided a forum for people to gather and discuss major issues of the day, including politics. These new forums were viewed as a threat by some political leaders, such as the Ottoman rulers of Egypt and some Ethiopian religious leaders. Coffee was sometimes banned because people who normally kept to themselves now had a reason to gather, linger over the beverage and discuss social issues. As power was transferred from leader to leader over time, sentiments changed and coffee and coffeehouses eventually took root. While coffee and coffeehouses are a routine aspect of modern life, they illustrate the significant stake that governments and political figures can have in societal adoption of innovations (Juma, 2016, p. 56).

Another example of a controversial innovation from bygone days is the development of the textile industries. Most clothing items we wear today were likely purchased from a department store, not personally tailored for us. The development of textile industries, machines and factories after the Industrial Revolution are to thank for this convenience. Larger-scale production of clothes brought about the textile industries in the mid-1800s and made new clothes more abundant and affordable to the masses. Prior to the Industrial Revolution, Great Britain was abound with smaller, independent businesses, such as textile artisans who made a living by producing high-demand goods for society. Riots ensued when the textile industry proposed the use of less expensive and lesser skilled labor to do the weaving instead of highly skilled artisans who spent their lives earning from the trade. Not only would this innovative technology replace hardworking textile professionals, but other professionals in this era feared that the industrialization would consume their livelihoods next. While there was little popular support for this emergent technology, the emergent textile industry had the economic power to control the market. By the 1860s, factory textile production was the norm in Great Britain.

In the case of textile industries, resistance to technological innovation formed not on the part of government, but by existing, or incumbent, merchants and small-business owners threatened by a new means of production. Large-scale textile production not only threatened the economic fortunes of individual merchants, but entire communities whose economic base was built upon a different business model (Juma, 2016, p. 27).

The foregoing historical cases illustrate how social resistance can form against new ideas and technological innovations that threaten established ways of doing things. In the case of coffee, government resistance formed when coffeehouses became places for community members to meet and discuss political affairs. These gatherings threatened the power and privilege of political leaders of the era. In the case of textile industries, industry and citizen resistance formed as a new economic order threatened established ways of life.

A final example of innovation throughout history can be cited in the evolution of technology through four industrial revolutions. From 1700s until present day, society has experienced four industrial revolutions, each introducing emergent technological innovations to society through the economy, culture, government, health, education and many other areas. The First Industrial Revolution introduced machinery, specifically the commercial steam engine, evolutionizing communication and transportation near the turn of the 19th century (Morrar, Arman, & Mousa, 2017; Daemmrich, 2017). The Second Industrial Revolution can be traced to the late 19th century, bringing electricity to society, transforming slow, laborious factory work into more effective, mass-production assembly line work within factories (Morrar et al., 2017; Daemmrich, 2017; Von Tunzelmann, 2003). About a century later, the Third Industrial Revolution again transformed society with digitalization as computers and the internet made information transfer effortless (Morrar et al., 2017; Daemmrich, 2017; Kamitake, 2008; Caruso,

2018). Today, the Fourth Industrial Revolution combines the digital revolution with natural aspects of life opening new research frontiers such as synthetic biology and big data applications (Morrar et al., 2017; Daemmrich, 2017; Caruso, 2018).

As history has shown in the preceding discussion, major technological innovations seldom enjoy universal support from government, industry and populace. With the Fourth Industrial Revolution comes new processes and products for which social outcomes are still unclear. The Fourth Industrial Revolution involves a merging of previously separate branches of science and technology into new fields of research-based exploration that are qualitatively different from and more far-reaching than their 20th century forerunners. Examples include new research programs in artificial intelligence, nanotechnology, plant genetic research, the internet of things, and other areas. Economist Klaus Schwab (2017) lays out the major technologies leading this revolution and the impacts to government, industry, individuals and society as a whole that come with them; Schwab suggests ways in which society can be empowered by these changes rather than disrupted by them.

While not representative of all emergent science and technology, the foregoing discussions illustrate how new innovations, including emergent science and technology, have the potential to transform all aspects of culture and society, such as the economy, government, health, and education. Concurrently, new innovations may be seen as threats to incumbent industries, political systems and established ways of life. Given their potential for transformational impact on all sectors of society, emergent science and technologies have been studied in the past century by a wide range of scholars from economics, sociology, psychology, political science, communication and technology studies. A multidisciplinary literature base has addressed the social process that occurs in response to the introduction of emergent science and technology in

the public sphere. Based on conceptual and empirical scholarship in this area, it is possible to offer a contemporary social science view of the social environment in which innovations vie for public acceptance and adoption.

1.3 Social Response to Emergent Science and Technology

A large body of literature has focused on the relationship between technology and society. One the most provocative threads of this research focuses on the direction of effects: Does technology dictate a society's history, culture and structure, or does society dictate the path and consequences of technology? The two respective camps, technological determinism and social determinism, can be seen as polar opposites on a continuum of philosophies regarding the role of technology in society (Marx & Smith, 2011; Bijker, 2015). Bimber (1994) argues that unidirectional views of either technology or society holding absolute power and influence over the other are less helpful than acknowledging the reciprocal relationship between technology and society. Still, he writes that technological determinism is a persistent theme in much literature and that the concept has a tendency to "lurk in the shadows" of academic literature on the subject (p. 80).

Of particular interest in conceptualizing the relationship between technology and society is describing the nature of society and the social environment in which technology is embedded. Prominent in the literature is description of modern society in developed nations as a risk society. Beck (1992) defines a risk society as a time when "the social production of wealth is systematically accompanied by the social production of risks …" and when "...the problems and conflicts relating to distribution in a society of scarcity overlap with the problems and conflicts that arise from the production, definition and distribution of techno-scientifically produced risks"

(p. 19). In the current era, society has "a heightened awareness" (Beck, Bonss, & Lau, 2003, p. 3) of the impossibility of mastering the changes that come with this reflexive modernity, which surpasses boundaries that were once in place to segregate members and institutions of society (Beck, Giddens, & Lash, 1994; Beck, 1992; Giddens, 1990). According to this view, modern society can no longer manage or control risks it has itself created in the quest for technological efficiency. In the modern risk-hypersensitive environment, all sectors of industry and classes of society are at risk. Such a view of society provides a useful lens for viewing modern technological development ushered in through the Fourth Industrial Revolution.

The current research uses theoretical constructs from risk society and reflexive modernity literature to develop a predictive model addressing public perceptions of emergent science and technology. A dependent variable is developed from seven prominent areas of emergent science and technology identified from the literature: nanotechnology, unmanned aerial vehicles, autonomous cars, artificial intelligence, big data technologies, synthetic biology, and plant genetic research. Subjects are asked to indicate their level of optimism that these technologies will be beneficial to themselves or their families' way of life. Responses are summed to form a scale measure titled Optimism toward Emergent Science and Technology. Variance in the scale measure is regressed against eight independent variables identified through the reflexive modernization theoretical perspective. The theoretical perspective, model variables and hypotheses are provided in Chapter 2.

1.4 Statement of the Problem

Emergent science and technology are being introduced to society today at a rapid pace. Despite widespread favorable publicity about Fourth Industrial Revolution technology and

innovation, a review of historical accounts and research demonstrates that social acceptance of emergent science and technologies is not a straightforward process. Resistance from government, industry or consumers can delay or entirely forestall the adoption of innovations regardless of their technical or economic advantages. Research reveals that perceived trust and other psychosocial factors play a key role in public acceptance of emergent science and technology. There is a need for empirical research to identify and measure these key predictors. Limited research has been published on public perceptions of emergent science and technology in the state of Indiana. The current research uses survey research methods and quantitative multivariate analysis to develop and test an empirical model that predicts public perception of emergent science and technology. Guiding the analysis is a theoretical model developed from risk society and reflexive modernization literature. The theoretical perspective is described in Chapter 2, while methodological procedures are described in Chapter 3.

1.5 Significance of the Study

The significance of this study lies in the fact that emergent science and technology are a central aspect of modern life in developed societies. While citizens share in the potential benefits of emergent technologies, they likewise share potential technology-borne risks to their livelihoods, health and established ways of living. Citizens are major stakeholders in the adoption and implementation of emergent science and technology and, as the preceding discussion has shown, play a major societal role in their acceptance.

The current research will develop and test an empirical model of public perception of emergent science and technology in the state of Indiana. Results from this research will be useful to educators, university Extension personnel, science communicators and others who interact

with the public on these topics. A more complete understanding of public perceptions can assist in the development of relevant educational and communication programs to help citizens better understand potential benefits and risks of emergent science and technology. Understanding the basis of how public perceptions about emergent science and technology arise is crucial to addressing misconceptions that may arise with them. Results will also be useful to scientists and administrators whose professional efforts depend in large part on public awareness and support.

1.6 Purpose of the Study

The purpose of this study was to explore and describe Indiana residents' perceptions of emergent science and technology as a means to improve well-being and way of life. An empirical model was developed to predict public perceptions of emergent science and technology. Emergent technologies have the potential to transform individuals' lives. Yet, scientists, educators, communicators and policymakers often lack empirical data on how individuals assess and form decisions about emergent science and technology. Guided by a reflexive modernization theoretical perspective, the current research will identify individuals' sociodemographic and attitudinal characteristics associated with perceptions of emergent science and technology. Findings from this research can be used to develop and improve education, communication and outreach programs that address citizens' information needs in this realm.

1.7 Research Objectives

1. To describe subjects' level of interest in emergent science and technology.
2. To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.

3. To describe subjects' perceived levels of optimism that emergent science and technology will improve quality of life.
4. To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

1.8 Study Site

Indiana is located in the Midwestern United States with a population of more than 6.5 million people. Indiana has a poverty rate of 13.5% and unemployment rate of 3.6 percent. High school graduation rates are above average (86.6%) for the state of Indiana. Indiana residents have a below average (45%) voter participation in congressional and presidential elections. Out of 50 continental U.S. states, Indiana is ranked 36 overall for a multitude of data points used to evaluate its value for residence (U.S. News Ranks…, 2019). Some of these points included quality of life (48 out of 50), crime and corrections (30 out of 50), education (35 out of 50), infrastructure (30 out of 50), fiscal stability (8 out of 50), economy (25 out of 50), and opportunity (11 out of 50).

1.9 Limitations of the Study

1. This study used mail survey research methods in Indiana to measure subjects' perceptions of emergent science and technology. Results are not generalizable beyond Indiana.
2. Mail survey research is limited in its ability to record details and nuances in subjects' responses.
3. Questionnaire items and their order are determined by the researchers, increasing the potential for researcher bias.

4. As with all modes of social science data collection, subjects may provide incomplete or inaccurate responses to questionnaire items (Johnson, 2014).

1.10 Basic Assumptions

1. Researchers collected data using recommended social science techniques, minimizing the potential for researcher bias.
2. It was assumed that adult subjects completing the survey questionnaire will answer honestly and to the best of their ability.

1.11 Definition of Terms

Emergent Science, Technology and Innovation — innovative and "relatively fast growing" tools and advancements that persist over time with the prominent potential to impact the economy and society. (Rotolo, Hicks, & Martin, 2015; Halaweh, M., 2013; Conway, D., 2013; Veletsianos, G., 2015).

Mass Media, medium — "The channels of communication that produce songs, novels, news, movies, online computer services, and other cultural products to a large number of people" (Campbell, Martin, & Fabos, 2017, p. 6).

Reflexive modernity — A time when society is considered a "risk society" where individuals have to decide on things which may affect their survival or way of life with little to know fundamental knowledge on the topic, (Beck, 1992; Beck et al., 1994).

Risk perception — The risk that non-expert individuals associate with science, technology or similar unknown things (Kahan, 2010).

CHAPTER 2. LITERATURE REVIEW

2.1 Introduction

This chapter summarizes peer-reviewed literature that was used to guide this research. After leading with a review of research objectives, the chapter provides the literature review strategy carried out in this research, followed by a discussion of key literature addressing public perception of emergent science and technology. Next, the chapter addresses the theoretical perspective used to guide the study, followed by study hypotheses and the conceptual framework. The chapter concludes with the need for the study and a summary of the chapter.

2.2 Research Objectives

1. To describe subjects' level of interest in emergent science and technology.
2. To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.
3. To describe subjects' perceived levels of optimism that emergent science and technology will improve quality of life.
4. To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

2.3 Strategy of Literature Review

A review of peer-reviewed literature was undertaken at the outset of the research. In the initial step, keywords were identified as a means to locate relevant strands of research. The following keywords were used in the initial search: perceived risk, public perceptions, risk perceptions, consumer perceptions, perceived risk of technology/science, public perceptions of

technology/science, risk perceptions of technology/science, consumer perceptions of technology/science, technology risk, technological risk, technology and media, poorly introduced technologies, emergent science/technology, and reflexive modernization. These keywords were used in search engines and online databases to identify relevant literature including Google Scholar and Purdue University Library databases. In addition, online searches were conducted on various peer-reviewed journal sites including *Risk Analysis*, *Public Understanding of Science*, and *Journal of Communication* to find articles of importance to this research.

As relevant papers were identified, the researcher carefully examined each paper's list of references to identify additional documents for inclusion in the collection of literature. This process continued until the search began to identify papers already included in the literature review.

2.4 Variables Affecting Public Perception of Science and Technology

The dependent variable in the current study was perceived optimism that emergent science and technology would enhance subjects' well-being and way of life. Development of a theoretical model of public perception of emergent science and technology requires the identification of suitable predictors, or independent variables. The following literature review focuses on the factors that have been shown to influence public perceptions of emergent science and technology.

Among the recurring study variables identified through the public perception literature of emergent science and technology is attitude toward government. Macnaghten and Chilvers (2014) describe an apparent distrust of government in the United Kingdom, particularly when it appears that government and industry are in close proximity regarding science and technology. Trust in

government can be undermined by perceptions that the government is not acting in the public interest. During an environmental energy project conducted by Sciencewise-ERC in 2009, research showed that the public perceived the government as lacking direction and being powerless to effect change (Macnaghten & Chilvers, 2014).

In research involving more than 3,200 interviews with Great Britain households, Barnett, Cooper, and Senior (2007) found that only 2 in 10 subjects believed that the government failed to act in the best interests of the public. These researchers also incorporated the concept of public efficacy in their work. Public efficacy refers to "the extent to which people believe that the public might be able to affect the course of decision-making" (Barnett et al., 2007, p. 921). Their research found that over half (60%) of the respondents felt that government affairs were beyond their comprehension and nearly two-thirds (65%) felt they had no control over government dealings.

With regard to public efficacy around genetic science, Barnett et al. (2007) found a small positive correlation between public efficacy and disagreement (60%) with the statement "government is too complex to understand" and agreement (65%) with the statement "people like me have no say in government." Alternatively, lower assessments of public efficacy were associated with increased feelings of powerlessness when it comes to government regulation and rules. Those who express higher levels of public efficacy express lower levels of faith in government rules and regulations, often perceiving that rules put into place to keep the public safe do not necessarily protect them from risks associated with modern genetic science (Barnett et al., 2007).

Level of science literacy has also been shown to be associated with public perceptions of emergent science and technology (Bauer, Durant, & Evans, 1994). The more educated an

individual is about science, the more likely he or she is to perceive emergent science and technology as a means for economic and social growth (Allum, 2007). Related to the concept of science literacy is that of scientism, defined in the current research as "a measure of how much faith an individual has in science." Scientism influences perceptions of the "role individuals believe science should play in public policy debates on the development of new technologies" (Mehta, 2001, p. 212). Research has consistently found that the American public has a "deep and abiding interest in personally relevant science and technology topics" (Falk, Storksdieck, & Dierking, 2007, p. 457). Results from Falk et al.'s (2007) interviews of 1,007 California residents showed a median score of 7 (on a scale of 1 to 10) when asked to rate their interest in science and technology. But interest does not equate to knowledge. When faced with uncertainties about emergent science and technology, the public may have little to no previous knowledge to guide decision-making (Binder, Hillback & Brossard, 2016).

Scientism has been shown to be associated with sociodemographic characteristics such as sex, education, income and age (Roberts, Reid, Schroeder, & Norris, 2011). Individuals with less education tend to express lesser amounts of trust and less positive attitudes toward science (Einsiedel, 1994). Males and individuals with higher socioeconomic status tend to have more positive attitudes toward science (Roberts et al., 2011; Einsiedel, 1994).

Priest (1995) posits that individuals' attitudes toward science influence how they perceive risk. Higher levels of scientism within an individual were associated with lower levels of perceived risk for genetically engineered foods. Individuals with higher levels of scientism were also more likely to assess genetically engineered foods as offering important benefits. In other words, high levels of scientism reflect increased trust in science and, in the case of genetically engineered foods, lower levels of concern about their consumption (Mehta, 2001).

Enjoyment in learning about science and technology has also been shown to influence attitudes toward science. Writing in the context of free-choice learning, Falk et al. (2007) assert that the public's primary venue for science learning is "extra-curricular" (p. 464). That is, in addition to learning science in formal settings such as schools, many individuals practice lifelong learning through museums, zoos and other informal and recreational settings. In telephone survey research in the Los Angeles area, Falk et al. (2007) found that the public often is driven to learn about science and technology purely from their own interests or personal questions that arise. Informal learning occurs in one's leisure time, through informal education settings and through mass media.

Research also shows the public is sensitive to long-term consequences of emergent science and technology as well as the broad purpose of each. Macnaghten and Chilvers (2014) stated that during the development of emergent science and technology, the primary focus communicated to the public is often on technology's current stages, not future implications. The lack of attention paid to the future heightens public concern when it comes to regulation of emergent science and technology. The authors asserted that the public's assessment of the purpose of the science plays a key role in formation of attitudes (Macnaghten & Chilvers, 2014). In the case of health-related science and technology, the public is more likely to be supportive of science and technology developed for a purpose they deem worthy or important. In such an instance, the public would also be more tolerant should ethical dilemmas surface.

Also crucial from the public standpoint is the perceived direction in which science is steering society. The public is more likely to perceive science and technology as acceptable if its outcomes are perceived as improving quality of life. Through a meta-analysis of 17 United Kingdom public dialogues combined with 40 interviews with scientific policy actors,

Macnaghten and Chilvers (2014) found that the public's concern toward scientific practices focuses on the ethics of decisions being made. The in-depth interviews revealed that policy actors are more open and willing to admit uncertainties that arise; this openness signifies that policy actors are aware of the ethical dilemmas science may pose and consider them when making decisions (Macnaghten & Chilvers, 2014).

Measurement of cultural values and worldviews has also been prominent in research focused on public perceptions of science and technology. Anthropologist Mary Douglas is widely credited as the seminal author of cultural theory, which has been commonly used in risk perception research. Culture, as defined in Douglas' (1978) grid-group cultural theory, refers to how an individual lives her life, how she views different events and institutions in society, and her cultural and social surroundings. The theory focuses on two continua representing different cultural feelings and views: grid and group. The grid continuum ranges from hierarchy, or trusting of experts and government figures, to Egalitarian, or skepticism toward these actors. High grid (hierarchy) and low grid (egalitarian) provide an indicator of an individual's level of support for experts, government, and institutions. The group continuum ranges from communitarian, social groups with the belief in averting risk, to individualist, individuals who perceive risk as unavoidable. High group (communitarian) and low group (individualist) are indicative of whether an individual works within social groups and believe that risk can be minimized.

Finucane and Holup (2005) discussed the different "cosmological types" referenced in this theory: Egalitarian, hierarchy, and individualist (p. 1609). Egalitarian individuals, low group and low grid, value equality in society, are skeptical of power figures misusing it, and feel that nature is subject to anthropogenic control; if the nature of things is threatened, this type will

oppose the risk (Finucane et al., 2005; McNeeley & Lazrus, 2014). Hierarchy individuals, high group and high grid, prioritize order, have faith in expert opinion, and feel that nature will preserve itself; if the risk to nature can be justified by an expert or government official, this type will accept the risk (McNeeley & Lazrus, 2014). Individualists, high grid and low group, are typically unattached to social groups though the groups around them are predictive of their fears; they are more indifferent to risks because they view them as unavoidable (McNeeley & Lazrus, 2014). In addition to these three types, Rawls (1971) posits a fourth type, communitarian. Communitarian, high group and low grid, is the view that an individual is part of a group and feels that risk can be averted.

Dake (1991) identified links among the four cultural worldviews and trends in risk perceptions. Specifically, he asserted that Egalitarian focuses on threats in one's social structure, and the hierarchy focuses on various opportunities that may arise from an industrial or technological risk. Sheehy, Legault, and Ireland (1996) elaborates on the two worldviews in the context of individuals' decision-making. Egalitarians desire information to make their own informed decisions. Hierarchy categorized individuals tend to feel that complex information weakens their ability to make sound decisions. In research with 1,065 adults in a German-speaking area of Switzerland on the subject of climate change, Shi, Visschers, and Siegrist (2015) found that cultural worldviews were significantly related to perceptions of climate change. The two high-grid worldviews, individualist and hierarchy, "were negatively related with concern about climate change," and lower willingness to be accepting of "climate-friendly" policy change or to change behavior (Shi et al., 2015, p. 2195). Communitarian type people typically indicated more concern for climate change in comparison to individualist, though when

knowledge on the subject increased it was more likely that individualist people's concern rose faster than that of a communitarian (Shi et al., 2015).

Cultural influences such as religion have also been researched as a factor influencing public perceptions of emergent science and technology. Conti, Satterfield, and Harthorn (2011) summarized cross-national findings from various studies and found mixed results, depending on the location. In the United States, religiosity was shown to predict perceptions of nanotechnology risk (Scheufele, Corley, Shihi,… & Ho 2008; Conti et al., 2011). Different aspects or principles of certain religions may also impact perceptions, such as Jewish doctrine on Kosher foods, Moslem guidelines for Halal, and Buddhist interpretations of Ahimsa, or "non-harming" (Mehta, 2001, p. 219).

Mehta (2001) surveyed 538 Canadian citizens and found no significant relationship between religiosity and public perceptions of genetically engineered food. Lang's (2013) research involving more than 350 interviews and surveys in the United States also failed to support religiosity as a significant predictor of public perceptions about agricultural biotechnology.

Mehta (2001) found that age and sex (being female) were both positively associated with religiosity but not with perception of risk. In a study of 650 university students in Israel and Turkey about perceived risk of terror attacks, researchers found that individuals who prioritize tradition (religion) were more likely to feel at risk from an attack. Israelites who reported giving more attention to tradition felt they were at a greater risk compared to Turkish citizens. Tradition indicates a sense of community or culture, meaning that individuals in similar cultural groups will perceive risk similarly (Kaptan, Shiloh, & Onkal, 2013).

An additional factor identified in research modeling individuals' perceptions of emergent science and technology is that of anomie, or lack of meaningful connection to society. Anomie has a rich history in sociological research, having served as one of the key constructs in Emile Durkheim's classic study on suicide (Bonell et al., 2013; Richardson, 1987). Anomie refers to a sense of normlessness that individuals may experience when society is in a state of rapid change. Anomic individuals may feel disconnected from society and its institutions and come to believe that norms that once provided order to society are no longer functional (Achterburg, Koster, & Waal, 2017). Under such circumstances, individuals may tend to view themselves as not having a place in or playing a meaningful role in modern society. Anomic individuals view modern social forces and institutions in a more negative light, including efforts and institutions associated with emergent science and technology (Achterburg et al., 2017; Zijdeerveld, 2000). Anomie lowers the level of trust the public has in science (De Keere, 2010). Research has shown that levels of anomie tend to be higher among those with lower levels of education (Achterburg et al., 2017; Zijderveld, 2000, Achterberg & Houtman, 2009; Lutterman & Middleton, 1970; Roberts & Rokeach, 1956).

While anomic, lesser-educated individuals have been shown to express lower levels of trust in scientific institutions, this same group may also indicate higher levels of trust in scientific methods themselves (Achterburg et al., 2017, p. 707). Higher levels of trust in scientific methods may be due to their hope that they may "restore a meaningful institutional order" to their lives because it is the easiest way to make sense of the world (Achterburg et al., 2017, p. 708). Conversely, individuals with higher education levels have been shown to express less trust in scientific methods and more trust in scientific institutions owing to greater institutional knowledge and appreciation of modern societal values.

The role of media as major channels of information about emergent science and technology is also reflected in the literature. Individuals often lack direct involvement or first-hand experience with emergent science and technology. In such cases, social and mass media are typically the main channel used to gain information (Mazey & Wingreen, 2017; Wachinger, Renn, Begg, & Kuhlicke, 2013). Though consumers may use their own judgment to make sense of information in the media, the media may amplify or otherwise alter their perception of risk (Wachinger et al., 2013).

Henderson, Wilson, Meyer….& Ward (2014) concluded that media tend to report on aspects of the technology or science that they feel are newsworthy; in this group's research on food incidents, interviewees summarize newsworthy as having to deal with "potential victims, the food's country of manufacture, and the potential harm to the public" (p. 621). How the media represents such science and technological risk impacts consumer perceptions of that risk when it comes to food (Henderson et al., 2014; Frewer, Miles, & Marsh, 2002; Frewer, Scholderer, & Bredahl, 2003; Raupp, 2014). You & Ju (2017) also found an association between the degree of media use and food risk perceptions. Mazey and Wingreen (2017) discussed the negative effects news media have on bionano sensors because of consumers' inability to comprehend such functionalities. In the case of nanotechnology, research shows that media reporting of few risk events coupled with audiences' low levels of knowledge about the subject has helped portray nanotechnology in a more positive light (Mazey & Wingreen, 2017; Pidgeon, Harthorn, Bryant…, 2009, Binder et al., 2016, Scheufele & Lewenstein, 2005).

The selection of a communication theory in social science research has a significant bearing on whether mass media are conceptualized to amplify or reduce public perceptions of risk. It should also be noted that failure to specify and use a communication theory can lead

researchers to quite different conclusions about the role of mass media in influencing public perceptions of emergent science and technology. While media have been shown to intensify audience perceptions of some risks, through such perspectives as media system dependency (Ball-Rokeach, 1985; Riffe, Lacy, & Varouhakis, 2008), they may also be conceived of as credible information channel through which audiences gain a deeper understanding of science and technology.

Consumer trust is another recurring variable in research modeling public perceptions of emergent science and technology. Research has shown that the public's level of trust in scientific, government, and industry actors (i.e., scientists, government regulators, and industry leaders) can impact the public's perception of emergent science and technology (Allum, 2007; Grove-White, Macnaghten, & Wynne, 2000; Priest, 2001; Wynne, 2001). Allum (2007), through an online survey of 1,142 participants, and Wynne (2001), through analysis on various movements to restore the public's faith in science, found that public trust in an actor and more generally in science and technology is based on judgments as to whether actors are making decisions based on their responsibility to consumers, their competence of the subject, and their shared goals for the science or technology. Additionally, Achterberg et al. (2017) analyzed 2,006 U.S. residents about trust in science and science actors. The researchers posit that "social categories, engagement with scientific principles and methods" are all highly trusted by the public, while the public has lower levels of trust in scientific institutions (Achterberg et al., 2017, p. 705). The findings suggest that the public today is more likely to question scientific institutions and motives of actor rather than science or the scientific method in general. Their assessments of institutions and actors can influence their perceptions of emergent science and technology.

Perceived trust in technology and innovations themselves has also been addressed in the literature. Mazey and Wingreen (2017) argued that assessments of trust in emergent technology are based on such technical aspects as the innovation's functionality, effectiveness, responsiveness, and reliability. Prior experience with similar technologies can also influence and individual's perceptions. For example, consumers expressed positive perceptions and higher levels of trust in bionano sensors due to their functionality and use in driverless cars (Mazey & Wingreen, 2017).

2.5 Theoretical Framework

An empirical model to predict public perceptions of emergent science and technology is developed from reflexive modernization theory. Major tenets of the theoretical perspective are discussed in the following section.

2.5.1 Reflexive Modernization

Reflexive modernization, also known as reflexive modernity or second modernity, is the social science perspective that modern society resides in a risk-laden environment and that boundaries formerly in place to protect societal members and institutions are no longer functional (Beck et al., 1994; Beck et al., 2003; Beck, 1992; Giddens, 1990). According to the perspective, various risks now facing society – health, environmental, economic – are of society's own making. As an example, science and technology have become major drivers not only of the economy but also in revolutionizing agriculture, medicine, and other aspects of everyday life. But with the benefits come new and pervasive risks. The literature of reflexive modernization asserts that scientific experimentation previously limited to the laboratory now endangers and poses risks to larger society, threatening all social groups and classes. Risks may

take the form of health, environmental, or other hazards brought about by science and technology. Risk becomes manifest through breakdowns in traditional family relations, eroding cultural norms, and a rapidly changing or unstable economy.

Reflexive modernization is based largely on the works of the late Ulrich Beck and Anthony Giddens in the early 1990s. The term *modernization* is often associated with the classic sociologist Max Weber, who described the transition of 1800s society from "traditional" to "modern." Following modernization is a period of "reflexive" modernity, where society has again transitioned, this time to a more complex and risk-filled society (Beck et al., 2003; Beck, 1992:4; Giddens, 1990). Beck's and Giddens' views on reflexivity differ in that Beck believed risks are global and there is only one outcome possible, while Giddens viewed risk on a social level and stated there are multiple outcomes possible (Knight & Warland, 2005). Though there is variance in the founders' conception of reflexive modernization, both remained focused on the primacy of risk in contemporary society.

A reflexive modernization approach to risk perception focuses on unintended effects of modern society being restructured and expanded in a multitude of institutions; institutions such as the market economy, technological advancement, and legal systems. According to Beck et al. (2003), reflexive modernity is a meta-level social change within society that has created multiple new boundaries and rules between social spheres. Giddens (1990), in the context of reflexivity as a characteristic of human activity, states that, "The reflexivity of modern social life consists in the fact that social practices are constantly examined and reformed in the light of incoming information about those very practices, thus constitutively altering their character" (p. 38). Ritzer and Stepnisky (2018) simplify the construct of reflexivity as a time when modern social practices constantly change in accordance with the flux of new information. In other words, society adapts

its social practices as it learns new things about different institutions, such as science and technology. Risk society is marked by changes in various institutions and an overabundance of new information filtering in daily.

Reflexive modernization is a perspective of viewing society through the lens of risk. To put it simply, man-made risks through the development of emergent science and technology are common, bringing with them unknown risks which may not develop and surface for years. These future risks will require new developments in science and technology in order to control or negate them, causing a domino effect of risk, uncertainty, and a need for continuous emergent science and technology. The variables chosen for this research may or may not have an impact and influence the perspective of reflexive modernization in that they can all push a person to feel more or less risk in association with emergent science and technology. Ultimately, this risk or lack thereof helps a person to develop their level of optimism toward emergent science and technology. Therefore, this theory and the variables chosen provide a relevant theoretical context in which to conceptualize public perceptions of emergent science and technology.

2.6 Application of Reflexive Modernization Theoretical Perspective

Application of the reflexive modernization theoretical perspective in the current study provides insights into factors expected to predict public perceptions of emergent science and technology. Using the theoretical perspective and the literature review process, the researcher initially identified nine independent variables to be included for testing in an empirical model designed to predict perceptions of emergent science and technology: (1) scientism; (2) interest in science; (3) trust in social institutions; (4) faith in government agencies to regulate emergent science and technology; (5) media system dependency; (6 and 7) cultural worldview; (8) anomie;

and (9) religiosity. Each variable was accessed by their prominence in the literature, whether or not a clear conclusion could be reached in past literature, and their interest to the researchers.

According to the theoretical perspective, public perceptions of emergent science and technology may be influenced by individuals' perceptions of scientists and science. Individuals who express confidence in science as a means to solve important problems are more likely to hold positive perceptions of science and technology than those who express more pessimistic views. Similarly, it would be expected that those who value and enjoy learning about science and technology are more likely to hold positive perceptions of science and technology than those who do not enjoy learning about science.

Trust in social institutions would also be expected to influence public perceptions of science and technology. Specifically, individuals who express higher levels of trust in government agencies and other expert sources are more likely to hold positive perceptions of science and technology than those who express lower levels of trust. Similarly, individuals who express higher levels of faith in government and regulatory agencies to protect society from risk are more likely to hold positive perceptions of science and technology than those who express lesser levels of faith in these authorities to regulate science and technology.

According to the theoretical perspective, individuals in a risk-intensive society rely on information for decision-making, particularly for complex topics such as science and technology. Individuals who attend more to mass media channels for information are more likely to be aware of benefits and risks of science and technology, including options for mitigating or reducing risk, when possible. According to the media system dependency theoretical perspective, those who express higher levels of dependence on mass media would be expected to hold more positive

perceptions of science and technology than those who express lower levels of dependence on media for information.

Cultural worldviews, such as those defined in grid-group cultural theory, have been shown in previous research to influence perceptions of risk. Specifically, it is expected that Egalitarian and communitarian would be associated less optimism toward emergent science and technology. Conversely, it is expected that hierarchy and individualist would be associated with higher levels of optimism toward emergent science and technology.

The theoretical perspective asserts that presence of anomie, or social disconnectedness, on the part of an individual would be associated with lower levels of optimism toward emergent science and technology. Anomic individuals would be expected to have less education and to be less supportive of emergent technology than non-anomic individuals. Finally, theory suggests that religiosity would play a role in formation of perceptions of emergent science and technology. Individuals expressing higher levels of religiosity would be expected to be less supportive of emergent science and technology than those with lower levels of religiosity, due in part to possible conflicts between science and religious values.

The nine independent variables were further considered in light of the review of literature. The researches first chose the most prominent variables found throughout the articles reviewed, then assessed their past success at predicting risk or optimism. Finally, the researches narrowed down the independent variables by their level of interest in each. Through this process, it was noted that one of the independent variables, religiosity, was frequently shown to have inconsistent or statistically non-significant results in peer-reviewed literature. Given the weak evidence supporting its inclusion, the variable was removed from consideration in the model, despite the researchers' interest in this particular variable. Thus, eight independent variables

were used for testing in the final model. Hypotheses were developed for each of the variables and are provided in the following section.

2.7 Hypotheses

Based on the preceding discussion, eight hypotheses derived from the theoretical perspective of reflexive modernization are investigated in the current research, as follows:

Hypothesis 1: Higher levels of scientism will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 2: Increased interest in science will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 3: Higher levels of institutional trust will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 4: Higher levels of faith in government to ensure technologies are safe will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 5: Higher levels of media system dependency will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 6: Higher group scores on the individualist-communitarian dimension of the group-grid typology in cultural theory will be associated with higher levels of

optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 7: Higher grid scores on the hierarchy-egalitarian dimension of group-grid typology in cultural theory will be associated with higher levels of optimism toward emergent science and technology.

Hypothesis 8: Lower levels of anomie will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

2.8 Conceptual Framework

A graphic presentation of the study's conceptual model is shown in Fig. 2.6. Eight independent variables, identified through literature and supported by the theoretical perspective used to guide the study, are shown on the left side of the graphic. The dependent variable, perceived optimism that emergent science and technology are beneficial to one's well-being and way of life, is shown on the right side of the graphic. Three sociodemographic variables, age, education, and sex, are control variables in the research. Measurement of dependent, independent and control variables is addressed in Chapter 3, Methods.

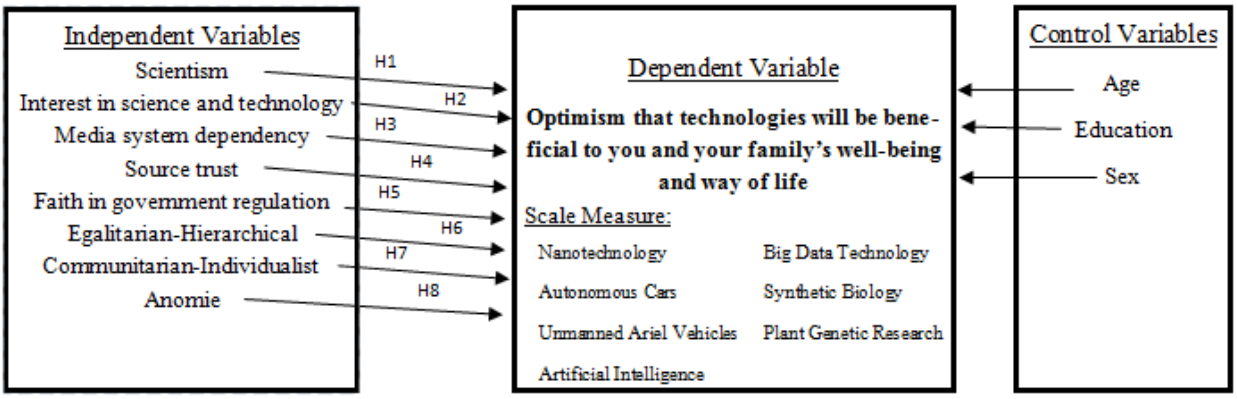

Figure 2.1: Graphic presentation of control, independent, and dependent variables.

2.9 Summary

This chapter reviewed relevant literature related to public perceptions of emergent science and technology. The literature review revealed that a number of variables have been examined as both correlates and causal variables in context of emergent science and technology. After reviewing some of the key findings from the literature, the researcher introduced the theoretical perspective selected to guide this research, Reflexive Modernization. The literature review uncovered no recent studies in Indiana that examined public perceptions of emergent science and technology through the lens of Reflexive Modernization. Application of the theoretical perspective to this study's objectives led to the identification of eight independent variables to be tested in an empirical model. Accordingly, eight hypotheses were proposed regarding association of each independent variable with the study's dependent variable, public perception of emergent science and technology. Finally, the chapter provided a conceptual framework graphic showing the study's independent and dependent variables, as well as three control variables.

A full discussion of research methods, including measurement procedures for all study variables, is provided in the following chapter.

CHAPTER 3. METHODS

3.1 Introduction

This chapter describes the procedures used to carry out this research. The chapter begins with a review of research objectives. Next, separate sections outline and discuss research design, sampling, research approval, design of the instrument, measurement, field testing, data collection, data analysis, threats to internal and external validity, and limitations.

3.2 Research Objectives

1. To describe subjects' level of interest in emergent science and technology.
2. To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.
3. To describe subjects' perceived levels of optimism that emergent science and technology will improve quality of life.
4. To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

3.3 Research Design

The researcher explored various population survey research methods and data collection modes capable of meeting study objectives. The population for the study was adult residents in the state of Indiana. Several social science research methods explored by the researcher – web-based survey, telephone survey, and so forth – offer advantages and disadvantages in terms of - cost, coverage, and vulnerability to response and other sources of error. Ultimately, the choice was made to use mail survey research methods because this data-collection mode allows for the

use of probability-based sampling methods with postal addresses. Because the overall number of postal (household) addresses and distribution characteristics are known with relative certainty, it is possible to estimate percentage of response and sampling error. The ability to calculate these statistics is important when the goal is to generalize findings to a study population.

Using a deductive approach, the research design follows quantitative procedures in sampling, measurement and analysis. The researcher used recommended survey research practices described by Dillman's Tailored Design Method, which allows the researcher to "customize" survey procedures per survey situation (Dillman, Smyth, & Christian, 2014, p. 16). Dillman et al. (2014) conclude that mail survey research can yield optimum response when particular data-collection procedures are followed, such as using multiple contacts with respondents, fielding a well-designed questionnaire, and incorporating a response incentive. As described in the following section, all of these recommendations were incorporated in the research design.

3.4 Sampling

The initial sampling design for this study called for random sampling of Indiana households. However, the current research is part of a larger project that required an oversampling of rural households to ensure adequate rural response for purposes outside of the current study objectives. For this reason, a stratified random sampling with urban and rural strata was used.

The researcher engaged the services of a private mail list vendor to purchase a mailing list of Indiana households. Using address-based sampling (ABS) procedures, a total of 4,500 Indiana adult names and addresses was purchased with 3,196 urban names and 1,304 rural names.

(Table 3.1). Before release, the vendor updated mailing lists using the U.S. Postal Service (USPS) Computerized Delivery Sequence (CDS) file to improve accuracy and reduce the number of undeliverable addresses (Harter Battaglia, & … Zukerberg, 2016).

Table 3.1: Mail Survey Strata in Current Research

Stratum	**N**	**%**
Urban	3,196	71%
Rural	1,304	29%
Total	**4,500**	**100%**

Because stratified samples are not representative of the population, a weighting procedure was used during data analysis so that descriptive and multivariate analyses would yield findings generalizable to the population. The weighting procedure is discussed in more detail in the Data Analysis section of this chapter.

3.5 Research Approval

To protect research subjects' rights, the researcher completed an online training module known as the Collaborative Institutional Training Initiative (CITI) Course. Once the training was complete, the researcher submitted an application to the Human Research Protection Program Institutional Review Board to request exemption for the current study. The protocol, titled Best Practices to Engage the Indiana Public on Emergent Science and Technology, was reviewed by the IRB at Purdue University and approved on February 5, 2018, with the protocol number 1712020022 (Appendix A).

3.6 Design of Instrument

The researcher designed questionnaire items to meet study objectives. Because the current study was part of a larger state survey project, not all of the items on the instrument were utilized or reported in the current research.

Development of the instrument began by identifying needed variables for the analysis. When possible, the researcher modeled the phrasing and layout of items using similar items from the peer-reviewed literature. Several meetings were held between the researcher and her major professor to discuss item content. Further discussions were had about the order and sequencing of items with the goal of encouraging survey response.

The services of a research methodology consultant were engaged from the National Opinion Research Center (NORC) at the University of Chicago. This collaboration was used to craft and order questionnaire items to conform to conversational norms. Items were reviewed for ease of reading, simplicity, and logical sequencing. The consultant had years of experience with survey projects and familiarity with U.S. Census procedures.

An additional task in developing the instrument was its graphic design and appearance. The consultant added a number of design embellishments to the questionnaire draft. The font was changed to a modern sans serif typeface throughout the document and a four-color cover was added. On the inside of the questionnaire, a two-color header was added to each page, and the second color was used as highlight throughout the document.

The final questionnaire was a 12-page booklet containing 132 items. The questionnaire was printed on white paper with a flat size of 11 by 17 inches and folded size of 8.5 by 11. The questionnaire's front cover featured four-color photos of Indiana and Purdue University landmarks. The title of the survey project was printed in display size on the front, along with the

Purdue University logo and contact information for the principal investigator. The back page of the questionnaire included a unique identifying number in the lower right-hand corner to track subject response, as well as the Purdue University logo and required Equal Employment Opportunity Statement.

Questionnaire items used in this study are provided in Appendix B.

3.7 Measurement

This section respectively addresses the measurement of dependent, independent and control variables used in this study.

3.7.1 Dependent Variable

The dependent variable was a composite variable measuring subjects' perceptions of emergent science and technology. Subjects were prompted with the text, "Some people believe new technologies offer benefits to society while others think new technologies threaten our current way of life. We are interested in how optimistic you are that the following technologies will be beneficial to you and your family's way of life."

Subjects were presented with seven science-based emergent technologies identified from the literature review: (1) Nanotechnology, (2) unmanned aerial vehicles, (3) autonomous (driverless) cars, (4) artificial intelligence, (5) big data technology, (6) synthetic biology, and (7) plant genetic research. As these are emergent technologies with which subject may not be familiar, concise definitions were provided for each technology (Fig. 3.1). The researchers started with modern dictionary definitions of the technology then edited and refined the definitions based on those found in the peer-reviewed literature.

Technology	Definition
Nanotechnology	The study and use of extremely small things – molecular level – to build microscopic devices.
Unmanned Aerial Vehicles (Drones)	Aircraft operated by remote control without a human pilot.
Autonomous (Driverless) Cars	Vehicles that sense the environment and operate without a human drive.
Artificial Intelligence	The development of "intelligent" computers and machines.
Big Data Technology	Use of huge amounts of data for analysis and decision-making.
Synthetic Biology	The merging of biology and engineering to build living parts and systems.
Plant Genetic Research	The study and use of plant genetics and breeding to develop improved plants and crops.

Figure 3.1: Definitions of technologies used in the questionnaire.

Six response categories were coded as follows: Very Optimistic, 5; Somewhat Optimistic, 4; Neither Optimistic nor Pessimistic, 3; Somewhat Pessimistic, 2; Strongly Pessimistic, 1; and Don't Know, 0 (zero). Subjects selecting the "don't know" category for any of the items were excluded from the model. Responses for the seven emergent science and technology items were then subjected to item analysis to assess reliability. The resulting Cronbach's alpha coefficient was 0.81. A reliability coefficient of this magnitude justifies the use of these items in a scale measure. The scale measure was used as the dependent variable in regression modeling.

3.7.2 Independent Variables

Scientism was a scale measure adapted from Johnson (2017) and Macnaghten and Chilvers (2014). Subjects were prompted with the text, "New science and technologies are changing the way we live, work, play, and communicate. With this in mind, we are very interested in your personal opinions on science and technology, and the scientists who design them. Please indicate your level of agreement with each of the following items."

Five response categories were as follows: Strongly agree, 5; somewhat agree, 4; neither agree nor disagree, 3; somewhat disagree, 2; and strongly disagree, 1. Subjects were asked to indicate their level of agreement with the following four statements: Science can eventually solve most of the problems facing the world; Science creates more problems than it solves; I am willing to accept new ideas if provided with sufficient scientific proof; and Science is more constructive than destructive. The item "Science creates more problems than it solves" was recoded in accordance with other scale items so that higher values corresponded to more positive perceptions of science. Item analysis was then used to assess reliability of the four items, resulting in an alpha coefficient was 0.68. This alpha is slightly below the 0.70 threshold recommended by Nunnally (1978) for developing scale measures. Because the alpha was only slightly below the recommended threshold and similar scale items were used in previous research in the literature, the current scale measure was used as an independent variable in regression modeling.

Level of interest in science and technology was a one-item variable in which respondents were asked, "In general, how would you rate your level of interest in new science and technology?" Responses were measured on a five-point scale, as follows: Very interested, 5;

moderately interested, 4; somewhat interested, 3; slightly interested, 2; and not interested, 1. The item was used as an independent variable in regression modeling.

Media system dependency was measured with the following prompt to subjects: "As part of our research, we are interested in your preferred methods of receiving information to stay informed and make decisions. How helpful are the following channels of information to you in staying informed and making decisions?" Seven common information and media channels were offered: Web/internet news sites, Facebook, Twitter, magazines, newspapers, radio, and email news briefings. Subject responses were measured on a five-point scale as follows: Very helpful, 5; somewhat helpful, 4; neither helpful nor unhelpful, 3; somewhat unhelpful, 2; and not at all helpful, 1. Responses for the seven information channel items were subjected to item analysis to assess reliability. The resulting alpha coefficient was 0.71. An alpha of this magnitude justifies the use of these items in a scale measure. The scale measure was used as an independent variable in regression modeling.

Source trust was measured with the following prompt to subjects: "There are many sources of knowledge and information to help people make decisions and stay informed on issues. Please tell us how trustworthy you find the following sources." Nine sources were included in this set of questions, as follows: Government agencies, news organizations, the food industry, farmers, health care providers, environmental groups, university scientists, friends or family, and Cooperative Extension. Responses were measured on five-point scale: Very trustworthy, 5; somewhat trustworthy, 4; neither trustworthy nor untrustworthy, 3; somewhat untrustworthy, 2; and not trustworthy at all, 1.

Because of the widely different types of information sources included in the question, a principal components analysis with orthogonal rotation was used to explore the underlying

correlational structure of the nine items (Norman & Streiner, 2008). Two factors emerged from the analysis. The researcher team examined factor loadings for all of the items. An item was assigned to a factor if the factor loading was at least 0.60 on one factor and less than 0.40 on the other. According to this scheme, the sources government agency, news organizations, environmental groups, and university scientists loaded on Factor 1. The sources farmers and friends/family loaded on Factor 2. The respective alpha coefficients were 0.75 and 0.43 for the two sets of items. Therefore, using the evaluation criteria established at the outset of the study, items loading on Factor 1 were summed to include a composite measure titled institutional trust. This measure was included in subsequent regression modeling as an independent variable. Items on Factor 2 did not have an adequate level of internal consistency (Nunnally, 1978) as assessed through item analysis and were excluded from the model.

Faith in government regulation was a single item measure that asked subjects to indicate their level of agreement with the statement, "I have faith in the government to ensure technologies are safe." Five response categories were offered, as follows: Strongly agree, 5; somewhat agree, 4; neither agree nor disagree, 3; somewhat disagree, 2; and strongly disagree, 1. The item was used as an independent variable in regression modeling.

Two variables – individualist and hierarchy – were used to measure subjects' worldviews in this research (Kahan, 2012; Kahan, Jenkins-Smith, & Braman, 2011). As a measure of Individualist, subjects were presented with the following prompt: "There is a lot of disagreement about how much the government should be involved in the decisions people make. We want to know how people in our state feel, so please let us know your level of agreement with the following statements." Five statements included in this section were as follows: The government interferes far too much in our everyday lives; Sometimes government

needs to make laws that keep people from hurting themselves; It's not the government's job to protect people from themselves; The government should stop telling people how to live their lives; and The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals. Five response categories were offered: Strongly agree, 5; somewhat agree, 4; neither agree nor disagree, 3; somewhat disagree, 2; and strongly disagree, 1. Two items (Sometimes government needs to make laws …; The government should do more …) were recoded in accordance with other items so that higher values would indicate a higher score on the individualist/communitarian continuum. The five items were subjected to item analysis to assess reliability. The resulting alpha coefficient was 0.70. An alpha of this magnitude justifies the use of these items in a scale measure. The scale measure was used as an independent variable in regression modeling.

As a measure of hierarchy, subjects were presented with the following prompt: "Another debate topic in our communities is the degree of equality and discrimination present. Please let us know your level of agreement with the following statements." Six statements included in this section were as follows: We have gone too far in pushing equal rights in this country; Our society would be better off if the distribution of wealth was more equal; We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women; Discrimination against minorities is still a very serious problem in our society; Some groups in society don't want equal rights, they want special rights just for them; and Society as a whole has become too soft. Five response categories were offered: Strongly agree, 5; somewhat agree, 4; neither agree nor disagree, 3; somewhat disagree, 2; and strongly disagree, 1. Three items (Our society would be better off…; We need to dramatically reduce inequalities…; Discrimination against minorities…;) were recoded in accordance with other

items so that higher values would indicate a higher score on the hierarchy/egalitarian continuum. The six items were subjected to item analysis to assess reliability. The resulting alpha coefficient was 0.79. An alpha of this magnitude justifies the use of these items in a scale measure. The scale measure was used as an independent variable in regression modeling.

The measure for anomie was modeled from variables in the peer-reviewed literature (Achterberg et al., 2017; Roberts & Rokeach, 1956; Srole, 1956). Subjects were asked to indicate their level of agreement with four statements: These days a person does not really know whom he or she can count on; Nowadays, a person has to live pretty much for today and let tomorrow take care of itself; It is hardly fair to bring a child into the world with the way things look for the future; and You sometimes cannot help wondering whether anything is worthwhile anymore. Five response categories were offered, as follows: Strongly agree, 5; somewhat agree, 4; neither agree nor disagree, 3; somewhat disagree, 2; and strongly disagree, 1. Responses for the four anomie items were subjected to item analysis to assess reliability. The resulting alpha coefficient was 0.77. An alpha of this magnitude justifies the use of these items in a scale measure. The scale measure was used as an independent variable in regression modeling.

3.7.3 Control Variables

Three control variables–sex, age, and educational attainment–were included in the model. While age, sex and educational attainment were not indicated by the theoretical perspective used to guide the study, they were included in the model as statistical controls. Control variables were used in quantitative analysis to help account for spurious relationships among variables that could lead to biased coefficient estimates in a model. In the current situation, the three control variables were slightly intercorrelated with hypothesized variables in the model. If the variance explained by control variables were not accounted for, it is

possible that variance being attributed to the study's independent variables were actually explained by the control variables. Therefore, inclusion of control variables in the model helps assure that variance attributed to independent study variables was unique variance that cannot be explained by other (spurious) variables.

Table 3.2 Model Variables, Type of Measure, and Coefficient Alpha (Scales)

Variable	Type of Measure	α
Dependent Variable		
Optimism that technologies will be beneficial to well-being and way of life	Seven-item scale	0.81
Predictor Variable		
Interest in science and technology	Single-item indicator	—
Scientism	Four-item scale	0.68
Institutional trust	Four-item scale	0.75
Faith in government regulation	Single-item indicator	—
Media system dependency	Seven-item scale	0.71
Individualism-Communitarian worldview	Five-item scale	0.70
Hierarchy-Egalitarian worldview	Six-item scale	0.79
Anomie	Four-item scale	0.77
Control Variable		
Sex	Single-item indicator	—
Age	Single-item indicator	—
Educational attainment	Single-item indicator	—

3.8 Field Test

The researcher field-tested a draft of the questionnaire for validity with a group of approximately 40 subjects. The 40 subjects, all adult residents living in Indiana, were similar to the target population and had no prior knowledge of the study. The researcher administered the field test to individuals and to small groups of individuals at their convenience. Subjects were

instructed to complete the questionnaire and to note in the margins any questions they had about particular items. An open-ended question was also included on the questionnaire to gain feedback from the participants regarding clarity of instructions or items. The researcher collected all completed questionnaires and carefully checked each for any comments or questions from the subjects. Based on results of the field test, several questionnaire items were rephrased for clarity and conciseness. Minor adjustments were also made in the layout of several attitude scales to ensure clarity and improve appearance.

3.9 Data Collection

Mailing addresses for the 4,500 Indiana households were received from the private list vendor through the organization's secure online portal. The list, in Excel format, included fields for subjects' full address and urban/rural status. The researcher provided the list to Purdue University Print Services through a secure electronic mail message. Purdue University Print Services performed all printing, collating and mailing for the project.

As a first step in the process, Print Services "cleansed" the list by visually inspecting addresses for completeness or other obvious errors. Print Services then verified the accuracy of addresses with the National Change of Address database. Bad addresses were replaced with extra names and addresses to ensure that 4,500 mailing addresses were usable.

As questionnaires were printed, each was given a unique identification number associated with each subject. The list of identification numbers and subject names was kept in a secure location by the principal investigator.

The researcher followed procedures recommended by Dillman et al. (2014) to carry out a series of mailings to the research subjects. As described in the timeline below, up to three

contacts were made with research subjects: an initial survey package, a follow-up postcard, and a second survey package.

3.9.1 Recruitment Timeline

The first mailing was sent on July 23, 2018, to all 4,500 household addresses. The second mailing, a follow-up postcard, was sent on August 6, 2018. The final mailing was sent out on September 4, 2018. In returned postcards (273) and surveys (418), 694 addresses were marked as undeliverable because they were incorrect, deceased, vacant, or listed the incorrect household. A total of 43 households contacted the researcher and asked to be removed from the study for reasons such as health issues, lack of interest, or unqualified to complete. Eleven incomplete questionnaires were returned blank. Due to the decrease in completed responses and the large number of households who asked to be removed, the researcher forwent the fourth mailing that was planned.

The initial survey package was mailed on July 23, 2018, to all 4,500 addresses. The package contained a cover letter, questionnaire, a survey information sheet, and an addressed business-reply envelope for return of the completed questionnaire. The cover letter explained the purpose of the study and encouraged subjects to participate. The letter also notified subjects that response would be tracked through an identification number printed on the questionnaire. A separate information sheet provided additional details about the project and contact information for the principal investigator and IRB office should the subject have any questions. The cover letter is provided in Appendix C, and the cover sheet is provided in Appendix D.

In addition, each initial survey package included a $2 bill as an incentive for subjects to participate in the project. A $2 bill was selected because of its novelty and also because public

opinion research has shown that a $2 incentive can boost response rates higher than can lesser amounts.

The researcher logged all incoming mail in an Excel file. Records were kept on identification numbers for every questionnaire returned either by the Post Office or by the respondent. Names corresponding to these numbers were removed from the master mailing list so as not to be included in subsequent mailings.

The second potential contact with subjects was made through a postcard mailed on August 8, 2018, approximately two-weeks after the initial survey package mailing. The purpose of the postcard was to remind subjects about the survey package they had received two weeks ago and to encourage their participation in the survey project. A copy of the postcard is provided in Appendix E.

Records were kept of identification numbers on postcards returned by the Postal Service, and subject names corresponding to these numbers were removed from the master mailing list.

The third contact included a complete survey package mailed to subjects on September 4, 2018, approximately six weeks after the initial mailing. This survey package was nearly identical to the initial package but included a modified cover letter and no monetary incentive. The modified cover letter is provided in Appendix F.

As returns were received from the third mailing, the researcher also received an increased number of messages from subjects requesting to be removed from the mailing list. Various reasons were given by respondents for requesting to be removed from future mailings, including age, failing health, or simply no interest in participating in the research. The matter was discussed by the researcher and principal investigator, and it was mutually agreed to halt any future contacts with survey subjects.

3.9.2 Response Rate

Following the data collection protocol described above, the research team mailed 4,500 questionnaires to the stratified random sample during the summer of 2018 and received a total of 1,003 completed questionnaires for a usable response rate of 26%. Approximately 694 survey packages were returned by the postal service as undeliverable. Urban residents accounted for 645 responses (64.3%), and rural residents accounted for 358 responses (35.5%). As shown in Figure 3.2, completed questionnaires were received from 87 of 92 Indiana counties (Rice, 2019).

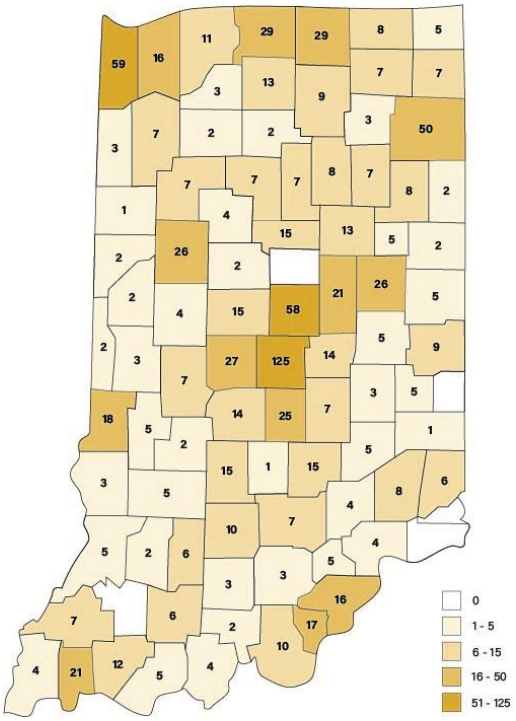

Figure 3.2: Number of survey respondents by Indiana county (n=1,003)

3.10 Data Analysis

Data from the completed questionnaires was entered into the Statistical Package for Social Sciences 25 (SPSS®) for analysis. A coding sheet developed by the principal investigator was used to guide data entry. Following data entry, basic descriptive statistics were generated for

all variables. The output was carefully examined for out-of-range values, missing data and other anomalies. Out-of-range values were corrected prior to analysis.

Because of the random stratified sampling design employed, data were weighted so that descriptive and multivariate statistics would be representative of known population parameters for the state of Indiana. The research team engaged the services of the mailing list vendor to perform the data weighting procedures, which involved weighting to account for non-random selection of urban and rural subjects (rural oversampling). In addition to weighting by urban/rural status, data were also weighted by age due to a high median age detected in the sample. As a part of the weighting procedure, imputation was performed for missing data in the age variable. A special module within SPSS 25 (SPSS Complex Samples®) was used for more accurate descriptive and multivariate analyses with the weighted data.

Descriptive data reported in Chapter 4 include weighted population estimates (percentages), mean population estimates, and standard errors. Unweighted means and standard deviations are provided for comparison purposes.

Multivariate analysis involved multiple linear regression (Pedhazur, 1982) conducted through the SPSS Complex Samples General Linear Model option. SPSS Complex Samples does not support hierarchy entry of independent variables. Therefore, control variables were entered with independent variables in the regression analysis. Reported output includes coefficient estimates, standard errors, t-values, significance levels, and R-square value.

A level of 0.05 was identified *a priori* as the statistical threshold to establish statistical significance for all descriptive and multivariate tests.

3.11 Threats to Internal and External Validity

All social science research is subject to threats to internal and external validity. Internal validity refers to whether a research procedure is actually measuring what the researcher intends for it to measure. External validity refers to the ability to generalize findings and whether findings are applicable across individuals, settings, and time periods. While it is not possible to eliminate all threats to internal and external validity, it is possible to minimize threats by taking specific recommended measures during the research process.

The researcher observed the following recommended practices to minimize threats to internal validity. Proper measurement was a concern from the outset of the project. Great care was taken in the phrasing and development of items for the survey questionnaire. When possible, items were modeled after those with established validity from the peer-reviewed literature. Scale items used in this research were subjected to item analysis and discarded from the model if the Cronbach coefficient alpha was not 0.70 or higher. (However, an exception was made for the scale measure of scientism, addressed earlier in this chapter.) The questionnaire was also field-tested with a group of adult subjects similar to the target population to identify any possible issues with clarity or ordering of items. Finally, the research team engaged the services of a research methodology expert to review all questionnaire items and design the instrument.

Also posing a major threat to internal validity are improperly specified theoretical models. As this study had the goal of developing and testing such a model, the researcher made a number of implicit assumptions about cause-and-effect relationships among variables. The threat to internal validity regarding causation was minimized by specifying relationships among variables based upon a review of literature and an established theoretical perspective. In addition, statistical tests were made to ensure that independent variables were not excessively

intercorrelated, which could threaten internal validity by biasing regression estimates. The variable weighting technique used in this research, along with use of the Complex Samples module in SPSS for data analysis, reduced standard error and, accordingly, helped minimize the risk of Type II error (accepting a false null hypothesis) in interpreting the model.

Steps also were taken to minimize threats to external validity. The population for the study was adult residents in the state of Indiana. The researcher used stratified random sampling and a maximum sample size allowed by the project budget to minimize the risk of coverage error (n=4,500). There was frame error in the mailing list. Both the list vendor and Purdue Printing Services used USPS database services to identify and replace bad addresses prior to the initial mailing. Finally, best practices from the literature and those recommended by the project consultant were followed in attempts to maximize subject participation. These practices included use of up to three mail contacts with research subjects (Dillman et al., 2014) and inclusion of a monetary ($2) incentive to boost survey response (Ary, Jacobs, Sorenson, & Walker, 2014).

3.12 Limitations

The researcher acknowledges the following limitations in study methodology:

1. The research team followed recommended best practices to maximize the study response rate. The 26% response rate is slightly below the 30% median rate reported in public opinion research (Groves, 2006). While procedures such as weighting reduce standard error and increase the ability to generalize findings to the study population, the research team recognizes that non-response bias poses a substantial threat to external validity.

2. The object of weighting data is to adjust sample characteristics to more closely reflect population parameters, when those population parameters are known. However, it should be acknowledged that the use of weighing relies on assumptions about the target population and nonrespondents that cannot be verified with complete accuracy in most social science survey situations (AAPOR, 2016; Brick, 2013), including the current study. In the current study, the research team reviewed the literature and then sought expert advice in making the decision to weight the data. Expert advice was sought from the study consultant and further from a staff research methodologist employed by the private vendor that provided the mailing list. The decision to weight the data was made with the assumption that its advantages (reduced standard error and greater confidence in generalizing to the population) outweighed disadvantages. The accuracy of the assumption cannot be verified with complete certainty.
3. When possible, the research team based measurement of study variables on similar variables and studies found in the peer-reviewed literature. However, some items needed to be modified for use with the current study's objectives. In addition, scale items for the worldview measures were slightly modified as the research team judged the original language use in some of the items to be politically polarizing. It is possible that these modifications create a threat to internal validity.
4. The software package used for analysis of weighted data (IBM SPSS Complex Samples 25) has limited functionality to perform some of the tasks desired in this research. For example, the Complex Samples module does not support item analysis, generation of correlation matrices, or hierarchy regression analysis. It was therefore necessary to conduct item analysis and generate correlation matrices in conventional

SPSS with unweighted data. Findings from these statistical operations contain some amount of error that cannot be quantified. For the regression analysis, it was not possible to enter control variables in hierarchy fashion in SPSS Complex Samples 25. The control variables were therefore entered in the model alongside independent variables. This procedure does not technically introduce error into the model, but presents limitations in partitioning the amount of variance explained by the control variables.

5. During formatting of the questionnaire, an item focused on television was inadvertently omitted from the media system dependency composite measure. The omission of this item weakens accurate measurement of the media system dependency scale item.

CHAPTER 4. RESULTS

4.1 Introduction

This chapter presents descriptive and multivariate findings from this study. After a review of the study's research objectives and hypothesis, the chapter provides an overview of participants' selected sociodemographic characteristics. Next, the chapter provides results for the four research objectives. Multivariate findings are provided at the end of the chapter.

4.2 Research Objectives

5. To describe subjects' level of interest in emergent science and technology.
1. To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.
2. To describe subjects' perceived levels of optimism that emergent science and technology will improve quality of life.
3. To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

4.3 Hypotheses

Hypothesis 1: Higher levels of scientism will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 2: Increased interest in science will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 3: Higher levels of institutional trust will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 4: Higher levels of faith in government to ensure technologies are safe will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 5: Higher levels of media system dependency will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 6: Higher group scores on the individualist-communitarian dimension of the group-grid typology in cultural theory will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 7: Higher grid scores on the hierarchy-egalitarian dimension of group-grid typology in cultural theory will be associated with higher levels of optimism toward emergent science and technology.

Hypothesis 8: Lower levels of anomie will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

4.4 Subjects' Sociodemographic Characteristics

This research includes responses from 1,003 adult subjects with an Indiana household in 2018 (Rice, 2018). All participants were 18 years of age or older. Table 4.1 provides basic sociodemographic information for study subjects.

The weighted sample was approximately 54% female and 46% male. Subjects' ages ranged from 18 to 99 years, with an unweighted mean of approximately 58 years and estimated population mean of 49 years. The discrepancy in means, and standard errors, shows the effect of the weighting procedure.

Data were weighted for urban/rural status in addition to age. Sample data in Table 4.1 thus reflect the state's rural/urban composition wherein just over three-fourths of the population is urban and slightly less than one-fourth is rural.

In terms of race and ethnicity, subjects were predominately White (88.7%), with relatively small percentages of Black or African American respondents, Hispanic or Latino respondents, Asian respondents, and American Indian respondents (Table 4.1).

Table 4.1: Subject Characteristics

Subject characteristics, weighted population estimates presented in percentages, number of respondents, unweighted median, unweighted mean, and mean population estimate provided for age variable (n=1,003).

Category	Response	%	N	Median[1]	Mean[2] (SD)	Mean Pop. Estimate[3] (SE)
Sex			954			
	Male	46.3				
	Female	53.7				
Age					58.26	48.72
			934	60.00	(15.49)	(0.78)
	18-34	8.7				
	35-44	12.2				
	45-54	17.3				

Table 4.1 continued

	55-64	23.8	
	65+	38.0	
Area of Residence			993
	Urban	77.8	
	Rural	22.2	
Race and Ethnicity			
	White	88.7	939
	Black or African American	5.2	939
	Hispanic or Latino	3.2	939
	Asian	1.9	939
	American Indian or Alaska Native	1.2	939
	Native Hawaiian or other Pacific Islander	0.0	938
	Other	2.0	931

[1] Unweighted median.
[2] Unweighted mean (standard deviation).
[3] Mean population estimate (standard error).

Table 4.2 reports subjects' annual gross household income, which varied from below $15,000 to $350,000. Of 1,003 respondents, nearly one-fourth (23.3%) reported incomes between $50,000 and $74,999 per year, nearly one-fifth (19.0%) reported incomes between $100,000 and $149,999 per year.

Table 4.2: Subjects' Gross Household Income

Respondents' gross household income, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003).

Gross Household Income	%	N	Median[1]	Mean[2] (SD)	Mean Pop. Estimate[3] (SE)
		731	$60,000.00	$72,341.38 (49,945.48)	$77,842.32 (2,645.18)
Under $15,000	7.3				
$15,000 to $24,999	5.4				
$25,000 to $34,999	10.1				
$35,000 to $49,999	15.7				
$50,000 to $74,999	23.3				
$75,000 to $99,000	12.7				
$100,000 to $149,999	19.0				
$150,000+	6.6				

[1] Unweighted median.
[2] Unweighted mean (standard deviation).
[3] Mean population estimate (standard error).

Subjects were also asked to indicate the level of education they had completed. Reponses varied from having completed eighth grade or less to having earned a doctorate or other professional degree. Nearly one-third (30%) reported having earned a bachelor's degree. Additional results are reported in Table 4.3.

Table 4.3: Highest Grade or Year of School Completed

Subjects' highest grade or year of school completed, weighted population estimates presented in percentages, number of respondents (n=1,003).

Highest Grade or Year of School Completed	Education Level (%)	N
		957
8th grade or less	0.3	
9th-12th grade, no diploma	2.7	
High school graduate or GED completed	16.3	
Completed a vocational, trade or business school program	7.1	
Some college credit, but no degree	17.9	
Associate Degree (AA, AS)	9.0	
Bachelor's Degree (BA, BS, AB)	30.0	
Master's Degree (MA, MS, MSW, MBA)	12.5	
Doctorate (PhD, EdD) or Professional Degree (MD, DDS, DVM, JD)	4.1	

As a part of the research, subjects were asked a series of questions to determine their position on two worldview axes: Individualist/communitarian and hierarchy/egalitarian. Subjects' placement on each axis indicates cultural values and psychological predispositions associated through research with perception of risk. The upper panel of Table 4.4 provides results for subjects' individualism/communitarian worldviews. Mean values below 3.0 tend toward communitarianism for each attitudinal item, while those above 3.0 tend toward

Individualism. As shown, subjects expressed the strongest individualist perception for two items: The government should stop telling people how to live their lives, and the government interferes too much in our everyday lives. More than 60% of the subjects somewhat or strongly agree with both statements.

The lower panel of the table provides results for hierarchy/egalitarian worldviews. Mean values above 3.0 tend toward hierarchy for each attitudinal item, while those below 3.0 tend toward egalitarian. As shown, subjects expressed the strongest hierarchy perceptions for two items: Some groups in society don't want equal rights, they want special rights just for them, and Society as a whole has become too soft. A majority of subjects somewhat or strongly agreed with both statements.

Table 4.4: Subjects' Worldviews

Subjects' worldview measures, individualism-communitarianism and hierarchy-egalitarian, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

Items	Percentages: Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	N	Mean[1] (SD)	Mean Pop. Estimate[2] (SE)
Individualist-Communitarian								
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals[4]	2.1	15.3	16.6	28.7	37.4	988	3.87 (1.15)	3.84 (.05)
The government should stop telling people how to live their lives[3]	31.4	30.4	25.7	9.0	3.4	987	3.85 (1.08)	3.77 (.05)
The government interferes too much in our everyday lives[3]	27.9	36.2	24.5	7.4	4.1	980	3.86 (1.03)	3.76 (.05)
It's not the government's job to try to protect people from themselves[3]	17.8	27.3	24.5	22.3	8.1	984	3.37 (1.20)	3.24 (.05)
Sometimes government needs to make laws that keep people from hurting themselves[4]	15.0	41.3	24.1	11.9	7.8	983	2.61 (1.12)	2.56 (.05)

Table 4.4 continued

Hierarchy-Egalitarian								
Some groups in society don't want equal rights, they want special rights just for them[3]	43.6	28.4	12.7	8.4	6.9	989	4.02 (1.21)	3.93 (.05)
Society as a whole has become too soft[3]	29.8	28.1	23.4	10.2	8.6	988	3.69 (1.18)	3.60 (.05)
We have gone too far in pushing equal rights in this country[3]	17.0	24.9	19.9	13.9	24.2	989	3.14 (1.41)	2.97 (.06)
Our society would be better off if the distribution of wealth was more equal[4]	24.3	27.2	16.8	14.4	17.2	993	2.80 (1.43)	2.73 (.06)
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women[4]	30.5	27.0	17.4	13.3	11.8	993	2.62 (1.40)	2.49 (.06)
Discrimination against minorities is still a very serious problem in our society[4]	33.7	32.5	12.8	13.5	7.5	991	2.42 (1.28)	2.29 (.05)

[1] Unweighted mean (standard deviation).
[2] Mean population estimate (standard error).
[3] Items scaled 5 to 1, strongly agree to strongly disagree.
[4] Items scaled 1 to 5, strongly agree to strongly disagree.

The questionnaire included four questions to measure subjects' levels of anomie. Results shown in Table 4.5 reveal relatively low levels of anomie. More than two-thirds (64.6%) of subjects somewhat or strongly agreed with the statement, "These days a person does not really know whom he or she can count on." However, half (50%) or more of the subjects somewhat or strongly disagreed with three of the four statements designed to measure social disconnectedness. Mean scores below 3.0, as shown for three of the four statements, also indicate relatively low levels of anomie.

Table 4.5: Level of Anomie

Respondents' level of anomie, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003).

Statements	Percentages					N	Mean[1] (SD)	Mean Pop. Estimate[2] (SE)
	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree			
These days a person does not really know whom he or she can count on	21.5	43.1	17.9	14.1	3.3	964	3.72 (1.07)	3.65 (0.05)
Nowadays, a person has to live pretty much for today and let tomorrow take care of itself	9.7	22.9	16.4	29.6	21.3	962	2.69 (1.30)	2.70 (0.06)
It is hardly fair to bring a child into the world with the way things look for the future	12.1	19.9	18.3	22.8	26.9	965	2.64 (1.34)	2.68 (0.06)
You sometimes cannot help wondering whether anything is worthwhile anymore	6.7	15.5	19.1	21.1	37.5	958	2.35 (1.29)	2.33 (0.06)

[1] Unweighted mean (standard deviation). Items scaled 5 to 1, strongly agree to strongly disagree.
[2] Mean population estimate (standard error).

4.5 Results for Research Objective 1

This section presents results for the first research objective, "To measure subjects' level of interest in emergent science and technology."

Subjects were asked to indicate their level of interest in emergent science and technology. As shown in Table 4.6, nearly two-thirds (63.2%) indicated they were moderately or very interested in the topic. Approximately 15% of the subjects indicated slight or no interest in emergent science and technology.

In terms of awareness of emergent science and technology, less than half (45.1%) of the subjects rated themselves as very or moderately aware. Approximately 21% of the subjects rated themselves as having slight or no awareness of emergent science and technology.

Table 4.6: Interest and Awareness in Emergent Science and Technology

Respondents' level of interest and level of awareness in emergent science and technology, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

Respondent Self-rating	Percentages (Interest/Awareness in Emergent Science and Technology) Very	Moderately	Somewhat	Slightly	None	N	Mean[1] (SD)	Mean[2] Pop. Estimate (SE)
Level of interest	28.0	35.2	21.7	11.9	3.2	988	2.73 (1.08)	2.73 (.05)
Level of awareness	8.4	36.7	34.0	14.9	6.0	981	2.33 (0.98)	2.26 (.04)

1 Unweighted mean (standard deviation). Item scale: 4 = very interested/aware; 3 = moderately interested/aware; 2 = somewhat interested/aware; 1 = slightly interested/aware; 0 = not interested/aware.

2 Mean population estimate (standard error).

Four items on the questionnaire were used to measure subjects' level of scientism, or confidence in the institution of science to provide solutions to problems. Results provided in Table 4.7 reveal that nearly 90% of subjects agreed they would be willing to accept new ideas if provided with sufficient scientific proof. Nearly three-fourths (72.9%) of subjects agreed that science is more constructive than destructive. However, support for science is not unconditional. While more than half (53.9%) of the subjects disagreed with the statement that science creates more problems than it solves, about one-third of the subjects neither agreed nor disagreed with the statement.

Table 4.7: Scientism

Respondents' perceptions of science and technology, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

Statements	---------- Percentages ---------- Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	N	Mean[1] (SD)	Mean Pop. Estimate[2] (SE)
I am willing to accept new ideas if provided with sufficient scientific proof	39.4	50.3	7.3	2.3	0.7	987	4.22(0.74)	4.25(.03)
Science is more constructive than destructive	26.0	46.9	22.6	3.2	1.1	986	3.90(0.85)	3.93(.04)
Science creates more problems than it solves[3]	1.5	11.2	33.4	35.6	18.3	987	3.53(0.97)	3.58(.04)
Science can eventually solve most of the problems facing the world	14.2	43.3	20.9	14.3	7.3	988	3.34(1.11)	3.43(.05)

[1] Unweighted mean (standard deviation). Items scaled 5 to 1, strongly agree to strongly disagree.
[2] Mean population estimate (standard error).
[3] Item scaled 5 to 1, strongly disagree to strongly agree.

4.6 Results for Research Objective 2

This section presents results for the second research objective, "To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology."

Subjects were asked to indicate their level of trust in a variety of available information sources to help them make decisions and stay informed on issues. Results shown in Table 4.8 reveal that farmers, university scientists, and friends and family were rated most trustworthy among the sources assessed. Government agencies, news organizations and the food industry were rated least trustworthy. While mean ratings for Cooperative Extension were somewhat positive, more than half (55.1%) subjects rated Extension as neither trustworthy nor untrustworthy.

Table 4.8: Source Trust

Respondents' perceived trust in various information sources for decision-making and staying informed on issues, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

	Percentages							
Source	**Very Trustworthy**	**Somewhat Trustworthy**	**Neither Trustworthy Nor Untrustworthy**	**Somewhat Untrustworthy**	**Not at all Trustworthy**	**N**	**Mean[1] (SD)**	**Mean[2] Pop. Estimate(SE)**
Farmers	22.2	48.9	23.0	4.3	1.6	977	3.91 (0.86)	3.86 (.04)
University scientists	22.3	47.4	22.5	5.2	2.6	974	3.76 (0.94)	3.82 (.04)
Friends or family	19.5	46.3	26.4	6.4	1.3	980	3.81 (0.86)	3.76 (.04)
Health care providers	10.9	48.7	21.3	14.9	4.2	978	3.54 (0.99)	3.47 (.04)
Cooperative Extension	8.1	28.9	55.1	4.0	3.9	894	3.44 (0.88)	3.33 (.03)
Environmental groups	7.9	42.3	27.3	15.4	7.1	972	3.20 (1.08)	3.29 (.04)
Government agencies	5.9	41.3	20.9	22.2	9.7	980	3.09 (1.11)	3.12 (.05)
News organizations	5.6	40.3	19.6	21.5	13.0	980	3.02 (1.20)	3.04 (.05)
Food industry	3.1	25.8	34.8	28.3	8.0	970	2.98 (0.99)	2.88 (.04)

[1] Unweighted mean (standard deviation). Item scale: 5 = very trustworthy; 4 = somewhat trustworthy; 3 = neither trustworthy nor untrustworthy; 2 = somewhat untrustworthy; 1 = not at all trustworthy.

[2] Mean population estimate (standard error).

Subjects were asked to indicate their level of agreement with the statement that they had faith in the government to ensure that technologies are safe. Results shown in Table 4.9 revealed that well over half (61.4%) of the subjects somewhat or strongly disagreed with the statement. Nearly one-fourth (23.6%) of the subjects neither agreed nor disagreed with the statement.

Table 4.9: Faith in Government Regulation

Respondents' level of agreement with statement regarding faith in government to ensure safety of technologies, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

Statements	---------- Percentages ---------- Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree	N	Mean[1] (SD)	Mean Pop. Estimate[2] (SE)
I have faith in the government to ensure technologies are safe	1.6	13.4	23.6	36.8	24.6	990	2.38 (1.06)	2.31 (.04)

1 Unweighted mean (standard deviation). Item scale: 5 = strongly agree; 4 = somewhat agree; 3 = neither agree nor disagree; 2 = somewhat disagree; 1 = strongly disagree.

2 Mean population estimate (standard error).

Subjects were asked to rate the helpfulness of various social media and mass media platforms for receiving information to stay informed and make decisions. Perceptions of helpfulness are commonly used measures of media system dependency in the communication literature. Results shown in Table 4.10 reveal relatively high levels of media system dependency for a mix of online and traditional media. Web and internet news sites were rated most highly among subjects, followed by traditional media outlets of radio and newspapers. More than three-fourths (80.6%) of subjects rated web and internet news sites as somewhat or very helpful. Social media platforms, Facebook and Twitter, were rated least helpful among the information channels assessed.

Table 4.10: Media System Dependency

Respondents' perceived helpfulness of various information channels for staying informed and making decisions, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

	---------- Percentages ----------							
Information Channel	**Very Helpful**	**Somewhat Helpful**	**Neither Helpful Nor Unhelpful**	**Somewhat Unhelpful**	**Not at all Helpful**	**N**	**Mean[1] (SD)**	**Mean[2] Pop. Estimate (SE)**
Web/internet news site	43.2	37.4	11.1	3.1	5.2	965	3.97 (1.16)	4.10 (.04)
Radio	21.8	51.7	15.5	3.7	7.3	966	3.73 (1.08)	3.77 (.05)
Newspapers	19.1	48.9	14.4	6.7	10.8	972	3.66 (1.17)	3.59 (.05)
Email news briefings	9.9	34.2	34.1	4.6	17.3	911	3.10 (1.23)	3.15 (.05)
Magazines	6.5	37.4	25.9	11.0	19.2	959	3.12 (1.21)	3.01 (.05)
Facebook	10.3	21.8	22.9	10.8	34.2	955	2.54 (1.38)	2.63 (.06)
Twitter	2.4	11.7	27.0	8.3	50.5	930	2.01 (1.17)	2.07 (.05)

1 Unweighted mean (standard deviation). Item scale: 5 = very helpful; 4 = somewhat helpful; 3 = neither helpful not unhelpful; 2 = somewhat unhelpful; 1 = not at all helpful.

2 Mean population estimate (standard error).

4.7 Results for Research Objective 3

This section presents results for the third research objective, "To measure subjects' perceived levels of optimism that emergent science and technology will improve quality of life."

Subjects were asked to provide their perceptions of selected emergent science-based technologies. Specifically, subjects rated seven emergent technologies regarding their optimism that the technology would be beneficial to themselves or their family's well-being and way of life. Results provided in Table 4.11 reveal that subjects were most optimistic about the benefits from nanotechnology and plant genetics research among the items assessed. Artificial intelligence and autonomous cars were rated least favorably among the technologies assessed. Examination of the distributions for big data technologies and artificial intelligence reveals relative disagreement, or polarization, among subjects as to the technologies' potential to improve well-being and way of life.

Table 4.11: Perceived Optimism for Emergent Science and Technology

Respondents' level of optimism that emergent technology will be beneficial to themselves or families' well-being or way of life, weighted population estimates presented in percentages, number of respondents, unweighted mean, and mean population estimate (n=1,003)

	Percentages								
Technology	**Very Optimistic**	**Somewhat Optimistic**	**Neither Optimistic Nor Pessimistic**	**Somewhat Pessimistic**	**Very Pessimistic**	**Don't Know**	**N**	**Mean[1] (SD)**	**Mean[2] Pop. Estimate (SE)**
Nanotechnology	26.0	35.7	22.6	4.8	1.0	9.8	977	3.85 (.94)	3.90 (.04)
Plant genetics research	24.6	41.1	14.7	9.0	6.9	3.8	986	3.65 (1.15)	3.70 (.05)
Synthetic biology	18.2	36.3	20.2	10.1	8.4	6.8	984	3.41 (1.20)	3.49 (.05)
Unmanned aerial vehicles	13.1	33.5	23.3	18.9	8.7	2.4	984	3.24 (1.20)	3.24 (.05)
Big data technologies	11.2	29.8	26.9	16.9	10.8	4.4	979	3.12 (1.16)	3.14 (.05)
Artificial intelligence	11.0	29.2	19.2	21.5	15.4	3.7	984	3.00 (1.26)	2.99 (.06)
Autonomous cars	8.9	18.4	17.0	24.4	28.1	3.3	983	2.49 (1.31)	2.54 (.06)

[1] Unweighted mean (standard deviation). Items scale: 5 = very optimistic; 4 = somewhat optimistic; 3 = neither optimistic nor pessimistic; 2 = somewhat pessimistic; 1 = very pessimistic. Responses of "Don't Know" not included.

[2] Mean population estimate (standard error).

4.8 Results for Research Objective 4

This section presents results for the first research objective, "To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology."

Multiple linear regression analysis was used to test the theoretical model developed in this research. Variance in the dependent variable (Level of Optimism Toward Emergent Technologies) was regressed on 11 independent variables. As discussed in Chapter 2, eight independent variables identified through theory were hypothesized to influence perceived optimism toward emergent technologies: scientism, faith in government regulation, interest in science and technology, institutional trust, media system dependency, hierarchy worldview, individualism worldview, and anomie. Three additional variables were used as control variables in the research: sex, age, and educational attainment. Because IBM SPSS Complex Samples 25 does not support hierarchical entry of independent variables, the control variables were entered with the eight independent variables.

Results of the analysis are provided in Table 4.12. Multiple linear regression in IBM SPSS Complex Samples 25 generates coefficients for weighted data that express the magnitude and direction of the relationship between a given independent variable and the dependent variable while holding other independent variables constant. As the coefficients are not standardized, they cannot be readily compared to each other based on their magnitude to assess relative effects on the dependent variable. Rather, the t-values and probability levels shown in the table provide information on the relative strength and significance of each independent variable.

Results indicated that the model was somewhat successful in predicting subjects' perceived optimism toward emergent technologies when looking at five variables which explained approximately one-third (33%) of the variance in perceived optimism. According to the model, heightened optimism was predicted by higher levels of scientism, greater faith in government to regulate technologies, interest in science and technology, and increased media system dependency. These findings are consistent with the theoretical perspective used to guide the study which states that higher levels of scientism, interest in science, faith in government regulation, and media system dependency would increase optimism toward emergent science and technology.

In addition, one of the control variables, educational attainment, was statistically significant in explaining variance in perceived optimism toward emergent technologies. Increased optimism was associated with higher levels of educational attainment.

Table 4.12: Multiple Linear Regression Analysis for Level of Optimism That Technologies Will be Beneficial to Well-Being and Way of Life, Model Estimates, Standard Error, t-Statistic, and Significance

Predictor Variable	**B**	**SE**	**t**	***p***
Scientism	0.671	0.093	7.230	0.000*
Faith in government regulation	0.769	0.232	3.311	0.001*
Interest in science and technology	0.675	0.221	3.060	0.002*
Media system dependency	0.137	0.049	2.799	0.005*
Educational attainment	0.274	0.132	2.071	0.039*
Sex	-0.827	0.478	-1.730	0.084
Anomie	-0.059	0.064	-0.931	0.352
Institutional trust	0.087	0.097	0.899	0.369
Hierarchy-Egalitarian worldview	-0.050	0.056	-0.833	0.378
Individualist-Communitarian worldview	-0.046	0.073	-0.634	0.527
Age	-0.083	0.162	-0.511	0.609
Model R-Square	**0.330**			

* Coefficient is significant at the 0.05 level.

Findings from the model provide information needed to determine the level of support for the eight hypotheses proposed in Chapter 2. The hypotheses are reproduced below along with a statement indicating support or lack of support for each.

Hypothesis 1: Higher levels of scientism will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was supported from the model findings.

Hypothesis 2: Increased interest in science will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis is supported from the model findings.

Hypothesis 3: Higher levels of institutional trust will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was not supported from the model findings.

Hypothesis 4: Higher levels of faith in government to ensure technologies are safe will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was supported from the model findings.

Hypothesis 5: Higher levels of media system dependency will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was supported from the model findings.

Hypothesis 6: Higher group scores on the individualist-communitarian dimension of the group-grid typology in cultural theory will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was not supported from the model findings.

Hypothesis 7: Higher grid scores on the hierarchy-egalitarian dimension of group-grid typology in cultural theory will be associated with higher levels of optimism toward emergent science and technology.

This hypothesis was not supported from the model findings.

Hypothesis 8: Lower levels of anomie will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

This hypothesis was not supported from the model findings.

CHAPTER 5. CONCLUSIONS

5.1 Introduction

In this chapter, the researcher reviews the research objectives and research hypotheses. Next, the chapter provides a discussion of research findings as well as implications for the developed theoretical model, research and practice. This chapter concludes with recommendations for future research.

5.2 Research Objectives

1. To describe subjects' level of interest in emergent science and technology.
2. To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.
3. To describe subjects' perceived levels of optimism that emergent science and technology will improve quality of life.
4. To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

5.3 Hypotheses

Hypothesis 1: Higher levels of scientism will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 2: Increased interest in science will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 3: Higher levels of institutional trust will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 4: Higher levels of faith in government to ensure technologies are safe will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 5: Higher levels of media system dependency will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 6: Higher group scores on the individualist-communitarian dimension of the group-grid typology in cultural theory will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

Hypothesis 7: Higher grid scores on the hierarchy-egalitarian dimension of group-grid typology in cultural theory will be associated with higher levels of optimism toward emergent science and technology.

Hypothesis 8: Lower levels of anomie will be associated with higher levels of optimism that emergent science and technology are beneficial to one's well-being and way of life.

5.4 Summary of Major Findings

In this section, the researcher will break down study findings by research objective.

5.4.1 Research Objective 1: To measure subjects' level of interest in emergent science and technology

Results reported in Chapter 4 revealed relatively high self-ratings of interest in new science and technology. The finding that over half the subjects reported moderate or high levels of interest in science was somewhat unexpected. While consistent with prior research showing the American public is interested in science and technology judged to be personally relevant (Falk et al., 2007), is also possible that high levels of reported science interest may be partially due to response bias – that is, individuals with more interest in science may have been more likely to participate in the research than those with less interest. Nonetheless, results demonstrate a clear audience demand for science news and information. Results for the questionnaire item on perceived awareness of new science and technology showed that less than half of the subjects rated themselves as being moderately or very aware of the topic. Findings of high interest yet middling awareness of emergent science and technology suggest opportunities for improving educational outreach on these topics. It is reasonable to assume that individuals with higher levels of interest in these topics would be more highly motivated to attend to science-based messaging on these topics. Such messaging could be transmitted through a wide range of communication channels used by the subjects for news and information, as discussed later in this chapter.

Four items tapping scientism were incorporated into the questionnaire to measure subjects' confidence in science to provide solutions to problems. As described in Chapter 3, these items were used to form a composite measure of scientism tested in the empirical model. Results showed subjects perceived relative confidence in science and its ability to help solve problems. Approximately 90% of the subjects agreed with the statement that they would be willing to accept new ideas if presented with sufficient scientific proof.

While other indicators were generally positive regarding subjects' perceptions of science, a significant portion of subjects were apparently ambivalent for some statements. At least one-fifth of the subjects neither agreed nor disagreed with the statements that science is more constructive than destructive and that science can eventually solve most worlds' problems. Approximately one-third of the subjects neither agreed nor disagreed with the statement that science creates more problems than it solves. Overall results reveal relatively high levels of scientism. Einsiedel (1994) found that individual with lower levels of education tend to have less faith in science, which may be a factor in the current findings. More than half the subjects in this research reported an associate's degree or higher in educational attainment.

5.4.2 Research Objective 2: To identify subjects' trusted sources of information and communication channel preferences for learning about emergent science and technology.

Chapter 4 reports source trust findings for nine institutional and informal sources of information for decision-making and staying informed on issues. Results showed that farmers, university scientists, and friends and family judged most trustworthy among the sources assessed. Government agencies, news organizations and the food industry received the lowest ratings among the sources assessed. Subjects clearly differentiated among sources as to the level of perceived trustworthiness. While none of the sources were judged untrustworthy by a majority of subjects, approximately one-third of the subjects rated both government agencies and news organizations as somewhat or completely untrustworthy. These results support prior research findings of low levels of trust in scientific institutions (Achterberg et al., 2015; Mazey & Wingreen, 2017).

Relatively low levels of trust in institutional sources of information are disconcerting in general but may create particular challenges in efficiently communicating news and information about emergent science and technology. Government agencies play a major role in regulating

these technologies, and news organizations have a mission of communicating unbiased news and information to the public. Confidence in the effective regulation of emergent science and technology, which is essential for public support of research and development, depends on the public trust of institutional actors involved.

Research results show that Indiana residents have a relatively high level of media system dependency.

Subjects listed the following communication channels as somewhat or very helpful: 80.4% for web/internet news sites, 73.5% for radio, and 56.5% for newspapers. Social media sites, Facebook and Twitter, were rated least helpful of the channels assessed. The finding of high levels of media system dependency is consistent with prior research (Mazey & Wingreen, 2017; Pidgeon, Harthorn, Bryant…, 2009, Binder et al., 2016, Scheufele & Lewenstein, 2005).

It is interesting to note that subjects indicated relatively high levels of media system dependency even as they expressed low levels of trust in news organizations. The finding raises questions about the processes underlying subjects' news judgments. Different scenarios might account for the apparently contradictory finding. For example, it is possible that subjects may not feel they have a choice in news sources. In such instances, they may express dependence on communication channels despite lack of trust. Another scenario is that dependence on the communication channels assessed may be to satisfy entertainment or other types of informational needs other than strictly news. According to media system dependency theory, media channels may satisfy a variety of needs in addition to news, including relaxation and entertainment (Ball-Rokeach, 1985).

The single-item measure of faith in government regulation yielded negative feedback from subjects (61.4%) who somewhat or strongly disagreed that they had faith in the government

to regulate emergent science and technology for safety. This result supports previous research (Macnaghten & Chilvers, 2014) that found individuals in Great Britain had distrust in government regulation when it seemed that government and industry were working together on the technology or science. These results are not consistent with previous research in the UK finding in which a large majority of subjects felt the government was acting with the public's best interest in mind (Barnett et al., 2007).

5.4.3 Research Objective 3: To measure subjects' perceived levels of optimism that emergent science and technology will improve quality of life.

Optimism toward emergent science and technology as a means to improve subjects' way of life and well-being was measured by offering subjects a list of seven emergent technologies and their definitions. The science and technology items included in the research were identified through literature as well as through mass media coverage prior to the study period: nanotechnology, plant genetic research, synthetic biology, unmanned aerial vehicles, big data technology, artificial intelligence, and autonomous cars. Each technology is considered emergent, with the public having little to no first-hand experience with it. Each technology is subject to both positive and negative evaluations based on subjects' values and their assessments as to whether each technology will be beneficial to them.

Among these technologies, nanotechnology (61.7% optimistic), plant genetic research (65.7% optimistic), and unmanned aerial vehicles (57.5% optimistic) were assessed most favorably among subjects. Despite uncertainties that these technologies pose and the mixed news coverage they received, the subjects judged the benefits of these technologies to outweigh potential risks. Such assessments may be based on perceived health, environmental, or economic advantages.

Artificial intelligence (52.5% pessimistic) and autonomous cars (36.9% pessimistic) were viewed least favorably among the technology items assessed. Potential reasons for subjects' lack of optimism could be linked to uncertainties about the application of artificial intelligence and the uncertainties about regulation of autonomous cars. In any case, subjects apparently did not judge benefits of either technology to outweigh potential risks to their well-being or way of life.

5.4.4 Research Objective 4: To develop and test a theoretical model that predicts subjects' perceived level of optimism toward emergent science and technology.

Guided by a review of literature and the Reflexive Modernity theoretical perspective, the researcher developed and tested an empirical model with the objective of identifying factors predictive of public perceptions toward emergent science and technology. A multivariate analysis procedure, multiple linear regression, was used to test the empirical model. The model was shown to be somewhat successful, explaining about one-third (33%) of the variance in subjects' level of optimism in emerging science and technology. The model tested eight theory-based hypotheses regarding public perception of emerging science and technology. Three of the hypotheses were centered on variables addressed previously:

Findings revealed support for four of the eight hypotheses. Based on the testing of hypotheses, the following statements can be made regarding factors influencing perceptions of emerging science and technology among study subjects:

1. Subjects expressing higher levels of confidence in science, as indicated through measures of scientism included in the research, tend to be more optimistic that emergent science and technology will be beneficial to themselves and their families.
2. Subjects expressing higher levels of faith in government to ensure technologies are safe tend to be more optimistic that emergent science and technology will be beneficial to themselves and their families.

3. Subjects expressing higher levels of interest in science tend to be more optimistic that emergent science and technology will be beneficial to themselves and their families.
4. Subjects expressing higher levels of perceived helpfulness in various social media and mass media platforms, as indicated through measures of media system dependency included in the research, tend to be more optimistic that emergent science and technology will be beneficial to themselves and their families.

Results from testing of the empirical model did not support four of the hypotheses. The following statements can be made regarding the four rejected hypotheses:

1. Higher levels of trust in institutional sources of information such as news organizations, environmental groups, and university scientists, did not predict optimism that emergent science and technology will be beneficial to themselves and their families.
2. Higher group scores on the individualist-communitarian dimension of the group-grid typology in cultural theory did not predict optimism that emergent science and technology will be beneficial to themselves and their families, contrary to expectations from theory.
3. Higher grid scores on the hierarchy-egalitarian dimension of group-grid typology in cultural theory did not predict optimism that emergent science and technology will be beneficial to themselves and their families, contrary to expectations from theory.
4. Lower levels of anomie on the part of subjects did not predict optimism that emergent science and technology will be beneficial to themselves and their families, contrary to expectations from theory.

Two measures of worldviews were incorporated into the research. Individualist-communitarian values were measured with five Likert-type items, while hierarchy-egalitarian values were measured with six Likert-type items. Scale measures were developed for each of the two sets of items for use as independent variables in the empirical model. Descriptive findings showed that a majority of subjects tended toward individualist values, with a mean value of 3.0 or higher, for most attitude statements on the individualist/communitarian axis. For example, nearly two-thirds of the subjects somewhat or strongly disagreed with the statement that the government should do more to advance society's goal even if that required limiting individuals' freedoms. Well over half agreed that the government should stop telling people how to run their lives. At least one-fifth of the subjects expressed ambivalence about four of the five statements (neither agreed nor disagreed). Results ultimately showed individualist characteristics for the population.

More mixed findings emerged for attitude statements on the hierarchy/egalitarian axis. Findings show the presence of both hierarchical and egalitarian values across the attitude statements. The item representing the highest degree of hierarchy value orientation was phrased that some groups in society do not want equal rights, but rather want special rights just for them. More than 70% of the subjects somewhat or strongly agreed with the subject. The item representing the highest degree of egalitarian value orientation was phrased that discrimination against minorities is still a very serious societal problem. Approximately two-thirds of the subjects somewhat or strongly agreed with the statement.

5.5 Discussion

The theoretical model developed in this study was shown to be somewhat successful, explaining about 33% of the variance in the dependent variable, level of optimism that emergent

science and technology will improve quality of life. Four of the eight variables–scientism, faith in government regulation, interest in science, and media system dependency–entered the model at statistical significance and in the hypothesized direction. In addition, the control variable educational attainment entered the model.

Contrary to expectation, four hypothesized variables failed to enter the model: institutional trust, hierarchy egalitarian worldview, individualist communitarian worldview, and anomie. This finding, coupled with the fact that nearly two-thirds of the variance remains unexplained, suggests strongly that additional work is needed for model specification relative to public perceptions of emergent science and technology.

Nonetheless, key goals were accomplished during this study. First, the effort was the first known of its kind to develop empirical metrics surrounding Indiana residents' level of optimism that emergent science and technology will improve quality of life. Beck's and Giddens' theory of reflexive modernity, Douglas' theory of cultural worldviews, and Ball-Rokeach's theory of media system dependency provided a cohesive framework in which to view and study Indiana residents' perceptions of emergent science and technology. Theoretical constructs from the current research, as well as some of its quantitative measures, may provide useful in future research in this domain. In addition, collective study findings have practical implications for educators, communicators and policymakers working in this space.

First, findings from this research suggest a relatively wide range of perceptions for the seven emergent technologies assessed. Nanotechnology and plant genetics research were rated most favorably among the technologies, while artificial intelligence and autonomous cars were rated least favorably. More than one-fourth of the subjects were neither optimistic nor pessimistic about big data technologies. Each of the technologies assessed has a unique risk

profile that is likely to be viewed differently among social groups. Predisposing members of the public to be more favorable to these technologies will likely require more than public relations or information campaigns. Neither is encouraging acceptance of these technologies a matter of simply educating the public, as is often advocated. A basic premise of the Reflexive Modernization theoretical perspective used to guide the study is that public perceptions are based on deeply held cultural values and other assessments that are not necessarily amenable to education or communication efforts.

The finding that subjects expressing higher levels of scientism are more optimistic about the benefits of emergent science and technology reinforces the importance of public engagement efforts focused on emergent science and technology. While formal education venues are obviously important, outreach efforts should also be extended to free-choice learning venues such as museums, fairs, and science cafes. Such venues serve thousands and are popular with all ages of the public. At the same time, it must also be kept in mind that increasing public awareness and confidence in science and the scientific method does not automatically extend positive social capital to all science actors. Studies cited in this research clearly show that individuals may have high levels of trust in the science itself (Roberts et al., 2011; Einsiedel, 1994), yet express lower levels of trust in scientists and scientific institutions themselves (Achterberg et al., 2015; Mazey & Wingreen, 2017). Building and maintaining reputational credibility is as important for scientists and science institutions as it is for all professions. Results from this research show that Indiana residents have a high level of trust for university scientists, which represents a strength on which to build.

Results from this study support others' work that has found faith in government regulation is associated with more positive perceptions of emerging science and technology

(Barnett et al., 2007). As suggested by the Reflexive Modernity theoretical perspective, members of the public today perceive that emergent technologies pose new risks to them and their families. They want assurances that protective regulations are in place. While it is hoped that scientists themselves are actively involved in this function, regulation of various technologies may fall under any number of different government jurisdictions. As was shown in this research, Indiana residents are relatively divided on the level of trust they place in government agencies. Efforts need to be intensified on the part of government regulatory agencies to be transparent in their actions and policies. It would be advantageous for agencies to be more proactive in communicating what their programs and initiatives are doing to protect the public through oversight and/or regulations or new science and technology.

A final contribution of this research is its recognition of the importance in measuring public perceptions as a part of the social process through which emergent science and technology is assessed. Ultimately, the public will serve as the final arbiter in the use and adoption of much new science and technology. Improved communication with them depends on a more complete understanding not only of their level of understanding, but also their subjective evaluations of new technologies, including perceived benefits and risks. While public involvement should be sought in deliberations of all new technologies, it is particularly important in instances where benefits and risks are not evenly distributed among social groups or geographically. A classic example of uneven distribution of risk involves the siting of nuclear or waste facilities. While the facilities may offer a general societal benefit, a particular social group or local residents may shoulder the primary risk.

5.6 Implications and Recommendations

This study adds to the multifaceted and interdisciplinary body of research and theory surrounding public perception and acceptance of emerging science and technology. The theoretical context of this research focused on Reflexive Modernization and the phases through which modernity passed to get to its current reflexive state. Examining the research problem through this theory profoundly affected the framing of research objectives and selection of major study constructs. A major premise of Reflexive Modernization is the recognition of the inescapability of risk in modern society. By exposing the uncertainties of emergent science and technology, Reflexive Modernization presents a significantly different perspective from that often provided by mass media or industry.

Among the contributions of Reflexive Modernity to development of the empirical model is the importance of faith in government agencies to ensure safety of emergent science and technology and level of trust institutional sources of information. Regression results revealed that faith in government agencies was a successful predictor in optimism that emergent science and technology would be beneficial to one's well-being and way of life, while level of trust was not a successful predictor. In retrospect, the findings may reveal that faith in government is a more direct measure of the willingness of the public to defer to the expertise of regulatory authorities. While trust in institutional sources is no doubt important, not all of the institutional sources included in this study's measure of trust have direct responsibility for managing or regulating risk. Public awareness of this fact may account for the failure of trust to predict optimism in the benefits of emerging science and technology.

As suggested by the Reflexive Modernization theoretical perspective, emergent science and technology bring with them an element of uncertainty. For example, long-term health or environmental risks cannot always be known. Some technologies may also prove to be

economically disruptive in that individual workers or entire industries may be significantly impacted or displaced. In this regard, public resistance to the specter of uncertainty is rational. In their communication efforts, government agencies and educational institutions should acknowledge uncertainty, address how uncertainty is built in to regulatory processes, and when possible, discuss efforts being undertaken to overcome or limit uncertainty.

Unexpected findings in the research raise questions that warrant additional thought. For instance, previous discussion in this chapter addressed the apparently contradictory finding of high media system dependency alongside low levels of trust in news organizations. A second question raised by unexpected study findings is the relatively high level of perceived trust placed in farmers, especially when compared to largely indifferent ratings accorded to Cooperative Extension. This finding could be a result of traditional views of farmers as trustworthy and hardworking members of the community, particularly in Indiana where agriculture is a major industry and way of life. As for the Cooperative Extension ratings, results from this project (not reported in this document) indicate relatively low levels of public awareness of Cooperative Extension. It is highly likely that subjects with a low level of awareness of Extension do not feel they have an adequate basis to judge trustworthiness.

It would seem prudent for Cooperative Extension to conduct additional public opinion research addressing perceptions of helpfulness, trust, and dependency on the publicly funded agency. A substantial portion of Indiana residents expressed overall indifference toward trustworthiness of the organization, despite its longstanding mission to educate and provide assistance to residents and communities. The recommended research may help Extension develop a stronger identity and connection with all Indiana residents.

Relative to media channel preferences, web/internet news sites were rated most helpful among the social media and mass media platforms assessed. This finding is a bit surprising

because the weighted sample is adjusted for age, and a majority of Indiana adults were not born into the digital age. On the other hand, it should be noted that the next highest rated media platforms were traditional media channels of radio and newspapers. As reported in Chapter 3, television was inadvertently dropped from the instrument during formatting.

The finding of high levels of trust in university scientists represents a strength on which to build when engaging the public on emerging science and technology topics. These findings provide confidence to move forward in communicating pertinent facts to the public and to help build awareness based on credible information on which consumers may develop their own opinions and make informed decisions. Purdue University and other educational institutions can use this information to encourage increased communication between scientists and the public. As discussed earlier, the university should explore multiple innovative ways to engage the public on emerging science and technology. For example, while communication approaches might well define mass media and social media as baseline communication methods, free-choice learning venues such as museums, science cafés and other public demonstrations represent additional relevant options for reaching youth and adults.

Findings from this research also have implications for the researcher's home department: the Department of Agricultural Sciences Education and Communication. The department offers baccalaureate degrees in Agricultural Communication and Agricultural Education. Through its graduate program, the department spans formal and informal education, media, communication, STEM learning systems, youth education, and allied areas. The department could integrate findings from this research into its courses and curricula that train college students for careers as teachers, professional communicators, Extension educators, and other impactful careers in which graduates may influence the public. Department faculty also have an opportunity to engage younger and non-traditional audiences to discover their needs, wants, expectations, and fears

about emergent science and technology. With its academic home in a research university, the department could help bridge the communication gap between scientists and Indiana residents through the development of evidence-based best practices for public engagement.

Finally, a number of recommendations can be made for future research on public perceptions of emerging science and technology. To gain a deeper understanding of specific science or technologies, future studies should be singular in their focus on that particular area of technology. Different areas of science and technologies have different risk profiles. Therefore, explained variance in modeling might well be enhanced by narrowing the study focus, particularly when perceptions of emergent science and technology serve as the dependent variable. In addition, the researchers suggest further elaboration of the theoretical model to include additional independent variables that may increase explained variance. Improved scale measurement of faith in regulatory agencies to protect the public is needed. Also needed are alterations to the research design to collect different types of data for analysis. An alternate study conducted with a qualitative research design could provide more in-depth insights into Indiana residents' level of optimism toward emergent science and technology. A research design employing personal interviews, for example, would enable researchers to interact with Indiana residents and to pose probing questions to better understand the dynamics of public opinion formation around emerging science and technology.

5.7 Conclusions

The current research provides a needed starting point in the understanding of factors influencing Indiana residents' perceptions of emergent science and technology, Still, there is much more to learn. Ongoing empirical research is needed to track public perceptions over time and for particular new technologies and areas of science. Certainly, innovative research designs

and improved measurement for key constructs will improve future research. Perhaps most urgent, however, is convincing policymakers and other decision-makers of not only the need for social science research in this domain, but for inclusion of social science expertise early in the process. In addition, mechanisms must exist to involve the public in conversations about emerging science and technology early and in a meaningful way. Social science can play a key facilitative role in this process.

As of this writing, the researcher is not aware of a singular methodology that has gained widespread acceptance for involving the public in upstream deliberations about emerging science and technology. One way to move forward would be for university administrators and faculty to establish committees or panels responsible for developing recommended best practices on public engagement with emergent science and technology. Tasks of such a committee might include developing mechanisms not only for conducting periodic public opinion research to guide its efforts but also in encouraging increased dialogue between the public and the academic community. Possible venues might include public forums, county Extension meetings, or special workshops or meetings with specific groups. Cooperative Extension might be called upon to play a significant role in county-level activities. Such an initiative would require a significant commitment of time and funding from administration, but could help public universities fulfill their 21st century mission and serve the public. If successful, the initiative would ultimately help consumers develop and voice informed decisions on emergent science and technology so that public concerns and questions could be addressed early in the process.

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APPENDIX A: IRB APPROVAL

PURDUE
UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	TUCKER, MARK A
From:	DICLEMENTI, JEANNIE D, Chair Social Science IRB
Date:	02/05/2018
Committee Action:(2)	Determined Exempt, Category (2)
IRB Action Date:	02 / 05 / 2018
IRB Protocol #:	1712020022
Study Title:	Best Practices to Engage the Indiana Public on Emergent Science and Technology

The Institutional Review Board (IRB) has reviewed the above-referenced study application and has determined that it meets the criteria for exemption under 45 CFR 46.101(b).

Before making changes to the study procedures, please submit an Amendment to ensure that the regulatory status of the study has not changed. Changes in key research personnel should also be submitted to the IRB through an amendment.

General

- To recruit from Purdue University classrooms, the instructor and all others associated with conduct of the course (e.g., teaching assistants) must not be present during announcement of the research opportunity or any recruitment activity. This may be accomplished by announcing, in advance, that class will either start later than usual or end earlier than usual so this activity may occur. It should be emphasized that attendance at the announcement and recruitment are voluntary and the student's attendance and enrollment decision will not be shared with those administering the course.
- If students earn extra credit towards their course grade through participation in a research project conducted by someone other than the course instructor(s), such as in the example above, the students participation should only be shared with the course instructor(s) at the end of the semester. Additionally, instructors who allow extra credit to be earned through participation in research must also provide an opportunity for students to earn comparable extra credit through a non-research activity requiring an amount of time and effort comparable to the research option.
- When conducting human subjects research at a non-Purdue college/university, investigators are urged to contact that institution's IRB to determine requirements for conducting research at that institution.
- When human subjects research will be conducted in schools or places of business, investigators must obtain written permission from an appropriate authority within the organization. If the written permission was not submitted with the study application at the time of IRB review (e.g., the school would not issue the letter without proof of IRB approval, etc.), the investigator must submit the written permission to the IRB prior to engaging in the research activities (e.g., recruitment, study procedures, etc.). Submit this documentation as an FYI through Coeus. This is an institutional requirement.

Categories 2 and 3

- Surveys and questionnaires should indicate
  - only participants 18 years of age and over are eligible to participate in the research; and
  - that participation is voluntary; and
  - that any questions may be skipped; and
  - include the investigator's name and contact information.
- Investigators should explain to participants the amount of time required to participate. Additionally, they should explain to participants how confidentiality will be maintained or if it will not be maintained.
- When conducting focus group research, investigators cannot guarantee that all participants in the focus group will maintain the confidentiality of other group participants. The investigator should make participants aware of this potential for breach of confidentiality.

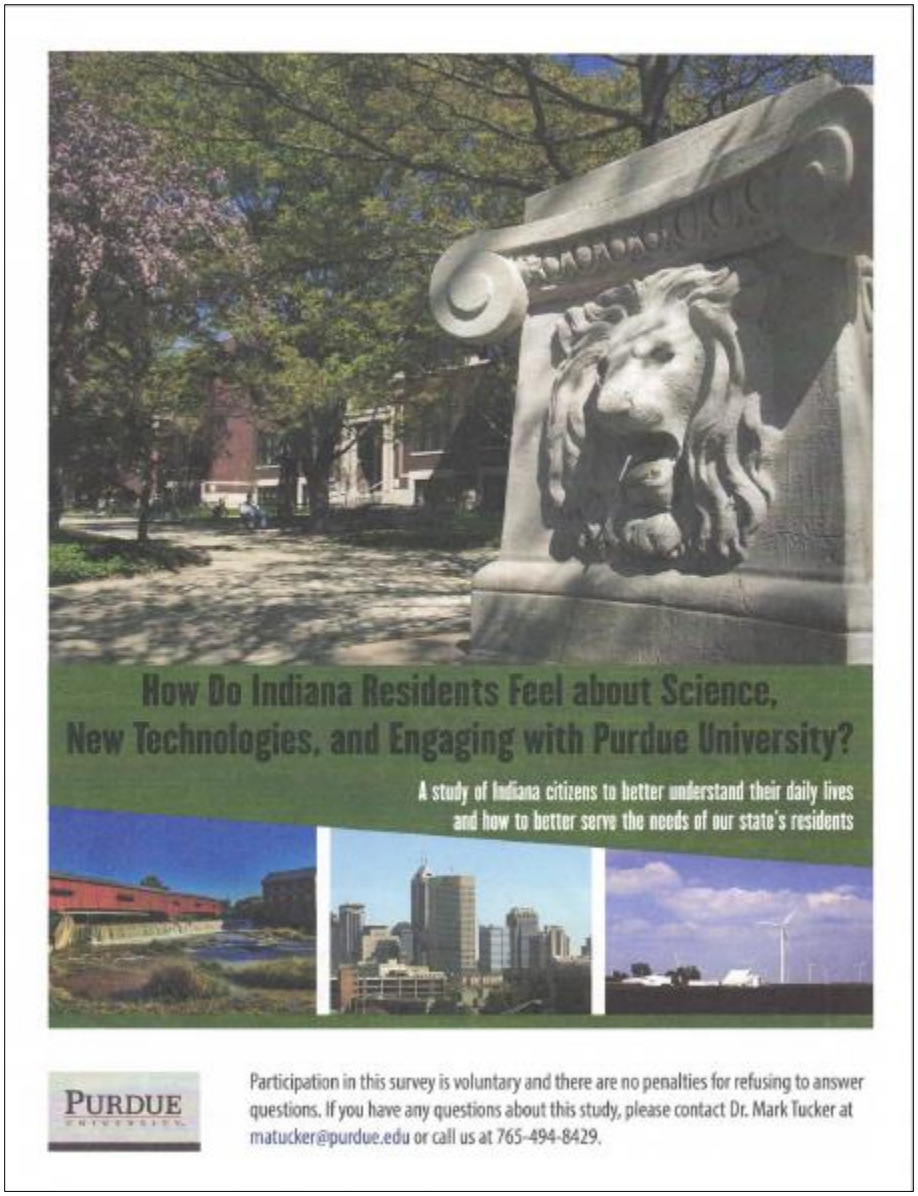
Category 6

- Surveys and data collection instruments should note that participation is voluntary.
- Surveys and data collection instruments should note that participants may skip any questions.
- When taste testing foods which are highly allergenic (e.g., peanuts, milk, etc.) investigators should disclose the possibility of a reaction to potential subjects.

You are required to retain a copy of this letter for your records. We appreciate your commitment towards ensuring the ethical conduct of human subjects research and wish you luck with your study.

Ernest C. Young Hall, 10th Floor - 155 S. Grant St. - West Lafayette, IN 47907-2114 - (765) 494-5942 - Fax: (765) 494-9911

APPENDIX B: INSTRUMENT



Where do you stand on commonly debated topics in our communities?

5. There is a lot of disagreement about how much the government should be involved in the decisions people make. We want to know how people in our state feel, so please let us know your level of agreement with the following statements.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
The government interferes far too much in our everyday lives	❑	❑	❑	❑	❑
Sometimes government needs to make laws that keep people from hurting themselves	❑	❑	❑	❑	❑
It's not the government's job to try to protect people from themselves	❑	❑	❑	❑	❑
The government should stop telling people how to live their lives	❑	❑	❑	❑	❑
The government should do more to advance society's goals, even if that means limiting the freedom and choices of individuals	❑	❑	❑	❑	❑

6. Another debated topic in our communities is the degree of equality and discrimination present. Please let us know your level of agreement with the following statements.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
We have gone too far in pushing equal rights in this country	❑	❑	❑	❑	❑
Our society would be better off if the distribution of wealth was more equal	❑	❑	❑	❑	❑
We need to dramatically reduce inequalities between the rich and the poor, whites and people of color, and men and women	❑	❑	❑	❑	❑
Discrimination against minorities is still a very serious problem in our society	❑	❑	❑	❑	❑
Some groups in society don't want equal rights, they want special rights just for them	❑	❑	❑	❑	❑
Society as a whole has become too soft	❑	❑	❑	❑	❑

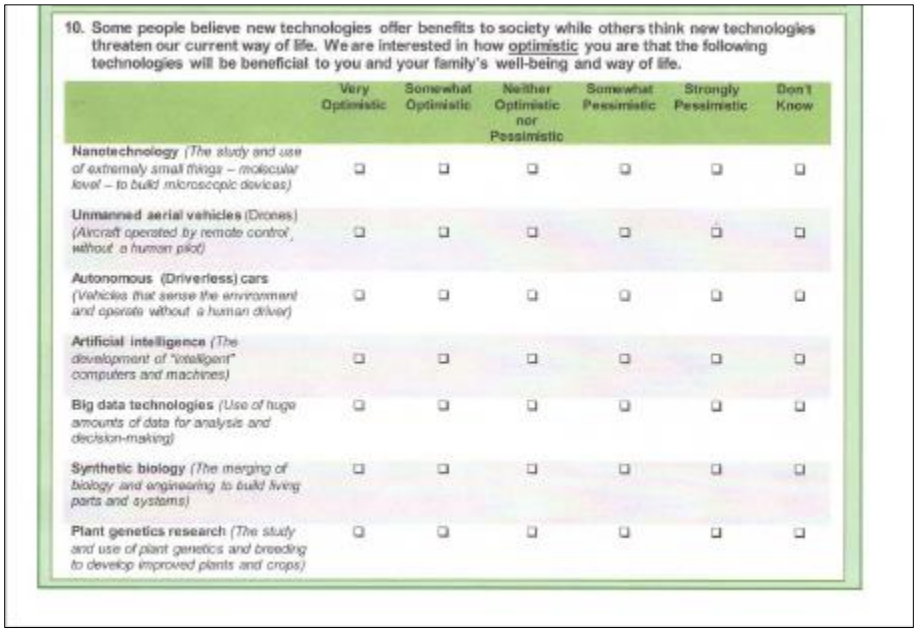
How do you find information and how much do you trust sources?

7. As a part of our research, we are interested in your preferred methods for receiving information to stay informed and make decisions. How helpful are the following channels of information to you in staying informed and making decisions?

	Very Helpful	Somewhat Helpful	Neither Helpful nor Unhelpful	Somewhat Unhelpful	Not At All Helpful
Web/Internet News Site	❑	❑	❑	❑	❑
Facebook	❑	❑	❑	❑	❑
Twitter	❑	❑	❑	❑	❑
Magazines	❑	❑	❑	❑	❑
Newspapers	❑	❑	❑	❑	❑
Radio	❑	❑	❑	❑	❑
Email news briefings	❑	❑	❑	❑	❑
Other (Please write in)					

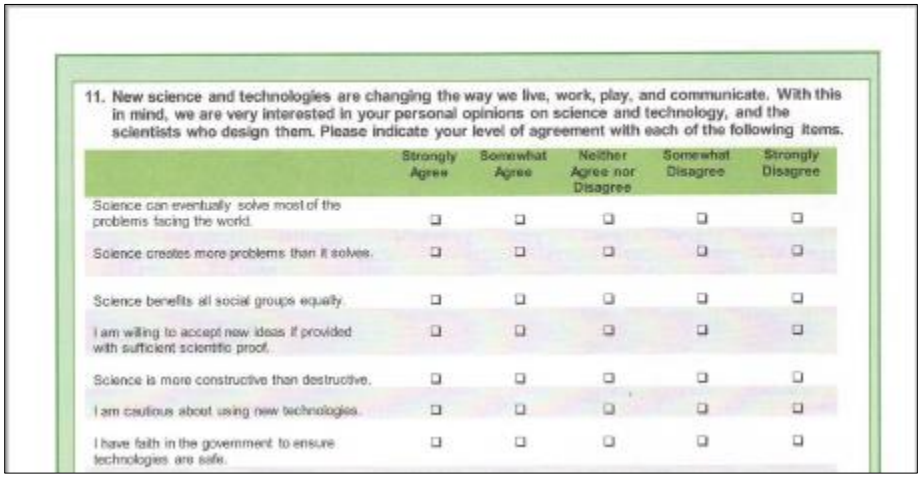
8. There are many sources of knowledge and information to help people make decisions and stay informed on issues. Please tell us how trustworthy you find the following sources.

	Very Trustworthy	Somewhat Trustworthy	Neither Trustworthy nor Untrustworthy	Somewhat Untrustworthy	Not At All Trustworthy
Government agencies	❑	❑	❑	❑	❑
News organizations	❑	❑	❑	❑	❑
The food industry	❑	❑	❑	❑	❑
Farmers	❑	❑	❑	❑	❑
Health care providers	❑	❑	❑	❑	❑
Environmental groups	❑	❑	❑	❑	❑
University scientists	❑	❑	❑	❑	❑
Friends or family	❑	❑	❑	❑	❑
Cooperative Extension	❑	❑	❑	❑	❑
Other (Please write in)					



10. Some people believe new technologies offer benefits to society while others think new technologies threaten our current way of life. We are interested in how optimistic you are that the following technologies will be beneficial to you and your family's well-being and way of life.

	Very Optimistic	Somewhat Optimistic	Neither Optimistic nor Pessimistic	Somewhat Pessimistic	Strongly Pessimistic	Don't Know
Nanotechnology *(The study and use of extremely small things – molecular level – to build microscopic devices)*	❑	❑	❑	❑	❑	❑
Unmanned aerial vehicles (Drones) *(Aircraft operated by remote control, without a human pilot)*	❑	❑	❑	❑	❑	❑
Autonomous (Driverless) cars *(Vehicles that sense the environment and operate without a human driver)*	❑	❑	❑	❑	❑	❑
Artificial intelligence *(The development of "intelligent" computers and machines)*	❑	❑	❑	❑	❑	❑
Big data technologies *(Use of huge amounts of data for analysis and decision-making)*	❑	❑	❑	❑	❑	❑
Synthetic biology *(The merging of biology and engineering to build living parts and systems)*	❑	❑	❑	❑	❑	❑
Plant genetics research *(The study and use of plant genetics and breeding to develop improved plants and crops)*	❑	❑	❑	❑	❑	❑



11. New science and technologies are changing the way we live, work, play, and communicate. With this in mind, we are very interested in your personal opinions on science and technology, and the scientists who design them. Please indicate your level of agreement with each of the following items.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
Science can eventually solve most of the problems facing the world.	❑	❑	❑	❑	❑
Science creates more problems than it solves.	❑	❑	❑	❑	❑
Science benefits all social groups equally.	❑	❑	❑	❑	❑
I am willing to accept new ideas if provided with sufficient scientific proof.	❑	❑	❑	❑	❑
Science is more constructive than destructive.	❑	❑	❑	❑	❑
I am cautious about using new technologies.	❑	❑	❑	❑	❑
I have faith in the government to ensure technologies are safe.	❑	❑	❑	❑	❑

In order to best understand the citizens of our state, we have included a few questions on your opinions about society, life and religion. There are no right or wrong responses to any of the statements.

19. Please let us know the degree to which you agree or disagree with the following statements.

	Strongly Agree	Somewhat Agree	Neither Agree nor Disagree	Somewhat Disagree	Strongly Disagree
These days a person does not really know whom he or she can count on.....	❑	❑	❑	❑	❑
Nowadays, a person has to live pretty much for today and let tomorrow take care of itself.....	❑	❑	❑	❑	❑
It is hardly fair to bring a child into the world with the way things look for the future.....	❑	❑	❑	❑	❑
You sometimes cannot help wondering whether anything is worthwhile anymore.....	❑	❑	❑	❑	❑

APPENDIX C: COVER LETTER

PURDUE UNIVERSITY

Agricultural Sciences Education and Communication
COLLEGE OF AGRICULTURE

July 21, 2018

<Address 1>
<Address 2>
<Address 3>

Dear <last name> Household,

I am writing to you to ask for your help with an important study. This survey, **How Do Indiana Residents Feel about Science, New Technologies and Engaging with Purdue University?**, seeks to increase our understanding of the ways science and technology are changing how Indiana residents and families live today. While technologies have the potential to improve our standard of living, people sometimes have questions or concerns about them. Purdue University is interested in your thoughts about new science and technology, and how we might engage with you on these and other topics. This request is being sent to a random sample of people from Indiana communities. Therefore, it is critical that people like you help inform us about what matters to you, your family, and Indiana residents in general by completing this survey.

Information you provide will help Purdue University better serve Indiana residents through more effective educational programs. The questionnaire should take no more than 20 minutes to complete. We have included a code number on your questionnaire so we can track response and avoid sending follow-up mail to those who have already completed the questionnaire. However, you can be assured all of your responses are confidential and will not be connected to your name in any way.

Please complete the enclosed questionnaire and return it in the self-addressed, postage-paid envelope. We are enclosing a $2 bill as a small token of appreciation for your response. Your participation is completely voluntary and you need not answer any questions you do not wish to answer. You also may end your participation at any time. More information about our survey procedures is on the reverse side, including information on how to reach us with any questions.

We realize you are busy and sincerely appreciate your help with this research. The results will be used to help improve Purdue University's responsiveness to the informational needs of Indiana residents. It is very important to us to receive your response. If you have any questions about this study, please contact us at matucker@purdue.edu or call us at 765-494-8429.

Thank you and best wishes.

Sincerely,

Mark Tucker

Dr. Mark Tucker
Professor
Purdue University

Lilly Hall of Life Sciences • 915 W. State St. • West Lafayette, IN 47907 •
(765) 494-8423 • FAX: (765) 496-1152 • asec@asec.purdue.edu • www.asec.purdue.edu

RESEARCH PARTICIPANT INFORMATION

How do Indiana Residents Feel about Science, New Technologies and Working with Purdue University?

Dr. Mark Tucker
Department of Agricultural Sciences Education and Communication
Purdue University

What is the purpose of this study?
The goal of this research is to measure your (Indiana residents) perceptions of new science and technologies and to determine whether you wish to interact more closely with Purdue University about these or other topics. We are also interested in your views on some other issues in the news and what communication sources you use to stay informed. There are about 4,500 Indiana residents in this study. Your participation is important to ensure our findings are valid.

What will I do if I choose to be in this study?
You will complete the enclosed questionnaire and return it to us in the envelope we provide to you. Please accept the enclosed $2 bill as a small token of our appreciation. Your response will help us better understand the interests and needs of Indiana residents. We may send up to three mail follow-ups to request your participation. However, you will not be contacted again after you return your completed questionnaire unless you request more information.

What are the possible risks or discomforts?
You may feel uncomfortable thinking about your personal attitudes. You may skip questions that make you uncomfortable. There is also a risk of breach of confidentiality, but we have taken steps to avoid such a breach. If you do not wish to answer a question, you may skip it and go to the next question or you may stop.

Are there any potential benefits?
It is our goal to help improve Purdue University's public outreach about science and technology. Your response may help us understand more about the informational needs of Indiana residents. You may also find it interesting to complete this survey.

Will I receive payment or other incentive?
You will receive a $2 bill as a small token of appreciation for participating in this research.

Will information about me and my participation be kept confidential?
The project's research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight. Please be assured your data is confidential. Your completed questionnaire will never be linked to your name. We keep track of names for about three months to ensure that names are crossed off our mailing list after individuals complete the questionnaire. During this time, all data and names are stored in the researchers' locked cabinet. The list of names will be destroyed after data are collected. Research results will contain no names and it will be impossible to connect anyone's identity with our published research findings.

What are my rights if I take part in this study?
Your participation in this study is voluntary. You may choose not to participate or, if you agree to participate, you can withdraw at any time without penalty or loss of benefits to which you are otherwise entitled.

Who can I contact if I have questions about the study?
If you have questions, comments or concerns about this research project, please contact Mark Tucker at 765-494-8429 or you may email matucker@purdue.edu.

If you have questions about your rights while taking part in the study or have concerns about the treatment of research participants, please call the Human Research Protection Program at (765) 494-5942, email (irb@purdue.edu) or write to:

Human Research Protection Program - Purdue University
Ernest C. Young Hall, Room 1032
155 S. Grant St.
West Lafayette, IN 47907-2114

IRB No. 1712020022

APPENDIX D: POSTCARD

PURDUE UNIVERSITY
Department of Agricultural Sciences
Education and Communication

Lilly Hall of Life Science, Room 3-230
915 W. State Street
West Lafayette, IN 47907

First Class
Presort Mail
U.S. Postage
PAID
Lafayette, IN
Permit No. 221

Dear <last name> Household,

We recently requested your help with an important study. The survey, **How Do Indiana Residents Feel about Science, New Technologies and Engaging with Purdue University?**, seeks to increase our understanding of the ways science and technology are changing how Indiana residents and families live today. Thank you if you have already completed and returned the questionnaire. If you have not yet done so, we hope you will complete the questionnaire and return it in the postage-paid envelope we provided to you.

The questionnaire should take no more than 20 minutes to complete, and your responses are completely confidential. Survey results will be used to improve Purdue University's responsiveness to the informational needs of Indiana residents. While your participation is strictly voluntary, it is very important to us to receive your response. Thank you for your consideration.

Sincerely,

Mark Tucker

Mark Tucker, Professor
Purdue University

APPENDIX E: FOLLOW-UP COVER LETTER

PURDUE UNIVERSITY | Agricultural Sciences Education and Communication
COLLEGE OF AGRICULTURE

August 21, 2018

<Address 1>
<Address 2>
<Address 3>

Dear <last name> Household,

Last month, we requested your help with an important study. The survey, **How Do Indiana Residents Feel about Science, New Technologies and Engaging with Purdue University?** seeks to increase our understanding of the ways science and technology are changing how Indiana residents and families live today. Thank you if you have already completed and returned the questionnaire. If you have not yet done so, we hope you will complete the enclosed questionnaire and return it in the attached postage-paid envelope.

While technologies have the potential to improve our standard of living, people sometimes have questions or concerns about them. Purdue University is interested in your thoughts about new science and technology, and how we might engage with you on these and other topics. This request is being sent to a random sample of people from Indiana communities. It is critical that people like you help inform us about what matters to you, your family, and Indiana residents in general by completing this survey.

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Your participation is completely voluntary and you need not answer any questions you do not wish to answer. You also may end your participation at any time. More information about our survey procedures is on the reverse side, including information on how to reach us with any questions.

We realize you are busy and sincerely appreciate your help with this research. The results will be used to help improve Purdue University's responsiveness to the informational needs of Indiana residents. It is very important to us to receive your response. If you have any questions about this study, please contact us at matucker@purdue.edu or call us at 765-494-8429.

Thank you and best wishes.

Sincerely,

Mark Tucker

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Professor
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