Selecting our own science:

The role of communication contexts and individual traits

in media selectivity

by

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SELECTING OUR OWN SCIENCE:
THE ROLE OF COMMUNICATION CONTEXTS AND INDIVIDUAL TRAITS IN MEDIA SELECTIVITY

ABSTRACT

This dissertation focuses on an integral aspect of public opinion formation—individual selectivity of information. Principally, I seek answers about *why* individuals opt for certain media. Broadly, my research is guided by the following question: How do communication contexts and individual traits contribute to and motivate individuals' selectivity? Though there have been many studies on the phenomenon of selective exposure in political science and political communication, my research is conducted in the context of a scientific issue. There is relatively little clear empirical data suggesting that people select news about science and technology based on political preferences. In my research, I use experimental and survey methodologies in combination with structural equation modeling, and linear and logistic regression models to draw conclusions about how and why individuals seek information about science.

This dissertation contains three separate but related studies. Study A uses experimental data to gain insight into the contexts which elicit selective exposure. Specifically, I examine how the presence or absence of ideological cues affects media channel selection. I present empirical evidence of ideological selective exposure in the context of a relatively novel scientific issue with which most Americans are unfamiliar, nanotechnology. I find that such selectivity occurs through both confirmation bias and defensive avoidance. Additionally, I find that ambiguous ideological cues in news articles about science serve to amplify ideological selective exposure.

Based on these results, I posit that perceived information utility may trump political loyalties when clear ideological cues are present in news articles about science and technology.

Studies B and C use survey data collected prior to and after the 2012 Presidential election to examine the relationship between need for cognition, knowledge, and partisan selective exposure. Study B looks at knowledge as a mediator in the relationship between cognitive need and partisan selective exposure, while Study C explores knowledge as a moderating variable. I find that, prior to the election, individuals who have relatively lower cognitive need are more likely to engage in selective exposure. Interestingly, after the 2012 election, knowledge played a moderating role in the relationship between need for cognition and partisan selective exposure such that those who had higher cognitive need had more factual knowledge about nanotechnology and were more likely to engage in partisan selective exposure.

Communication technologies have fragmented the media ecosystem and scholars are concerned that fragmentation of the public sphere has occurred as a result. The notion of selective exposure is inherently at odds with the normative ideals of democratic citizenship. As post-normal science evolves and new fields develop, the spheres of science and politics will increasingly intersect. In light of this politicization, scientists and science communicators need to recognize that science does not operate in a vacuum and need to better connect with public audiences. Understanding the mechanisms of selectivity will allow us to further understand how public audiences form their opinions of and attitudes toward science and technology. Strategic communication of science to public audiences will ultimately benefit scientists, practitioners of science communication, and science as an institution.

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CHAPTER 1.

SELECTING OUR OWN SCIENCE

Although both information selection and processing are integral aspects of public opinion formation, this dissertation addresses the former, that is, individual selectivity of information. Principally, I seek answers about *why* individuals choose certain media over others. Though there have been many studies of the phenomenon of selective exposure in political science and political communication, my research is conducted in the context of scientific and technological issues and science communication. There is relatively little clear empirical data suggesting that people select science and technology news based on political preferences. Additionally, much of the scholarship on media selectivity, most of which has been conducted in political science and political communication, has explored partisan selective exposure. While partisan selectivity is highly appropriate in the context of political and civic issues, ideology is equally relevant when it comes to science and technology news. Few mediated articles about science include information that specifically identifies a political party. Instead, it is more common for news articles about scientific issues to include ideological cues. What emerges from my dissertation is that such issues are as much affected by political loyalties and values as other issues in the public sphere.

Broadly, the research presented in this dissertation is guided by the following question: How do communication contexts and individual traits contribute and motivate individuals' selectivity? With this work, I contribute to the literature on selective exposure by empirically exploring both confirmation bias and defensive avoidance, and tease apart some of the mechanisms of selectivity as it relates to issues of science and technology. Though this area of research is immense, it is still just one aspect of furthering our understanding of attitude formation among lay audiences and the drivers of public opinion about science. Yet, it is a

necessary piece of the puzzle. A better understanding of how and why individuals choose specific information is undoubtedly linked to how they process it. A deeper understanding of the mechanisms and processes behind selective exposure may enable more effective public communication, especially when it comes to the risks and benefits associated with science and technology.

Science and technology pervade human society. Much of the United States' industry and prosperity depend on science and many public policy issues have implications for science and technology. Citizens in a democracy such as the U.S. are asked to make decisions about scientific issues every time they cast votes. Citizens elect political representatives they trust to vote on policies in ways that align with their values, opinions, and attitudes. And many of the policies that affect the public are scientific and technological in nature. Indeed, the policies that ultimately govern how science and technology are funded, conducted, and regulated in society affect us all, especially in the context of the environment, and public health and safety issues. Therefore, to some extent, citizens are expected to have some understanding of the scientific and technological issues facing society.

Though some citizens acquire information about science from informal science settings such as museums and outreach activities, the majority of people rely on media to act as their primary source of scientific and technological information (National Science Board, 2014). And media have evolved substantially since the broadcast era. These changes in communication technologies have influenced how audiences use and, in terms of web 2.0 technologies, engage with mediated information. The fragmented nature of new media and its technologies have changed how individuals encounter information and how information subsequently informs their attitudes toward science.

This chapter sets the stage for the empirical data that follow. First, I describe changes in the media environment, which has been integral to the renaissance in scholarship on selectivity. I then examine the theoretical underpinnings of selective exposure followed by a description of the issue used as an exemplar in this dissertation—nanotechnology.

NEW MEDIA AND THE FRAGMENTED AUDIENCE

Media effects models have been transitioned through several paradigm shifts in the twentieth century (McQuail, 2010). Scholars have argued that we are currently in an emerging third age of communication (Blumler & Kavanagh, 1999). The first age occurred in the middle of the century, following World War II, and was characterized by stable political institutions and political elites who were unconcerned by apathetic members of the electorate. In terms of science and technology, this meant political elites were playing dominant roles in making decisions about scientific research and development (Smith, 1990) and public opinion was not as important for policy decisions about science and technology as it is today. During this time, communication scholars posited so-called limited effects models such as the two-step flow of information (Katz & Lazarsfeld, 1955; Lazarsfeld, Berelson, & Gaudet, 1948).

However, Blumler and Kavanagh (1999) neglect the so-called "magic bullet" communication models of the early 1940s. These models were largely a result of the radio broadcast of H. G. Wells' popular fantasy, *War of the Worlds*, in 1938. The broadcast, which was about an alien invasion, aired on Halloween night and caused widespread panic among the American populace (Cantril, 1940). In this early era of communication scholarship, radio was widely accepted as a means for important announcements and many citizens accepted this medium as a trusted vehicle for news. The resulting fear and panic led communication scholars

to theorize that media effects were extensive and accepted by audiences who were largely helpless to resist (Scheufele & Tewksbury, 2007), which set the tone for the research agenda that followed.

The second age of communication saw a changing communication environment with the advent of broadcast media. Television engaged large audiences through limited channel options. Mediated information was balanced and similar news stories were covered across media channels, allowing citizens to have a shared base of civic information. Elites in the second age had to adjust their communication strategies for broadcast media, and began to cater to mass audiences, tailoring speeches using pretested language (Blumler & Kavanagh, 1999). Communication scholarship in this era returned to the concept of powerful media effects as the mass media messages being broadcast to public audiences were consonant and ubiquitous due to limited channel options. Media effects theories such as the spiral of silence (Noelle-Neumann, 1974) and cultivation (Morgan, Shanahan, & Signorielli, 2009) developed during this time.

The third age is still emerging. The introduction of new communication technologies heralded this new era of communication. As expected, it is marked by an increase in media choices made possible by technological advancements and an increase in the overall use of technology by citizens. Media are ubiquitous and Blumler and Kavanagh (1999) posited that a "pick-and-choose" (p.218) culture would emerge. Indeed, as media choices have proliferated, their hypothesis appears to be borne out in the literature. Mass media have become less "mass" and more individualized (Chaffee & Metzger, 2001), yet are still essential to our daily lives; we watch television, surf the Web, listen to music, and read the news every day. And we do all of this on multiple devices, attending to any channel we choose (Pew Research Center, 2014). As a

result of this "pick-and-choose" culture, communication as a field of study has experienced a renaissance in the scholarship of limited effects models.

Media is undoubtedly becoming more and more fragmented. But what exactly are media consumers exposed to? And how do these choices affect their dispositions toward the issues of science and technology facing society? Some scholars are concerned that media fragmentation will lead to a lack of shared context for message interpretation and the demise of the inadvertent audience (e.g., Bennett & Iyengar, 2008), while others find little evidence for this (e.g., Webster & Ksiazek, 2012). Still others argue that the inadvertent audience is not entirely lost. Many television programs, such as *South Park, The Simpsons*, *The Daily Show with Jon Stewart*, and *The Colbert Report*, among others, are not billed as news, yet still provide some public affairs commentary and may increase civic and political knowledge (Brewer & Cao, 2006; Xenos & Becker, 2009). And while science programs, such as *Nova* and *Nature*, still exist, the availability of channels that contain entertainment media are boundless, often leading citizens away from programs about public affairs, politics, and science and technology (Prior, 2007; Prior, 2013).

Yet, if citizens lack common ground for discussion and interaction of both scientific and political issues, polarization among the mass publics may occur. The ability to cocoon ourselves in echo chambers reinforces our existing opinions by allowing us to be exposed only to media that are consistent with our preexisting attitudes. According to Sunstein (2007), "[w]ithout shared experiences, a heterogeneous society will have a much more difficult time in addressing social problems. People may even find it hard to understand one another. Common experiences, emphatically including the common experiences made possible by the media, provide a form of social glue." (p. 9) In other words, media fragmentation has the potential to lead to social fragmentation.

We already see much of this fragmentation in public attitudes toward science and technology. Issues such as climate change and clean energy are galvanizing and dividing the American public. For example, as of October 2010, 59 percent of Americans believed there was solid evidence the Earth is warming, while 32 percent believed there was no evidence of warming (Pew Research Center, 2010). And partisan divides over support for funding alternative energy research have been increasing since 2008 (Pew Research Center, 2011).

These patterns highlight that trends in fragmentation and subsequent ideological polarization observed among the electorate (Baldassarri & Gelman, 2008; Evans, 2003; Gastil, Kahan, & Braman, 2006; Levendusky, 2013), might be also observable for issues of science and technology. Although some may assume that public opinion of science and technology are independent of politics and public affairs, empirical data strongly suggest that this is not the case (Brossard, 2013; Scheufele, 2013). Science is increasingly embedded in society as public audiences are asked to cast votes for political elites who make policy decisions related to science and technology. Scientific research, funding, and regulation are some of the areas that are increasingly affected by politics in contemporary society.

Science and technology are continually evolving and new issues frequently capture the public's interest. As this happens, citizens will be increasingly faced with unfamiliar issues that lack clear heuristic cues which facilitate interpretation of novel information. And as consumers move away from traditional print and broadcast media, media diets have become more varied and science news and information is increasingly consumed online (Anderson, Brossard, & Scheufele, 2010). As of 2012, online sources have become the primary source of science and technology information for public audiences (National Science Board, 2014). In this fragmented

media environment, the resulting patterns of selection have important implications for the future of these technologies.

SELECTIVE EXPOSURE

Compared to the broadcast era of limited channels, individual selectivity plays a large role in information seeking and subsequent processing in the current disjointed media environment (Bennett & Iyengar, 2008; Brossard, 2013; Scheufele & Nisbet, 2012). Seeking information that generally conforms to one's own views and opinions while avoiding attitude discrepant information has been termed selective exposure (Sears, 1965; Sears & Freedman, 1967), a phenomenon which is not novel. As early as 1960, Joseph Klapper noted that "[t]he tendency of people to expose themselves to mass communications in accord with their existing opinions and interests and to avoid unsympathetic material, has been widely demonstrated" (Klapper, 1960, pp. 19-20). Since this dissertation is primarily concerned with selective exposure, it is necessary to understand its theoretical foundations.

One motivation for selective exposure is rooted in the theory of cognitive dissonance (Festinger, 1957). Underlying this theory is the observation that individuals prefer cognitions, which are items of information we know, that are consonant with each other. When cognitions are incompatible, individuals are said to be in a state of cognitive dissonance and are motivated to resolve it (Festinger, 1957; Festinger, 1962; Festinger, 1964). In other words, if an individual knows various things that are inconsistent with each other, she will attempt to make them more consistent. Selective exposure is an important mechanism for the alleviation of cognitive dissonance (Festinger, 1957; Festinger, 1962; Festinger, 1964). In this context, the use of the term "selective exposure" refers specifically to a cognitive mechanism—one in which

individuals actively seek out attitude-consistent information and avoid attitude-inconsistent information to reduce dissonance.

Cognitive dissonance is also related to information processing, which in turn, may influence selective exposure (Smith, Fabrigar, Powell, & Estrada, 2007). Individuals are likely to selectively expose themselves to information because of their information processing goals and their need to reduce dissonance. Information processing can be accuracy- or goal-driven (Kunda, 1990). Accuracy goals motivate individuals to arrive at accurate conclusions while directional goals motivate individuals to arrive at conclusions that are typically consistent with existing views. If one is driven by directional goals, then she is likely to seek information that will allow her to arrive at a particular conclusion. If she encounters information that is counter to her preexisting opinion, cognitive dissonance occurs and she is motivated to alleviate that (Festinger, 1957).

Before examining other motivations of selective exposure, it should be noted that some research in selective exposure (e.g., Harrison, 2000; Lazarsfeld et al., 1948) has obfuscated the terms "selective exposure" and "*de facto* selectivity." *De facto* selectivity refers to empirical findings of correlations between the attitudes of audiences and the content of communications to which they were exposed (Sears & Freedman, 1967). It is a description of the phenomenon that occurs *because* of selective exposure, which is a psychological mechanism that accounts for *de facto* selectivity. A classic example of *de facto* selectivity can be found in "The People's Choice" (Lazarsfeld et al., 1948). Using panel data to study the 1940 U.S. Presidential campaign, the authors note:

"The fact that people select their exposure along the line of their political predispositions is only a special case of a more general law which pervades the whole field of communication

research. Exposure is always selective; in other words, a positive relationship exists between people's opinions and what they choose to listen to or to read" (p. 164).

Referring to these findings, Sears and Freedman (1967) argue that such claims "are simply descriptive statements: they only assert that communication audiences usually share, to an extraordinary degree, the viewpoints of the communicator. These statements […] are noncommittal with respect to the *cause* of this bias" (emphasis theirs, p. 196). The term *de facto* selectivity has fallen out of use in modern scholarship and has been replaced by "selective exposure," which is used in a less precise fashion. Indeed, "selective exposure" is currently used in contemporary literature to describe both empirical relationships between audience bias and media content, and the psychological mechanism of dissonance reduction.

For the sake of consistency and clarity, I use "selective exposure" in this dissertation to refer to the description of the phenomenon with indication of its causes since I use experimental data to test my hypotheses. To describe the mechanisms that result in empirical observations of selective exposure, I use the more precise terms "confirmation bias" and "defensive avoidance," similar to other contemporary scholarship in this area (e.g., Garrett, Carnahan, & Lynch, 2013; Knobloch-Westerwick & Kleinman, 2012; Stroud, 2011). "Confirmation bias" refers to seeking information that is congruent and consistent with one's own attitudes or beliefs, while "defensive avoidance" refers to selectively evading incongruent information.

Another motivation for selective exposure is related to the cognitive miser or low information rationality (Popkin, 1991) hypothesis. Individuals have been described as cognitive misers who aim to conserve cognitive resources. Information that is inconsistent with one's existing views and opinions requires more cognitive effort to process (Edwards & Smith, 1996). Thus, scholars have argued that consistent information has a higher likelihood of selection

compared to incongruent information (Ziemke, 1980). To conserve cognitive resources, individuals use heuristics, or mental shortcuts, to arrive at conclusions. We know that individuals often use heuristics to form judgments in the political realm (Lau & Redlawsk, 2001). Heuristic cues and mental shortcuts, such as values, can act as perceptual filters through which people arrive at conclusions and form attitudes about scientific and technological issues (Brossard, Scheufele, Kim, & Lewenstein, 2009).

Although there is a fair amount of scholarship in this area, most of it has been conducted in the context of political issues, not scientific ones. Additionally, we know relatively little about the conditions under which selective exposure is likely to occur. While some work has explored how media source and socialization of news consumption affects selective exposure (e.g., Messing & Westwood, 2012), there has been relatively little scholarship on the contextual conditions that induce partisan selectivity. The next section presents the issue I used to study the communication contexts and individual traits that may affect selective exposure of science and technology information.

PARTISAN AND IDEOLOGICAL SELECTIVITY OF SCIENCE AND TECHNOLOGY INFORMATION

Balanced information acquisition is a normative necessity for a well-functioning democracy. Ideally, citizens would be exposed to a diverse marketplace of ideas, but there is concern that such exposure is becoming limited. Although the empirical evidence is contested (Abramowitz & Saunders, 1998, 2008; Fiorina, Abrams, & Pope, 2008; Prior, 2013), there is some agreement that the American electorate is becoming more balkanized. And though there are some positive consequences of polarization, scholars primarily point to its negative effects on

democracy (Layman, Carsey, & Horowitz, 2006; Sobieraj & Berry, 2011). The polarization debate has expanded to include media consumption habits of the electorate and there have been attempts to determine the direction of causality between polarization and partisan media use (e.g., Stroud, 2008). Scholars are concerned that the splintering of the media landscape, brought about by the proliferation of online tools, has the potential to enhance polarization by offering a multitude of choice for the news consumer, allowing for selective exposure (Bennett & Iyengar, 2008; Chaffee & Metzger, 2001; Mutz, 2002; Mutz & Martin, 2001; Scheufele & Nisbet, 2012; Sunstein, 2001, 2007). While we know that individuals tend to filter information in accordance with their partisan preferences (e.g., Bennett & Iyengar, 2008; Iyengar & Hahn, 2009), the conditions under which selective exposure occur are relatively unknown.

Most of the work exploring the dynamics of information seeking and selectivity have explored relatively familiar and accessible political issues such as Presidential campaigns, abortion, gay marriage, civil liberties, and social security reform (Barlett, Drew, Fahle, & Watts, 1974; Brannon, Tagler, & Eagly, 2007; Garrett, 2009a; Gil de Zuniga, Correa, & Valenzuela, 2012; Iyengar & Hahn, 2009; Knobloch-Westerwick & Meng, 2009; Messing & Westwood, 2012). While many of these issues are salient for public audiences, contemporary politics involves numerous complex topics for which there are not always readily accessible partisan or ideological cues. Indeed, individuals are often exposed to issues about which they have little knowledge. Additionally, much of the current literature in selective exposure links political partisanship with selectivity of media source (Iyengar & Hahn, 2009; Iyengar, Hahn, Krosnick, & Walker, 2008). For obvious reasons, partisan selectivity is appropriate in the context of political and civic issues. However, partisanship is arguably less relevant compared to ideology when it comes to scientific issues.

Few mediated articles about science include information that specifically identifies a political party. It is more common for news about science and technology to include views from think tanks or other organizations that are not explicitly associated with a political party. Instead, they are often described based on their ideological leanings. In this area, there is also a paucity of research. There are few studies of selective exposure about science and those that exist link prior attitudes about science, not ideological leanings, to information seeking (e.g., Jang, 2014). This dissertation examines both partisan and ideological selectivity of scientific and technological information. In Chapter 3, I examine how ideological cues in news articles about science affect ideological selectivity, while Chapter 4 probes the relationship between an individual trait, need for cognition, knowledge, and partisan selective exposure.

Issues of science and technology are becoming a larger part of public discourse. For example, in his recent State of the Union address on February 28, 2014, President Obama stated, "Climate change is a fact." (The White House, 2014). This statement prompted a flurry of discussion among lay audiences, primarily on social media such as Twitter. And there is increasing recognition among experts that science is embedded in the political fabric of society. Contemporary scientific issues are not only more politicized, they are complex, laden with uncertainty, and require policy decisions that involve numerous stakeholders (Scheufele, 2013).

NANOTECHNOLOGY

Nanotechnology is a broad term used to describe a large range of scientific disciplines. It describes the understanding and manipulation of matter at very small scales, such as the molecular and atomic levels—a nanometer is one billionth of a meter. For reference, a human hair is approximately 80,000 to 100,000 nanometers (nm) thick, while a sheet of paper is

100,000 nm thick (National Nanotechnology Initiative, 2014b). The National Nanotechnology Initiative (NNI), a research and development initiative established in 2001 by then-President Bill Clinton with eight federal agencies, describes nanoscience and nanotechnology as "the study and application of extremely small things and that can be used across all the other science fields, such as chemistry, biology, physics, materials science, and engineering" (National Nanotechnology Initiative, 2014b).

Nanoparticles are not all man-made or novel—they exist in nature. However, developments in scientific fields such as microscopy have enabled us to take advantage of and manipulate nanoparticles. The key to nanotechnology is the difference in the physical and chemical properties that matter can exhibit at the nanoscale compared to the macroscale, which can be leveraged to create materials that are lightweight and durable. Nanoscale materials have are currently in use in many consumer products, including tennis rackets, motorcycle helmets, sunscreens, and food containers (National Nanotechnology Initiative, 2014b).

Following the establishment of the NNI in 2001, the George W. Bush administration increased funding for nanotechnology in 2003 with the 21st Century Nanotechnology Research and Development Act (National Nanotechnology Initiative, 2014a). Federal agencies currently involved with the NNI include the Department of Commerce, Department of Homeland Security, National Science Foundation, and the Environmental Protection Agency, among others. The NNI aims to "advance a world-class nanotechnology research and development program," "foster the transfer of new technologies into products for commercial and public benefit," "develop and sustain educational resources, a skilled workforce, and a dynamic infrastructure and toolset to advance nanotechnology," and "support responsible development of nanotechnology" in the U.S. (National Nanotechnology Initiative, 2014a, pp. 5-6).

It has been 13 years since the establishment of the NNI, yet public audiences in the U.S. remain relatively unaware of this new technology. In fact, in survey data collected in January 2012 by GfK Knowledge Networks for a project on framing of emerging technologies (for more information about these data, see Cacciatore, 2013), 38 percent of respondents had heard, read, or seen "nothing at all" about nanotechnology. Slightly over a third of the sample (37.9 percent) felt they were "not informed at all" about nanotechnology. Yet, as I will explain below, most emerging issues in science and technology share features with nanotechnology. Specifically, nanotechnology is an exemplar of an emerging scientific issue that encompasses many scientific disciplines, is rife with uncertainty, and has significant policy and ethical, social, and legal implications (ELSI). Nanotechnology is therefore a good context in which to examine individual traits, communication contexts, and information seeking habits, which influence how public audiences form toward emerging science and technology in the U.S.

Scientific issues such as nanotechnology have been called "post-normal science" (Funtowicz & Ravetz, 1993). This term is related to Kuhn's view of contemporary science, in which he refers to "normal science" as "research firmly based upon one or more past scientific achievements, achievements that some particular scientific community acknowledges for a time as supplying the foundation for its further practice." (Kuhn, 1970, p. 10). Normal science, then, is science conducted within an established "paradigm," which is a set of accepted practices and theories. Most scientists work within a paradigm for their entire careers, doing what Kuhn refers to as "mopping-up operations" (p. 24). This is not to disparage the efforts of those who work with normal science. Instead, it simply points out that "normal" research rarely aims to discover new theories. Within a paradigm, as Funtowicz and Ravetz (1993) put it, "uncertainties are managed automatically, values are unspoken, and foundational problems unheard of" (p. 740).

Post-normal science, on the other hand, contains large quantities of uncertainty, which need to be managed by appropriate actors, and profound policy implications that affect the role of any emerging science in society (Funtowicz & Ravetz, 1993). Lay audiences often lack the tools and frameworks necessary to evaluate complex scientific information in a rational manner. Because of this, they often rely on heuristic cues and shortcuts when forming judgments about post-normal science (e.g., Brossard et al., 2009). And nanotechnology, which is part of the larger nano-bio-info-cogno (NBIC) revolution characterized by rapid development and the intersection of many scientific disciplines, is just one of many examples of post-normal science. Faced with other NBIC technologies, such synthetic biology and bioinformatics, lay publics will continue to encounter decisions imbued with large amounts of uncertainty and ELSI.

Currently, and unlike climate change or nuclear energy, nanotechnology is a relatively politically neutral issue. Although studies have shown that public audiences interpret nanotechnology information through a religious lens (Brossard et al., 2009), there is little evidence to suggest that there will be strong partisan opinions about this issue. This may be partly attributed to the lack of public awareness of nanotechnology. In fact, according to our sample, nearly 80 percent of Americans report knowing "nothing at all" or "just a little" about it. Therefore, I do not expect that there will be existing politically-driven opinions about nanotechnology, which may confound any ideological cues used to frame new information.

In this dissertation, I use the issue of nanotechnology as representative of emerging NBIC technologies. The advantage of using this scientific issue is two-fold. First, as mentioned, unlike many political issues, the American public is largely unaware of nanotechnology, making it is a relatively partisan neutral issue. In addition, they often lack the frameworks necessary to incorporate new information about such complex issues (Scheufele, 2013). In general, lay

audiences are more aware of political issues relative to scientific ones and have partisan frameworks in place to help them organize new political information. Second, as future generations continue to face new technological and scientific developments, examining how public audiences seek information in the contexts of post-normal science allows us to better understand patterns of information seeking that may arise for future technologies.

To examine how communication contexts and individual traits may affect selective exposure in the context of nanotechnology, I use data obtained from experiments embedded in an online panel survey using a nationally representative sample of the population of the United States. Two waves of panel data were collected around the 2012 Presidential election. Chapter 2 describes these data and their collection in detail—the experimental design, manipulations, and the questionnaire. Chapter 3 presents a study using the experiments conducted in both waves of the data collection. It focuses on a particular type of communication context, the presence and type of ideological cues included in media presentations of science, and its effect on selective exposure. Specifically, I explore how ideological cues presented in news stories affect selectivity of scientific information.

Chapter 4 contributes to the growing literature on how and why individuals choose media to attend to. It explores how an individual trait, need for cognition, affects partisan selection of media channels. I use these panel data to make causal inferences about this relationship. In Chapter 4, I also explore how knowledge is related to selection of information from a source consistent with one's political party identification, that is, partisan selective exposure. To do so, I use the data described in Chapter 2 as survey data. The final chapter summarizes the key findings of my research and their implications for science communication research and public communication of science and technology. I also include suggestions for how future scholarship

can expand our understanding of selective exposure and what I believe are important next steps toward furthering our understanding of public attitude formation.

CHAPTER 2.

METHODOLOGY

This dissertation seeks answers about how and why individuals select information about science and technology. In Study A in Chapter 3, I use an experiment embedded in an online survey to learn how ideological cues in news articles may affect subsequent ideologically-driven information seeking. Study A contains three separate analyses that constitute an in-depth exploration of the experiment. Studies B and C in Chapter 4 use these data as a survey, by controlling for the experimental manipulation, to gain insight into the relationship between need for cognition, knowledge, and partisan selectivity. Specifically, in Study B, I examine the role of knowledge as a mediator in the relationship between cognitive need and partisan selective exposure. Study C tests whether knowledge is a moderator in this relationship.

In the experiment conducted for this dissertation, respondents were exposed to a news article which contained one of three types of ideological cues: consistent, inconsistent, or no cues. Following exposure to the stimulus, respondents were asked to perform an information-seeking task by selecting one of nine available headlines. Before explaining the procedure and design in greater detail, I present the data used for my research.

GfK KNOWLEDGE NETWORKS DATA

Data used in this dissertation were obtained from a GfK Knowledge Networks online panel survey. The online survey was fielded in 2012 around the Presidential election; wave 1 was fielded between September 25 and October 8, and wave 2 was fielded post-election, from December 7 to December 25. The experiment was conducted in both waves using a probability-based web panel called KnowledgePanel®, which is run by GfK Knowledge Networks.

KnowledgePanel® is representative of the population of the United States. Its initial online sample is obtained through probability sampling techniques (see AAPOR, 2011 for more information on online panels).

GfK Knowledge Networks initially selects households for their panel using address-based sampling (ABS). Recruited households are then contacted by email. Existing panelists are directed to their online member page to participate in the survey. To offset attrition, multiple recruitment samples are fielded at even intervals throughout the calendar year. Households that do not already have Internet access are provided a laptop computer and Internet access. Those that have existing personal computers and Internet access are incentivized with points, redeemable for cash, for completing surveys. GfK Knowledge Network's description of KnowledgePanel is as follows (GfK Knowledge Networks, 2013):

> "KnowledgePanel is a probability-based web panel. By definition, all members of the panel have a known probability of selection. As a result, it is mathematically possible to calculate a proper response rate that takes into account all sources of nonresponse. In contrast, opt-in Web panels do not permit the calculation of a response rate since the probabilities of selection are unknown. Consequently, opt-in panels are mathematically capable of computing only the survey completion rate representing the final stage of gaining cooperation of survey research subjects, excluding the nonresponse resulting from panel recruitment, connection, and panel retention."

Wave 1

Wave 1 of the survey was fielded to 3,326 active panel members, eighteen years of age or older, randomly drawn from KnowledgePanel®. Those who were contacted but did not consent to participate were terminated from the survey. Efforts were made to enhance survey completion, including email reminders to non-responders during the field period. Of the 3,326 panelists randomly drawn from the GfK KnowledgePanel®, 1,902 responded to the invitation, yielding a final stage completion rate of 57.2 percent. However, only 86 percent of the 1,902 respondents consented to participate resulting in 1,627 consented cases. In order to calculate a weight for these data, respondents whose survey times were greater or less than two standard deviations of the standardized mean were removed. The resulting weight for wave 1, which makes the sample representative of the U.S. population, provided by GfK Knowledge Networks, was based on 1,401 respondents.

Wave 2

In wave 2, 1,374 of the 1,401 respondents from wave 1 were available for the survey. Of these respondents, 1,143 consented to the survey resulting in a completion rate of 85 percent for wave 2. To calculate a final weight for these panel data, 43 respondents were excluded based on the same criteria as wave 1. Descriptive statistics and results reported in this dissertation are those using the wave 2 post-stratification weight calculated and provided by GfK Knowledge Networks.

Other response metrics for these panel data were calculated by GfK according to Callegaro and Disogra (2008). The household recruitment rate, calculated using the American Association for Public Opinion Research (AAPOR) Response Rate 3 (RR3) was 14.8 percent

and the profile rate was 65.3 percent, for a cumulative response rate of 5.5 percent over both waves.

The mean age in the sample was 46.5 years (*SD* = 17.2 years) and roughly half of the entire (waves 1 and 2) sample was female (53.4 percent), with White respondents in the majority (67.2 percent). The median level of education and household income of respondents in the sample were "some college, no degree" and "$50,000 to $59,999," respectively.

EXPERIMENTAL DESIGN AND PROCEDURE

Design

The central idea of causality in the social sciences is that one state, event, or variable produces a change in another over the course of time. Variability in states, events, or variables is necessary for inferring causal relationships. As researchers, we infer that causal relationships exist from patterns we observe in data, which we refer to as observed effects. However, variability alone is insufficient for establishing causal relationships. Establishing causality is more intricate and complex than simply observing patterns in data. Experimental designs allow us to control the conditions under which we observe these effects and we thus have greater confidence in our causal inferences (Shadish, Cook, & Campbell, 2002). Even with experiments, however, there will still be threats to the validity of causal inferences. These include threats to both internal validity, such as the effects of history and maturation, and external validity, such as pretest sensitization (Babbie, 2013). The modified Solomon four-group design (Solomon, 1949) used in this dissertation attempts to account for these threats (my experimental design added two extra experimental groups to the four groups suggested by Solomon (1949).

In the original four-group design, two of the four experimental groups have both pretest and postttest observations. Of these, only one group is exposed to the experimental stimulus. The remaining two groups have posttest-only observations, of which only one is exposed to the stimulus. Table 2-1 shows the modified Solomon design. Groups A through D are analogous to the original Solomon four groups. Groups E and F were added to the design to allow for comparisons within each wave.

Table 2-1. Solomon group design of the experiment embedded in the online panel survey. Cues refer to ideological cues embedded in the stimulus, which is a news article about nanotechnology.

Solomon group	Wave 1			Wave 2	
	Experimental stimulus	Survey type		Experimental stimulus	Survey type
A	no cues	full		cues	full
B	no cues	full		no cues	full
C	cues + no cues	partial		cues	full
D	cues + no cues	partial		no cues	full
E	cues	full		cues	full
F	cues	full		no cues	full

ELECTION

Using the Solomon design requires that pretest observations of some groups are omitted (Table 2-1; Groups C and D) in order to prevent sensitization. This was accomplished by using a partial survey. The partial survey was identical to the full survey until after respondents were exposed to the stimulus. Following exposure to the stimulus, participants assigned to the partial survey responded to 2 attitudinal measures, followed by 6 demographic questions. They were not given the option to select a headline, thus there should be no sensitization to the instrument

measuring the outcome variable. The stimulus in the modified Solomon design is analogous to exposure to an ideologically cued condition, regardless of whether it is consistently or inconsistently cued. Exposure to no cues is considered to be the absence of a stimulus. It should be noted that the Presidential election demarcates the waves of the panel data and was not considered a stimulus since, in theory, all participants were exposed to that event.

Procedure

Respondents were randomly assigned to one of six conditions (i.e. news articles in which partisan cues had been manipulated). The news excerpts were from a Canadian newspaper, the Ottawa Citizen to represent a relatively neutral and unfamiliar news source. In wave 1, the article was about regulation of nanosilver and food safety. In wave 2, the issue of nano zinc oxide in cosmetics was used. The article was presented to participants in one of three experimental conditions, either with consistent or inconsistent partisan cues, or in a non-cued condition. In the cued experimental manipulation, a fictional conservative think tank, American Heartland Foundation, opposed new U.S. Food and Drug Administration (FDA) guidelines to regulate the use of nanotechnology in consumer products, while a fictional liberal think tank, The Progress Institute, favored the guidelines. In the inconsistently cued condition, the converse was presented, with The Progress Institute adopting the stance opposing the guidelines while American Heartland Foundation favoring them. The non-cued condition did not identify the think tanks or their partisan leanings. The excerpts included quotes from representatives of each think tank and the order of the quotes was randomized. The experimental stimuli can be found in Appendix C.

Following exposure to one of the three news articles, participants were asked to choose from nine headlines for more information. The headlines were randomized in a 3 (media source) × 3 (topic area) design. The media sources were MSNBC, Fox News, and the Canadian Broadcasting Corporation, hereafter CBC, and the headlines were from three broad topics—the ability of nanotechnology to stimulate the economy, the risks of nanotechnology in consumer products, and federal regulations on nanomaterials (Appendix D). Participants were presented with a logo of the media outlet next to the headline. Tables 2-2, 2-3, and 2-4 provide an overview of the dependent variable used in Chapter 4 in the Solomon group design. Table 2-2 includes all respondents, while 2-3 and 2-4 include only respondents who received consistent and inconsistent cues, respectively.

The results of my analyses suggest that respondents tended to view CBC, another Canadian media organization, as more similar to MSNBC than Fox News. The argument that participants were likely to view the Ottawa Citizen as a more liberal news channel could also be made. However, my analyses are unaffected by the choice of outlet for the news article since this remained constant across all experimental conditions. Additionally, since bias is in the eye of the perceiver, it is unlikely that there will be a news source that every member of the public can agree is completely unbiased.

Table 2-2. Percent of respondents who selected MSNBC, CBC, and Fox News in the whole sample.

Solomon group	wave 1					wave 2			
	MSNBC	CBC	Fox News	N		MSNBC	CBC	Fox News	N
A	45.3	14.3	40.3	135	ELECTION	39.8	25.9	34.3	135
B	29.3	26.5	44.2	52		33.8	18.0	48.3	52
C	-	-	-	-		34.7	30.7	34.6	355
D	-	-	-	-		40.3	14.4	45.3	71
E	37.8	27.4	34.8	211		42.7	30.8	26.5	208
F	41.6	14.6	43.8	218		36.0	26.0	39.0	224
Average	38.5	20.7	40.8	154		37.9	24.3	38.0	174

Table 2-3. Percent of respondents who selected MSNBC, CBC, and Fox News among respondents who received only consistent cues.

Solomon group	wave 1					wave 2			
	MSNBC	CBC	Fox News	N		MSNBC	CBC	Fox News	N
A	50.1	16.9	32.9	66	ELECTION	40.9	28.8	30.4	66
B	29.3	26.5	44.2	52		33.8	18.0	48.3	52
C	-	-	-	-		32.9	34.4	32.7	182
D	-	-	-	-		40.3	14.4	45.3	71
E	35.1	33.6	31.1	103		52.9	28.2	19.0	100
F	48.7	8.5	42.8	98		44.9	21.9	33.2	101
Average	40.8	21.4	37.8	80		41.0	24.3	34.8	95

Table 2-4. Percent of respondents who selected MSNBC, CBC, and Fox News among respondents who received only inconsistent cues.

Solomon group	wave 1					wave 2			
	MSNBC	CBC	Fox News	N		MSNBC	CBC	Fox News	N
A	40.5	12.0	47.5	69	ELECTION	38.8	23.2	38.0	69
B	29.3	26.5	44.2	52		33.8	18.0	48.3	52
C	-	-	-	-		36.6	26.9	36.5	173
D	-	-	-	-		40.3	14.4	45.3	71
E	40.4	21.5	38.2	108		33.3	33.3	33.4	109
F	35.9	19.5	44.6	121		26.8	29.4	43.8	123
Average	36.5	19.9	43.6	88		34.9	24.2	40.9	100

Questionnaire

Following an introduction and consent form, participants were asked a series of questions about their media use patterns. These questions were designed to tap general media consumption habits as well as media use patterns specific to the 2012 Presidential election. Next, respondents were asked a battery of political knowledge items, followed by definitions of the technologies referred to in the survey. Although the experiment, and thus this dissertation, is focused on nanotechnology, the issue of genetically modified (GM) foods was also referred to in some of the survey questions. A condensed version of the definitions of nanotechnology and GM foods were available to respondents for the remainder of the survey when they held their mouse pointers over the term.

Following the definitions, there were a battery of items designed to tap respondents' factual knowledge about the technologies and election-specific questions, such as voting intention and time to decision of vote. After this, respondents were randomly assigned to the experimental conditions. Following the experimental stimulus and headline selection, they were asked a series of questions designed to measure information processing. Attitudinal outcome

variables specific to science and technology were included after that. Respondents were then asked general attitudinal questions about deference to scientific authority, open- and closed-mindedness, need for cognition, trust in various groups involved in policy decision-making, and the relationship between humans and nature. Those who were not afforded the opportunity to select a headline following the stimulus responded to the information processing battery, followed by attitudinal questions about deference to scientific authority and open- and closed-mindedness.

The questionnaire, which took approximately 25 minutes to complete, ended with the collection of demographic data not provided by GfK Knowledge Networks. In wave 2, the experiment contained an identical questionnaire, but the specifics in the stimulus and headlines were changed from nanosilver and issues of food safety to nano zinc oxide and cosmetics.

CHAPTER 3.

STUDY A: IDEOLOGICAL SELECTIVITY OF SCIENCE AND TECHNOLOGY INFORMATION

This first study seeks to explore whether ideologically driven media habits influence how individuals seek scientific information by examining variations in the circumstances under which such media use may be more or less likely. To do so, I rely on an experiment with a nationally representative sample of the American population to examine media consumption processes in the context of a scientific issue with which most citizens are unfamiliar. In addition to examining in more detail the literature on media selectivity, this first study responds to the call for greater examination of science embedded in society, where public opinion, expert knowledge, and policy decisions often overlap (Brossard & Scheufele, 2013; Scheufele, 2013).

As explained in Chapter 2, respondents were exposed to news articles containing different ideological cues. I find that when exposed to information that lacks clear ideological cues, individuals are significantly more likely to avoid an article from an attitude inconsistent source. Instead, they revert to partisan sources of information. As an explanation, I build on the framework of selectivity proposed by Sears and Freedman (1967) and suggest that perceived information utility may trump ideological selectivity in certain situations.

SELECTIVE EXPOSURE AND PARTISAN MEDIA HABITS

As explained in Chapter 1, the current media landscape lends itself to confirmation bias and defensive avoidance. In the era of broadcast television that characterized the media landscape of the 1950s and 1960s, viewers were limited to relatively few media choices. Selective exposure, to the extent that it existed, was determined more by viewing time than

media outlet choice. With today's fragmented media ecosystem, our source choices are virtually limitless. We are presented with many opportunities to attend to news sources that align with our own views on most, if not all, issues on our agenda. Indeed, exposure to news can be actively avoided altogether and some scholars point to entertainment media as the culprit of both polarization and political apathy among the American electorate (Prior, 2007; Prior, 2013). Scholars have taken note of the effects of media fragmentation and selective exposure has been among their chief concerns (Bennett & Iyengar, 2008; Scheufele & Nisbet, 2012).

Most of the research in selective exposure has been conducted using political issues, and has shown that individuals prefer information from attitude-consistent sources compared to attitude-inconsistent sources. While the effects of partisan selectivity on media choice have been weaker in other countries (e.g., Trilling & Schoenbach, 2013), Iyengar and Hahn (2009) showed that in the United States, Republicans preferred Fox News to CNN and NPR, while Democrats divided their time relatively equally between CNN and NPR. Numerous other studies have similarly found that group views and predispositions align with their media use patterns (e.g., Griffith et al., 2013; Iyengar et al., 2008; Stroud, 2008). While some scholarship shows that Republicans and conservatives are more likely to exhibit a confirmation bias (Iyengar et al., 2008), others demonstrate the opposite (Knobloch-Westerwick & Kleinman, 2012). Since the majority of studies have demonstrated confirmation bias to differing extents on both sides of the political aisle, I have few expectations about the degree of selectivity exhibited by either liberals or conservatives. Additionally, although much of the scholarship on selective exposure has been conducted on partisan selectivity, in the present study I explore ideological selectivity for the reasons described in Chapter 1. To reflect this, my experimental stimulus manipulates

ideological instead of partisan cues and my subsequent analyses explore ideological selective exposure.

I am interested in whether confirmation bias occurs when a scientific issue is used instead of a political one. There is clear evidence suggesting people select news about issues other than politics based on political preferences. Specifically, Iyengar and Hahn (2009) found that partisan selectivity occurred for soft news topics, including travel, sports, and crime. Therefore, I expect a similar outcome with respect to scientific issues. Formally, we pose the following hypothesis:

> H1a: When confronted with a science news story, conservatives, compared to liberals, are more likely to select information from Fox News regardless of the contextual cues presented to them in the stimulus material.
>
> H1b: When confronted with a science news story, liberals, compared to conservatives, are more likely to select information from MSNBC regardless of the contextual cues presented to them in the stimulus material.

CONFIRMATION BIAS, CONTEXTUAL CUES, AND INFORMATION UTILITY

There are many studies in the literature on media selectivity and selective exposure that demonstrate confirmation bias. Of these, the study by Iyengar and Hahn (2009) has come to characterize the literature on partisan selectivity. Other studies have found similar results. For example, Stroud (2008) found that conservatives were more likely to "listen to conservative talk radio, watch FOX, and access conservative websites" (p. 352) relative to liberals who were more likely to attend to liberal media. However, evidence of confirmation bias does not necessarily imply that defensive avoidance is occurring. Indeed, empirical evidence has shown that attitude inconsistent information is not always avoided (Canon, 1964; Festinger, 1964).

More recently, Garrett and colleagues (2009b; 2013) have argued that confirmation bias and defensive avoidance should be distinguished in the literature as "the dissonance-mitigating consequences of these two forms of selective exposure are not equivalent" (Garrett et al., 2013, p. 115). Yet with the exception of the work of Garrett and colleagues, relatively few studies have specifically sought to probe defensive avoidance. Using survey data collected between 2004 and 2008, Garrett and colleagues have shown that Americans who use attitude consistent information also tend to use more attitude discrepant information. They called for future work to "examine the motivations for exposure to other perspectives" (p. 132) and the present study contributes to this body of work by examining the mechanisms behind exposure to both consistent and inconsistent views.

Although contextual cues embedded in information have yet to be explored, scholars have found that social cues have a significant effect on partisan confirmation bias. In fact, the presence of social endorsements significantly reduces the likelihood of individuals opting for attitude congruent channels (Messing & Westwood, 2012). Using a nationally representative sample, Messing and Westwood (2012) showed that recommendations by other readers significantly reduced the likelihood of Republicans and Democrats selecting Fox News and MSNBC, respectively. While this work extends our knowledge of the interaction between social cues and partisan selectivity habits, we know little about how contextual cues embedded in media presentations of information affect the mechanisms of selective exposure.

In addition to social cues, scholars have identified the perceived utility of information as another factor influencing information selectivity (Sears & Freedman, 1967). Information utility is the extent to which any piece of knowledge serves a practical purpose. As previous research has found, the greater the perceived utility of information, the more likely an individual is to

attend to it, regardless of its alignment with preexisting attitudes (Freedman, 1965). A recent study found evidence further supporting this claim. Using a sample of undergraduate students, Knobloch-Westerwick and Kleinman (2012) found that information about the political party about to take office was perceived to be more useful than attitude congruent information. In particular, Republicans did not exhibit confirmation bias towards attitude congruent messages and the authors propose that learning about the Democratic Party's policy stances was more useful in light of their victory in the 2008 elections. In doing so, the authors identified yet another condition under which partisan selectivity is reduced; when information about an opposing party is necessary in the context of an election.

The need for information arises from uncertainty and can elicit various responses with respect to information seeking (Atkin, 1973). Among these functions are surveillance and guidance information seeking. Surveillance information is information that individuals seek in order to "keep abreast of relevant events in the world around him, and to interpret his internal feelings in response to environmental stimuli" (Atkin, 1973, p. 211). Guidance information seeking, on the other hand, becomes salient when people are exposed to novel objects or situations as they then use such guidance information to help make sense of new issues. It seems reasonable to posit that in familiar contexts, individuals are more likely to seek information for purposes of surveillance instead of guidance. Perhaps once individuals are familiar with an issue, surveillance information may be all that is required to keep informed. On the other hand, in unfamiliar environments, information that provides guidance is necessary to arrive at conclusions or judgments about the issue. As technologies and scientific developments continue to emerge, individuals will increasingly be faced with unfamiliar information and these contexts may elicit guidance instead of surveillance information seeking.

Although studies have shown that public audiences interpret nanotechnology information through a religious lens (Brossard et al., 2009), there is little evidence to suggest that there will be strong partisan or ideologically-driven opinions about this issue. Therefore, for reasons explained in Chapter 1, I do not expect that there will be existing politically-driven opinions about nanotechnology, which may confound any ideological cues used to frame new information. In the context of this relatively novel and unfamiliar issue, I hypothesize that individuals will be motivated to seek information for the purpose of guidance if clear ideological cues are absent. In this case, individuals will return to partisan sources to help them make sense of the information. On the other hand, clear ideological cues should allow individuals to categorize unfamiliar information, allowing subsequent surveillance information seeking to keep abreast of current information. Therefore, I should observe greater selective exposure when contextual cues are absent. Formally, I pose the following hypothesis:

H2: The absence of ideological cues in the stimulus will accentuate the effect of selective exposure.

STUDY A: METHODOLOGICAL APPROACH

In my initial data analysis for study A, I examined selection of media channel using the simplest regression models applicable to dichotomous nominal dependent variables, binary logistic regression models. While most of the independent variables in the binary logit models were also used in the multinomial models, *attention to newspapers*, *attention to news on television*, *attention to news online*, and *attention to news on social media* were combined to create a general measure of *attention to media* (M = 2.49, SD = .79, *Cronbach's* alpha = .77) for the first round of data analysis. I will refer to this as Analysis I.

To further explore my research questions and test my hypothesis, I used multinomial logistic regression models predicting channel selection. In these models, I did not create an average index of media attention and chose to include separate media variables in the model. I did this in order to explore the main effects of media on channel selection. I will refer to the analyses using multinomial logistic regression models as Analysis II and III. In Analysis II, I exclude participants who were presented inconsistent ideological cues in the experimental stimulus. These respondents were included in Analysis III.

Data and subjects

To examine ideological selectivity, I relied on the data from the selectivity experiment obtained from GfK Knowledge Networks. The online survey of U.S. adults 18 years and older is nationally representative. This chapter relies on the modified Solomon four-group design described in Chapter 2. As Chapter 2 provides an overview of this dataset, the discussion here is limited to a brief reminder of the experimental stimulus and headlines, from which the respondents were asked to select.

Experimental stimulus and headlines

Respondents were randomly assigned to one of six news articles in which partisan cues had been manipulated. The news excerpts were from a Canadian newspaper, the Ottawa Citizen to represent a relatively neutral and unfamiliar news source. The issues of regulation of nanosilver and food safety and nano zinc oxide in cosmetics were used. Respondents received the article in one of three conditions; with consistent or inconsistent ideological cues, or in a non-cued condition. Following exposure to the article, participants were asked to choose from nine

headlines, randomized in a 3 (media source) × 3 (topic area) design. Headlines were presented next to a logo of the media channel. The channels were MSNBC, Fox News, and CBC, and the headlines were from three broad topics—the ability of nanotechnology to stimulate the economy, the risks to the environment, health, and safety (EHS) of nanotechnology in consumer products, and federal regulations on nanomaterials (Appendix D). The media source CBC was included in the options as a relatively less ideologically-charged option for respondents.

Dependent variables

Logistic regression

Four dichotomous dependent variables were created, two for each wave of data collection. In both waves, *selection rate of MSNBC* was created by coding respondents who selected a headline from MSNBC as "1," while those who selected a headline Fox News or CBC were coded as "0." *Selection rate of Fox News* was created in a similar manner, with a selection of Fox News as "1" and all others as "0".

Multinomial logistic regression

Two dichotomous dependent variables were created, one for each wave of data collection. In both waves, *selection of media channel* was created by coding respondents who selected a headline from Fox News as "0," while those who selected a headline from MSNBC were coded as "2," and respondents who selected CBC coded as "1".

Independent variables

Demographics

Age, *gender*, *income*, *education*, and *race* were included in the models to control for demographic influences on the dependent variables. Descriptive statistics of the demographic variables can be found in Chapter 2. *Age* was measured as a continuous variable. *Gender*, *education*, *race*, and *household income* were measured categorically.

Political characteristics

Self-reports of fiscal and social ideology were used to create a mean index of *political ideology* (*M* = 4.15, *SD* = 1.38, *Pearson's r* = .70), ranging from "very liberal" (1) to "very conservative" (7). Political interest was measured in both waves by asking respondents to indicate how interested they were in politics and public affairs on an 11-point Likert scale ranging from "not at all interested" (0) to "very interested" (10) (wave 1: *M* = 6.50, *SD* = 3.03, wave 2: *M* = 6.57, *SD* = 2.78).

Media attention

Attention to media items were measured on 5-point scales (1 = "None" and 5 = "A lot"). *Attention to news on television* (*M* = 2.99, *SD* = .98, *Cronbach's alpha* = .89), *newspapers* (*M* = 2.80, *SD* = 1.04, *Cronbach's alpha* = .89), *online* (*M* = 2.30, *SD* = 1.11, *Cronbach's alpha* = .92), and *on social media* (*M* = 1.77, *SD* = .99, *Cronbach's alpha* = .95) were measured by asking the respondents how much attention they pay to news stories about (i) international and national affairs, (ii) local government and politics, (iii) science and technology, and (iv) scientific studies in new areas of research on each medium. Items were averaged to create indices. As mentioned, I included an index of *media attention* (*M* = 2.49, *SD* = .79, *Cronbach's*

alpha = .77) in Analysis I instead of separate media variables. In Analysis II and III, I used separate media variables to explore the main effect of media on channel selection.

Experimental stimulus

Dichotomous variables were created for both waves to capture whether respondents were exposed to the cued news article or the non-cued stimulus. The variable called *exposure to ideological cues* coded respondents who read the cued news article as "1" while all other respondents were coded as "0." Those who received inconsistent cues were excluded from models using this variable.

In order to include respondents who received inconsistent cues in the analysis, two dichotomously coded variables were created. The first, *exposure to consistent cues*, had respondents who saw consistent cues coded as "1," while those in the non-cued and inconsistently cued conditions were coded as "0." The second, *exposure to inconsistent cues*, had respondents exposed to inconsistent cues coded as "1," while all others were coded as "0."

Topic selection

As mentioned earlier, headlines were randomized in a 3 (channel) × 3 (topic) design. Two separate dichotomous variables were created to account for topic selection. Respondents who selected an environment, health, and safety (EHS) topic were assigned a value of "1" for the variable *EHS*, while all others were coded as "0." Similarly, the variable *regulation* captures respondents who selected a headline about regulation of nanomaterials. In wave 1, 45.3 percent of our sample selected a headline about EHS, 39.3 percent selected a headline about nanotech regulations, and 15.4 percent selected a headline about the economy. In wave 2, 43 percent

selected a headline about EHS, 42 percent selected a regulation-related headline, and 15 percent selected a headline about jobs and the economy related to nanotechnology.

Data analysis

Analysis I

Four hierarchical binomial logistic regression models were used to predict selection of media source in the experiment. Variables were included in the models in the following blocks:

1) Demographics (*age*, *gender*, *education*, *income*, *race*)
2) Political characteristics (*ideology*, *political interest*)
3) Media use (*attention to media*)
4) Exposure to partisan cues (*cued stimulus*)

In the final block, two-way interactions between ideology and exposure to the cued stimulus were included. In all analyses, interaction terms were created by multiplying the standardized main effect variables to avoid collinearity between the interaction term and its components (Cohen, Cohen, West, & Aiken, 2003).

Controls for the headline topic selected by respondents were not included in the logistic regression models as there should be no systematic differences since headline topics and sources were randomly paired. In order to check that this was the case, I ran the models with topic controls included as independent variables. There were no substantive differences between the models with controls and those without.

Analysis II and III

In the multinomial logistic regression models, independent variables included in the models were demographics (*age*, *gender*, *education*, *income*, *race*), political characteristics (*ideology*, *political interest*), media use (attention *to newspapers, news on television, online,* and on *social media* in the multinomial logit models), *exposure to partisan cues* (either excluding or including respondents who received inconsistent cues), and *topic selection*. Two-way interactions between ideology and exposure to partisan cues were also included.

As mentioned above, controls were excluded from Analysis I. However, in the analyses using multinomial logistic regression, there were substantive differences in the models when topic selection was included. Therefore, controls for topic selection were included in Analysis II and III as two dichotomous variables.

STUDY A: RESULTS

The results of Analysis I, II, and III predicting the likelihood of seeking information from one of the three media channels in waves 1 and 2 of the experiment are presented in this section. The dependent variable in Analysis I is dichotomous; binomial logistic regression models were used in this analysis (Table 3-1). Dependent variables with three nominal categories were used with multinomial logistic regression in Analysis II and III. Respondents who were exposed to the experimental stimulus with inconsistent ideological cues were excluded from Analysis II (Tables 3-2 and 3-3), while Analysis III (Tables 3-4 and 3-5) included these individuals. For ease of interpretation, the logit coefficients of all three analyses were converted to probabilities, also known as selection rates. These were calculated by holding all other variables aside from the independent variable of interest at their respective means.

Analysis I

The results of the logit models predicting likelihood of seeking information from Fox News and MSNBC in waves 1 and 2 of the experiment are presented in Table 3-1. The logit coefficients for the models predicting exposure to MSNBC were negative while the coefficients predicting Fox News were positive. Additionally, the magnitude of the coefficients were similar in waves 1 and 2 for models predicting MSNBC and Fox News.

Table 3-1. Logistic regression coefficients predicting likelihood of selecting a headline from *MSNBC* and *Fox News Channel* in waves 1 and 2.

	Predicted likelihood B (S.E.)			
	MSNBC (wave 1)	*Fox News* (wave 1)	*MSNBC* (wave 2)	*Fox News* (wave 2)
Block 0: Controls				
Received consistent cues (wave 1)	—	—	.27 (.18)	-.39 (.20)
Received inconsistent cues (wave 1)	—	—	-.49 (.27)	-.05 (.26)
Block 1: Demographics				
Age	-.01 (.01)	.00 (.01)	-.01 (.01)	.00 (.01)
Gender (female)	-.11 (.22)	.34 (.23)	.12 (.17)	.11 (.18)
Education	.03 (.06)	-.04 (.06)	-.05 (.04)	-.05 (.05)
Household income	.02 (.03)	-.03 (.03)	.03 (.02)	-.05 (.02)*
Race (White)	-.36 (.24)	-.19 (.25)	.00 (.18)	.11 (.20)
Block 2: Political characteristics				
Ideology (conservative)	-.28 (.08)***	.58 (.09)***	-.27 (.06)***	.51 (.07)***
Political interest	-.03 (.04)	-.05 (.05)	.02 (.04)	-.06 (.04)
Block 3: Media use				
Attention to media	.10 (.16)	.29 (.17)	-.03 (.12)	.02 (.13)
Block 4: Exposure to partisan cues				
Cued stimulus	.01 (.21)	-.14 (.23)	-.05 (.18)	-.45 (.20)*
Block 5: Interaction				
Ideology × Exposure to cues	.31 (.11)**	-.39 (.12)***	.11 (.08)	-.18 (.10)
Intercept	1.03 (.83)	-2.94 (.89)***	.84 (.64)	-1.22 (.68)
Log likelihood	-261.77	-243.79	-436.63	-394.60
Nagelkerke R^2	.09	.18	.07	.19
N	417	417	683	683

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

To address hypothesis 1a and 1b about individuals selecting media channels congruent with their ideological views when confronted with a news story about science, I found that the selection rate of MSNBC was highest among those who reported being "very liberal" (60.8 percent in wave 1, 58.6 percent in wave 2) and lowest among "very conservative" respondents (23.1 percent in wave 1, 18.2 percent in wave 2). The trend in the selection rate of Fox News

mirrored that of MSNBC, with “very conservative” respondents being most likely to select Fox News (75.8 percent in wave 1, 73.1 percent in wave 2) and “very liberal” respondents being the least likely to select the same source (9.4 percent in wave 1, 8.8 percent in wave 2). Figure 3-1 shows how selection rates of Fox News and MSNBC change with ideology.

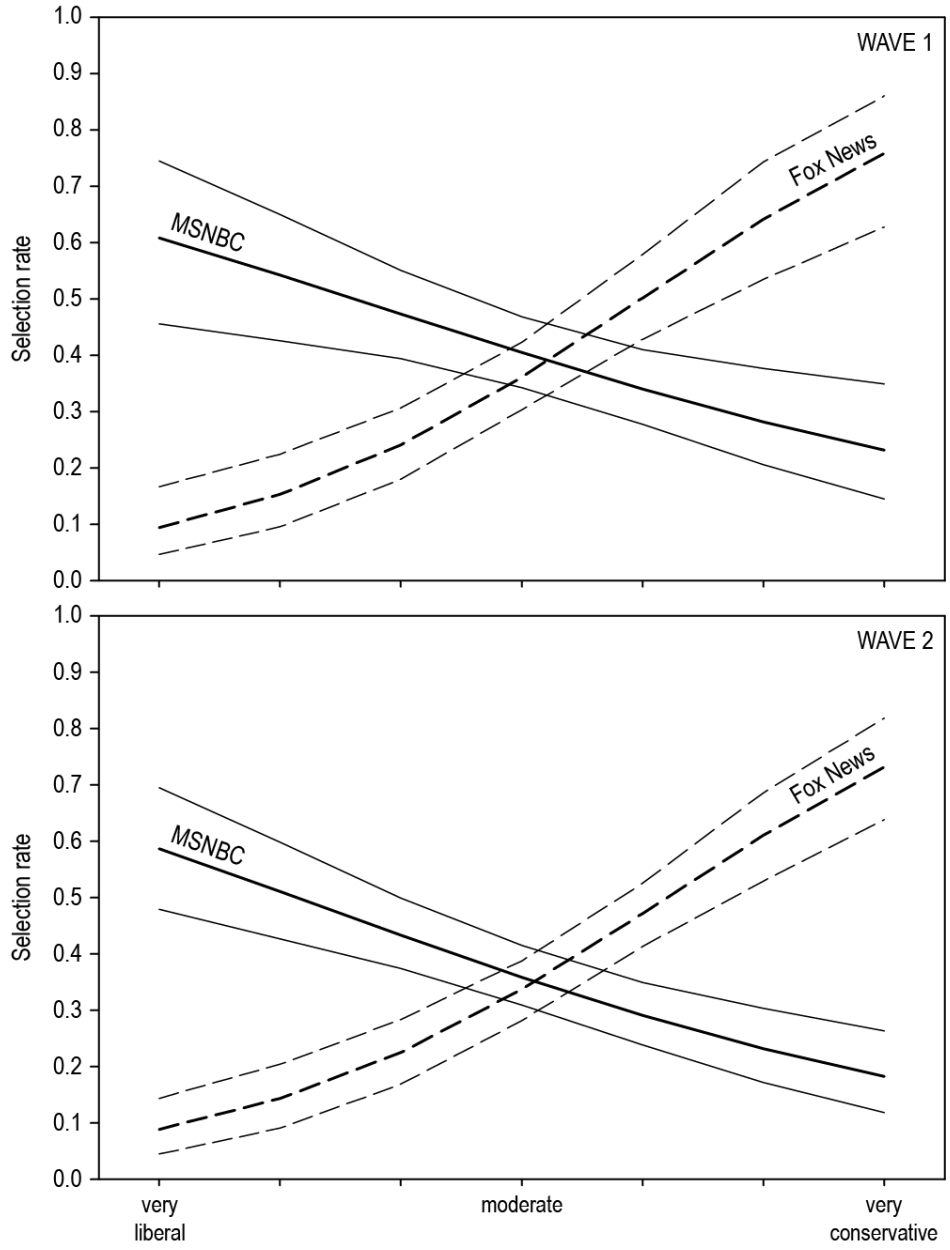

Figure 3-1. Mean values and 95 percent confidence intervals showing main effect of ideology on selection of MSNBC and Fox News in waves 1 and 2.

To address my second hypothesis, which posited that the absence of ideological cues would accentuate ideological selectivity, interactions between political ideology and exposure to ideological cues were included in all four logit models. The interactions were significant in all

four models, with positive logit coefficients predicting selection of MSNBC and negative logit coefficients predicting selection of Fox News in both waves (Figure 3-2). The coefficients were smaller in wave 2 compared to wave 1 for both MSNBC and Fox News models.

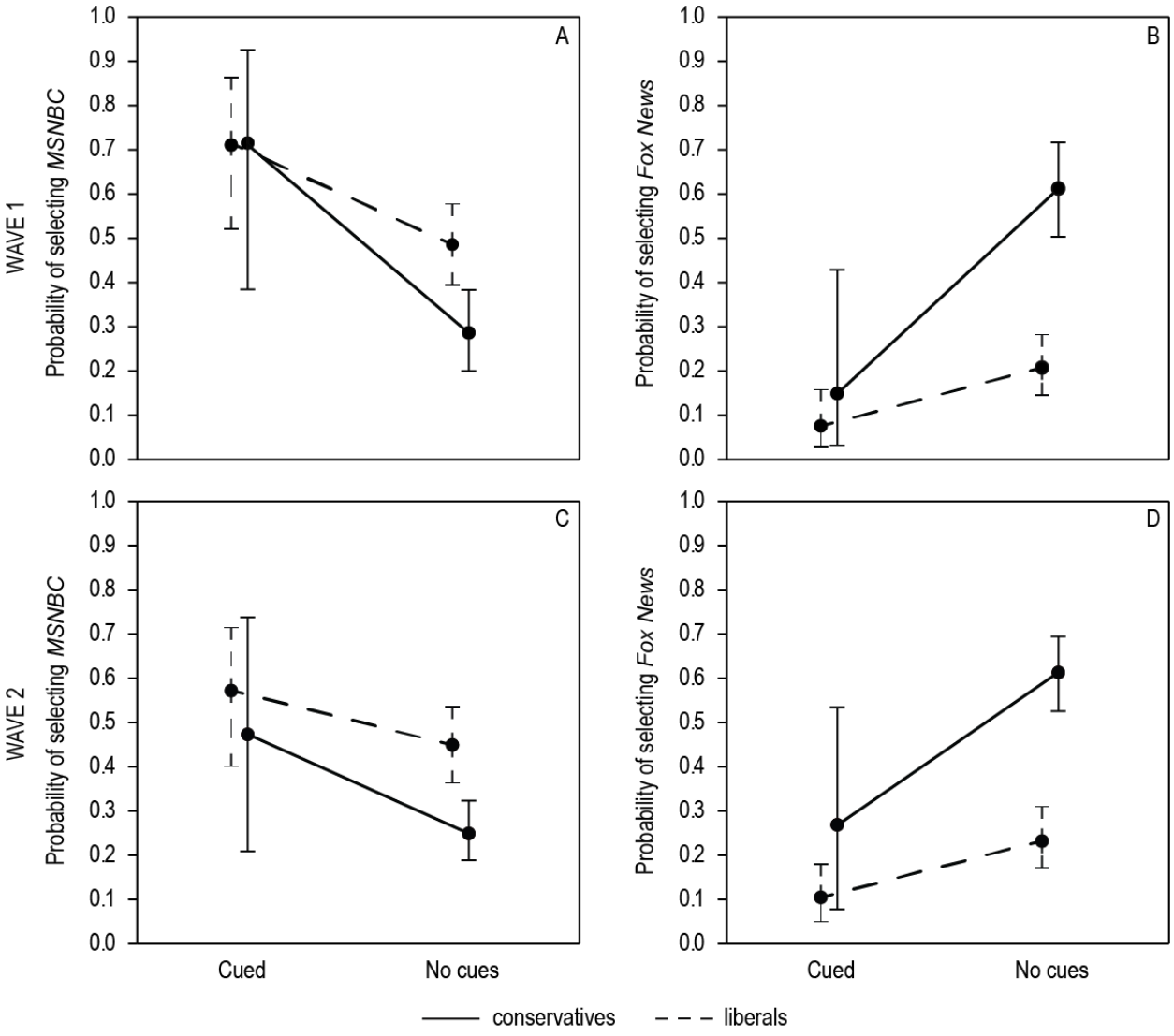

Figure 3-2. Interactive effect of partisan cueing and ideology on the likelihood of selecting a headline from *MSNBC* (A, C) and *Fox News* (B, D).

In the model predicting selection of MSNBC in wave 1, the difference between conservatives who received ideological cues in the stimulus and those who did not was significant (panel A of Figure 3-2). Similarly, in the model predicting selection of Fox News in wave 1, the difference between conservatives in cued and non-cued conditions was also significant (panel B of Figure 3-2). Although the overall interaction was significant in wave 2, the confidence intervals of conservatives who received the cued stimulus overlapped with that of conservatives who saw the non-cued stimulus (panels C and D of Figure 3-2). In all four models, the confidence intervals of liberals overlapped between experimental conditions. These findings are similar to those of the multinomial logistic regression model described in Chapter 4. However, while the logit models only describe the likelihood of selecting MSNBC or Fox News relative to the other two channels, using multinomial models gives us a more nuanced comparison of the selection rate of between all three media channels.

Analysis II

To address my first hypothesis, in wave 1 (Table 3-2) I found a significant, positive relationship between ideology and the selection rate of Fox News relative to CBC (B = .61, SE = .13, $p \leq .001$) and a significant, negative relationship when predicting the selection rate of MSNBC relative to Fox News (B = -.45, SE = .10, $p \leq .001$). Similar coefficients were observed in wave 2 (Table 3-2). The selection rate of Fox News relative to CBC was highest among those who reported being "very conservative" (92.8 percent in wave 1, 87.9 percent in wave 2) and lowest among "very liberal" respondents (24.8 percent in wave 1, 21.2 percent in wave 2). The selection rate of Fox News relative to MSNBC showed a similar trend, with "very conservative" respondents being most likely to select Fox News (80.8 percent in wave 1, 82.6 percent in wave

2) and "very liberal" respondents being the least likely to select the same source (22.5 percent in wave 1, 17.3 percent in wave 2).

Table 3-2. Multinomial logistic regression predicting channel selection in wave 1 (N = 366).

	Predicted likelihood B (S.E.)		
	$Fox\ News/_{CBC}$	$MSNBC/_{CBC}$	$MSNBC/_{Fox\ News}$
Intercept	-1.00 (1.17)	-.23 (1.13)	.77 (.93)
Age	-.01 (.01)	-.02 (.01)	-.01 (.01)
Gender (female)	.32 (.33)	.29 (.32)	-.03 (.26)
Education	.00 (.09)	.02 (.09)	.02 (.07)
Race (White)	-.85 (.40)*	-.88 (.38)*	-.03 (.29)
Household income	.00 (.04)	.05 (.04)	.04 (.03)
Ideology (conservative)	.61 (.13)***	.16 (.12)	-.45 (.10)***
Political interest	-.07 (.07)	-.11 (.07)	-.05 (.06)
Attention to newspapers	.23 (.24)	-.03 (.23)	-.26 (.20)
Attention television news	-.32 (.22)	.41 (.22)	.72 (.20)***
Attention to online news	.00 (.20)	-.11 (.19)	-.11 (.16)
Attention to news on social media	.47 (.20)*	.28 (.20)	-.19 (.16)
Exposure to ideological cues	-.13 (.31)	.02 (.31)	.14 (.25)
Topic selection: EHS	.03 (.46)	.21 (.45)	.18 (.38)
Topic selection: regulation	.58 (.49)	.93 (.49)	.35 (.39)
Interaction			
Ideology × Exposure to cues	-.39 (.24)	.17 (.23)	.56 (.20)**

-2LL = 694.42, Nagelkerke R^2 = 20.6%.
*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

In wave 1, race and attention to news on TV and social media were significant predictors of channel selection. Non-White respondents had a higher likelihood of selecting Fox (81.7 percent) and MSNBC (89.1 percent) relative to CBC. Respondents who reported paying a lot of attention to news on TV were more likely to select MSNBC than Fox News. Among those who

said they pay a lot of attention to TV news, the selection rate of MSNBC was 77.9 percent. For those who reported paying no attention to news on TV, their selection rate was 16.5 percent.

In the second wave, exposure to ideological cues and selecting a topic about EHS issues were significant predictors in our model (Table 3-3). Respondents who selected a headline about EHS were less likely to pick Fox News compared to CBC; among those who selected a EHS-related headline, selection rate of Fox was 47.1 percent while those who did not select a EHS-related headline had a selection rate of 70.5 percent. With respect to ideological cues, the selection rate of Fox News compared to CBC was 66.5 percent among those who received no cues. Among respondents who received consistent cues, the selection rate of Fox News was lower (49.1 percent). A similar trend was observed when comparing selection of MSNBC to Fox News in wave 2. Among respondents who received no cues, the selection rate of Fox News was 56.6 percent, while those who received clear ideological cues had a selection rate of 43.9 percent.

Table 3-3. Multinomial logistic regression predicting channel selection in wave 2 (N = 678).

	Predicted likelihood B (S.E.)		
	$Fox\ News/_{CBC}$	$MSNBC/_{CBC}$	$MSNBC/_{Fox\ News}$
Intercept	.89 (.82)	1.98 (.77)**	1.09 (.71)
Age	.00 (.01)	-.01 (.01)	-.01 (.01)
Gender (female)	.29 (.22)	.27 (.21)	-.02 (.20)
Education	-.09 (.06)	-.08 (.06)	.01 (.05)
Race (White)	.13 (.24)	.11 (.22)	-.03 (.22)
Household income	-.05 (.03)	-.01 (.03)	.04 (.02)
Ideology (conservative)	.55 (.09)***	.03 (.08)	-.52 (.07)***
Political interest	-.04 (.05)	.02 (.05)	.06 (.04)
Attention to newspapers	-.08 (.16)	-.01 (.14)	.07 (.14)
Attention television news	-.15 (.15)	-.03 (.14)	.12 (.14)
Attention to online news	.00 (.13)	-.13 (.12)	-.14 (.12)
Attention to news on social media	.16 (.13)	-.11 (.12)	-.05 (.12)
Exposure to ideological cues	-.72 (.22)***	-.20 (.20)	.51 (.19)**
Topic selection: EHS	-.99 (.33)**	-.54 (.32)	.46 (.28)
Topic selection: regulation	-.33 (.36)	-.27 (.34)	.06 (.29)
Interactions			
Ideology × Exposure to cues	-.29 (.17)	-.07 (.15)	.22 (.15)

$-2LL$ = 1352.04, Nagelkerke R^2 = 18.6%.
*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

To address my second hypothesis, I included an interaction between ideology and exposure to ideological cues in both waves 1 and 2 models. While the interaction was not significant in wave 2, there is a significant positive coefficient in the wave 1 model when comparing the selection of MSNBC to Fox News (B = .56, SD = .20, $p \leq .01$). To visualize the interaction, I used a ternary graph to plot the data (Figure 3-3). Ternary plots allow visualization of a variable that contains three parts. In this case, the three parts of the dependent variable are the selection rates of Fox News, MSNBC, and CBC, which sum to 1. Among those who received obvious ideological cues, there is little difference in the selection rate of liberals and

conservatives. However, among those who received no cues, liberals were more likely to select MSNBC and CBC relative to Fox News. As the ideology spectrum shifts from liberal to conservative, the selection rate of Fox News increases while that of MSNBC declines.

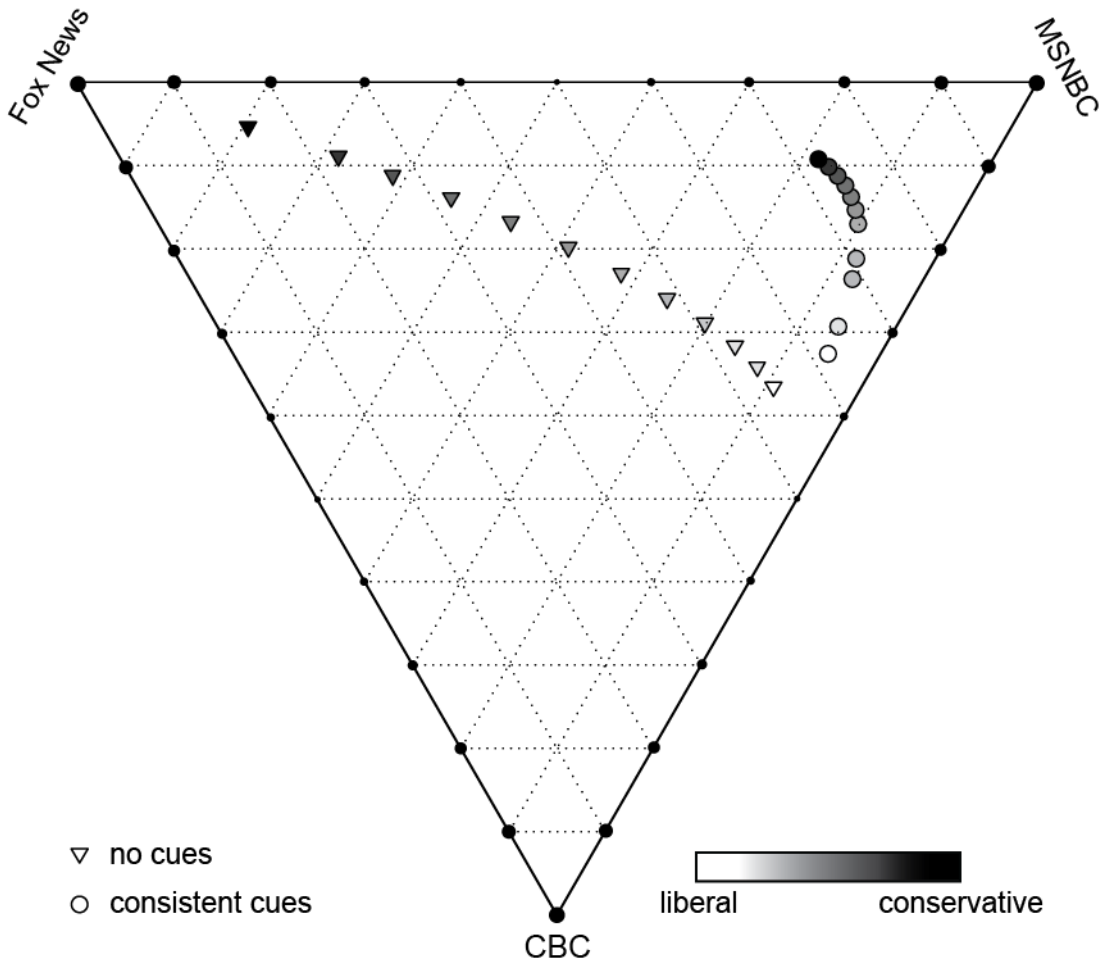

Figure 3-3. Ternary graph showing the interactive effect of ideological cueing and political ideology on the selection rate of MSNBC, Fox News, or CBC. The model used to estimate selection rate excluded survey participants who received inconsistent cues. The apices of the graph represent a selection rate of 1.0 for the respective channels.

Analysis III

As in Analysis II, which excludes those who were exposed to inconsistent ideological cues, political ideology was a significant predictor of headline choice in both waves (Table 3-4) and 2 (Table 3-5). The selection rate of Fox News over CBC in wave 1 among those who identified as "very liberal" was 34.6 percent, compared to 89.9 percent among those who identified as "very conservative." Similarly, the selection rate of Fox News relative to MSNBC in the same wave was 84.6 percent among those who are "very conservative" and 23.6 percent among those who are "very liberal." The same trend is observed in wave 2 of analysis B. "Very conservative" respondents had a 83.5 percent likelihood of selecting Fox News over CBC; the selection rate among the "very liberal" was 19.2 percent. With respect to selection of MSNBC compared to Fox News, those who are "very liberal" had a selection rate of 83.4 percent while the "very conservative" had a rate of 19.1 percent.

Table 3-4. Multinomial logistic regression predicting channel selection in wave 1 (N = 588).

	Predicted likelihood B (S.E.)		
	$Fox\ News/_{CBC}$	$MSNBC/_{CBC}$	$MSNBC/_{Fox\ News}$
Intercept	.17 (.91)	1.06 (.91)	.89 (.75)
Age	.00 (.01)	-.02 (.01)*	-.02 (.01)*
Gender (female)	-.28 (.25)	-.12 (.25)	.15 (.21)
Education	-.11 (.07)	-.02 (.07)	.08 (.05)
Race (White)	-.96 (.30)**	-.62 (.30)*	.34 (.23)
Household income	.01 (.03)	.05 (.03)	.04 (.03)
Ideology (conservative)	.47 (.09)***	-.01 (.09)	-.48 (.08)***
Political interest	-.06 (.05)	-.10 (.05)*	-.04 (.04)
Attention to newspapers	.07 (.19)	.02 (.18)	-.05 (.16)
Attention television news	-.14 (.18)	.30 (.18)	.43 (.16)**
Attention to online news	.13 (.15)	-.07 (.15)	-.20 (.13)
Attention to news on social media	.24 (.15)	-.09 (.15)	-.16 (.12)
Exposure to consistent cues	-.11 (.31)	.00 (.30)	.11 (.25)
Exposure to inconsistent cues	-.27 (.29)	-.32 (.29)	-.05 (.24)
Topic selection: EHS	.68 (.34)*	.57 (.33)	-.11 (.31)
Topic selection: regulation	.82 (.35)*	.73 (.35)*	-.09 (.31)
Interactions			
Ideology × Exposure to consistent cues	-.15 (.19)	.33 (.19)	.48 (.16)**
Ideology × Exposure to inconsistent cues	-.23 (.20)	-.40 (.19)*	-.18 (.17)

-2LL = 1136.90, Nagelkerke R^2 = 18.2%.
*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Table 3-5. Multinomial logistic regression predicting channel selection in wave 2 (N = 1002).

	Predicted likelihood B (S.E.)		
	$Fox\ News/_{CBC}$	$MSNBC/_{CBC}$	$MSNBC/_{Fox\ News}$
Intercept	1.20 (.67)	1.89 (.65)**	.69 (.59)
Age	.00 (.01)	.00 (.01)	-.01 (.01)
Gender (female)	.13 (.18)	.19 (.17)	.06 (.16)
Education	-.14 (.05)**	-.08 (.05)	.06 (.04)
Race (White)	-.04 (.20)	.21 (.18)	.25 (.18)
Household income	-.04 (.02)	-.02 (.02)	.02 (.02)
Ideology (conservative)	.51 (.07)***	-.01 (.06)	-.51 (.06)***
Political interest	-.01 (.04)	.05 (.04)	.06 (.03)
Attention to newspapers	-.11 (.13)	-.07 (.12)	.04 (.11)
Attention television news	-.07 (.12)	.12 (.12)	.19 (.11)
Attention to online news	-.03 (.11)	-.27 (.10)**	-.24 (.10)*
Attention to news on social media	.16 (.10)	.12 (.10)	-.04 (.10)
Exposure to consistent cues	-.72 (.21)***	-.24 (.20)	.48 (.19)*
Exposure to inconsistent cues	-.41 (.21)	-.23 (.21)	.18 (.19)
Topic selection: EHS	-.95 (.27)***	-.60 (.26)*	.35 (.23)
Topic selection: regulation	-.40 (.29)	-.22 (.28)	.18 (.24)
Interactions			
Ideology × Exposure to consistent cues	-.15 (.14)	.02 (.13)	.17 (.13)
Ideology × Exposure to inconsistent cues	-.11 (.14)	-.08 (.13)	.04 (.13)

-2LL = 2018.25, Nagelkerke R^2 = 16.9%.
*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Age, race, and political interest were also significant in the wave 1 model. Younger respondents had a higher selection rate of MSNBC relative to CBC and Fox News. Non-White respondents were more likely to select to read a headline from an American source compared to the Canadian one. The selection rate of Fox News among non-White respondents was 83.3 percent compared to 65.7 percent among Whites. The difference in selection rate by race was not as large in terms of selecting MSNBC; among non-Whites, the selection rate of MSNBC was 69.6 percent compare to 55.2 percent among Whites. In addition to age and race, political

interest was negatively correlated with selection of MSNBC over CBC. For those who were not at all interested in politics, their selection rate of MSNBC was 71.0 percent. Among those who were most interested in politics, selection rate of MSNBC was 47.4 percent. Attention to news on TV and the topic of the headline selected were also significant predictors in Analysis II. Respondents who selected a headline about EHS or regulatory issues were more likely to opt for Fox News or MSNBC over CBC.

Similar to Analysis II, the interactions between political ideology and exposure to ideological cues were included in both models. However, in Analysis III, respondents who received inconsistent cues in the stimulus were included in the model. The interaction was significant only in wave 1, and had a positive effect only when comparing selection of MSNBC and Fox News (Table 3-4).

Figures 3-4 and 3-5 show the interactive effect of consistent and inconsistent cues and ideology on headline selection, respectively. It is obvious from these graphs that when respondents were faced with communication contexts with no cues or inconsistent cues, they opted for channels that align with their political views. The liberals in our sample tended to stay away from Fox News regardless of the cues presented to them. However, conservatives were more likely to select a channel other than Fox only when they were presented with consistent ideological cues in the stimulus.

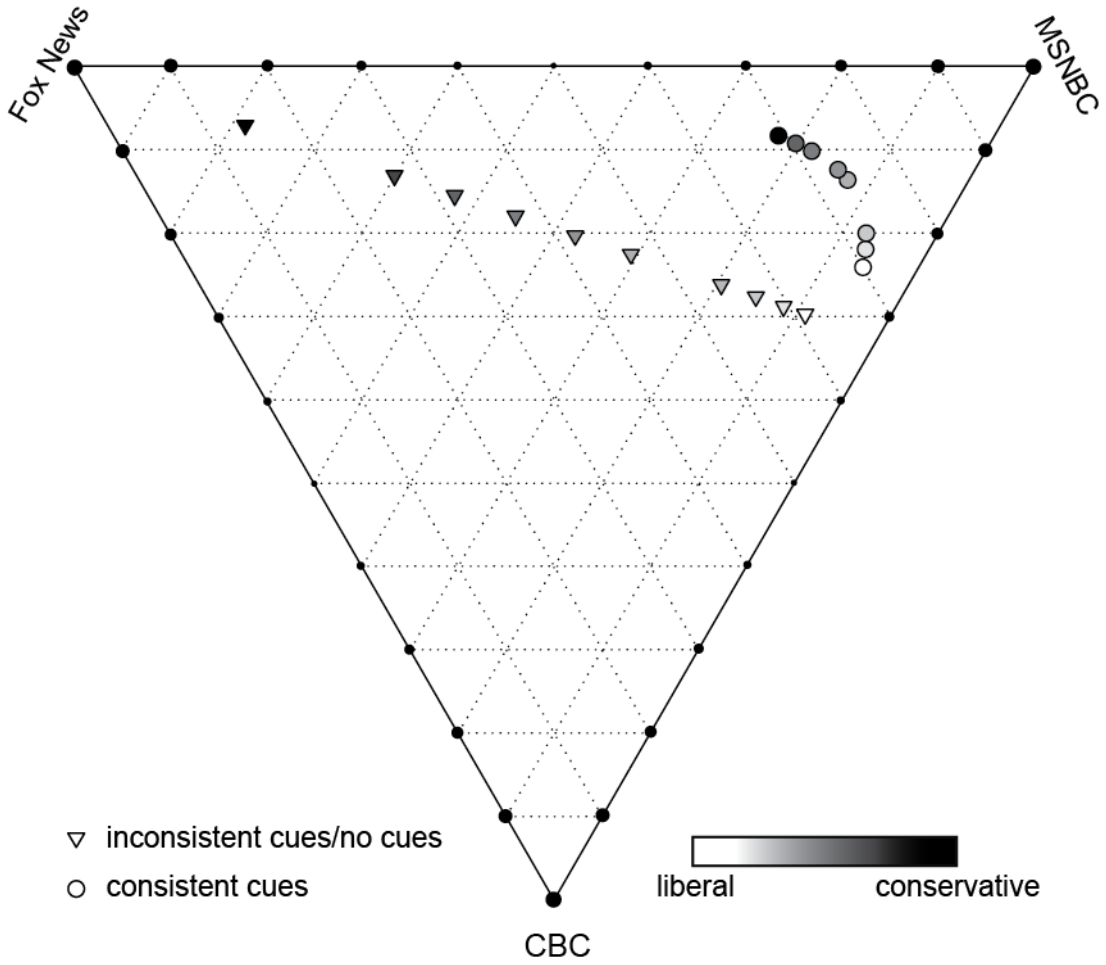

Figure 3-4. Ternary graph showing the interactive effect of consistent ideological cueing and political ideology on the selection rate of MSNBC, Fox News, or CBC in wave 1. The apices of the graph represent a selection rate of 1.0 for the respective channels.

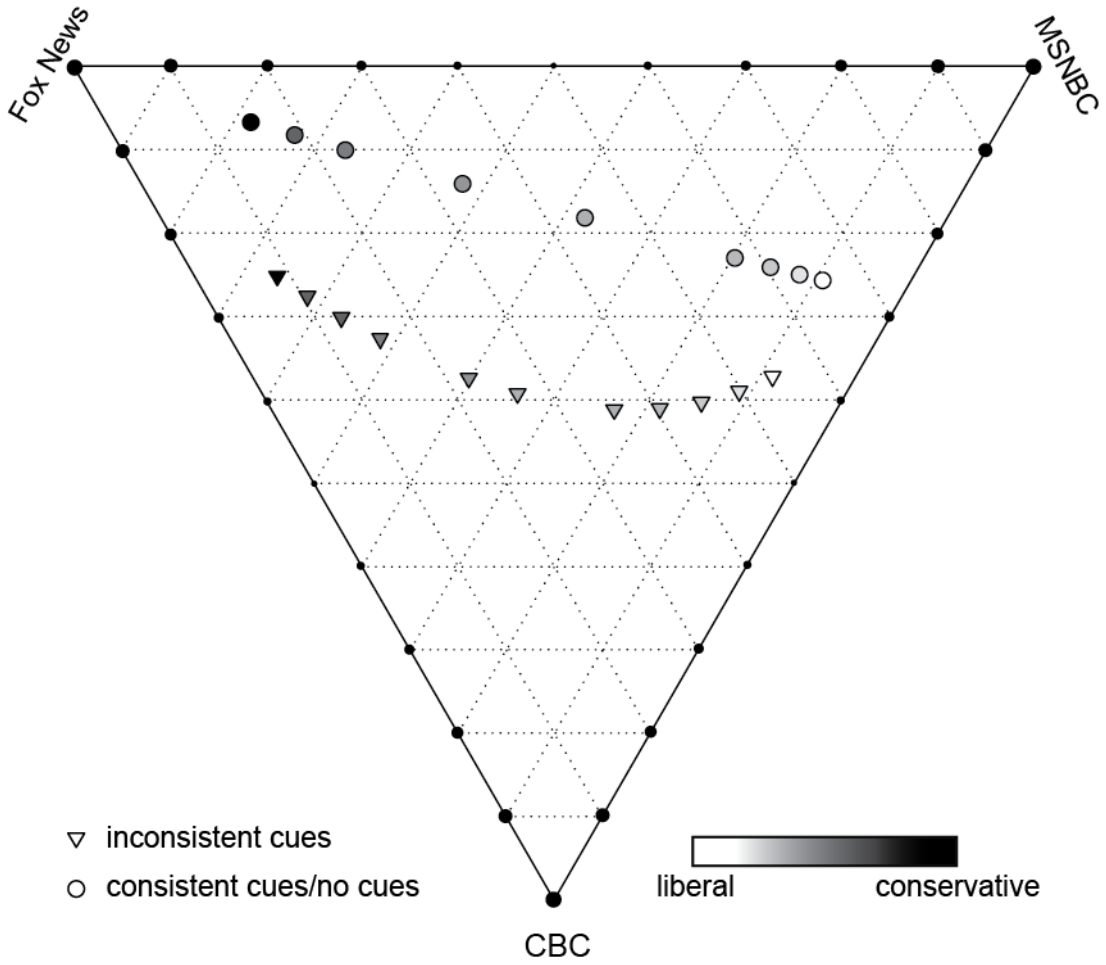

Figure 3-5. Ternary graph showing the interactive effect of inconsistent ideological cueing and political ideology on the selection rate of MSNBC, Fox News, or CBC in wave 1. The apices of the graph represent a selection rate of 1.0 for the respective channels.

STUDY A: DISCUSSION

A well-functioning democracy relies on its citizens to have some level of knowledge (Delli Carpini & Keeter, 1996). And it is even more beneficial to a society if its citizens are exposed to a diverse marketplace of ideas (Mutz & Martin, 2001). As consumers migrate from print and broadcast media to the Internet for information about science and technology (Anderson et al., 2010; Brossard, 2013), this fragmented online environment makes it difficult

for citizens to experience cross-cutting information as it allows them to cocoon themselves in so-called "echo chambers" (Sunstein, 2001). The consequences of these "echo chambers" have been causes of concerns for several scholars, who point to polarization as the primary detrimental outcome. As explained in Chapter 1, we know relatively little about the conditions under which selective exposure is likely to occur. While some work has explored how media source and socialization of news consumption affects selective exposure (Messing & Westwood, 2012), there has been relatively little scholarship on the contextual conditions that induce partisan selectivity. Using an online experiment and a sample representative of the U.S. population, my first study attempts to identify such conditions.

Before a comprehensive discussion of the findings, it is necessary to highlight some considerations that may limit this work. A common argument against experiments is the artificiality of the settings to which respondents are subjected. I am not contending that this is the case for the present study. Indeed, it is unlikely that individuals expose themselves to a relatively neutral source, in this case a Canadian newspaper, on a routine basis. In fact, it could be argued that a Canadian periodical represents a relatively liberal source instead of a neutral one. However, it is challenging to find an objectively neutral source of news. Additionally, although it is not impossible that consumers are exposed to information that lack ideological cues, it would be rare that news articles contain no heuristics, or mental shortcuts, which help people make sense of what they are reading. In this case, the experimental manipulation was justified for the purposes of this study, which was to identify specific conditions under which selective exposure occurs.

Despite the limitations of experiments in the social sciences, these results provide insights to ideological selectivity. In both waves, the main effect of ideology was significant,

replicating the findings of previous studies (Iyengar and Hahn, 2009) but with a significant difference. In particular, politically-driven selectivity was found to occur in the context of an unfamiliar scientific issue. I found evidence of confirmation bias among both conservatives and liberals—in general, conservatives were more likely to select Fox News, while liberals were more likely to select MSNBC. At first glance, this may not seem surprising as confirmation bias has been demonstrated in many studies (e.g., Iyengar & Hahn, 2009; Stroud, 2008; Stroud, 2010) and is a relatively robust finding. However, while previous studies involved political issues, our experiment involved a relatively neutral and unfamiliar scientific one. Despite this, ideological selectivity still occurred, emphasizing the notion that science is becoming more and more politicized and that respondents use ideological frameworks to anchor new information about such issues.

The goal of this study was to explore the contexts under which ideological selectivity occurs. To do so, respondents were assigned to different experimental conditions, two which included clear ideological cues in a news article while another contained no cues. The results showed that ideological selectivity was heightened by a lack of unequivocal partisan cues, regardless of whether cues were absent completely or inconsistent with existing opinion. And this selectivity effect was heightened through mechanisms that not only involve confirmation bias, but also by defensive avoidance. In particular, conservatives in our sample exhibited evidence of both confirmation bias and defensive avoidance. This is clearly demonstrated in Figure 3-2. When ideological cues were absent from the news article or were inconsistent, the selection rate of Fox News among conservatives increased significantly compared to when cues were present. Similarly, conservatives actively avoided MSNBC when there were no clear ideological cues.

This finding of defensive avoidance represents a departure from previous work that has found a positive correlation between exposure to congruent and incongruent sources (Garrett et al., 2013). One possible explanation may lie in how the data were used in the respective studies. In the present work, I distinguished between ideological groups, i.e. conservatives and liberals. However, Garrett and colleagues did not separate political groups when they conducted their analyses. Instead, they looked at congruent attitudes and media use at the aggregate level. Future scholarship should attempt to better understand the details of the relationship between these mechanisms of selective exposure at both an aggregate level and among different groups.

The findings of confirmation bias and defensive avoidance presented in this study appear to be driven mostly by conservatives (Figure 3-2). Other studies have also found evidence of conservative Republicans engaging more in confirmation bias relative to liberal Democrats (e.g., Iyengar et al., 2008). A potential explanation for this is that Republican elites have been very vocal in accusing mainstream media of having a liberal slant (Watts, Domke, Shah, & Fan, 1999). Conservatives are therefore less likely to trust mainstream media (Lee, 2005) and may opt for ideologically consistent sources as a result. However, it should be noted that some studies have found Democrats engaging in confirmation bias to a greater extent relative to Republicans (e.g., Knobloch-Westerwick & Kleinman, 2012). Future studies should explore the extent to which either side of the partisan and ideological aisle is susceptible to confirmation bias and defensive avoidance in order to understand why they are so affected.

In the existing literature on selective exposure, there is evidence that perceived utility of information can trump partisan selectivity (Atkin, 1973; Knobloch-Westerwick, 2008). Few studies have examined the conditions under which information utility trumps partisan loyalty. One situation in which this occurs is when the political regime is about to change after a national

election (Knobloch-Westerwick & Kleinman, 2012). This study has identified another potential condition under which perceived utility of information may trump confirmation bias. When people are faced with unfamiliar issues, political cues may be important heuristics that help them interpret and understand new information. When such cues are present, it is possible that information utility trumps any tendency towards confirmation bias. In the condition where participants were not exposed to any cues in the stimulus material, it may be that they were too unfamiliar with the issue to interpret it, and were therefore unable to assign any value to it in terms of utility. In this case, it seems reasonable to assume that readers may have retreated to a trusted partisan source to help make sense of the issue.

The heightened ideological selectivity due to the lack of contextual cues was observed only in wave 1. The waves of data collection and experimentation were fielded around the 2012 Presidential election and there are two possible explanations for the lack of a significant interaction in the second wave. First, it could be attributed to a deflation of hype and excitement around the election itself. The second wave was fielded in December, well after the winner of the Presidential election was decided. The second explanation involves changes in media coverage surrounding an election. It is likely that media coverage prior to the election was very different from post-election coverage, and it may be that news consumers were fatigued by election coverage relatively quickly after the election was decided.

Selective exposure appears unavoidable in the current fragmented media environment. Although some of the results of this study paint a relatively bleak picture for the likelihood of citizens' exposure to cross-cutting information, there is a building body of evidence that perceived utility of information plays an important role in information selection. Specifically, perceived informational utility may trump ideological selectivity in certain situations and expose

individuals to a diverse marketplace of ideas. Ideological selectivity is only one aspect of the media use-polarization puzzle. Yet another level is information processing. But before we can understand how individual biases affect information processing, it is necessary to understand how citizens are selecting their media diets. Therefore, understanding the processes and mechanisms of selective exposure is an integral part of deepening our understanding of the formation of public opinion and attitudes toward science and technology.

CHAPTER 4.

STUDIES B AND C: THE RELATIONSHIP BETWEEN NEED FOR COGNITION, KNOWLEDGE, AND PARTISAN SELECTIVITY OF SCIENTIFIC INFORMATION

Information seeking and processing are inextricably linked. The previous chapter highlighted the importance of political ideology as a factor in individual selection of scientific and technological information. Individuals appear to use these ideological cues to make sense of the information they encounter in media. This chapter attempts to link individual traits to partisan selectivity and to explore the relationships between a particular trait, need for cognition, knowledge, and media choice.

In this fragmented media environment, audiences have a virtually unlimited number of sources to choose from. As such, scholars are concerned about its implications for public affairs and politics (Bennett & Iyengar, 2008). The previous chapter underscores this concern and extends it to the realm of science and technology. Not only should we be concerned about the implications of selectivity in the context of public affairs, we should also be attentive to its implications for the scientific endeavor. Most public audiences today acquire information about science from online media (National Science Board, 2014) and we know that public opinion and attitudes are shaped by media content (Scheufele & Lewenstein, 2005).

Exploring the mechanisms that guide individual choice of media will extend our understanding of how public opinion is formed in such a segmented media environment. In my attempt to explain why individuals select channels in accordance with their political views, even if the information they seek is about science, I use structural equation modeling (SEM) and linear regression on the sample representative of the U.S. population, which I described in Chapter 2. I find that audience members with lower cognitive need are more likely to rely on partisan

heuristics when selecting media, i.e., they are more likely to select media from channels that are known to be consistent with their political party identification. I also find that individuals who are more knowledgeable tend to engage in greater partisan selectivity. Although knowledge and need for cognition have been shown to be positively correlated, these results present a somewhat conflicting picture, one that needs to be studied in more detail to be understood.

In this chapter, I have conducted two separate but related studies to explore how need for cognition and knowledge are related to partisan media use. Study B uses a structural equation model, and I test whether knowledge is a mediator of the relationship between need for cognition and partisan selective exposure. In Study C, I explore the role of knowledge as a moderator in this relationship using a linear regression model.

STUDY B

In its earliest conceptualizations, the need for cognition has been described as the "need to understand and make reasonable the experiential world" (Cohen, Stotland, & Wolfe, 1955, p. 291). Fundamentally, it is an individual's need to increase his or her understanding of external cues and stimuli. Individuals with high need for cognition also "need to understand" (Katz, 1960, p. 170) the world around them and have been described as "thinkers" for whom thinking is enjoyable (Murphy, 1947). Consequently, this personality trait has been conceptualized as an individual's "tendency to engage in and enjoy thinking" (Cacioppo & Petty, 1982, p. 116).

In their seminal study, Cacioppo and Petty (1982) develop and validate a scale measuring cognitive need using four different studies. Using university faculty as representatives of individuals with high cognitive need and assembly line workers to represent those with lower needs, the study also explored correlations between need for cognition, intelligence, and

dogmatism. Dogmatism is a measure of "openness-closedness of cognitive systems, general authoritarianism, and general intolerance" (Rokeach, 1956, p. 41). Compared to open-minded individuals, closed-minded individuals have greater difficulty discerning between information and its source (Rokeach, 1956). On the other hand, as Powell (1962) put it, "the more open [one's] belief system, the better should be [one's] ability to evaluate and act upon information about the world, independently, and on its own merits" (p. 61; for a review of dogmatism and open- and closed-mindedness, see Vacchiano, Strauss, and Hochman (1969)). They found that the need for cognition was negatively correlated with being closed minded and positively related to intelligence, a point to which I will return.

The need for cognition has also been linked to information processing. Goal-driven information processing is a robust phenomenon, which has been observed and studied by scholars in multiple academic disciplines including psychology (Kahneman, Slovic, & Tversky, 1982; Petty & Cacioppo, 1986), communication (Brossard et al., 2009; Meffert, Chung, Joiner, Waks, & Garst, 2006), political science (Braman & Nelson, 2007), and law (Kahan, Braman, Monahan, Callahan, & Peters, 2010). An important assumption underlies goal-driven information processing, namely, that individuals are "cognitive misers" (Fiske & Taylor, 1991; Popkin, 1991). Scholars have outlined several models of information processing, and the ones which are most relevant to this dissertation are the Elaboration Likelihood Model (Petty & Cacioppo, 1986), the Heuristic-Systematic Model (HSM; Chaiken, 1980; Chaiken, Liberman, & Eagly, 1989), and the System 1 and System 2 model (Kahneman, 2003; Kahneman, 2011; Kahneman et al., 1982; Tversky & Kahneman, 1974).

Briefly, ELM posits two modes of processing information contained in persuasive messaging: central and peripheral processing (Petty & Cacioppo, 1986). The central route is

more deliberate, requiring more cognitive effort, and produces changes in attitudes that persist longer, while the peripheral route relies on heuristics, simple decision rules or mental shortcuts, and is relatively automatic and effortless. ELM has been used to examine the heuristic of source credibility in the context of attitude change. Individuals who require less elaboration were more likely to use source credibility in message processing compared to those who had higher elaboration needs (Verplanken, 1991).

Another model identifies two similar information processing modes as System 1 and 2 (Kahneman, 2011). System 1 explains why individuals often arrive at immediate decisions and then make every effort to counter argue claims to the contrary, that is, individuals arrive at decisions prior to constructing rationales for those decisions. Conversely, System 2 is responsible for deliberate, effortful, and controlled thinking. Similarly, HSM posits that the two processing routes are heuristic and systematic processing. Heuristic processing parallels ELM's peripheral route, while systematic processing is analogous to the central route (Chaiken, 1980). Overall, these three models of information processing posit a slow, deliberate route, which is used in rational deliberation and decision-making, and a fast, intuitive, heuristic-driven one responsible for goal-oriented information processing.

In their chapter in *Unintended Thought* (1989), Shelly Chaiken and colleagues hypothesized that need for cognition influences how frequently individuals use heuristic cues for information processing. Logically, they posited that individuals with low cognitive need are more likely to use heuristic cues compared to those with higher needs. Although these scholars primarily discuss information processing, exposure to information is a necessary condition for such processing. And there have been relatively few studies examining need for cognition in the context of exposure to information (for an exception, see Winter & Kramer, 2012). Scholarship

that has been conducted in this area has been done using the framework of uses and gratifications, which is a framework for explaining how individuals use media to gratify their social and psychological needs (Katz, Blumler, & Gurevitch, 1973). However, much of this work has not been specifically related to heuristic-driven selectivity. For example, studies have explored how cognitive need moderates the relationship between media skepticism and exposure to information (Tsfati & Cappella, 2005) and its influence on online media use (Tuten & Bosnjak, 2001).

More recently, a theoretical framework for moderators of selective exposure has been proposed. Scholars have suggested that one way to understand how individual traits moderate selectivity of information is "in terms of their role in the regulation of information-processing capacity or information-processing strategies" (Smith et al., 2007, p. 957). The authors also note that empirical demonstrations of interactive effects in selective exposure are rare, although their work contributes to the literature while using an undergraduate sample. In other words, Smith et al. suggest that individual traits that contribute to information processing may play a role in selective exposure because these traits affect how individuals process information. Thus, it is reasonable to posit that need for cognition has a negative effect on selectivity and that individuals with low need for cognition are more likely than their counterparts with high cognitive need to use heuristics when selecting information. Given the results presented in Chapter 3, it seems likely that individuals with lower need for cognition are more likely to use partisan cues as heuristics when selecting information. Therefore, I pose the following hypothesis:

> H1: Compared to those with higher cognitive need, respondents with lower need for cognition will select headlines that are more consistent with their partisanship. In other

words, those with lower need for cognition will engage in more partisan selective exposure.

Studies have also found that certain groups of individuals are better at goal-driven processing than others. In general, scholars have shown that individuals who are more politically sophisticated are more prone to biased, goal-driven reasoning (Taber & Lodge, 2006; Wells, Reedy, Gastil, & Lee, 2009). In *The Reasoning Voter* (1991), Popkin notes that educated people are better equipped to interpret and connect cues while being more generally informed about politics because of different media habits relative to less educated citizens. That the more educated have a greater tendency to reason in a biased manner makes sense in light of their greater ability to connect cues from new information to their predispositions (Popkin, 1991). Again, the framework proposed by Smith et al. (2007) allows us to make sense of the relationship between individual traits and selective exposure in light of how they affect information processing.

Moreover, studies in selective exposure have shown that individuals who are more engaged with the issue have a greater tendency to select information that aligns with particular traits. Specifically, in addition to empirically demonstrating partisan selectivity, Iyengar and Hahn (2009) found that individuals who were more interested in politics were more likely to selectively exposure themselves to congruent information. In the context of this dissertation, I defined the scientific analogs to political sophisticates as those who are more knowledgeable about the scientific issue at hand. The reason for this is two-fold. First, there is some precedence for this in the political science literature. In their study of confirmation and disconfirmation bias in information processing, Taber and Lodge (2006) find a sophistication effect, such that more

knowledgeable respondents were more susceptible to processing bias. Second, the questionnaire did not contain a measure of interest in nanotechnology.

Typically, interest and knowledge in politics are used as a proxy for public engagement. In the context of my research, using knowledge to define sophisticates is a proxy for an individuals' engagement with the issue of nanotechnology. Given the evidence in current scholarship on information processing and selective exposure, I propose the following hypothesis:

> H2: Compared to individuals with little knowledge of nanotechnology, those with more factual knowledge will be more likely to select headlines consistent with their partisanship.

Studies have also found evidence for a relationship between need for cognition and knowledge. For example, Wolfe and Grosch (1990) found that students with high need for cognition scored higher on test questions than those with low needs. Others have presented similar results supporting the positive relationship between need for cognition and knowledge (e.g., Cacioppo & Petty, 1984; Martin, Ward, Achee, & Wyer, 1993). Given such empirical evidence, it is reasonable to examine the relationship between need for cognition, knowledge, and partisan selectivity. Therefore, there is the potential for knowledge to mediate the relationship between need for cognition and partisan selectivity. In light of the separate bodies of evidence relating need for cognition to knowledge and knowledge to selective exposure, this study seeks to test the following hypothesis:

> H3: Knowledge mediates the relationship between need for cognition and partisan selective exposure.

STUDY B: METHOD

To examine the relationship between knowledge and partisan selective exposure, I used the data obtained from GfK Knowledge Networks, described in Chapter 2, as survey data. Therefore, in all the analyses presented in this chapter, I included controls for the experimental manipulations that respondents were subjected to.

Data were analyzed using structural equation modeling (SEM), which allows for simultaneous examination of the entire system of variables in a model (Kaplan, 2009). This allows researchers to determine the extent to which the model is consistent with the data (Byrne, 1998). In addition, SEM allows for estimation of measurement error and incorporates both observed and unobserved, i.e., latent, variables.

To construct the SEM, variables were defined as exogenous or endogenous. Exogenous variables are unaffected by other latent variables in the model while endogenous variables can be affected by both exogenous variables and other endogenous ones. Exogenous variables in the models presented in this chapter are *need for cognition* in both waves 1 and 2. The remaining variables (*knowledge* and *partisan selective exposure* in both waves) are endogenous. Data from each wave were analyzed in separate models.

Measures

Partisan selective exposure

After exposure to the stimulus, respondents were given two opportunities to select a headline for further information. In the first round of selection, respondents were asked to choose from nine headlines. As explained in Chapter 2, the topic and channel of these headlines were randomly assigned. Following the initial selection, respondents were then shown the remaining

eight headlines and asked to select which headline they would next most like to read. The display screen showing the remaining eight headlines included their initial selection, which was faded and thus unavailable.

Using both selections of respondents, a measure of *partisan selective exposure* was created by accounting for the media source selected by the respondent and his or her partisanship (respondents' self-reported party identification was provided by GfK Knowledge Networks). In other words, this scale measured the extent of congruence between respondents' partisanship and the headlines they selected following exposure to the stimulus. For example, Republicans who selected Fox News twice received a high partisan selectivity score. Republicans who selected Fox News followed by MSNBC received a lower score on the scale. It is important to note that this measure does not align with the left-right spectrum of partisanship. In other words, Democrats who selected MSNBC twice received the same score as Republicans who selected Fox News twice.

Partisan selective exposure measures, ranging from -6 (highly incongruent) to +6 (highly congruent), were created for both waves 1 and 2. In wave 1, the mean was 1.19 with a standard deviation of 3.65. In wave 2, the mean was 0.94 with a standard deviation of 3.59. In the models, selectivity in both waves were modeled as single-factor latent variables. Therefore, these variables had a factor loading of 1.00 and error variances were constrained to 0.

Attention to media

Attention to news on television, *in newspapers*, *online*, and on *social media* are described in Study A (Chapter 3). Identical measures were used in this study and in Study C.

Factual knowledge of nanotechnology

Knowledge of nanotechnology was measured by presenting respondents with three statements about nanotechnology: (i) "Nanotechnology involves materials that are not visible to the naked eye," (true) (ii) "Currently, there are only a few dozen consumer products in the market using nanotechnology," (false) and (iii) "Nanotechnology allows scientists to arrange molecules in ways that do not occur in nature" (true). Respondents were asked to indicate whether they thought the statements were "definitely false," "likely false," "definitely true," or "likely true." They also had the option to select "don't know." These statements were used in previous surveys on the societal implications of nanotechnology. For comparability with prior surveys, I used the same items to tap respondents' knowledge. Responses were coded dichotomously, with "don't know" coded as incorrect responses. Although responses were ultimately dichotomously coded, participants were offered more than two response options (along with "don't know") to decrease the possibility of responding correctly by chance. With only true or false to select from, respondents have a 50 percent chance of answering any knowledge item correctly, regardless of their actual knowledge of nanotechnology. These items were then summed to create a measure of knowledge ranging from 0 to 3, depending on the number of items respondents answered correctly. The three knowledge items were identical in waves 1 (M = 1.30, SD = 1.16) and 2 (M = 1.67, SD = 1.02).

In both models, knowledge was a single-factor item. Therefore, the observed variables were allowed to load on the latent variables with factor loadings of 1.00. The error variances of the observed variables were constrained to 0.

Need for cognition

Need for cognition was measured using four items selected for face validity from the original 45 items used in Cacioppo and Petty (1982). Respondents were asked how much they agree with the following statements: (i) "I prefer complex to simple problems," (ii) "I only think as hard as I have to," (iii) "I prefer to think about small, daily projects to long-term ones," and (iv) "I really enjoy a task that involves coming up with new solutions to problems." Responses were measured on an 11-point Likert scale (0 = "Do not agree at all," 10 = "Agree very much"). These items were identical in both waves.

In the models, the four items were allowed to load on a latent variable in each wave (Figure 3-1). The measurement models were used as confirmatory factor analyses of the *need for cognition* variables in both waves.

Control variables

Age, *gender*, *race*, *education*, and *household income* were included as controls in the structural equation and hierarchical OLS models. *Attention to news on television, newspapers, online news,* and *social media* were also included as control variables. Descriptive statistics for these variables can be found in Chapter 2.

Strength of ideology (M = 2.09, SD = 1.87) was included in the models as a control variable. Since the goal was to test relationships between need for cognition, knowledge, and partisan selective exposure, there was little cause for including ideological strength as a latent variable in the model. Although it is unlikely to mediate the relationships between the variables of interest, it was significantly correlated with *partisan selective exposure* in both waves (wave 1: *Pearson's* r = .17, $p \leq .001$; wave 2: *Pearson's* r = .23, $p \leq .001$). Therefore, I included *strength of ideology* as a control variable in both the measurement and hybrid models. This

measure was created by folding the political ideology scale. The items used to create this measure were only asked in wave 1. *Political ideology* (*M* = 4.18, *SD* = 1.39, *Pearson's r* = .70) was created by averaging two self-reported items, measured on 7-point Likert scales (1 = "Very liberal," 7 = "Very conservative"), asking about respondents' ideology regarding social and fiscal issues. The resulting scale for ideological strength ranged from 0 to 6.

Data analysis

I used the software package LISREL 8.80 (Jöreskog & Sörbom, 2007) for structural equation modeling. The analysis was conducted on a measurement model (confirmatory factor analysis) and a final hybrid model examining the relationships between the structural variables. The experimental manipulations and control variables were included in both the measurement and hybrid models. In order to include control variables in the SEM, a residualized correlation matrix was constructed by regressing each variable in the model on the controls. Initial analysis began with a base model (Figure 4-1) and incremental adjustments were made based on the modification indices (Bollen, 1989).

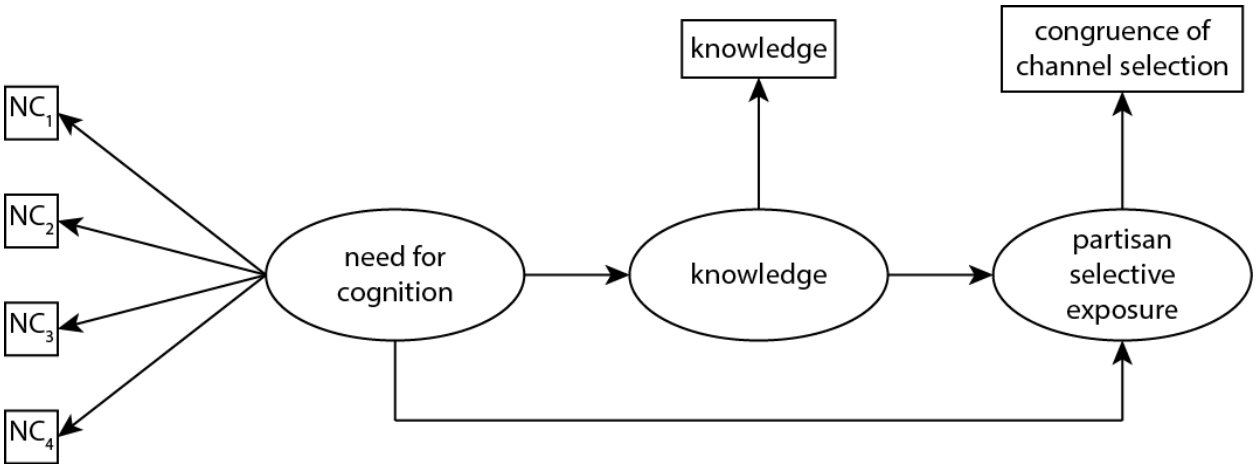

Figure 4-1. Hybrid model examining the relationships between need for cognition, knowledge, and partisan selective exposure in waves 1 and 2. Data from each wave were analyzed in separate models. Knowledge and partisan selectivity were modeled as observed variables with factor loadings of 1.00 and error variances of 0.00.

STUDY B: RESULTS

Confirmatory factor analysis

The measurement models confirmed four factors for each *need for cognition* latent variable (wave 1: χ^2 (7, N = 554) = 19.6, p = 0.01; wave 2: χ^2 (7, N = 969) = 22.7, p = 0.00). In order to avoid issues associated with the χ^2 statistic (see Bentler & Bonett, 1980 for more on goodness of fit statistics), I use a two-index presentation strategy and report other goodness of fit statistics according to the recommendations made by Hu and Bentler (1999). Therefore, in addition to the χ^2 statistic, I report the root mean square error of approximation (RMSEA) and the standardized root mean square residual (SRMR). The goodness of fit statistics indicated that both wave 1 and 2 models provided a good fit for the data (wave 1: RMSEA = .06, SRMR = .03; wave 2: RMSEA = .05, SRMR = .02).

Factor loadings are shown in Table 4-1. In wave 1, NC_1 ("I prefer complex to simple problems") and NC_4 ("I really enjoy a task that involved coming up with new solutions to problems") had higher factor loadings than NC_2 ("I only think as hard as I have to"), and NC_3 ("I prefer to think about small, daily projects to long-term ones") did not load significantly on to the latent variable. In wave 2, all four factors were significant. However, NC_2 and NC_3 had higher factor loadings than NC_1 or NC_4. Using the modification indices, some of the error terms associated with the observed variables were allowed to correlate. The relationships between error variances can be found in Table 4-2. In wave 1, the errors of NC_2 and NC_3 were allowed to correlate, while in wave 2, the errors of NC_1 and NC_4 were allowed to correlate. These associations were then included in the final hybrid models. The complete LISREL output for the measurement models can be found in Appendix E.

Table 4-1. Observed variables and factor loadings for *need for cognition* latent variables.

Observed variables	Factor loading
Wave 1	
I prefer complex to simple problems. (NC_1)	.79
I only think as hard as I have to. (NC_2)	.22
I prefer to think about small, daily projects to long-term ones. (NC_3)	.08[a]
I really enjoy a task that involves coming up with new solutions to problems. (NC_4)	.75
Wave 2	
I prefer complex to simple problems. (NC_1)	.11
I only think as hard as I have to. (NC_2)	.72
I prefer to think about small, daily projects to long-term ones. (NC_3)	.60
I really enjoy a task that involves coming up with new solutions to problems. (NC_4)	.10

NC_2 and NC_3 in both waves were reverse-coded before including in model.
[a]NC_3 was not significant.

Table 4-2. Error variance/covariance matrix for observed exogenous and endogenous *need for cognition* variables.

	Wave 1				*Wave 2*			
	NC_1	NC_2	NC_3	NC_4	NC_1	NC_2	NC_3	NC_4
Wave 1								
NC_1	0.38							
NC_2	—	0.95						
NC_3	—	0.53	0.99					
NC_4	—	—	—	0.44				
Wave 2								
NC_1	—	—	—	—	0.99			
NC_2	—	—	—	—	—	0.48		
NC_3	—	—	—	—	—	—	0.65	
NC_4	—	—	—	—	0.52	—	—	0.99

NC_2 and NC_3 in both waves were reverse-coded before including in model.

Hybrid model

Overall, the hybrid models were a good fit for the data (wave 1: χ^2 (7, N = 554) = 19.6, p = 0.01; RMSEA = .06, SRMR = .03; wave 2: χ^2 (7, N = 969) = 22.7, p = 0.00; RMSEA = .05, SRMR = .02). The coefficients in the models are shown in Figures 4-2 and 4-3 (see Appendix E for complete LISREL output from hybrid models). In wave 1, the relationship between need for cognition and partisan selective exposure was negative and significant (γ = -.10). Those with higher need for cognition tended to select headlines from media channels that were less congruent with their political party identification.

Interestingly, in wave 1, the association between need for cognition and knowledge was not significant (γ = .06). Additionally, I did not find evidence of a statistically significant relationship between knowledge and selective exposure in wave 1 (β = .02).

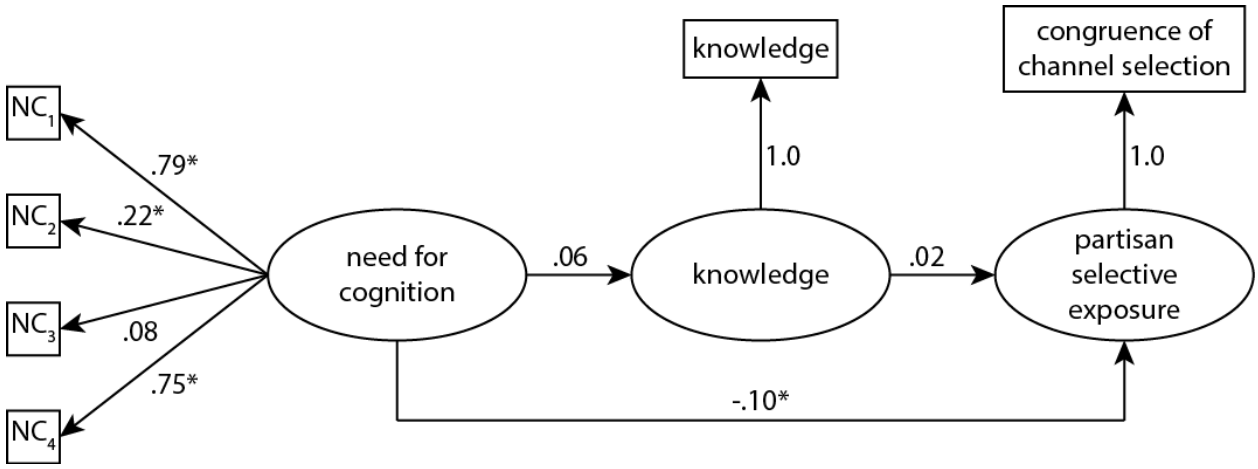

Figure 4-2. Structural model examining the relationships between need for cognition, factual knowledge about nanotechnology, and partisan selective exposure in wave 1(N = 554, χ^2 = 19.56, df = 7, RMSEA = .06, CFI = .97, SRMR = .03). Controls for demographics (age, gender, race, education, and income), media attention, and experimental manipulations were included in this model. Knowledge and partisan selectivity were modeled as observed variables with factor loadings of 1.00 and error variances of 0.00.

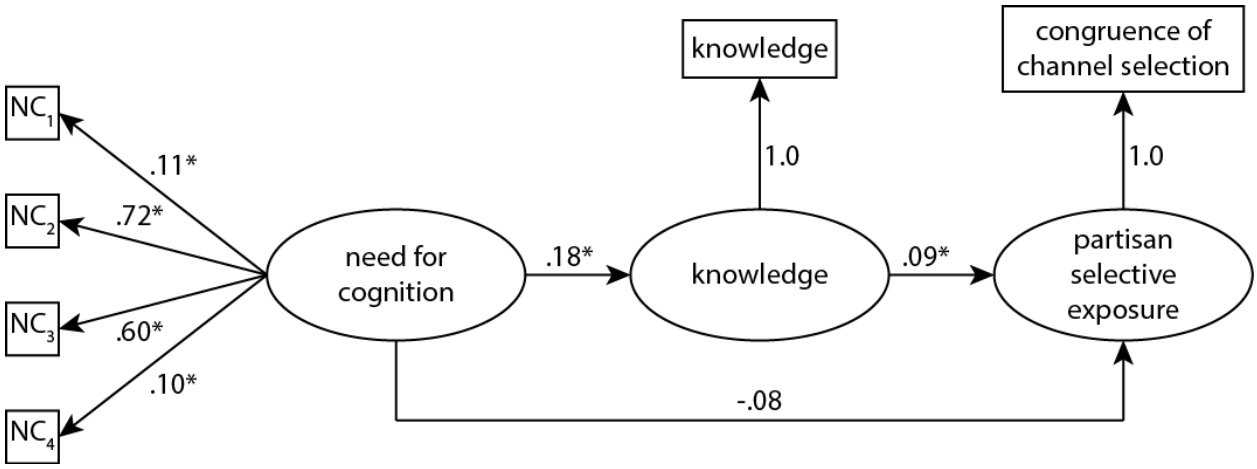

Figure 4-3. Structural model examining the relationships between need for cognition, factual knowledge about nanotechnology, and partisan selective exposure in wave 2 (N = 969, χ^2 = 22.73, df = 7, RMSEA = .05, CFI = .97, SRMR = .02). Controls for demographics (age, gender, race, education, and income), media attention, and experimental manipulations were included in this model. Knowledge and partisan selectivity were modeled as observed variables with factor loadings of 1.00 and error variances of 0.00.

In wave 2, the relationship between cognitive need and partisan selective exposure was not significant (γ = -.08). However, the relationship between knowledge and selective exposure was positive and significant (β = .09). Additionally, need for cognition and knowledge were significantly related (γ = .18). In other words, knowledge played a mediating role in the relationship between need for cognition and partisan selective exposure. Those who scored higher on need for cognition tended to have more factual knowledge about nanotechnology and were more likely to select headlines from media sources that were consistent with their partisanship.

STUDY B: DISCUSSION

This study sought to examine how an individual trait, need for cognition, affected partisan selective exposure. To do so, I used structural equation modeling to separately analyze waves of panel data collected from an online experiment fielded before and after the 2012 Presidential election. In these models, experimental conditions are controlled for and the data are used as a survey instrument. Before a discussion of my findings, it is necessary to note several limitations of this work.

First, these models did not account for interest in nanotechnology, or interest in science and technology more generally. This variable is likely to influence how individuals select media. It may be that individuals who are more interested are less likely to rely on partisan heuristics when selecting information compared to those who are less interested in science and technology. However, since I did not measure interest in the survey, I can only recommend that future studies explore this variable as well.

Second, the items tapping knowledge of nanotechnology in this study were coded into binary variables. Although the measure was able to capture the confidence respondents felt in their responses (e.g., "definitely true" vs. "likely true"), I did not include this nuance of the measurement in this study as I was primarily interested in respondents' knowledge instead of their confidence in that knowledge. However, binary knowledge variables do not capture many details about respondents' understanding of nanotechnology such as cognitive complexity (Bieri, 1955). Future work should explore whether other dimensions of knowledge, including cognitive complexity and confidence in one's knowledge, play a role in partisan selective exposure.

Lastly, research suggests that existing attitudes toward an issue can affect how individuals seek and process new information (Chaffee, Saphir, Graf, Sandvig, & Hahn, 2001).

Therefore, future explorations of information seeking and selective exposure should take into account existing attitudes toward the issue at hand. Additionally, empirical evidence suggests that accounting for attitudes toward other technologies may prove to be a fruitful avenue for investigation (Akin, Yeo, Scheufele, Brossard, & Xenos, 2014, May).

Keeping in mind these limitations, my results show that cognitive need does affect selective exposure. The hybrid model showed that need for cognition and partisan selective exposure, at least in the first wave, were negatively related. As hypothesized (H1), individuals with lower need for cognition were more likely to engage in partisan selectivity. This lends support to the cognitive miser theory (Fiske & Taylor, 1991), highlighting that cognitive processing resources are finite and that individuals seeks to conserve them. Since information that is inconsistent with one's existing beliefs have been found to require more resources to process (Edwards & Smith, 1996), it may be that those who have greater motivation to make sense of their experiential world are more willing to expend cognitive resources to process conflicting information. Therefore, such individuals are less likely to rely on cognitive heuristics when seeking information.

Interestingly, this effect was only significant in wave 1, prior to the election. This may be because people are already devoting a significant amount of cognitive effort to the upcoming election. News media prior to such events are consistently filled with information about candidates. And the information stream is constant. Issues that are little related to the election are likely to be of low priority in terms of processing for many people. Therefore, individuals who have higher cognitive needs are the ones who are more likely to select their media thoughtfully and less likely to rely on partisan heuristics.

In support of hypothesis 2, I found that knowledge in wave 2 was positively related to selective exposure. In the realm of politics, the finding that political sophisticates engage in greater partisan selectivity is hardly surprising. This has been demonstrated both in the context of information seeking (Iyengar & Hahn, 2009) and processing (Taber & Lodge, 2006) about political issues. In this case, respondents were asked to seek information about a scientific issue, nanotechnology. And those with more knowledge about nanotechnology were more likely to select a headline that was consistent with their political party identification. This finding is indicative of how embedded scientific and technological issues are in society and public affairs on the whole.

In addition to examining how cognitive need and knowledge influence partisan selective exposure, my goal for this study was also to determine whether knowledge was a mediator in the relationship between need for cognition and consistency of headline selection. Hypothesis (H3) was supported, but only in wave 2 (Figure 4-3). Respondents who had higher need for cognition tended to have more factual knowledge about nanotechnology. These relatively higher cognitive need and knowledge respondents were those who were more prone to select information that was congruent with their partisanship.

The lack of a mediating relationship in wave 1 may be due to the difference in knowledge between waves 1 and 2 of the study. Perhaps the small amount of exposure to nanotechnology in wave 1 was sufficient to provide respondents with a perception of familiarity with the issue, even if this meant respondents were able to answer only one more item correctly in the second wave. In wave 1, where presumably respondents are very unfamiliar with nanotechnology, they use heuristic cues to anchor their selection of information. In this case, those who have lower need for cognition tended to rely more on partisan loyalties when selecting information. In wave 2,

where respondents may have been slightly more "knowledgeable," the more sophisticated individuals were more likely to expose themselves to attitude-consistent information. Yet, a distinction should be made between factual knowledge and perceived familiarity, which have been shown to be different constructs (Ladwig, Dalrymple, Brossard, Scheufele, & Corley, 2012). In wave 1, 40.5 percent scored 0 (out of 3) on the knowledge battery, while in wave 2, only 19.3 percent received the same score. Sophisticates, which in this case refers to individuals with greater knowledge, have been found to be more biased in their information processing (Taber & Lodge, 2006) and this increase in knowledge may have led to increases in goal-driven processing, which may influence their information selection habits.

STUDY C

Study C explores another potential role of knowledge—as a moderator—in the relationship between need for cognition and partisan selectivity. In Study B, I used a structural equation models to examine knowledge as a mediating variable. In this follow-up study, I turn to exploring whether knowledge and need for cognition interact to produce differential outcomes on partisan selectivity. Here, I have opted for a more parsimonious ordinary least squares (OLS) regression model to test knowledge as a moderating variable. Although there has been relatively more work on selective exposure in recent years (e.g., Stroud, 2011), few studies have explored how individual traits and orientations are related to selectivity. Recent notable exception found that religiosity exacerbated attitude congruent information seeking (Jang, 2014) and that attitude ambivalence also plays a role in selectivity (Sawicki et al., 2013). However, there has been little scholarship on the role of need for cognition in partisan selective exposure. In the absence of such evidence, I explore the following research question:

RQ2: Does knowledge moderate the effect of need for cognition on partisan selectivity? In other words, do knowledge and need for cognition interact to differentially affect partisan selective exposure?

STUDY C: METHOD

Measures

Dependent variables

Partisan selective exposure (described in Study B of this chapter) in waves 1 and 2 were used as dependent variable in the regression models.

Independent variables

Independent variables in the models included demographics (*age*, *gender*, *race*, *education*, and *household income*), *strength of ideology*, *need for cognition*, attention to media (*newspapers*, *television*, *online*, and on *social media*), and *factual knowledge about nanotechnology*. The demographic variables are described in Chapter 2, while the items tapping *strength of ideology* and *factual knowledge about nanotechnology* are described in Study B of this chapter. Media attention variables are described in Chapter 3. *Need for cognition* in the SEM was modeled as four observed variables loading on to a latent variable in each wave. However, in the hierarchical OLS model, the four items in each wave were averaged to create a scale of *need for cognition* in both waves (wave 1: $M = 6.46$, $SD = 1.90$; wave 2: $M = 6.57$, $SD = 1.65$).

Control variables

Controls for the experimental stimulus were included in both models. In the model predicting partisan selectivity in wave 1, I controlled for the effects of the experiment administered in the same wave. In the model predicting selectivity in wave 2, I included controls for the experimental manipulations in both waves. These controls were included as two dummy variables in each wave. There were three experimental conditions in each wave: consistent, inconsistent, and no cues. The dichotomous coding was identical in both waves. *Consistent cues* is a binary variable with respondents who received consistent cues coded as "1" and all other participants coded as "0." Respondents who received inconsistent cues were coded as "1" in the variable called *inconsistent cues*, with all others coded as "0." These variables were included in the models to account for all three experimental conditions, with the non-cued conditions in both waves as reference groups.

Data analysis

Independent variables were introduced to the models in blocks in order of theorized causality. Since one of the goals of this model was to examine interactive effects between individual traits on the dependent variable, two-way interactions were included in a block following the main effects blocks and a three-way interaction was included in the last block of the model. The interactions were tested in both waves. Interaction terms were created by multiplying standardized variables to avoid collinearity between the terms and its components (Cohen et al., 2003). The blocks were ordered as follows:

0. Experimental controls (stimulus, control for dependent variable in wave 1 was included in wave 2 model)
1. Demographics (*age*, *gender*, *race*, *education*, and *household income*)

2. Individual traits (*strength of ideology*, *need for cognition*)
3. Attention to media (*attention to newspapers, television, online,* and *social media*)
4. Factual knowledge about nanotechnology
5. Experimental manipulations
6. Interaction (*knowledge* × *need for cognition*)

STUDY C: RESULTS

The total variance accounted for by the models in waves 1 and 2 were 8.0 percent and 22.4 percent, respectively (Table 4-3). In wave 1, demographics and individual characteristics accounted for most of the variance in the dependent variable. Unsurprisingly, in wave 2 the majority of the variance was accounted for by the control variables, which included partisan selectivity in the first wave. Other blocks that were significant in accounting for the variance of the dependent variable in wave 2 included individual characteristics, knowledge, and the block containing the interactions.

Table 4-3. Variance accounted for by each block in the hierarchical OLS regression model predicting partisan selective exposure in waves 1 (N = 565) and 2 (N = 563).

	R^2 (%)	
	Wave 1	*Wave 2*
Block 0: Controls	0.9	14.2***
Block 1: Demographics	3.2**	1.4
Block 2: Individual characteristics	2.2***	3.2***
Block 3: Media attention	1.4	0.6
Block 4: Nanotechnology knowledge	0.1	2.5**
Block 5: Interactions	0.2	0.5
Total R^2	8.0	22.4

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.

Table 4-4 shows regression coefficients for both waves 1 and 2 regression models. In wave 1, household income was a significant predictor of partisan selective exposure ($\beta = .10$, $p \leq .05$). Interestingly, this relationship is reversed in wave 2, with income negatively related to the dependent variable ($\beta = -.12$, $p \leq .01$). In both waves, strength of political ideology was significant and positively related to partisan selectivity (wave 1: $\beta = .13$, $p \leq .01$; wave 2: $\beta = .18$, $p \leq .001$). Stronger ideologues tended to engage in more partisan selective exposure. With regards to attention to media, only attention to social media significantly predicted selective exposure ($\beta = -.12$, $p \leq .05$) and this relationship was only found in wave 1. Those who paid less attention to news on social media in wave 1 were more likely to select headlines consistent with their party identification.

Table 4-4. Predicting partisan selective exposure.

	Wave 1 (*N* = 565)		*Wave 2* (*N* = 563)	
	Zero-order	β	Zero-order	β
Block 0: Controls				
Consistent cues (wave 1)	-.01	-.07	.00	.00
Inconsistent cues (wave 1)	-.08*	-.10	-.02	.04
Consistent cues (wave 2)	—	—	.02	.03
Inconsistent cues (wave 2)	—	—	-.05	-.02
Congruence of headline selection (wave 1)	1.00***	—	.37***	.34***
Block 1: Demographics				
Age	.00	-.04	.06	.05
Gender (female)	.02	.06	.04	.03
Race (White)	.10*	.02	.03	-.06
Education	.13***	.03	.08*	.06
Household income	.15***	.10*	-.01	-.12**
Block 2: Individual characteristics				
Strength of political ideology	.17***	.13**	.23***	.18***
Need for cognition (wave 1)	.10**	.03	.04	.01
Need for cognition (wave 2)	—	—	.01	-.02
Block 3: Media attention				
Newspapers	.11**	.07	.04	-.01
Television	.10**	.04	.04	-.01
Online	.09*	.05	.00	-.01
Social media	-.05	-.12*	-.10**	-.07
Block 4: Nanotechnology knowledge				
Knowledge (wave 1)	.09*	.03	.15***	.09*
Knowledge (wave 2)	—	—	.17***	.13**
Block 5: Interaction				
Knowledge × Need for cognition	—	-.04	—	-.07
Total R^2	—	*8.0*	—	*22.4*

*$p \leq .05$, **$p \leq .01$, ***$p \leq .001$.
Cell entries for blocks 0 through 4 are standardized regression coefficients while cell entries for block 5 are before-entry standardized regression coefficients.

Factual knowledge of nanotechnology in both waves were significant predictors of partisan selective exposure in wave 2 (wave 1 knowledge: $\beta = .09$, $p \leq .05$; wave 2 knowledge: $\beta = .13$, $p \leq .01$) Respondents who scored higher on knowledge in both waves of the survey were

significantly more likely to select a party-consistent headline in wave 2. In order to explore the interaction between knowledge and need for cognition, I standardized and multiplied the component variables and included them in the last block of the interaction. The interaction was not significant (β = -.07, p = .06) in the model.

STUDY C: DISCUSSION

Before discussing these results, it is necessary to recognize that some of the limitations of Study B also apply to the present study. Knowledge, again, was a scale created by summing three dichotomous variables. Additionally, the lack of measures for interest in nanotechnology or science more generally also applies to this model. Despite these limitations, this study sheds further light on the relationship between cognitive need, knowledge, and partisan selectivity. Specifically, these findings do not provide statistically significant evidence that knowledge and need for cognition do not interact to differentially affect selective exposure. It is possible that with a larger sample size, the moderating effect of knowledge on need for cognition might be significant. Despite the lack of significance in the model, I used Stata's Clarify package (King, Tomz, & Wittenberg, 2000) to graph the interaction (Figure 4-4). Interestingly, the figure shows that knowledge decreases partisan selective exposure (a finding contrary to the significant main effect in the model) and that it more strongly affects individuals with greater need for cognition. However, given the lack of significance of the interaction in the model, the estimation shown in the figure should not be awarded too much credence.

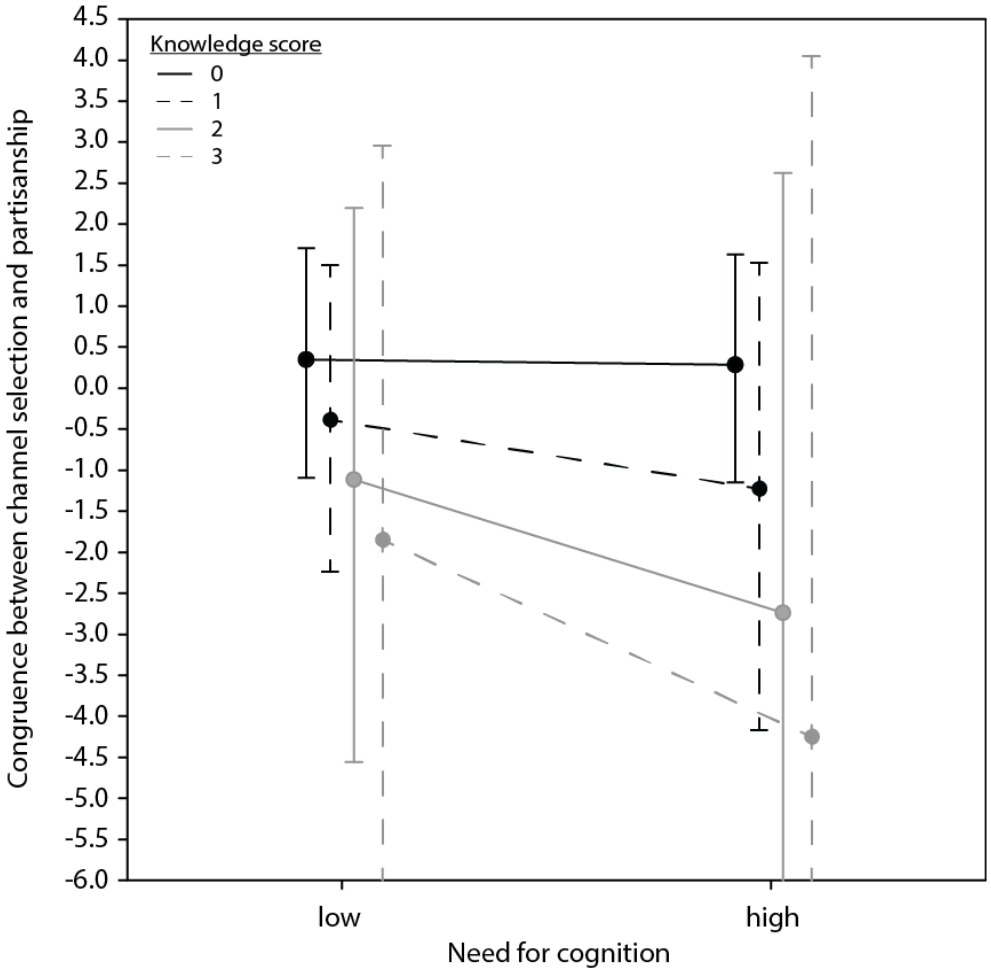

Figure 4-4. Interactive effect of knowledge and need for cognition on partisan selective exposure. *Note*: Scale on y-axis only partially displayed.

It is important to note that there is some inconsistency between the findings of Studies B and C. Notably, using SEM, I found that need for cognition is negatively related to partisan selective exposure in wave 1. This finding, however, was absent in the OLS regression model. SEM is often considered a better assessment tool (Bollen, 1989) because of its more rigorous analysis. SEM allows researchers to model the relationships among multiple independent and dependent constructs simultaneously, while linear regressions can only analyze the relationship between a single pair of constructs (Gerbing & Anderson, 1988). Therefore, the lack of a

significant relationship between cognitive need and partisan selective exposure is not entirely surprising.

Turning to the interactive effect, I chose to use a linear model to examine knowledge as a moderator instead of multiple groups SEM. I did this because the sample sizes of the groups would have been relatively small for this type of analysis and linear models are more supportive of such sample sizes. Typically, SEM requires at least 100 to 150 cases (Gefen, Straub, & Boudreau, 2000). In dividing the sample into groups based on levels of knowledge, the group sizes, in some cases, would be less than recommended.

STUDIES B AND C: CONCLUSIONS

This chapter used two analytical approaches to examine the relationships between individual traits and partisan selectivity. Using the data obtained from GfK Knowledge Networks as described in Chapter 2 as survey data, I tested relationships between need for cognition, knowledge, and partisan selective exposure. In Study B, I used structural equation modeling to simultaneously examine causal relationships between these variables. I also used this technique to explore whether knowledge was a mediator between cognitive need and partisan selectivity. In Study C, I used a hierarchical ordinary least squares regression model to determine whether knowledge was a moderator in the relationship between need for cognition and selectivity.

My results indicate that need for cognition and knowledge do affect partisan selectivity. Cognitive need has a negative effect on selectivity such that individuals with greater need for cognition are less likely to engage in selective exposure. However, this appears to occur only when individuals are very unfamiliar with an issue. I hypothesize that this is related to the cognitive miser motivation for selective exposure and information processing, as proposed by

Fiske and Taylor in their book, *Social Cognition* (1991). Individuals with lower need for cognition appear to rely more on partisan heuristics when selecting information, which requires less cognitive resources to process. On the other hand, those who have a greater need to understand and make sense of their surroundings are less likely to revert to partisan heuristics when seeking information.

Although my analyses did not find statistically significant evidence for a moderating role of knowledge in the relationship between need for cognition and partisan selectivity, I did find evidence of a mediating role. Specifically, individuals with greater need for cognition were more likely to have more factual knowledge about the issue and tended to engage more in partisan selective exposure. This trend and the relationship between cognitive need and selective exposure in wave 1 are in opposition of each other. On the one hand, in wave 1, individuals with lower cognitive need tend to select media channels consistent with their political party identification. On the other hand, in wave 2, those who had higher cognitive need tended to be more knowledgeable about nanotechnology and also tended to engage in greater partisan selective exposure. I posit that this is partly due to a lack of exposure to the issue in wave 1. In the first wave, when individuals are relatively more unfamiliar with the issue of nanotechnology compared to wave 2, they act as cognitive misers and those with lower need for cognition tend to resort to partisan loyalties to select information. However, in wave 2, after the exposure that wave 1 provided, I found that individuals with higher need for cognition tended to be the "nano sophisticates," i.e., those who had more factual knowledge about nanotechnology, and engaged more in partisan selective exposure. These complex results highlight that the nuances of this relationship remains to be disentangled. Future scholarship should focus on explicating the relationships between these variables.

The studies conducted in this chapter contribute to the selectivity literature by providing an in-depth examination of the effect of an individual trait on selectivity. It remains to be seen what effect such traits have on information processing, a subsequent step in the process of opinion formation. Additionally, although partisan selectivity has been relatively well studied in the context of public affairs and politics, relatively little research has been conducted in the context of scientific and technological issues. That lay publics use political identification to select information about science emphasizes how embedded science is in society and how central media are to public attitudes toward science. Science and technology do not operate in a socio-political vacuum. It is imperative that scholars understand that science is not divorced from its societal context and that future studies continue to explore the intersection of science, media, and politics.

CHAPTER 5.

CONCLUSIONS AND FUTURE RESEARCH

Partisan and ideological selectivity of information have important implications for information processing and the formation of public attitudes and opinion toward science and technology. To contribute to the literature on selective exposure, this dissertation has examined how communication contexts and individual traits influence ideological and partisan selectivity in the context of an unfamiliar scientific issue, nanotechnology. To do so, I used an experiment embedded in both waves of an online panel survey, which was fielded before and after the 2012 Presidential election. Before highlighting the key findings of my research, it is necessary to discuss some limitations inherent in social science research, focusing in particular on experiments and surveys.

LIMITATIONS OF SOCIAL SCIENCE RESEARCH

The central idea of causality in the social sciences is that one state, event, or variable produces a change in another over the course of time. Variability in states, events, or variables is necessary for inferring causal relationships. As researchers, we infer that causal relationships exist from the patterns we observe in data. However, variability is insufficient for establishing causal relationships. Establishing causality is much more intricate and complex than simply observing patterns in data. And much of the difficulty in inferring causal relationship can be drawn from its definition. Therefore, it will be fruitful to examine the conditions that define causal relationships.

In general, there are three conditions that must be met to conclude that a relationship is causal (Blalock, 1979): temporal antecedence, the degree to which two variables vary together or

covariation, and the lack of a spurious relationship between the two variables. First, if variable A causes variable B, both variables must be present in the appropriate temporal sequence, that is, variable A must be observed before variable B. In order to establish this condition of temporal antecedence, researchers require longitudinal survey data or experimental data. This condition of causality cannot be established using cross-sectional data. As Marsh (1982) put it, "to argue *post hoc ergo propter hoc* [using cross-sectional data] is to commit a logical fallacy." (p. 83). Temporal antecedence is clearly established in the studies described in this dissertation. In both Chapters 3 and 4, respondents were asked to select headlines after they were exposed to the stimulus and after their knowledge was measured. While need for cognition was measured after the experimental manipulation, it is highly unlikely that involvement in the experiment changed respondents' need for cognition, which is typically a relatively stable trait (Cacioppo & Petty, 1982; Cohen et al., 1955) and has been used as such in various other studies (e.g., Verplanken, 1993).

It is insufficient to observe merely the presence or absence of variables and determine that they are correlated. From variation in our data, we can determine the degree to which variables covary. This is the second prerequisite for causality. However, correlation is not equivalent to causation. It is merely our assumption that the relationship points in the direction of the explanatory to dependent variable, and we label them thusly. It is, therefore, important to note that correlation between two variables alone does not rule out the possibility of a reverse relationship between the two variables.

The third condition is, theoretically, impossible to meet. In order to unequivocally determine that changes in variable A causes changes in variable B, we need to rule out the possibility of spurious relationships. According to Rosenberg (1968), "[s]trictly speaking, there

is no such thing as a spurious relationship; there are only spurious interpretations." However, we use "spurious relationship" to describe a relationship between two variables in which there is no logical meaning. Therefore, term "spurious" is being applied to the validity of the causal inferences drawn from the relationship between variables. One classic example of a spurious relationship is the correlation between the number of storks and babies born in Germany. Coincidental statistical association between pairs of brooding storks and the number of babies born resulted in a spurious interpretation of the causal relationship between the two (Sies, 1988). However, researchers neglected to include a third factor, fecundity in urban relative to rural areas, of both storks and humans (Marsh, 1982).

Such extraneous variables should be included as controls in statistical analyses, which I have done in the studies presented. Yet, in order to establish that a causal relationship between two variables exists in reality, I would have to control for all possible extraneous variables, which is impossible. However, allowing theoretical considerations to guide my hypothesis testing reduces the chances of finding spurious relationships. Several methodological considerations need to be accounted for when attempting to infer causality from relationships observed in data. Experiments and survey research have different implications for causality and the validity of inferences arrived at.

The methods which were used to collect these data affect my ability to make causal inferences from them. They have advantages and disadvantages, most often related to time and money, but also related to the validity of the information we obtained. The types of validity which I am most concerned with are internal and external validity. Internal validity refers to our confidence that the changes in the dependent variable are caused by an explanatory factor. In other words, it is the degree of confidence we have that covariation between variables A and B

are due to variable A causing variable B (Shadish et al., 2002). External validity, on the other hand, relates to the generalizability of the inferences drawn from data.

In general, experiments and survey research are used to test causality and our hypotheses about how the world works. There are different types of surveys, e.g., Internet, mail, telephone, and face-to-face surveys, some of which allow us to make more valid causal inferences than others. The relationships between variables in surveys are different from those in experiments, and these subsequently affect the internal and external validity of our conclusions. Overall, experiments have greater internal validity compared to surveys, while surveys are generally higher in external validity. The main drawback of experiments is their artificiality, which makes inferences and conclusions less generalizable to a population. Therefore, embedding an experiment within a survey representative of the U.S. population has advantages of both experiments and surveys although artificiality is still somewhat of a concern. For example, as pointed out in Chapter 3, citizens are unlikely to encounter a news article that has inconsistent ideological cues.

In surveys, the relationships we observe can be categorized as "property-disposition" relationships, while experiments produce "stimulus-response" relationships (Rosenberg, 1968). A property is an enduring characteristic of an individual, such as age, race, or gender. A disposition is "a potential or tendency of the individual which may be activated under particular circumstances." (Rosenberg, 1968, p. 76). Examples of dispositions include attitudes, opinions, and beliefs.

In an experiment, a researcher generally has two or more groups containing matched subjects with similar dispositions. Alternatively, random assignment into groups achieves a similar outcome. The stimulus is applied to one (or some) of these groups and not others. Groups

to which the stimulus is not applied are known as control groups. The resulting difference on the outcome or dependent variable can then be attributed to the stimulus. In survey research, we generally attempt to correlate a property (e.g., race) with a disposition (e.g., political ideology). In this simple comparison of the two methods, it begins to become obvious that experiments are more useful for inferring causal relationships compared to survey research. More specifically, there are several ways in which experiments differ from survey research, and these differences have implications for the causal inferences that we can draw from data collected in these respective ways (Rosenberg, 1968).

First, the temporal and conceptual distance between a property and a disposition is much greater than that between a stimulus and a response. In an experiment, the response is generally measured relatively quickly after the stimulus is applied and can thus be attributed to it with some amount of confidence. However, properties are often ascribed to individuals at birth, while dispositions are measured at a much later time. The influence of properties on dispositions are, therefore, not immediate and direct compared to the effects of stimuli on responses. This decreases the internal validity of survey research relative to experiments.

A second way in which experiments and surveys differ are in the comparability of the comparison groups. In an experiment, researchers strive to match control and experimental groups as closely as possible, usually on demographic characteristics. After applying a stimulus to the experimental group, comparison with the control group allows us to attribute observed changes to the stimulus. Similarly, we could compare the experimental group with itself if we measure responses before and after application of a stimulus. In both cases, we strive for similarity between groups that we are comparing. Since the comparison groups are well matched,

we can have relatively high confidence that changes in the outcome variable are due to changes in the stimulus, which gives us a high degree of internal validity.

In a survey, on the other hand, we are generally unable to compare one group with another based on properties and come up with any meaningful conclusions about causality between the property at hand and the disposition. For example, if we were to examine a property such as race, our comparison would be between groups of different races. The generalizability of such a comparison is limited as there are a host of demographic and psychological differences that are not accounted for by a comparison on the basis of race. Therefore, our comparison groups would not be matched on many properties.

A final issue is most intuitively related to inferences of causality. The directionality of relationships in experiments is usually unambiguous; the relationship between a stimulus and response is generally unidirectional. However, relationships between properties and dispositions are not always unidirectional. Obviously, the example of race and political ideology does not apply here, as race clearly precedes political ideology, but many property-disposition relationships have the problem of equivocal directionality. However, in the case of the experiments conducted for this dissertation, all concepts that are dynamic were measured before the experimental manipulation. Only stable traits, such as need for cognition we asked following headline selection.

In sum, experiments and surveys have various strengths and weaknesses with respect to internal and external validity. Experiments are the primary tool for establishing causal relationships (Babbie, 2013) but lack external validity because of their artificiality. Surveys are more generalizable, and some types of surveys can be used to infer causality. In particular, panel data, in which dispositions are measured in the same group of subjects at two different points in

time, can offer insights into causal relationships. Therefore, longitudinal data have greater internal validity, in terms of establishing causality, compared to cross-sectional data, while being more externally valid than experimental data. However, internal validity is a concern for survey researchers, particularly spurious explanations for observed relationships.

Given the numerous threats to internal and external validity, it is appropriate to question whether a study can be designed to conclusively prove a causal relationship between two variables. The simple response to such a question is that no study can be designed in this manner. As we have discussed, cross-sectional evidence is insufficient to verify a causal argument. Experimental data can determine causality, but its artificiality leaves much to be desired with respect to external validity. Caution should be used when generalizing inferences drawn from experimental data to the larger population. Longitudinal survey data, on the other hand, is more externally valid and thus generalizable, and a causal direction can be established. However, the third condition for causality cannot be met, even with data such as these. It would be impossible to control every potential extraneous variable that exists. Controlling for the more obvious extraneous variables simply increases our confidence that the observed relationship holds in the real world. Therefore, the "[p]recise nature and direction of the causal relation has to be assumed, for it cannot be tested." (Marsh, 1982, p. 65).

These factors accentuate the necessity of models, which allow us to examine theoretical assumptions about the relationship between variables. As Marsh (1982) puts it, "[i]t is the model that stands between the researcher and unbridled empiricism in the attempt to draw causal inferences" (p. 72). Using theoretical models, I have empirically tested my hypotheses using data. In hypothesis testing, data and theory are strongly dependent. Data lend support (or more accurately, fail to reject) a theory, while theoretical considerations indicate which variables are

likely to be related. In sum, theory and data cannot be divorced from each other and I have used both, in addition to a substantial amount of caution, to draw causal inferences about ideological and partisan selectivity among the population at large.

KEY FINDINGS AND DIRECTIONS FOR FUTURE RESEARCH

Finding #1: Ideological selective exposure occurs when individuals are faced with issues other than politics.

Though many scholars have shown that partisan selective exposure is common among individuals in the context of politics and public affairs (e.g., Garrett, 2009b; Iyengar & Hahn, 2009; Sawicki et al., 2013; Stroud, 2011), few have examined its effects on science information. Those who have examined science and technology information seeking have typically not done so within the framework of selective exposure (Ho, Detenber, Rosenthal, & Lee, 2014; Xenos, Becker, Anderson, Brossard, & Scheufele, 2011). And although one study has used climate change to explore selective exposure (Jang, 2014), the issue is a highly politicized and controversial one among public audiences. Moreover, the general public has been exposed to the issue of climate change in the media for much longer compared to nanotechnology. The results presented in my dissertation, on the other hand, indicate that citizens may use political ideology to anchor new scientific information even if it is about a relatively unfamiliar topic. In this case, participants used their ideology to select new information about nanotechnology: Liberals preferred MSNBC over Fox News while conservatives preferred Fox News over the other two channel options, MSNBC and CBC. I observed this trend in both waves of the experiment, indicating that the election had little effect on ideological selectivity. Obviously, the headline choices presented to participants represented the end points on the spectrum of political ideology.

It would be interesting to measure individual perceptions of various media outlets, which are less glaringly partisan and examine the degree of selectivity that individuals subsequently exhibit.

In this dissertation, I chose to examine the effect of ideological cues on selective exposure. However, *de facto* selectivity in the context of scientific and technological information can occur with partisan cues (e.g., Feldman, Maibach, Roser-Renouf, & Leiserowitz, 2012), for example, when using the issue of climate change. Climate change is an issue that has been covered in the media significantly more than nanotechnology. It could be said that climate change is a scientific issue that has been "medialized" (Weingart, 1998). Medialization refers to the idea that science is becoming "increasingly media-oriented" (Weingart, 1998, p. 872) and that the "*science-media-coupling*" (Weingart, 1998) is increasing. Because it has been in the media for a longer time than nanotechnology, climate change is more medialized such that individual perceptions of the issue have been shaped by "mediated realities" (Scheufele, forthcoming) for a longer period of time. In this case, climate change as an issue has been associated with political parties through these mediated realities. Nanotechnology, on the other hand, is much less medialized than climate change and it remains to be seen whether future media coverage of this issue will associate it with political partisanship.

Finding #2: Ambiguous communication contexts heighten ideological selective exposure.

The experiment embedded in the online survey was designed to test the effects of communication contexts on partisan selective exposure. In particular, I examined how ideological cues in news articles influence subsequent information seeking among lay audiences. Although there was little difference in the responses of those who received inconsistent cues compared to those who received no cues, the differences in partisan selective exposure among

those who received ambiguous (either inconsistent cues or none) cues compared to clear, consistent ones were significant. When individuals were faced with ambiguous cues in media stories, partisan selective exposure was heightened. In other words, conservatives who were exposed to ambiguous cues were more likely to select Fox News compared to those who received consistent ideological cues. A similar trend was found among liberals in the sample but to a somewhat lesser degree. Previous scholarship is mixed about whether one side of the partisan aisle or the other is to "blame" when it comes to selective exposure (e.g., Iyengar & Hahn, 2009; Knobloch-Westerwick & Kleinman, 2012). Although selective exposure seems unlikely to be attributable to only one group of partisans, future work should attempt to better understand whether motivations for selectivity among ideological groups differ.

Finding #3: Ideological selectivity occurred through confirmation bias and defensive avoidance.

As mentioned, selecting a headline from a channel consistent with one's ideology was heightened when cues in the news article were ambiguous. When individuals were exposed to no cues or inconsistent ones, they tended to opt for channels that would support their existing ideology. Therefore, they exhibited a confirmation bias. Additionally, they tended to avoid channels that they recognized as inconsistent with their views (Figure 3-2). The binary and multinomial logistic regression models of Study A clearly show that confirmation bias and defensive avoidance are both occurring (Figures 3-2, 3-3, and 3-4). In addition, these data and figures show that this is largely driven by conservatives in the sample. This is an area that will likely prove fruitful for future scholarship. This study has shown that both confirmation bias and defensive avoidance occur to result in ideological selective exposure. Yet others have shown that these mechanisms do not always occur simultaneously (Garrett et al., 2013). We know relatively

little about these mechanisms and this remains a promising area of research. What are the motivations behind confirmation bias and defensive avoidance? As of now, we can only speculate about the motivations. Is it because the cognitive load is lighter when information is congruent? Or does selective exposure occur to alleviate cognitive dissonance? It is likely that some combination of multiple motivations drives individuals to such behavior. It is time to open the "black box" of the motivations behind selective exposure and peer inside.

Finding #4: Perceived information utility may trump ideological loyalties when clear communication cues are present.

Only when people received clear cues in the stimulus did their likelihood of selecting an ideologically-consistent headline decreased. Previous studies have shown that perceived utility of information may be one reason why partisan loyalties are temporarily ignored (Freedman, 1965). It may be the case that individuals who saw consistent cues in the article were able to subsequently seek information they perceived as useful. For example, the consistent cues may have helped a parent organize the information appropriately and allowed them to search for further information on nanotechnology health risks for their children. If that same parent was exposed to ambiguous cues, he or she may not have been able to appropriately organize the same information and may have resorted to ideological loyalties to help categorize it. Again, this is merely my hypothesis as to why individuals who received unequivocal cues exhibited stronger selective exposure. Future work should specifically test this hypothesis by measuring the perceived utility of the information presented to respondents.

Finding#5: Need for cognition and knowledge affect partisan selective exposure.

In this work, I found that a relatively stable personality trait, need for cognition, was negatively correlated to partisan selective exposure prior to the 2012 Presidential election. I also found that knowledge had a mediating effect on the relationship between need for cognition and selective exposure such that "nano sophisticates," analogous to political sophisticates (Converse, 1964), tended to have higher need for cognition and were more likely to engage in partisan selective exposure compared to the less sophisticated. On the one hand, in the first wave of data, people with lower need for cognition were more likely to select headlines congruent with their views. On the other hand, in wave 2, those with higher need for cognition had greater knowledge and were more likely to engage in selective exposure. Previous work on need for cognition, knowledge, and intelligence have shown that these concepts are weakly and positively correlated (Cacioppo & Petty, 1984; Wolfe & Grosch, 1990). The results I obtained in wave 2 are supportive of this—respondents who had a higher cognitive need and those with more knowledge were more likely to engage in selectivity. Yet, in wave 1, I found the opposite result with regards to need for cognition. It may be that even a small amount of exposure to an issue, such as the experiment in wave 1, may be sufficient to alter the relationship between these variables. In wave 1, people act as cognitive misers—those who have lower cognitive need select information based on partisan loyalties to reduce the effort required to process the information. In wave 2, the exposure to nanotechnology from wave 1 may have been sufficient to allow those with greater need for cognition to score better on the knowledge measures. In this case, I found that more sophisticated respondents were more likely to engage in partisan selectivity.

Nanotechnology is not a typical scientific issue. As mentioned in Chapter 1, it encompasses multiple disciplines and is thus highly complex. And though it is not typical, we may observe issues such as these emerge as post-normal science continues to advance. For many

of these post-normal issues, traits such as need for cognition may ultimately cause individuals to realize that the complexity of emerging scientific issues are simply beyond their understanding because they lack specialized training in these fields. In this case, contextual cues become even more important as these can help guide how we select information about science.

In Study C, I failed to find statistically significant evidence of knowledge as a moderator in the relationship between need for cognition and partisan selective exposure. However, the interaction (between cognitive need and knowledge) was close to significance ($p = .06$). It may be that these data lack sufficient power to discover a moderating relationship. Perhaps a larger sample might provide evidence of knowledge as a moderator. Since the main goal of this study was the experiment on communication contexts, future studies could design data collection efforts to more specifically test for this interaction. Future research should also ask whether there other personality traits, stable or otherwise, that may be related to partisan selective exposure and attempt to discern causal relationships between traits other than need for cognition, such as open- and closed-mindedness or dogmatism.

IMPLICATIONS FOR SCIENCE COMMUNICATION RESEARCH

From a research perspective, it is worthwhile to examine the processes of selective exposure and motivated information processing together. It may be useful to have a holistic model of public opinion formation about science, though this could also apply to politics, which accounts for both these processes. Selective exposure has the potential to lead to biased or motivated information processing, a phenomenon also referred to as motivated reasoning. Recent studies in these fields have separated information seeking from processing (e.g., Iyengar & Hahn, 2009; Taber & Lodge, 2006). However, these processes are undoubtedly related. In fact,

John Zaller's (1992) Receive-Accept-Sample (RAS) model of how individuals acquire information and convert it to public attitudes accounts for both these processes. Contemporary research has moved away from studying information seeking and processing in combination but a holistic model of science opinion formation will likely provide more answers to the questions raised in the present work. In such a model, we need to not only examine how opinionated and interested individuals contribute to public opinion about science, but also how apathetic citizens contribute (see Donsbach and Mothes (2012) for a discussion of "de-polarization" of attitudes). Partisan ideology and identification will clearly be values that guide public attitudes. But what other factors influence how we select and understand science? Accordingly, it behooves us to recognize that "the public" is not, and likely has never been, a single entity. Instead, there are many publics—audiences for whom the interpretations of identical communications differ and we should attempt to understand what drives such differences in the fragmented audiences of this brave new world of science communication.

Information seeking is but one step along the road to opinion formation. Logically, information processing would be the next step. Although a substantial amount of work has been conducted in this area (e.g., Brossard et al., 2009; Cacciatore et al., 2014; Cassino, Taber, & Lodge, 2007; Eveland Jr, Shah, & Kwak, 2003; Kunda, 1990; Meffert et al., 2006; Moons & Mackie, 2007; Taber & Lodge, 2006; Yeo, Cacciatore, & Scheufele, forthcoming), few studies have explored how to elicit more "accurate" information processing, that is, processing driven by accuracy goals (Kunda, 1990). In addition to information processing, future studies should examine how information seeking and processing affect public attitudes toward science. Understanding both information selectivity and processing mechanisms will allow us to further

understand how public audiences form their opinions of and attitudes toward science and technology.

This dissertation has been primarily concerned with the issue of selective exposure. Yet, it is worth questioning whether we should be studying selective attention instead of selective exposure. This problem is two-fold. First, given that people rarely look at the second page of online search results (Spink, Wolfram, Jansen, & Saracevic, 2001), they also rarely read entire articles online (Manjoo, 2013). Although many may expose themselves to communications by clicking on a link for more information, few will attend to that material wholeheartedly. In fact, data have shown that online readers recall less information from news compared to readers of print newspapers (Tewksbury & Althaus, 2000), possibly because they pay less attention to online media (Haile, 2014). Second, the media use measures that we currently employ are also insufficient to capture the valence of any specific piece of information that one attends to, regardless of how much attention they report paying to it. For example, even if someone pays "frequent" attention to news about national government and politics online, we know little about the valence of the content that he or she is exposed to. One solution would be to combine current measures of media attention with sentiment or content analyses of the media sources. By creating an index of media attention that accounts for the tone or valence of its content, our understanding of information seeking and processing may potentially be furthered.

IMPLICATIONS FOR PUBLIC COMMUNICATION OF SCIENCE

In addition to implications for research in science communication, the findings presented in this dissertation have practical implications. In particular, the findings from Chapter 3 can inform how we communicate science to public audiences in a strategic manner. If the issue at hand is a

relatively unfamiliar one, it may be beneficial to include cues that can help people anchor their understanding of it. If we do so, it is more likely that citizens can subsequently select information that they perceive to be more useful, instead of resorting to predispositions and heuristic cues when opting for scientific information. In a broader sense, my findings indicate the need for more strategic science communication. Research on how a particular message or issue is perceived is worth undertaking prior to constructing communications about science and technology. Better science communication efforts will be strategic and based on empirical data, such as those presented here, and not on intuition as has often been the case. In addition, practitioners of science communication should evaluate the effectiveness of the messages they disseminate. This calls for science communicators to have some training and resources in these areas, and websites such as the Journalist's Resource (http://journalistsresource.org/) by Harvard University's Shorenstein Center on Media, Politics and Public Policy are starting to fill this role to some extent.

Communication technologies have become increasingly complex and fragmented. And scholars are concerned that fragmentation of the public sphere has occurred as a result. The notion of selective exposure and goal-driven information processing is inherently at odds with the normative ideals of democratic citizenship. As Donsbach and Mothes (2012) point out, "A free exchange of contrasting political opinions and a basic interest in politics are seen as fundamental requirements for citizens to comply with their civic duties in a democracy […] if news audiences know 'less about broader subjects' and have 'less and less in common with each other,' the performance of democracy might be severely hampered" (p. 6). This has also become the case with scientific and technological issues. The publics are divided on issues ranging from global warming to vaccinations. Communication about science and technology, then, is

increasingly important if lay audiences are asked to form opinions about unfamiliar issues and cast votes that will eventually lead to policy-making.

How public audiences arrive at their opinions of science and technology has traditionally been related to public understanding of science and scientific literacy. This top-down process is known as the "deficit model" (Gross, 1994; Miller, 1998). The general argument of the deficit model is that more knowledge and greater scientific literacy increases public acceptance of science and technology. Yet, the general public spends relatively little time in formal education settings learning about science. The average American spends only about 5 percent of his or her lifetime in a classroom and only a fraction of this time is spent learning science. Additionally, only about 30 percent of American adults have ever taken a college-level science class. Given the small amount of time citizens spend in formal science education, it seems unlikely that public attitudes toward science can be understood through this knowledge deficit model. In fact, empirical data in several social science fields, in particular communication, have since challenged the deficit model. Scholars have shown that individual traits, such as ideology, deference to scientific authority, and religiosity (Brossard, Scheufele, Kim, and Lewenstein, 2009; Ho, Scheufele, and Corley, 2010; Smith and Leiserowitz, in press), are strong influencers of public opinion and attitudes toward science.

As post-normal science evolves and new scientific fields develop, the spheres of science and politics will intersect more and more. Federal money is the main source of funding for academic research and development (National Science Board, 2014). Close to 60 percent of academic research is funded by the federal taxes (National Science Board, 2014) and while the majority of the work funded is in engineering, some of this research is on controversial topics such as stem cells, genetically modified foods, and global climate change. In addition to issues of

funding, scientists themselves have long played significant roles in public policy. As advisors to political elites, many scientists have a hand in shaping science and technology policies, and use their credibility as scientists for advocacy (for a more in-depth discussion, see Scheufele, forthcoming).

In light of the increasing politicization, scientists and practitioners of science communication need to recognize that the scientific endeavor does not operate in a vacuum and thus need to better connect with public audiences. Mediated realities shape how public audiences perceive salient issues about science and technology, and scientists and practitioners of science communication can capitalize on new technologies, such as social and web-2.0 media, to disseminate their messages. In this dissertation, I used nanotechnology as an exemplar of emerging scientific issues. Many new issues in science are likely to share characteristics with nanotechnology. Specifically, the interdisciplinary nature of new science and technology make it difficult, even for scientists, to comprehend every aspect of the issue. And many lay audiences lack the framework to accurately process information about these issues. For issues with high complexity, it may be that public audiences will not be able to fully comprehend the scope of the issue and heuristic cues may have to be included in communications to help us makes sense of them.

How American taxpayers perceive and understand science are likely to impact the types of research they support. I believe science continues to have the "marketing problem," that Larry Page so bluntly pointed out in 2007 (Ham, 2007). Not only do science communicators need to understand the science of science communication to better their craft, scientists also need to realize that strategic communication of science to public audiences will ultimately benefit themselves and science as an institution.

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APPENDIX A: WAVE 1 QUESTIONNAIRE

UNIVERSITY OF WISCONSIN-MADISON
Research Participant Information and Consent

Title of the Study: **Information-Seeking and Public Opinion of Emerging Technologies**

Principal Investigator: Dominique Brossard
(phone: 608-262-0482, email: dbrossard@wisc.edu)
Researchers: Sara K. Yeo
(phone: 608-890-2264, email: skyeo@wisc.edu)

DESCRIPTION OF THE RESEARCH
You are invited to participate in a research study about how people in America feel about new technologies.

We are asking randomly chosen people to answer questions about these issues to get a good idea of what people think about them. Before we begin, we want to assure you that all the information you give will be kept completely confidential and that none of it will be released in any way that would permit identification of you or your family. Your participation in this study is, of course, voluntary. All research will be conducted on the Internet using an online survey.

WHAT WILL MY PARTICIPATION INVOLVE?
If you decide to participate in this research, you will be asked to complete an online questionnaire. Participation will require answering a series of questions and reading a news article. Your participation will last approximately 18 minutes. You will be asked to complete one survey or interview. While reading and answering the following questions, please do not visit other websites online.

ARE THERE ANY RISKS TO ME?
We don't anticipate any risks to you from participation in this study.

ARE THERE ANY BENEFITS TO ME?
We don't expect any direct benefits to you from participation in this study.

HOW WILL MY CONFIDENTIALITY BE PROTECTED?
While there will probably be publications as a result of this study, your name will not be used. Only group characteristics will be published.

WHOM SHOULD I CONTACT IF I HAVE QUESTIONS?
You may ask any questions about the research at any time. If you have questions about the survey, please contact the Principal Investigator, Dominique Brossard at 608-262-0482. You may also call the researcher, Sara K. Yeo at 608-890-2264.
If you are not satisfied with the response from the research team, have more questions, or want to talk with someone about your rights as a research participant, you should contact the Education Research and Social & Behavioral Science IRB Office at 608-263-2320.
Your participation is completely voluntary. You have the right to withdraw from the study at any

time.

Selecting 'Yes' below indicates that you have read this consent form, had an opportunity to ask any questions about your participation in this research, and voluntarily consent to participate.

Consent1. I agree to participate in this study and have read the consent form above.

Yes……. 1
No…….... 2

We are conducting a study on how people in America feel about new technologies and how they affect our world. People have all sorts of views about new scientific advancements and technology policy in the United States. We are asking randomly chosen people to answer questions about these issues to get an idea of what people think about them.

Before we begin, there are a few points we would like to cover. We want to assure you that all the information you give will be kept completely confidential and that none of it will be released in any way that would permit identification of you or your family. Your participation in this study is, of course, voluntary.

While reading and answering the following questions, please do not visit other websites online.

To begin, here are a few questions about your typical use of media. Please read each item carefully and select the appropriate option to indicate your response:

M1. How many days a week do you read a newspaper, either in print or online?
[DROP DOWN MENU] days

M2. How much attention do you pay to news stories about the following topics when you read the **newspaper**, either in print or online?

None	Very little	Some	Quite a bit	A lot
1	2	3	4	5

a) International and national affairs
b) Local government and politics
c) Stories related to science and technology
d) Stories about scientific studies in new areas of research

M3. How much attention do you pay to news stories about the following topics when you watch **television news**, either on a traditional television or in online sources (such as Hulu or websites of television networks, such as ABC, CBS, NBC, Fox or CNN)?

None	Very little	Some	Quite a bit	A lot
1	2	3	4	5

a) International and national affairs
b) Local government and politics
c) Stories related to science and technology
d) Stories about scientific studies in new areas of research

M4. How much attention do you pay to news stories about the following topics when you go to **social networking sites** (such as Facebook or Twitter)?

None	Very little	Some	Quite a bit	A lot
1	2	3	4	5

a) International and national affairs
b) Local government and politics
c) Stories related to science and technology
d) Stories about scientific studies in new areas of research

M5. How much attention do you pay to news stories about the following topics when you **go online**? Please exclude social networking sites (such as Facebook or Twitter) and online versions of print newspapers or television shows and answer this question based on your usage of blogs, websites, and online-only newspapers.

None	Very little	Some	Quite a bit	A lot
1	2	3	4	5

a) International and national affairs
b) Local government and politics
c) Stories related to science and technology
d) Stories about scientific studies in new areas of research

M6. In the past week, from what TV news network did you get most of your information about the 2012 presidential campaign?

ABC 1
CBS 2
CNN 3
Fox News Channel 4
MSNBC.....5
NBC 6
PBS 7
Don't watch TV news **[ANCHOR]**.....8

M7. If you had free time after 6 o'clock at night and the following programs were available, how likely would you be to watch each of the following?

Not at all likely										Very likely
0	1	2	3	4	5	6	7	8	9	10

a) ABC Nightly News
b) NBC Nightly News
c) CBS Nightly News
d) PBS *Newshour*
e) Fox News
f) CNN
g) MSNBC

h) A comedy or sitcom program like *The Big Bang Theory* or *Modern Family*
i) A drama program like *CSI: Crime Scene Investigation* or *The Mentalist*
j) A science fiction program like *Supernatural* or *Fringe*
k) A reality TV program like *Storage Wars* or *The Bachelor*
l) A sports program like *ESPN Sportscenter*

SN1. We would like to know more about your typical use of social networking sites. How often do you use social networking sites such as Facebook or Twitter?

Never.....1
Every few weeks.....2
1-2 days a week.....3
3-5 days a week.....4
About once a day 5
Several times a day 6

SN2. How often do you **agree** or **disagree** with the political opinions or political content your friends post on social networking sites?

Always or almost always disagree.....1
Disagree most of the time 2
Sometimes agree, sometimes disagree
3
Agree most of the time.....4
Always or almost always agree.....5

SN3. When one of your friends posts something about politics on a social networking site that you **disagree** with, how do you usually respond?

Ignore the post you disagree with 1
Respond to it by posting a reply or something of your own.....2
Neither/Something else.....3
Don't know 9

SN4. When you yourself have posted something political on a social networking site, how often do you get a strong **negative** reaction from a friend or someone who follows you?

Never										All the time	Not applicable
0	1	2	3	4	5	6	7	8	9	10	

PS1. Next are some questions to help us see how much information about politics gets out to the public. Many people don't know the answers to these questions. If this is the case, please select "Don't Know". Thinking about where the political parties stand on important issues, please respond to the following questions.

Republican Party	Democratic Party	Don't know
1	2	9

a) Which party is generally more supportive of increasing taxes on higher income people to

reduce the federal budget deficit?

b) Which party is generally more supportive of reducing the size and scope of the federal government?
c) Which party is generally more supportive of allowing drilling for oil in the Arctic National Wildlife Refuge (ANWR)?
d) Which political party is considered to be the more conservative party on most political issues?
e) Which party is generally more supportive of removing barriers to responsible scientific research involving human stem cells?

PS2. How interested are you generally in politics and public affairs?

Not interested at all										Very interested
0	1	2	3	4	5	6	7	8	9	10

Now, we will give you definitions about some technological issues. Please keep these definitions in mind as you take this survey. Please also note that for the remainder of the survey, moving your cursor over each of these terms will provide you with a definition of that term.

Nanotechnology allows scientists to see and work with materials at the nanoscale. Materials can behave in different ways when working with them at this scale. Nano-sized particles are often used in consumer goods, such as nanosilver in cleaning products and carbon nanotubes in tennis rackets.

Genetically modified foods are foods whose genetic characteristics have been altered using the techniques of genetic engineering. Usually, the goal is to make food that, for example, tastes better, grows faster, is more resistant to drought or disease, or will improve nutrition.

PS3. Please indicate how well informed you feel you are about the following issues.

Not informed at all										Very well informed
0	1	2	3	4	5	6	7	8	9	10

a) Nanotechnology
b) Genetically modified foods
c) 2012 U.S. presidential election
d) Politics and current affairs

PS4. Now you are going to read a few statements about some scientific topics. Of course, most people don't know the answers to all of these, but please tell us if you think each of the following statements is true or false.

Definitely true	Likely true	Likely false	Definitely false	Don't know
1	2	3	4	5

a) Nanotechnology involves materials that are not visible to the naked eye.
b) Currently, there are only a few dozen consumer products in the market using nanotechnology.
c) Nanotechnology allows scientists to arrange molecules in ways that do not occur in nature.
d) Ordinary tomatoes do not contain genes while genetically modified ones do.
e) Currently more than half of U.S. soybeans are grown from genetically modified seed.
f) By eating genetically modified foods, a person's genes could also become modified.

PS5. Now we'd like to return to the issue of politics for a moment. Have you decided which candidate you will vote for in the upcoming Presidential election?

Obama 1
Romney 2
Other 3
Undecided 9

PS6. How long ago did you make that decision?

I decided after the conventions, during the campaign 1
I decided as soon as Romney was determined to be the Republican candidate 2
I have known all along how I will vote.....3

Next, you will see a screenshot of an excerpt from a newspaper article. Because this is a screenshot, you will not be able to click on any links within the news excerpt. Please read it carefully. We will ask you more questions after you are finished.

[DISPLAY EXPERIMENTAL STIMULUS]

MC1.1. Does the American Heartland Foundation self-identify as a liberal or conservative think tank?

Liberal 1
Conservative 2
Don't know 9

MC1.2. Does The Progress Institute self-identify as a liberal or conservative think tank?

Liberal 1
Conservative 2
Don't know 9

MC2.1. Is the American Heartland Foundation in favor of or opposed to regulations on food safety?

In favor of 1
Opposed to 2
Don't know 9

MC2.2. Is The Progress Institute in favor of or opposed to regulations on food safety?

In favor of 1
Opposed to 2

Don't know 9

Art1. Next, you will see some recent headlines from newspaper articles to provide more background on nanotechnology. Please select the article you would **most** like to read.

[DISPLAY HEADLINES]

Art2. Of the remaining headlines, please select the article you would **next** like to read.

[DISPLAY HEADLINES WITHOUT SELECTION FROM PREVIOUS QUESTION]

A1. Thinking back to the article and headlines you just read, please indicate how much you agree or disagree with the following statements. I was…

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

a) … deciding which argument I should support.
b) … weighing which arguments were stronger.
c) … thinking about what someone else would think about the issue of nanosilver.
d) … seeking information that supports my position.
e) … seeking information that would help me prepare for a discussion with others.
f) … seeking information that opposes my position.

A2. Imagine that you are talking to a friend who has never heard of the issue of nanotechnology or the use of nanosilver. Please list as many reasons as you can that are **in favor** of the use of nanosilver in the boxes provided below. Please only list one reason per box.

_____
_____
_____
_____
_____

A3. Please list as many reasons as you can that are **against** the use of nanosilver in the boxes provided below. Please only list one reason per box.

_____
_____
_____
_____
_____

A4. Next, we would like to know how you feel about some scientific developments. How much do you support or oppose each of the following?

Strongly oppose										Strongly support
0	1	2	3	4	5	6	7	8	9	10

a) Nanotechnology
b) Federal funding of nanotechnology
c) Genetically modified foods
d) Federal funding of genetically modified foods

A5. How **beneficial** do you think each of the following is for society as a whole?
(Moving your cursor over these terms will provide you with a definition of that term.)

Not at all beneficial						Very beneficial
1	2	3	4	5	6	7

a) Nanotechnology
b) Genetically modified foods
c) Nuclear power
d) Synthetic biology
e) Stem cell research

A6. How **risky** do you think each of the following is for society as a whole?

Not at all risky						Very risky
1	2	3	4	5	6	7

a) Nanotechnology
b) Genetically modified foods
c) Nuclear power
d) Synthetic biology
e) Stem cell research

A7. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

a) Scientists know best what is good for the public.
b) Scientists should do what they think is best, even if they have to persuade people that it is right.
c) The principles I believe in are quite different from those believed in by others.
d) I often reserve my judgment until I have had a chance to hear the opinions of someone I respect.
e) Most people just don't know what's good for them.
f) In the long run it is best to pick friends whose beliefs are the same as your own.

A8. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much

0	1	2	3	4	5	6	7	8	9	10

a) I prefer complex to simple problems.
b) I only think as hard as I have to.
c) I prefer to think about small, daily projects to long-term ones.
d) I really enjoy a task that involves coming up with new solutions to problems.

A9. Here is a list of groups that have been involved in decision-making about scientific issues. How much weight do you think each group should have when our society is faced with decisions about scientific issues?

No weight at all										A lot of weight
0	1	2	3	4	5	6	7	8	9	10

a) Religious groups
b) Elected officials
c) Scientists
d) Average citizens

A10. How much do you think the same groups understand scientific issues?

Don't understand at all										Understand very well
0	1	2	3	4	5	6	7	8	9	10

a) Religious groups
b) Elected officials
c) Scientists
d) Average citizens

A11. Now we would like to ask you which of the following sources of information, if any, you trust to tell the truth about the risks and benefits of technologies and their applications. How much do you trust…

Do not trust their information at all										Trust their information very much
0	1	2	3	4	5	6	7	8	9	10

a) University scientists
b) Industry scientists
c) Corporations
d) Friends and family
e) News media
f) Religious organizations
g) Regulatory agencies, such as the Environmental Protection Agency (EPA), or the Food and Drug Administration (FDA)
h) Environmental organizations
i) Online sources

A12. The next statements relate to the relationship between humans and nature. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

a) We have the right to modify the natural environment to suit our needs.
b) Human intelligence alone cannot guarantee that the earth will be livable forever.
c) We are **not** meant to rule over nature.
d) Technology will allow us to solve the problems currently facing the earth.

Because we try to get responses and opinions from different people all across the U.S., we would like to ask you a few questions that help us to reach people of different ages, genders, neighborhoods, and so on. Once again, these responses will only be used for academic research purposes.

V1. How much guidance does religion provide in your everyday life?

No guidance at all										A great deal of guidance
0	1	2	3	4	5	6	7	8	9	10

V2. The terms "liberal" and "conservative" may mean different things to people, depending on the kind of issue one is considering. In terms of **economic issues**, would you say you are:

Very liberal 1
Liberal 2
Somewhat liberal 3
Moderate 4
Somewhat conservative 5
Conservative 6
Very conservative 7

V3. Now, thinking in terms of **social issues**, would you say you are:

Very liberal 1
Liberal 2
Somewhat liberal 3
Moderate 4
Somewhat conservative 5
Conservative 6
Very conservative 7

V4. How many years of formal education have you completed?
[DROP DOWN MENU] years

V5. How many college-level science courses have you taken?
[DROP DOWN MENU]

V6. Is your college degree in a scientific or science-related field?

Yes 1
No.....2

Thank you very much for participating in our study. Nanotechnology is an important issue and this study was designed to test how people interpret scientific information in the media.

The quotes and examples in the article you read were taken or paraphrased from real media coverage of these issues. However, the article itself was fictional as were the identified think tanks.

If you have questions about the research after today you should contact the Principal Investigators Dominique Brossard at dbrossard@wisc.edu. You may also call the researcher, Sara K. Yeo at 608-890-2264.

Thanks again for your participation.

APPENDIX B: WAVE 2 QUESTIONNAIRE

UNIVERSITY OF WISCONSIN-MADISON
Research Participant Information and Consent
Title of the Study: **Information-Seeking and Public Opinion of Emerging Technologies**

Principal Investigator: Dominique Brossard
(phone: 608-262-0482, email: dbrossard@wisc.edu)
Researchers: Sara K. Yeo
(phone: 608-890-2264, email: skyeo@wisc.edu)

DESCRIPTION OF THE RESEARCH
You are invited to participate in a research study about how people in America feel about new technologies.

We are asking randomly chosen people to answer questions about these issues to get a good idea of what people think about them. Before we begin, we want to assure you that all the information you give will be kept completely confidential and that none of it will be released in any way that would permit identification of you or your family. Your participation in this study is, of course, voluntary. All research will be conducted on the Internet using an online survey.

WHAT WILL MY PARTICIPATION INVOLVE?
If you decide to participate in this research, you will be asked to complete an online questionnaire. Participation will require answering a series of questions and reading a news article. Your participation will last approximately 18 minutes. You will be asked to complete one survey or interview. While reading and answering the following questions, please do not visit other websites online.

ARE THERE ANY RISKS TO ME?
We don't anticipate any risks to you from participation in this study.

ARE THERE ANY BENEFITS TO ME?
We don't expect any direct benefits to you from participation in this study.

HOW WILL MY CONFIDENTIALITY BE PROTECTED?
While there will probably be publications as a result of this study, your name will not be used. Only group characteristics will be published.

WHOM SHOULD I CONTACT IF I HAVE QUESTIONS?
You may ask any questions about the research at any time. If you have questions about the survey, please contact the Principal Investigator, Dominique Brossard at 608-262-0482. You may also call the researcher, Sara K. Yeo at 608-890-2264.
If you are not satisfied with the response from the research team, have more questions, or want to talk with someone about your rights as a research participant, you should contact the Education Research and Social & Behavioral Science IRB Office at 608-263-2320.
Your participation is completely voluntary. You have the right to withdraw from the study at any

time.

Selecting 'Yes' below indicates that you have read this consent form, had an opportunity to ask any questions about your participation in this research, and voluntarily consent to participate.

Consent1. I agree to participate in this study and have read the consent form above.

Yes……. 1
No…….... 2

We are conducting a study on how people in America feel about new technologies and how they affect our world. People have all sorts of views about new scientific advancements and technology policy in the United States. We are asking randomly chosen people to answer questions about these issues to get an idea of what people think about them.

Before we begin, there are a few points we would like to cover. We want to assure you that all the information you give will be kept completely confidential and that none of it will be released in any way that would permit identification of you or your family. Your participation in this study is, of course, voluntary.

While reading and answering the following questions, please do not visit other websites online.

To begin, here is a question about your use of media during the 2012 Presidential election. Please read each item carefully and select the appropriate option to indicate your response:

M6. From what TV news network did you get most of your information about the 2012election?

ABC 1
CBS 2
CNN 3
Fox News Channel 4
MSNBC.....5
NBC 6
PBS 7
Don't watch TV news 8

PS7. Next are some questions to help us see how much information about politics gets out to the public. Many people don't know the answers to these questions. If this is the case, please select "Don't Know". Thinking about where the political parties stand on important issues, please respond to the following questions.

Republican Party	Democratic Party	Don't know
1	2	9

f) Which party is generally more supportive of increasing taxes on higher income people to reduce the federal budget deficit?
g) Which party is generally more supportive of reducing the size and scope of the federal government?
h) Which party is generally more supportive of allowing drilling for oil in the Arctic National Wildlife Refuge (ANWR)?

i) Which political party is considered to be the more conservative party on most political issues?
j) Which party is generally more supportive of removing barriers to responsible scientific research involving human stem cells?

PS8. How interested are you generally in politics and public affairs?

Not interested at all										Very interested
0	1	2	3	4	5	6	7	8	9	10

Now, here are definitions about some technologies. Please keep these definitions in mind as you take this survey. Also note that for the remainder of the survey, moving your cursor over each of these terms will provide you with a definition of that term.

Nanotechnology allows scientists to see and work with materials at the nanoscale. Materials can behave in different ways when working with them at this scale. Nano-sized particles, also known as nanoparticles, are often used in consumer goods, such as zinc oxide in cosmetics and paint.

Genetically modified foods are foods whose genetic characteristics have been altered using the techniques of genetic engineering. Usually, the goal is to make food that, for example, tastes better, grows faster, is more resistant to drought or disease, or will improve nutrition.

PS9. Please indicate how well informed you feel you are about the following issues.

Not informed at all										Very well informed
0	1	2	3	4	5	6	7	8	9	10

e) Nanotechnology
f) Genetically modified foods
g) 2012 U.S. presidential election
h) Politics and current affairs

PS10. Now you are going to read a few statements about some scientific topics. Of course, most people don't know the answers to all of these, but please tell us if you think each of the following statements is true or false.

Definitely false	**Likely false**	**Likely true**	**Definitely true**	**Don't know**
1	**2**	**3**	**4**	**9**

g) Nanotechnology involves materials that are not visible to the naked eye.
h) Currently, there are only a few dozen consumer products in the market using nanotechnology.
i) Nanotechnology allows scientists to arrange molecules in ways that do not occur in nature.
j) Ordinary tomatoes do not contain genes while genetically modified ones do.
k) Currently more than half of U.S. soybeans are grown from genetically modified seed.
l) By eating genetically modified foods, a person's genes could also become modified.

PS11. Now we'd like to return to the issue of politics for a moment. Which candidate did you vote for in the Presidential election?

Obama 1
Romney 2
Other **[ANCHOR]** 3
Did not vote **[ANCHOR]** 9
Prefer not to say 0

Last time, you read an excerpt from a news article about nanotechnology. Next, you will see a screenshot of an excerpt from a different newspaper article on a related topic. Because this is a screenshot, you will not be able to click on any links within the news excerpt. Please read it carefully. We will ask you more questions after you are finished.

[DISPLAY EXPERIMENTAL STIMULUS]

MC1.3. Does the American Heartland Foundation self-identify as a liberal or conservative think tank?

Liberal 1
Conservative 2
Don't know 9

MC1.4. Does The Progress Institute self-identify as a liberal or conservative think tank?

Liberal 1
Conservative 2
Don't know 9

MC2.3. Is the American Heartland Foundation in favor of or opposed to regulations of nano zinc oxide in consumer products?

In favor of 1
Opposed to 2
Don't know 9

MC2.4. Is The Progress Institute in favor of or opposed to regulations of nano zinc oxide in consumer products?

In favor of 1
Opposed to 2
Don't know 9

Art1. Next, you will see some recent headlines from newspaper articles to provide more background on nanotechnology. Please select the article you would **most** like to read.

[DISPLAY HEADLINES]

Art2. Of the remaining headlines, please select the article you would **next** like to read.

[DISPLAY HEADLINES WITHOUT SELECTION FROM PREVIOUS QUESTION]

A13. Thinking back to the article and headlines you just read, please indicate how much you agree or disagree with the following statements. I was…

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

g) …deciding which argument I should support.
h) …weighing which arguments were stronger.
i) …thinking about what someone else would think about the issue of nano zinc oxide.
j) …seeking information that supports my position.
k) …seeking information that would help me prepare for a discussion with others.
l) …seeking information that opposes my position.

Imagine that you are talking to a friend who has never heard of the issue of nanotechnology or the use of nanoparticles in cosmetics and sunscreens.

A14. Please list as many reasons as you can that are **in favor** of the use of nano zinc oxide in the boxes provided below. Please only list one reason per box.

_____
_____
_____
_____
_____

A15. Please list as many reasons as you can that are **against** the use of nano zinc oxide in the boxes provided below. Please only list one reason per box.

_____
_____
_____
_____
_____

A16. Next, we would like to know how you feel about some scientific developments. How much do you support or oppose each of the following?

Strongly oppose										Strongly support
0	1	2	3	4	5	6	7	8	9	10

e) Nanotechnology
f) Federal funding of nanotechnology
g) Increased regulation of nano zinc oxide in consumer products
h) Allowing the free market to regulate the development of nano zinc oxide in consumer products
i) Genetically modified foods
j) Federal funding of genetically modified foods

A17. How **beneficial** do you think each of the following is for society as a whole?
(Moving your cursor over these terms will provide you with a definition of that term.)

Not at all beneficial						Very beneficial
1	2	3	4	5	6	7

f) Nanotechnology
g) Genetically modified foods
h) Nuclear power
i) Synthetic biology
j) Stem cell research

A18. How **risky** do you think each of the following is for society as a whole?

Not at all risky						Very risky
1	2	3	4	5	6	7

f) Nanotechnology
g) Genetically modified foods
h) Nuclear power
i) Synthetic biology
j) Stem cell research

A7_W2. Please indicate how confident you are in the safety and regulatory approval systems governing science and technology in the U.S.

Not at All confident										Very confident
0	1	2	3	4	5	6	7	8	9	10

A7_2. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

e) I prefer complex to simple problems.
f) I only think as hard as I have to.
g) I prefer to think about small, daily projects to long-term ones.
h) I really enjoy a task that involves coming up with new solutions to problems.

A8_W2. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

i) Even though freedom of speech for all groups is a worthwhile goal, it is unfortunately necessary to restrict the freedom of certain political groups.
j) My blood boils when a person stubbornly refuses to admit he or she is wrong.
k) It is dangerous to compromise with our political opponents because it usually leads to the betrayal of our own side.
l) Most of the opinions shared today are not worth the time it takes to hear them.

A8_W2b. Next are some questions about how people feel about conflict. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

a) I hate arguments.
b) I find conflicts exciting.
c) I enjoy challenging the opinions of others.
d) Arguments don't bother me.
e) I feel upset after an argument.

A8. Here is a list of groups that have been involved in decision-making about scientific issues. How much weight do you think each group should have when our society is faced with decisions about scientific issues?

No weight at all										A lot of weight
0	1	2	3	4	5	6	7	8	9	10

e) Religious groups
f) Elected officials
g) Scientists
h) Average citizens

A9. How much do you think the same groups understand scientific issues?

Don't understand at all										Understand very well
0	1	2	3	4	5	6	7	8	9	10

e) Religious groups
f) Elected officials
g) Scientists
h) Average citizens

A10. Now we would like to ask you which of the following sources of information, if any, you

trust to tell the truth about the risks and benefits of technologies and their applications. How much do you trust…

Do not trust their information at all										Trust their information very much
0	1	2	3	4	5	6	7	8	9	10

j) University scientists
k) Industry scientists
l) Corporations
m) Friends and family
n) News media
o) Religious organizations
p) Regulatory agencies, such as the Environmental Protection Agency (EPA), or the Food and Drug Administration (FDA)
q) Environmental organizations
r) Online sources

A11. The next statements relate to the relationship between humans and nature. How much do you agree or disagree with each of the following statements?

Do not agree at all										Agree very much
0	1	2	3	4	5	6	7	8	9	10

e) We have the right to modify the natural environment to suit our needs.
f) Human intelligence alone cannot guarantee that the earth will be livable forever.
g) We are **not** meant to rule over nature.
h) Technology will allow us to solve the problems currently facing the earth.

Thank you very much for participating in our study. Nanotechnology is an important issue and this study was designed to test how people interpret scientific information in the media.

If you have questions about the research after today you should contact the Principal Investigators Dominique Brossard at dbrossard@wisc.edu. You may also contact the researcher, Sara K. Yeo at skyeo@wisc.edu.

Thanks again for your participation.

APPENDIX C: EXPERIMENTAL STIMULI
Wave 1

Consistently cued article

Policy Institutes Divided on Regulation of Nanosilver in Food

QUINN EVANS
AUGUST 27, 2011

Environment, Health, and Safety (EHS) regulations for nanotechnology have come under fire from policy institutes in the wake of the U.S. FDA's new draft guidance on food safety. The guidelines suggest tighter regulations on the use of nanosilver in food packaging. This would delay products from entering the marketplace but would allow researchers to better determine the health risks of nanosilver.

The conservative policy institute, American Heartland Foundation (AHF), argues that the guidelines are unnecessary as research has yet to demonstrate that nanosilver products are unsafe.

"The scientific evidence is inconclusive," says Jamie Whitlock of AHF. "And premature regulations could stifle industry at a time when job creation should be a top priority. Markets should be allowed to regulate themselves."

On the other hand, The Progress Institute, a liberal think tank, is calling the guidelines insufficient, citing research that suggests nanosilver is potentially toxic to humans.

"Nanosilver in food packaging can end up in our food supply and potentially be ingested. This is seriously worrying," says Morgan Reynolds of The Progress Institute. "We need regulations until we can better understand the risks involved."

Representatives from the FDA were not available for comment.

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Wave 2

Consistently cued article

OTTAWA CITIZEN

Policy Institutes Divided on Regulation of Nanoparticles in Sunscreens

QUINN EVANS
AUGUST 27, 2011

Environment, Health, and Safety (EHS) regulations for nanotechnology have come under fire from policy institutes in the wake of the FDA's new draft guidance on the use of zinc oxide nanoparticles. The guidelines suggest tighter regulations on the use of nano zinc oxide in cosmetics and sunscreens. This would delay products from entering the marketplace but would allow researchers to better determine the health risks of these nanoparticles.

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APPENDIX D: HEADLINES
Wave 1

Fox News

Government considering new nanosilver regulations - Fox News
The federal government has recently shown intense interest in the safety of food and food packaging products containing nanomaterials.

Debate over nanosilver regulations continues - Fox News
As nanotechnology advance, it is likely that policy debates over regulating the use of nanosilver in everyday products will continue.

New rules expected on safety of nanosilver products - Fox News
The guidelines are the most extensive effort yet to address vexing issues surrounding the rapidly expanding field of nanotechnology.

Nanosilver's effects on health and environment unclear, panel says - Fox News
A recent study called for further investigation of the miniscule substances, which are found in products from makeup to food packaging.

Nanosilver under study by scientists - Fox News
Researchers look at what effect tiny substances found in products like food packaging and sunscreen may have on the environment.

Study raises concerns about nanosilver - Fox News
Studies suggest that nanosilver may carry health risks similar to asbestos, but scientists say findings are not cause for alarm.

U.S. bets on nanotechnology to aid economy - Fox News
U.S. start-ups are part of an amibitious effort to create a thriving high technology hub in the Midwest.

Collaborating for profits in nanotechnology - Fox News
Collaborations betweem small companies and venture finance firms in the field of nanotechnology are driving a $225 billion market.

Nanotechnology start-ups on the rise - Fox News
Deals between large companies and finance firms are turning nanotechnology into one of the mos closely watched start-up industries.

CBC

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Wave 2

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APPENDIX E: STRUCTURAL EQUATION MODELING

Wave 1

Measurement model

Observed variables
Rcongr Rcog1 Rcog2 Rcog3 Rcog4 Rknow
Latent Variables
NCW1 knowW1 congrW1
Correlation Matrix
1.000
-.107 1.000
.104 .166 1.000
.038 .089 .545 1.000
-.050 .588 .179 .036 1.000
.019 .063 .062 .024 .002 1.000
Standard Deviations
3.49587257 2.48022072 2.52593735 2.40730811 2.39499148 1.09008112
Sample size is 554
Relationships
Rcog1 Rcog2 Rcog3 Rcog4 = NCW1
Rknow = 1*knowW1
Rcongr = 1*congrW1
Let the errors of Rcog2 and Rcog3 correlate
Set the variance of Rcongr to 0.0001
Set the variance of Rknow to 0.0001
LISREL Output: ND = 3 ML MI SC RS
Path Diagram
End of Problem

Covariance Matrix

	Rcongr	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**	**Rknow**
Rcongr	12.221					
Rcog1	-0.928	6.151				
Rcog2	0.918	1.040	6.380			
Rcog3	0.320	0.531	3.314	5.795		
Rcog4	-0.419	3.493	1.083	0.208	5.736	
Rknow	0.072	0.170	0.171	0.063	0.005	1.188

Parameter Specifications

LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	0	0	0
Rcog1	1	0	0
Rcog2	2	0	0
Rcog3	3	0	0
Rcog4	4	0	0
Rknow	0	0	0

PHI

	NCW1	knowW1	congrW1
NCW1	0		
knowW1	5	6	
congrW1	7	8	9

THETA-DELTA

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	0					
Rcog1	0	10				
Rcog2	0	0	11			
Rcog3	0	0	12	13		
Rcog4	0	0	0	0	14	
Rknow	0	0	0	0	0	0

Number of Iterations = 11

LISREL Estimates (Maximum Likelihood)

LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	1.000
Rcog1	1.958	- -	- -
	(0.214)		
	9.133		
Rcog2	0.555	- -	- -
	(0.123)		
	4.512		

Rcog3	0.202	- -	- -
	(0.118)		
	1.703		
Rcog4	1.786	- -	- -
	(0.198)		
	9.001		
Rknow	- -	1.000	- -

PHI

	NCW1	**knowW1**	**congrW1**
NCW1	1.000		
knowW1	0.055	1.188	
	(0.054)	(0.071)	
	1.033	16.627	
congrW1	-0.334	0.072	12.221
	(0.172)	(0.162)	(0.735)
	-1.949	0.447	16.628

THETA-DELTA

	Rcongr	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**	**Rknow**
Rcongr	0.000					
Rcog1	- -	2.317				
		(0.779)				
		2.974				
Rcog2	- -	- -	6.072			
			(0.372)			
			16.337			
Rcog3	- -	- -	3.202	5.754		
			(0.289)	(0.347)		
			11.085	16.588		
Rcog4	- -	- -	- -	- -	2.547	
					(0.656)	
					3.885	
Rknow	- -	- -	- -	- -	- -	0.000

Squared Multiple Correlations for X - Variables

Rcongr	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**	**Rknow**
1.000	0.623	0.048	0.007	0.556	1.000

Goodness of Fit Statistics

Degrees of Freedom = 7
Minimum Fit Function Chi-Square = 19.560 (P = 0.00660)
Normal Theory Weighted Least Squares Chi-Square = 19.562 (P = 0.00660)
Estimated Non-centrality Parameter (NCP) = 12.562
90 Percent Confidence Interval for NCP = (3.003 ; 29.740)

Minimum Fit Function Value = 0.0354
Population Discrepancy Function Value (F0) = 0.0227
90 Percent Confidence Interval for F0 = (0.00543 ; 0.0538)
Root Mean Square Error of Approximation (RMSEA) = 0.0570
90 Percent Confidence Interval for RMSEA = (0.0279 ; 0.0877)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.308

Expected Cross-Validation Index (ECVI) = 0.0860
90 Percent Confidence Interval for ECVI = (0.0687 ; 0.117)
ECVI for Saturated Model = 0.0759
ECVI for Independence Model = 0.768

Chi-Square for Independence Model with 15 Degrees of Freedom = 412.840
Independence AIC = 424.840
Model AIC = 47.562
Saturated AIC = 42.000
Independence CAIC = 456.743
Model CAIC = 122.003
Saturated CAIC = 153.660

Normed Fit Index (NFI) = 0.953
Non-Normed Fit Index (NNFI) = 0.932
Parsimony Normed Fit Index (PNFI) = 0.445
Comparative Fit Index (CFI) = 0.968
Incremental Fit Index (IFI) = 0.969
Relative Fit Index (RFI) = 0.898

Critical N (CN) = 523.340

Root Mean Square Residual (RMR) = 0.273
Standardized RMR = 0.0348
Goodness of Fit Index (GFI) = 0.988
Adjusted Goodness of Fit Index (AGFI) = 0.965
Parsimony Goodness of Fit Index (PGFI) = 0.329

Fitted Covariance Matrix

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	12.221					
Rcog1	-0.655	6.152				
Rcog2	-0.186	1.087	6.380			
Rcog3	-0.067	0.395	3.314	5.795		
Rcog4	-0.597	3.497	0.992	0.360	5.736	
Rknow	0.072	0.108	0.031	0.011	0.099	1.188

Fitted Residuals

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	0.000					
Rcog1	-0.273	0.000				
Rcog2	1.104	-0.047	0.000			
Rcog3	0.387	0.136	0.000	0.000		
Rcog4	0.179	-0.004	0.091	-0.153	0.000	
Rknow	0.000	0.062	0.140	0.052	-0.094	0.000

Summary Statistics for Fitted Residuals

Smallest Fitted Residual = -0.273
Median Fitted Residual = 0.000
Largest Fitted Residual = 1.104

Stemleaf Plot

- 0|3210000000000
0|1111124
0|
1|1

Standardized Residuals

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	- -					
Rcog1	-1.968	- -				
Rcog2	3.060	-0.961	- -			
Rcog3	1.094	1.414	- -	- -		
Rcog4	1.073	-2.169	1.535	-1.314	- -	
Rknow	- -	1.351	1.238	0.467	-1.702	- -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -2.169
Median Standardized Residual = 0.000
Largest Standardized Residual = 3.060

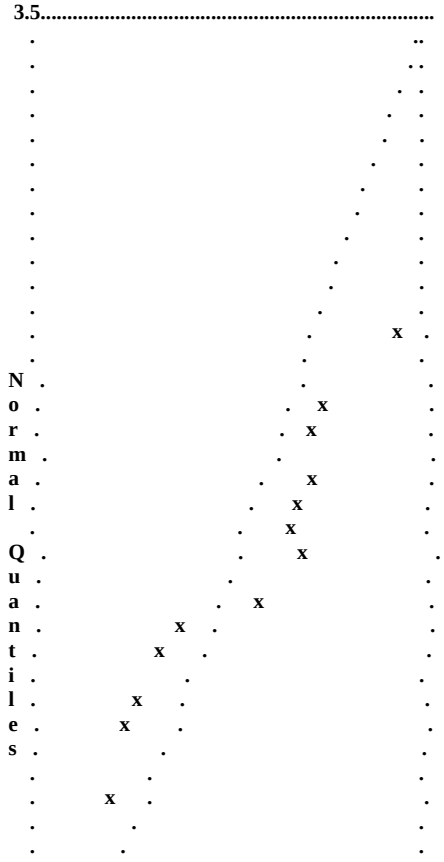
Stemleaf Plot

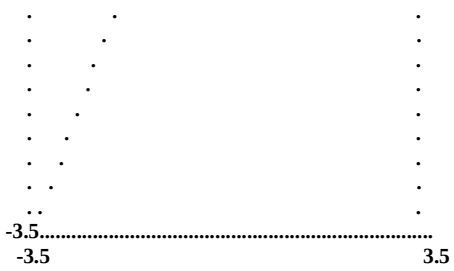
- 2|20
- 0|73000000000
0|5112445
2|1

Largest Positive Standardized Residuals

Residual for **Rcog2** and **Rcongr** **3.060**

Qplot of Standardized Residuals





Modification Indices and Expected Change

Modification Indices for LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	- -
Rcog1	- -	1.824	3.873
Rcog2	- -	1.366	8.566
Rcog3	- -	0.056	0.429
Rcog4	- -	2.896	1.152
Rknow	- -	- -	- -

Expected Change for LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	- -
Rcog1	- -	0.123	-0.059
Rcog2	- -	0.095	0.075
Rcog3	- -	-0.019	-0.016
Rcog4	- -	-0.142	0.030
Rknow	- -	- -	- -

Standardized Expected Change for LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	- -
Rcog1	- -	0.135	-0.208
Rcog2	- -	0.104	0.261
Rcog3	- -	-0.020	-0.057
Rcog4	- -	-0.155	0.104
Rknow	- -	- -	- -

Completely Standardized Expected Change for LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	- -
Rcog1	- -	0.054	-0.084
Rcog2	- -	0.041	0.104
Rcog3	- -	-0.008	-0.023
Rcog4	- -	-0.065	0.043
Rknow	- -	- -	- -

No Non-Zero Modification Indices for PHI

Modification Indices for THETA-DELTA

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	- -					
Rcog1	4.028	- -				
Rcog2	8.408	6.566	- -			
Rcog3	0.421	3.644	- -	- -		
Rcog4	1.252	4.700	9.218	3.891	- -	
Rknow	- -	1.955	1.208	0.049	2.992	- -

Expected Change for THETA-DELTA

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	- -					
Rcog1	-0.736	- -				
Rcog2	0.897	-0.958	- -			
Rcog3	-0.194	0.385	- -	- -		
Rcog4	0.376	-12.916	1.034	-0.363	- -	
Rknow	- -	0.152	0.106	-0.021	-0.172	- -

Completely Standardized Expected Change for THETA-DELTA

	Rcongr	Rcog1	Rcog2	Rcog3	Rcog4	Rknow
Rcongr	- -					
Rcog1	-0.085	- -				
Rcog2	0.102	-0.153	- -			
Rcog3	-0.023	0.064	- -	- -		
Rcog4	0.045	-2.174	0.171	-0.063	- -	
Rknow	- -	0.056	0.039	-0.008	-0.066	- -

Maximum Modification Index is 9.22 for Element (5, 3) of THETA-DELTA

Standardized Solution

LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	3.496
Rcog1	1.958	- -	- -
Rcog2	0.555	- -	- -
Rcog3	0.202	- -	- -
Rcog4	1.786	- -	- -
Rknow	- -	1.090	- -

PHI

	NCW1	knowW1	congrW1
NCW1	1.000		
knowW1	0.051	1.000	
congrW1	-0.096	0.019	1.000

Completely Standardized Solution

LAMBDA-X

	NCW1	knowW1	congrW1
Rcongr	- -	- -	1.000
Rcog1	0.789	- -	- -
Rcog2	0.220	- -	- -
Rcog3	0.084	- -	- -
Rcog4	0.746	- -	- -
Rknow	- -	1.000	- -

PHI

	NCW1	knowW1	congrW1
NCW1	1.000		

knowW1	0.051	1.000	
congrW1	-0.096	0.019	1.000

THETA-DELTA

	Rcongr	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**	**Rknow**
Rcongr	0.000					
Rcog1	- -	0.377				
Rcog2	- -	- -	0.952			
Rcog3	- -	- -	0.527	0.993		
Rcog4	- -	- -	- -	- -	0.444	
Rknow	- -	- -	- -	- -	- -	0.000

Time used: 0.016 Seconds

Hybrid model

Observed variables
Rcongr Rcog1 Rcog2 Rcog3 Rcog4 Rknow
Latent Variables
NCW1 knowW1 congrW1
Correlation Matrix
1.000
-.107 1.000
.104 .166 1.000
.038 .089 .545 1.000
-.050 .588 .179 .036 1.000
.019 .063 .062 .024 .002 1.000
Standard Deviations
3.49587257 2.48022072 2.52593735 2.40730811 2.39499148 1.09008112
Sample size is 554
Relationships
Rcog1 Rcog2 Rcog3 Rcog4 = NCW1
Rknow = 1*knowW1
Rcongr = 1*congrW1
knowW1 = NCW1
congrW1 = NCW1 knowW1
Let the errors of Rcog2 and Rcog3 correlate
Set the variance of Rcongr to 0.0001
Set the variance of Rknow to 0.0001
LISREL Output: ND = 3 ML MI SC RS
Path Diagram
End of Problem

Covariance Matrix

	Rcongr	**Rknow**	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**
Rcongr	12.221					
Rknow	0.072	1.188				
Rcog1	-0.928	0.170	6.151			
Rcog2	0.918	0.171	1.040	6.380		
Rcog3	0.320	0.063	0.531	3.314	5.795	
Rcog4	-0.419	0.005	3.493	1.083	0.208	5.736

Parameter Specifications

LAMBDA-X

	NCW1
Rcog1	1
Rcog2	2
Rcog3	3
Rcog4	4

BETA

	knowW1	congrW1
knowW1	0	0
congrW1	5	0

GAMMA

	NCW1
knowW1	6
congrW1	7

PSI

knowW1	congrW1
8	9

THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	10			
Rcog2	0	11		
Rcog3	0	12	13	
Rcog4	0	0	0	14

Number of Iterations = 7

LISREL Estimates (Maximum Likelihood)

LAMBDA-Y

	knowW1	congrW1
Rcongr	- -	1.000
Rknow	1.000	- -

LAMBDA-X

	NCW1
Rcog1	1.958
	(0.214)
	9.133
Rcog2	0.555
	(0.123)
	4.512
Rcog3	0.202
	(0.118)
	1.703
Rcog4	1.786
	(0.198)
	9.001

BETA

	knowW1	congrW1
knowW1	- -	- -
congrW1	0.077	- -
	(0.136)	
	0.563	

GAMMA

	NCW1
knowW1	0.055
	(0.054)
	1.033
congrW1	-0.339
	(0.172)
	-1.971

Covariance Matrix of ETA and KSI

knowW1	congrW1	NCW1

knowW1	1.188		
congrW1	0.072	12.221	
NCW1	0.055	-0.334	1.000

PHI

NCW1
1.000

PSI

Note: This matrix is diagonal.

knowW1	**congrW1**
1.185	12.102
(0.071)	(0.730)
16.612	16.575

Squared Multiple Correlations for Structural Equations

knowW1	**congrW1**
0.003	0.010

Squared Multiple Correlations for Reduced Form

knowW1	**congrW1**
0.003	0.009

Reduced Form

	NCW1
knowW1	0.055
	(0.054)
	1.033
congrW1	-0.334
	(0.172)
	-1.949

THETA-EPS

Rcongr	Rknow
0.000	0.000

Squared Multiple Correlations for Y - Variables

Rcongr	Rknow
1.000	1.000

THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	2.317 (0.779) 2.974			
Rcog2	- -	6.072 (0.372) 16.337		
Rcog3	- -	3.202 (0.289) 11.085	5.754 (0.347) 16.588	
Rcog4	- -	- -	- -	2.547 (0.656) 3.885

Squared Multiple Correlations for X - Variables

Rcog1	Rcog2	Rcog3	Rcog4
0.623	0.048	0.007	0.556

Goodness of Fit Statistics

Degrees of Freedom = 7
Minimum Fit Function Chi-Square = 19.560 (P = 0.00660)
Normal Theory Weighted Least Squares Chi-Square = 19.562 (P = 0.00660)
Estimated Non-centrality Parameter (NCP) = 12.562
90 Percent Confidence Interval for NCP = (3.003 ; 29.740)

Minimum Fit Function Value = 0.0354
Population Discrepancy Function Value (F0) = 0.0227
90 Percent Confidence Interval for F0 = (0.00543 ; 0.0538)
Root Mean Square Error of Approximation (RMSEA) = 0.0570

90 Percent Confidence Interval for RMSEA = (0.0279 ; 0.0877)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.308

Expected Cross-Validation Index (ECVI) = 0.0860
90 Percent Confidence Interval for ECVI = (0.0687 ; 0.117)
ECVI for Saturated Model = 0.0759
ECVI for Independence Model = 0.768

Chi-Square for Independence Model with 15 Degrees of Freedom = 412.840
Independence AIC = 424.840
Model AIC = 47.562
Saturated AIC = 42.000
Independence CAIC = 456.743
Model CAIC = 122.003
Saturated CAIC = 153.660

Normed Fit Index (NFI) = 0.953
Non-Normed Fit Index (NNFI) = 0.932
Parsimony Normed Fit Index (PNFI) = 0.445
Comparative Fit Index (CFI) = 0.968
Incremental Fit Index (IFI) = 0.969
Relative Fit Index (RFI) = 0.898

Critical N (CN) = 523.340

Root Mean Square Residual (RMR) = 0.273
Standardized RMR = 0.0348
Goodness of Fit Index (GFI) = 0.988
Adjusted Goodness of Fit Index (AGFI) = 0.965
Parsimony Goodness of Fit Index (PGFI) = 0.329

Fitted Covariance Matrix

	Rcongr	**Rknow**	**Rcog1**	**Rcog2**	**Rcog3**	**Rcog4**
Rcongr	12.221					
Rknow	0.072	1.188				
Rcog1	-0.655	0.108	6.151			
Rcog2	-0.186	0.031	1.087	6.380		
Rcog3	-0.067	0.011	0.395	3.314	5.795	
Rcog4	-0.597	0.099	3.497	0.992	0.360	5.736

Fitted Residuals

	Rcongr	Rknow	Rcog1	Rcog2	Rcog3	Rcog4
Rcongr	0.000					
Rknow	0.000	0.000				
Rcog1	-0.273	0.062	0.000			
Rcog2	1.104	0.140	-0.047	0.000		
Rcog3	0.387	0.052	0.136	0.000	0.000	
Rcog4	0.179	-0.094	-0.004	0.091	-0.153	0.000

Summary Statistics for Fitted Residuals

Smallest Fitted Residual = -0.273
Median Fitted Residual = 0.000
Largest Fitted Residual = 1.104

Stemleaf Plot

- 0|3210000000000
0|1111124
0|
1|1

Standardized Residuals

	Rcongr	Rknow	Rcog1	Rcog2	Rcog3	Rcog4
Rcongr	- -					
Rknow	- -	- -				
Rcog1	-1.968	1.351	- -			
Rcog2	3.060	1.238	-0.961	- -		
Rcog3	1.094	0.467	1.414	- -	- -	
Rcog4	1.073	-1.702	-2.166	1.535	-1.314	- -

Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -2.166
Median Standardized Residual = 0.000
Largest Standardized Residual = 3.060

Stemleaf Plot

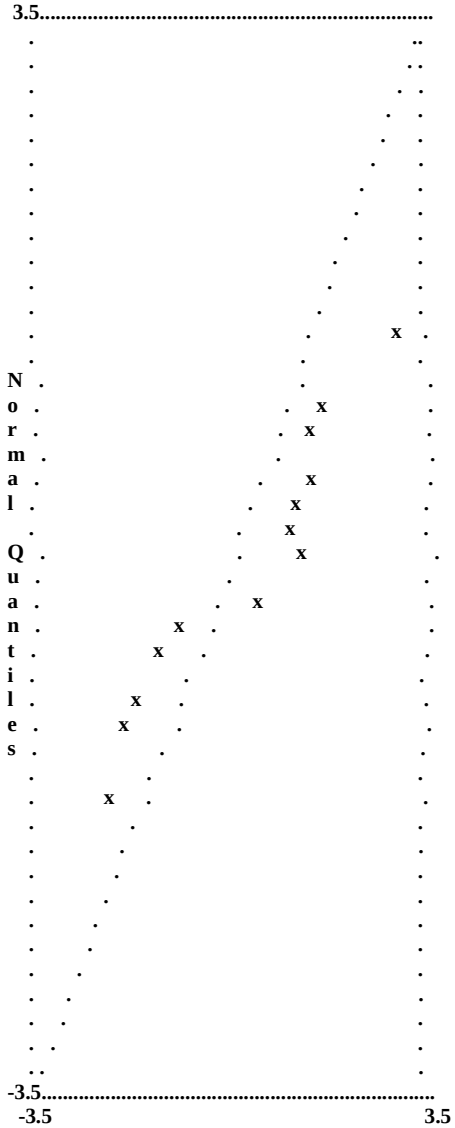
- 2|20

- 0|73000000000
  0|5112445
  2|1

Largest Positive Standardized Residuals

Residual for	**Rcog2**	and	**Rcongr**	**3.060**

Qplot of Standardized Residuals



Modification Indices and Expected Change

No Non-Zero Modification Indices for LAMBDA-Y

No Non-Zero Modification Indices for LAMBDA-X

No Non-Zero Modification Indices for BETA

No Non-Zero Modification Indices for GAMMA

No Non-Zero Modification Indices for PHI

No Non-Zero Modification Indices for PSI

Modification Indices for THETA-DELTA-EPS

	Rcongr	Rknow
Rcog1	4.028	1.955
Rcog2	8.408	1.208
Rcog3	0.421	0.049
Rcog4	1.252	2.992

Expected Change for THETA-DELTA-EPS

	Rcongr	Rknow
Rcog1	-0.736	0.152
Rcog2	0.897	0.106
Rcog3	-0.194	-0.021
Rcog4	0.376	-0.172

Completely Standardized Expected Change for THETA-DELTA-EPS

	Rcongr	Rknow
Rcog1	-0.085	0.056
Rcog2	0.102	0.039
Rcog3	-0.023	-0.008
Rcog4	0.045	-0.066

Modification Indices for THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	- -			
Rcog2	6.566	- -		
Rcog3	3.644	- -	- -	
Rcog4	4.688	9.218	3.891	- -

Expected Change for THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	- -			
Rcog2	-0.958	- -		
Rcog3	0.385	- -	- -	
Rcog4	-12.900	1.034	-0.363	- -

Completely Standardized Expected Change for THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	- -			
Rcog2	-0.153	- -		
Rcog3	0.064	- -	- -	
Rcog4	-2.172	0.171	-0.063	- -

Maximum Modification Index is 9.22 for Element (4, 2) of THETA-DELTA

Standardized Solution

LAMBDA-Y

	knowW1	congrW1
Rcongr	- -	3.496
Rknow	1.090	- -

LAMBDA-X

	NCW1
Rcog1	1.958

Rcog2	0.555
Rcog3	0.202
Rcog4	1.786

BETA

	knowW1	**congrW1**
knowW1	- -	- -
congrW1	0.024	- -

GAMMA

	NCW1
knowW1	0.051
congrW1	-0.097

Correlation Matrix of ETA and KSI

	knowW1	**congrW1**	**NCW1**
knowW1	1.000		
congrW1	0.019	1.000	
NCW1	0.051	-0.096	1.000

PSI

Note: This matrix is diagonal.

knowW1	**congrW1**
0.997	0.990

Regression Matrix ETA on KSI (Standardized)

	NCW1
knowW1	0.051
congrW1	-0.096

Completely Standardized Solution

LAMBDA-Y

	knowW1	congrW1
Rcongr	- -	1.000
Rknow	1.000	- -

LAMBDA-X

	NCW1
Rcog1	0.789
Rcog2	0.220
Rcog3	0.084
Rcog4	0.746

BETA

	knowW1	congrW1
knowW1	- -	- -
congrW1	0.024	- -

GAMMA

	NCW1
knowW1	0.051
congrW1	-0.097

Correlation Matrix of ETA and KSI

	knowW1	congrW1	NCW1
knowW1	1.000		
congrW1	0.019	1.000	
NCW1	0.051	-0.096	1.000

PSI

Note: This matrix is diagonal.

knowW1	congrW1
0.997	0.990

THETA-EPS

Rcongr	Rknow
0.000	0.000

THETA-DELTA

	Rcog1	Rcog2	Rcog3	Rcog4
Rcog1	0.377			
Rcog2	- -	0.952		
Rcog3	- -	0.527	0.993	
Rcog4	- -	- -	- -	0.444

Regression Matrix ETA on KSI (Standardized)

	NCW1
knowW1	0.051
congrW1	-0.096

Time used: 0.016 Seconds

Wave 2

Measurement model

Observed variables
RcongrW2 Rcog1W2 Rcog2W2 Rcog3W2 Rcog4W2 RknowW2
Latent Variables
NCW2 knowW2 congrW2
Correlation Matrix
1.000
-.031 1.000
-.054 .049 1.000
-.021 .096 .430 1.000
.025 .528 .096 .018 1.000
.076 .074 .122 .106 .071 1.000
Standard Deviations
3.47328315 2.41755288 2.60442741 2.27321624 2.33695271 .95114500
Sample size is 969
Relationships
Rcog1W2 Rcog2W2 Rcog3W2 Rcog4W2 = NCW2
RknowW2 = 1*knowW2
RcongrW2 = 1*congrW2
Let the errors of Rcog1W2 and Rcog4W2 correlate
Set the variance of RcongrW2 to 0.0001
Set the variance of RknowW2 to 0.0001
LISREL Output: ND = 3 ML MI SC RS
Path Diagram
End of Problem

Covariance Matrix

	RcongrW2	**Rcog1W2**	**Rcog2W2**	**Rcog3W2**	**Rcog4W2**	**RknowW2**
RcongrW2	12.064					
Rcog1W2	-0.260	5.845				
Rcog2W2	-0.488	0.309	6.783			
Rcog3W2	-0.166	0.528	2.546	5.168		
Rcog4W2	0.203	2.983	0.584	0.096	5.461	
RknowW2	0.251	0.170	0.302	0.229	0.158	0.905

Parameter Specifications

LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	0	0	0
Rcog1W2	1	0	0
Rcog2W2	2	0	0
Rcog3W2	3	0	0
Rcog4W2	4	0	0
RknowW2	0	0	0

PHI

	NCW2	knowW2	congrW2
NCW2	0		
knowW2	5	6	
congrW2	7	8	9

THETA-DELTA

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	0					
Rcog1W2	0	10				
Rcog2W2	0	0	11			
Rcog3W2	0	0	0	12		
Rcog4W2	0	13	0	0	14	
RknowW2	0	0	0	0	0	0

Number of Iterations = 33

LISREL Estimates (Maximum Likelihood)

LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	1.000
Rcog1W2	0.258 (0.098) 2.625	- -	- -
Rcog2W2	1.878 (0.232) 8.097	- -	- -

Rcog3W2	1.352	- -	- -
	(0.172)		
	7.856		
Rcog4W2	0.241	- -	- -
	(0.095)		
	2.535		
RknowW2	- -	1.000	- -

PHI

	NCW2	**knowW2**	**congrW2**
NCW2	1.000		
knowW2	0.168	0.905	
	(0.039)	(0.041)	
	4.312	21.998	
congrW2	-0.213	0.251	12.064
	(0.142)	(0.106)	(0.548)
	-1.506	2.358	22.000

THETA-DELTA

	RcongrW2	**Rcog1W2**	**Rcog2W2**	**Rcog3W2**	**Rcog4W2**	**RknowW2**
RcongrW2	0.000					
Rcog1W2	- -	5.778				
		(0.264)				
		21.844				
Rcog2W2	- -	- -	3.256			
			(0.841)			
			3.870			
Rcog3W2	- -	- -	- -	3.339		
				(0.456)		
				7.327		
Rcog4W2	- -	2.921	- -	- -	5.403	
		(0.204)			(0.247)	
		14.295			21.855	
RknowW2	- -	- -	- -	- -	- -	0.000

Squared Multiple Correlations for X - Variables

RcongrW2	**Rcog1W2**	**Rcog2W2**	**Rcog3W2**	**Rcog4W2**	**RknowW2**
1.000	0.011	0.520	0.354	0.011	1.000

Goodness of Fit Statistics

Degrees of Freedom = 7
Minimum Fit Function Chi-Square = 22.728 (P = 0.00190)
Normal Theory Weighted Least Squares Chi-Square = 22.199 (P = 0.00235)
Estimated Non-centrality Parameter (NCP) = 15.199
90 Percent Confidence Interval for NCP = (4.596 ; 33.393)

Minimum Fit Function Value = 0.0235
Population Discrepancy Function Value (F0) = 0.0157
90 Percent Confidence Interval for F0 = (0.00475 ; 0.0345)
Root Mean Square Error of Approximation (RMSEA) = 0.0474
90 Percent Confidence Interval for RMSEA = (0.0260 ; 0.0702)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.536

Expected Cross-Validation Index (ECVI) = 0.0519
90 Percent Confidence Interval for ECVI = (0.0409 ; 0.0707)
ECVI for Saturated Model = 0.0434
ECVI for Independence Model = 0.545

Chi-Square for Independence Model with 15 Degrees of Freedom = 515.167
Independence AIC = 527.167
Model AIC = 50.199
Saturated AIC = 42.000
Independence CAIC = 562.424
Model CAIC = 132.467
Saturated CAIC = 165.402

Normed Fit Index (NFI) = 0.956
Non-Normed Fit Index (NNFI) = 0.933
Parsimony Normed Fit Index (PNFI) = 0.446
Comparative Fit Index (CFI) = 0.969
Incremental Fit Index (IFI) = 0.969
Relative Fit Index (RFI) = 0.905

Critical N (CN) = 787.902

Root Mean Square Residual (RMR) = 0.118
Standardized RMR = 0.0239
Goodness of Fit Index (GFI) = 0.992
Adjusted Goodness of Fit Index (AGFI) = 0.977
Parsimony Goodness of Fit Index (PGFI) = 0.331

Fitted Covariance Matrix

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	12.064					
Rcog1W2	-0.055	5.845				
Rcog2W2	-0.401	0.485	6.783			
Rcog3W2	-0.289	0.349	2.540	5.168		
Rcog4W2	-0.051	2.983	0.453	0.326	5.461	
RknowW2	0.251	0.043	0.316	0.227	0.041	0.905

Fitted Residuals

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	0.000					
Rcog1W2	-0.205	0.000				
Rcog2W2	-0.088	-0.177	0.000			
Rcog3W2	0.123	0.178	0.006	0.000		
Rcog4W2	0.254	0.000	0.131	-0.231	0.000	
RknowW2	0.000	0.127	-0.014	0.002	0.117	0.000

Summary Statistics for Fitted Residuals

Smallest Fitted Residual = -0.231
Median Fitted Residual = 0.000
Largest Fitted Residual = 0.254

Stemleaf Plot

- 2|31
- 1|8
- 0|91000000000
  0|1
  1|22338
  2|5

Standardized Residuals

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	- -					
Rcog1W2	-0.770	- -				
Rcog2W2	-0.775	-2.420	- -			
Rcog3W2	0.766	1.732	1.881	- -		

Rcog4W2	0.987	- -	1.841	-2.298	- -	
RknowW2	- -	1.777	-0.686	0.061	1.700	- -

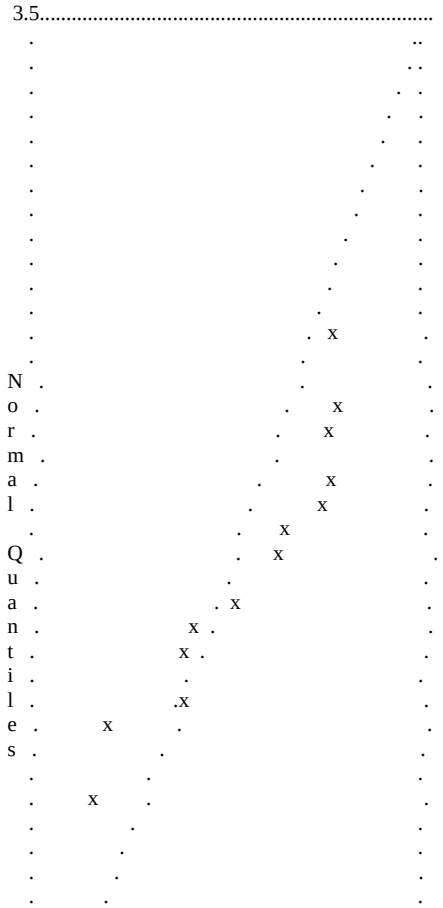
Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -2.420
Median Standardized Residual = 0.000
Largest Standardized Residual = 1.881

Stemleaf Plot

- 2|43
- 1|
- 0|88700000000
0|18
1|077889

Qplot of Standardized Residuals



Modification Indices and Expected Change

Modification Indices for LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	- -
Rcog1W2	- -	1.079	2.263
Rcog2W2	- -	0.471	0.600
Rcog3W2	- -	0.004	0.586
Rcog4W2	- -	0.814	2.641
RknowW2	- -	- -	- -

Expected Change for LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	- -
Rcog1W2	- -	0.074	-0.029
Rcog2W2	- -	-0.116	-0.023
Rcog3W2	- -	0.007	0.016
Rcog4W2	- -	0.062	0.030
RknowW2	- -	- -	- -

Standardized Expected Change for LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	- -
Rcog1W2	- -	0.070	-0.100
Rcog2W2	- -	-0.110	-0.080
Rcog3W2	- -	0.007	0.057
Rcog4W2	- -	0.059	0.104
RknowW2	- -	- -	- -

Completely Standardized Expected Change for LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	- -
Rcog1W2	- -	0.029	-0.041
Rcog2W2	- -	-0.042	-0.031
Rcog3W2	- -	0.003	0.025
Rcog4W2	- -	0.025	0.044
RknowW2	- -	- -	- -

No Non-Zero Modification Indices for PHI

Modification Indices for THETA-DELTA

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	- -					
Rcog1W2	2.569	- -				
Rcog2W2	0.571	13.369	- -			
Rcog3W2	0.613	10.138	3.530	- -		
Rcog4W2	2.413	- -	11.160	11.972	- -	
RknowW2	- -	1.388	0.381	0.002	0.579	- -

Expected Change for THETA-DELTA

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	- -					
Rcog1W2	-0.366	- -				
Rcog2W2	-0.275	-0.762	- -			
Rcog3W2	0.206	0.485	6.586	- -		
Rcog4W2	0.343	- -	0.668	-0.506	- -	
RknowW2	- -	0.073	-0.096	-0.005	0.046	- -

Completely Standardized Expected Change for THETA-DELTA

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	- -					
Rcog1W2	-0.044	- -				
Rcog2W2	-0.030	-0.121	- -			
Rcog3W2	0.026	0.088	1.112	- -		
Rcog4W2	0.042	- -	0.110	-0.095	- -	
RknowW2	- -	0.032	-0.039	-0.002	0.021	- -

Maximum Modification Index is 13.37 for Element (3, 2) of THETA-DELTA

Standardized Solution

LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	3.473
Rcog1W2	0.258	- -	- -
Rcog2W2	1.878	- -	- -
Rcog3W2	1.352	- -	- -
Rcog4W2	0.241	- -	- -
RknowW2	- -	0.951	- -

PHI

	NCW2	knowW2	congrW2
NCW2	1.000		
knowW2	0.177	1.000	
congrW2	-0.061	0.076	1.000

Completely Standardized Solution

LAMBDA-X

	NCW2	knowW2	congrW2
RcongrW2	- -	- -	1.000
Rcog1W2	0.107	- -	- -
Rcog2W2	0.721	- -	- -
Rcog3W2	0.595	- -	- -
Rcog4W2	0.103	- -	- -
RknowW2	- -	1.000	- -

PHI

	NCW2	knowW2	congrW2
NCW2	1.000		
knowW2	0.177	1.000	

congrW2	-0.061	0.076	1.000

THETA-DELTA

	RcongrW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2	RknowW2
RcongrW2	0.000					
Rcog1W2	- -	0.989				
Rcog2W2	- -	- -	0.480			
Rcog3W2	- -	- -	- -	0.646		
Rcog4W2	- -	0.517	- -	- -	0.989	
RknowW2	- -	- -	- -	- -	- -	0.000

Time used: 0.016 Seconds

Hybrid model

Observed variables
RcongrW2 Rcog1W2 Rcog2W2 Rcog3W2 Rcog4W2 RknowW2
Latent Variables
NCW2 knowW2 congrW2
Correlation Matrix
1.000
-.031 1.000
-.054 .049 1.000
-.021 .096 .430 1.000
.025 .528 .096 .018 1.000
.076 .074 .122 .106 .071 1.000
Standard Deviations
3.47328315 2.41755288 2.60442741 2.27321624 2.33695271 .95114500
Sample size is 969
Relationships
Rcog1W2 Rcog2W2 Rcog3W2 Rcog4W2 = NCW2
RknowW2 = 1*knowW2
RcongrW2 = 1*congrW2
knowW2 = NCW2
congrW2 = NCW2 knowW2
Let the errors of Rcog1W2 and Rcog4W2 correlate
Set the variance of RcongrW2 to 0.0001
Set the variance of RknowW2 to 0.0001
LISREL Output: ND = 3 ML MI SC RS
Path Diagram
End of Problem

Covariance Matrix

	RcongrW2	**RknowW2**	**Rcog1W2**	**Rcog2W2**	**Rcog3W2**	**Rcog4W2**
RcongrW2	12.064					
RknowW2	0.251	0.905				
Rcog1W2	-0.260	0.170	5.845			
Rcog2W2	-0.488	0.302	0.309	6.783		
Rcog3W2	-0.166	0.229	0.528	2.546	5.168	
Rcog4W2	0.203	0.158	2.983	0.584	0.096	5.461

Parameter Specifications

LAMBDA-X

	NCW2
Rcog1W2	1
Rcog2W2	2
Rcog3W2	3
Rcog4W2	4

BETA

	knowW2	congrW2
knowW2	0	0
congrW2	5	0

GAMMA

	NCW2
knowW2	6
congrW2	7

PSI

knowW2	congrW2
8	9

THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	10			
Rcog2W2	0	11		
Rcog3W2	0	0	12	
Rcog4W2	13	0	0	14

Number of Iterations = 20

LISREL Estimates (Maximum Likelihood)

LAMBDA-Y

	knowW2	congrW2
RcongrW2	- -	1.000
RknowW2	1.000	- -

LAMBDA-X

	NCW2
Rcog1W2	0.258
	(0.098)
	2.625
Rcog2W2	1.878
	(0.232)
	8.097
Rcog3W2	1.352
	(0.172)
	7.856
Rcog4W2	0.241
	(0.095)
	2.535

BETA

	knowW2	congrW2
knowW2	- -	- -
congrW2	0.327	- -
	(0.120)	
	2.728	

GAMMA

	NCW2
knowW2	0.168
	(0.039)
	4.312
congrW2	-0.268
	(0.144)
	-1.858

Covariance Matrix of ETA and KSI

	knowW2	congrW2	NCW2

knowW2	0.905		
congrW2	0.251	12.064	
NCW2	0.168	-0.213	1.000

PHI

NCW2
1.000

PSI

Note: This matrix is diagonal.

knowW2	**congrW2**
0.876	11.924
(0.041)	(0.544)
21.541	21.918

Squared Multiple Correlations for Structural Equations

knowW2	**congrW2**
0.031	0.012

Squared Multiple Correlations for Reduced Form

knowW2	**congrW2**
0.031	0.004

Reduced Form

	NCW2
knowW2	0.168
	(0.039)
	4.312
congrW2	-0.213
	(0.142)
	-1.506

THETA-EPS

RcongrW2	RknowW2
0.000	0.000

Squared Multiple Correlations for Y - Variables

RcongrW2	RknowW2
1.000	1.000

THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	5.778 (0.264) 21.844			
Rcog2W2	- -	3.256 (0.841) 3.870		
Rcog3W2	- -	- -	3.339 (0.456) 7.327	
Rcog4W2	2.921 (0.204) 14.295	- -	- -	5.403 (0.247) 21.855

Squared Multiple Correlations for X - Variables

Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
0.011	0.520	0.354	0.011

Goodness of Fit Statistics

Degrees of Freedom = 7
Minimum Fit Function Chi-Square = 22.728 (P = 0.00190)
Normal Theory Weighted Least Squares Chi-Square = 22.199 (P = 0.00235)
Estimated Non-centrality Parameter (NCP) = 15.199
90 Percent Confidence Interval for NCP = (4.596 ; 33.393)

Minimum Fit Function Value = 0.0235
Population Discrepancy Function Value (F0) = 0.0157
90 Percent Confidence Interval for F0 = (0.00475 ; 0.0345)
Root Mean Square Error of Approximation (RMSEA) = 0.0474

90 Percent Confidence Interval for RMSEA = (0.0260 ; 0.0702)
P-Value for Test of Close Fit (RMSEA < 0.05) = 0.536

Expected Cross-Validation Index (ECVI) = 0.0519
90 Percent Confidence Interval for ECVI = (0.0409 ; 0.0707)
ECVI for Saturated Model = 0.0434
ECVI for Independence Model = 0.545

Chi-Square for Independence Model with 15 Degrees of Freedom = 515.167
Independence AIC = 527.167
Model AIC = 50.199
Saturated AIC = 42.000
Independence CAIC = 562.424
Model CAIC = 132.467
Saturated CAIC = 165.402

Normed Fit Index (NFI) = 0.956
Non-Normed Fit Index (NNFI) = 0.933
Parsimony Normed Fit Index (PNFI) = 0.446
Comparative Fit Index (CFI) = 0.969
Incremental Fit Index (IFI) = 0.969
Relative Fit Index (RFI) = 0.905

Critical N (CN) = 787.902

Root Mean Square Residual (RMR) = 0.118
Standardized RMR = 0.0239
Goodness of Fit Index (GFI) = 0.992
Adjusted Goodness of Fit Index (AGFI) = 0.977
Parsimony Goodness of Fit Index (PGFI) = 0.331

Fitted Covariance Matrix

	RcongrW2	**RknowW2**	**Rcog1W2**	**Rcog2W2**	**Rcog3W2**	**Rcog4W2**
RcongrW2	12.064					
RknowW2	0.251	0.905				
Rcog1W2	-0.055	0.043	5.845			
Rcog2W2	-0.401	0.316	0.485	6.783		
Rcog3W2	-0.289	0.227	0.349	2.540	5.168	
Rcog4W2	-0.051	0.041	2.983	0.453	0.326	5.461

Fitted Residuals

	RcongrW2	RknowW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
RcongrW2	0.000					
RknowW2	0.000	0.000				
Rcog1W2	-0.205	0.127	0.000			
Rcog2W2	-0.088	-0.014	-0.177	0.000		
Rcog3W2	0.123	0.002	0.178	0.006	0.000	
Rcog4W2	0.254	0.117	0.000	0.131	-0.231	0.000

Summary Statistics for Fitted Residuals

Smallest Fitted Residual = -0.231
Median Fitted Residual = 0.000
Largest Fitted Residual = 0.254

Stemleaf Plot

- 2|31
- 1|8
- 0|91000000000
0|1
1|22338
2|5

Standardized Residuals

	RcongrW2	RknowW2	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
RcongrW2	- -					
RknowW2	- -	- -				
Rcog1W2	-0.770	1.777	- -			
Rcog2W2	-0.775	-0.686	-2.421	- -		
Rcog3W2	0.765	0.061	1.732	1.880	- -	
Rcog4W2	0.987	1.700	- -	1.841	-2.298	- -

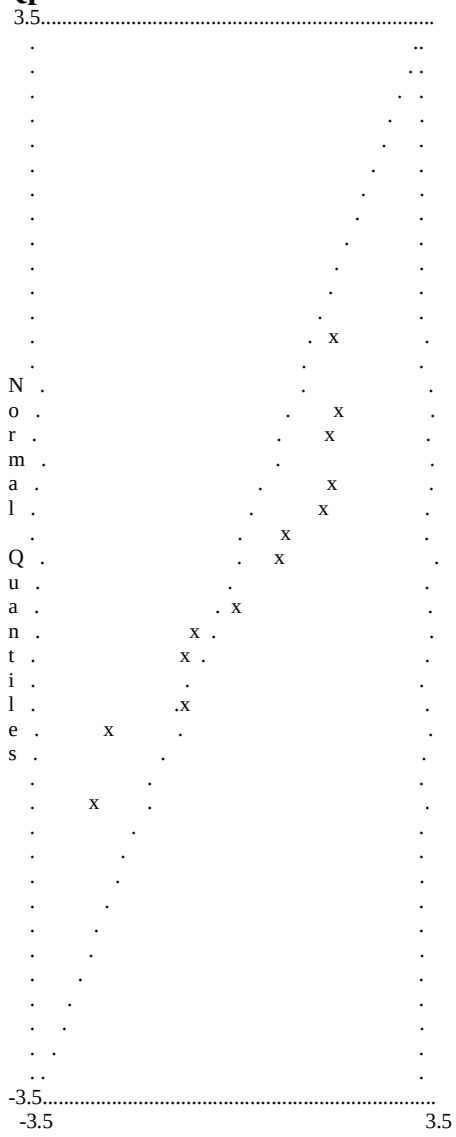
Summary Statistics for Standardized Residuals

Smallest Standardized Residual = -2.421
Median Standardized Residual = 0.000
Largest Standardized Residual = 1.880

Stemleaf Plot

- 2|43
- 1|
- 0|88700000000
  0|18
  1|077889

Qplot of Standardized Residuals



Modification Indices and Expected Change

No Non-Zero Modification Indices for LAMBDA-Y

No Non-Zero Modification Indices for LAMBDA-X

No Non-Zero Modification Indices for BETA

No Non-Zero Modification Indices for GAMMA

No Non-Zero Modification Indices for PHI

No Non-Zero Modification Indices for PSI

Modification Indices for THETA-DELTA-EPS

	RcongrW2	**RknowW2**
Rcog1W2	2.569	1.388
Rcog2W2	0.571	0.381
Rcog3W2	0.613	0.002
Rcog4W2	2.413	0.579

Expected Change for THETA-DELTA-EPS

	RcongrW2	**RknowW2**
Rcog1W2	-0.366	0.073
Rcog2W2	-0.275	-0.097
Rcog3W2	0.206	-0.005
Rcog4W2	0.343	0.046

Completely Standardized Expected Change for THETA-DELTA-EPS

	RcongrW2	**RknowW2**
Rcog1W2	-0.044	0.032
Rcog2W2	-0.030	-0.039
Rcog3W2	0.026	-0.002
Rcog4W2	0.042	0.021

Modification Indices for THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	- -			
Rcog2W2	13.369	- -		
Rcog3W2	10.138	3.535	- -	
Rcog4W2	- -	11.159	11.972	- -

Expected Change for THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	- -			
Rcog2W2	-0.762	- -		
Rcog3W2	0.485	6.590	- -	
Rcog4W2	- -	0.668	-0.506	- -

Completely Standardized Expected Change for THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	- -			
Rcog2W2	-0.121	- -		
Rcog3W2	0.088	1.113	- -	
Rcog4W2	- -	0.110	-0.095	- -

Maximum Modification Index is 13.37 for Element (2, 1) of THETA-DELTA

Standardized Solution

LAMBDA-Y

	knowW2	congrW2
RcongrW2	- -	3.473
RknowW2	0.951	- -

LAMBDA-X

	NCW2
Rcog1W2	0.258
Rcog2W2	1.878
Rcog3W2	1.352

Rcog4W2	0.241

BETA

	knowW2	congrW2
knowW2	- -	- -
congrW2	0.090	- -

GAMMA

	NCW2
knowW2	0.177
congrW2	-0.077

Correlation Matrix of ETA and KSI

	knowW2	congrW2	NCW2
knowW2	1.000		
congrW2	0.076	1.000	
NCW2	0.177	-0.061	1.000

PSI

Note: This matrix is diagonal.

knowW2	congrW2
0.969	0.988

Regression Matrix ETA on KSI (Standardized)

	NCW2
knowW2	0.177
congrW2	-0.061

Completely Standardized Solution

LAMBDA-Y

	knowW2	congrW2
RcongrW2	- -	1.000
RknowW2	1.000	- -

LAMBDA-X

	NCW2
Rcog1W2	0.107
Rcog2W2	0.721
Rcog3W2	0.595
Rcog4W2	0.103

BETA

	knowW2	congrW2
knowW2	- -	- -
congrW2	0.090	- -

GAMMA

	NCW2
knowW2	0.177
congrW2	-0.077

Correlation Matrix of ETA and KSI

	knowW2	congrW2	NCW2
knowW2	1.000		
congrW2	0.076	1.000	
NCW2	0.177	-0.061	1.000

PSI

Note: This matrix is diagonal.

knowW2	congrW2
0.969	0.988

THETA-EPS

RcongrW2	RknowW2
0.000	0.000

THETA-DELTA

	Rcog1W2	Rcog2W2	Rcog3W2	Rcog4W2
Rcog1W2	0.989			
Rcog2W2	- -	0.480		
Rcog3W2	- -	- -	0.646	
Rcog4W2	0.517	- -	- -	0.989

Regression Matrix ETA on KSI (Standardized)

	NCW2
knowW2	0.177
congrW2	-0.061

Time used: 0.000 Seconds