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FROM THE MUNDANE TO THE PROFOUND: DEVELOPING A POLITICAL MODEL OF WEATHER INFORMATION PROCESSING AND CLIMATE CHANGE BELIEFS

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FROM THE MUNDANE TO THE PROFOUND: DEVELOPING A POLITICAL MODEL OF WEATHER INFORMATION PROCESSING AND CLIMATE CHANGE BELIEFS

A DISSERTATION APPROVED FOR THE
DEPARTMENT OF POLITICAL SCIENCE

BY

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Contents

Abstract

This dissertation examines the relationships between the mundane, our daily habits of weather information collection, and the profound, our beliefs about climate change and relevant policy solutions. Climate change is a hotly contested, highly partisan policy issue which results in many conflicting models of information processing. Weather information, such as daily temperature and precipitation forecasts, on the other hand is much less controversial. However, this information is often portrayed in the context of climate information, relying on portrayals of averages and extremes over longer periods of time. This type of information can therefore bypass many of the filters, such as identity and emotion, that are frequently applied to climate and news information. Using a variety of cross-sectional quantitative analyses, I examine these relationships between the mundane, weather information, and the profound, climate change beliefs. Findings first suggest individual differences help explain patterns of usage of weather information. I also find that some, but not all, weather information sources are related to climate change beliefs and in varying ways. These findings suggest not all weather information is processed in the same manner; rather, some sources may activate relevant filters while others do not. Finally, I find that information and beliefs about climate change help explain policy preferences.

Chapter 1

Individual Models of Information Processing and Belief Formation

1.1 Introduction

How, when, and to what extent do our everyday actions influence our fundamental political beliefs? This dissertation will examine this essential question using data on the relationship between how individuals find weather information, for many an everyday process, and their beliefs about the existence and risk of climate change. Everyday, individuals make choices among a variety of sources to check the upcoming weather. This weather information is often necessarily presented in the context of climate. Meteorologists discuss concepts such as historically high temperatures while weather apps often display record temperatures and seasonal average rainfall amounts. These descriptions are vital to individuals' understanding of what to expect on any given day. The fact that today may be hotter or wetter than usual, than average, informs a variety of other daily decisions. Relying on this intricate link between weather and climate change, I

posit in this dissertation that individual behaviors in checking the weather, which sources they use, will have a relationship with their climate change beliefs. Using unique survey data, I can examine how individuals' information search patterns are related to their beliefs about climate change. I ask first, if patterns of weather information search exist and what characterizes them. I then examine how these patterns and the sources that comprise the information search patterns are related to climate change beliefs. I examine these questions within a whole model of individual information processing, accounting for other information search processes such as news use that affect belief formation. Finally, I investigate potential explanations for climate policy preferences focusing on climate change beliefs and everyday experiences of weather.

In a more specific sense, this project then has the overarching goal of establishing a model of the effect of weather information search behaviors on the development of climate change beliefs among the public. Put simply, individuals first search for or receive information from a variety of sources. They then process this information in particular ways, resulting in changes to (or not) in beliefs. Two competing information processing hypotheses result: either individuals act as 1) Bayesian updaters and adjust their beliefs to new information or 2) they act in a motivated way and do not adjust their beliefs accordingly. To elicit and describe a full model of this process I synthesize the literatures on Risk Information Searching and Processing (RISP), primarily developed in communication (Griffin, Dunwoody and Neuwirth, 1999), and theories of motivated reasoning, primarily developed in psychology though highly influential in political science (Kunda, 1990; Taber and Lodge, 2006), with the political science literature on public opinion (Converse, 2006; Zaller, 1992; Achen, 1975; Herron and Jenkins-Smith, 2006). Figure 1.1 graphically represents the results of these

efforts.

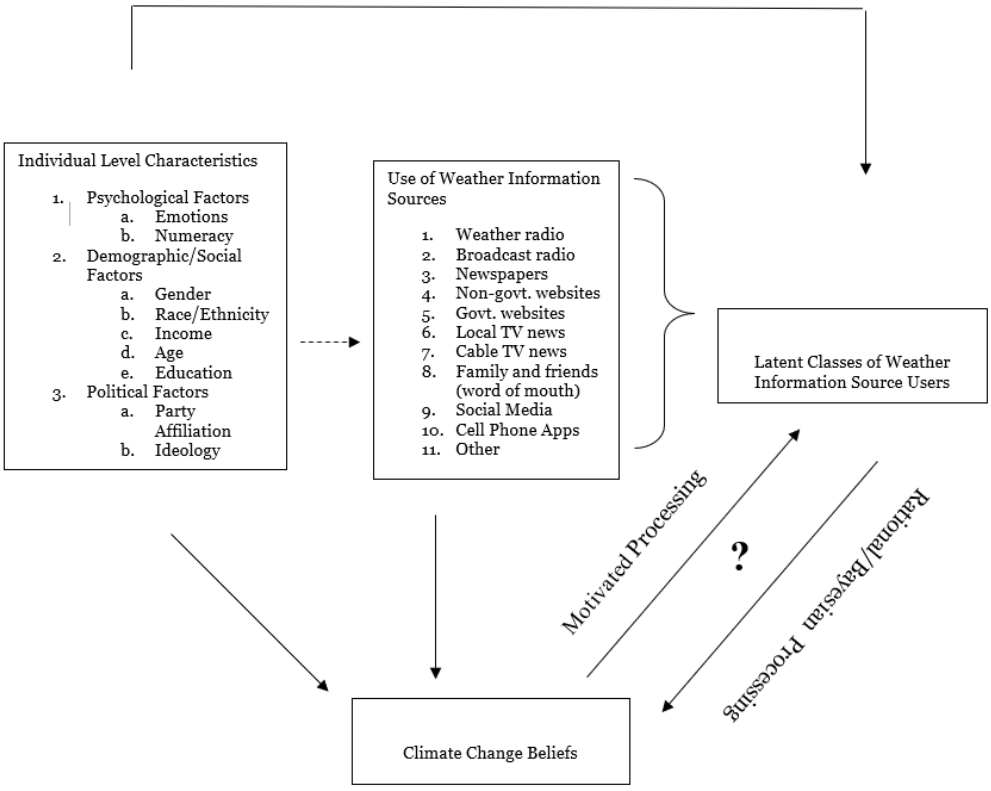


Figure 1.1: Model of Weather Information Processing

This figure represents the interaction of a variety of theories and concepts. What is important to note is the centrality of weather information search behaviors and subsequent processing. One potentially important element of this processing is the match between forecasted weather and experienced weather. As predicted and actual weather match more frequently, associated climate messaging, positive or negative, may be more persuasive. Thus, the daily nature of

weather forecasts may have a strong cumulative effect on climate change beliefs. These behaviors are unlike other elements in the figure because of their daily, if not more frequent, nature for most individuals; Lazo, Morss and Demuth (2009) estimate individuals obtain forecasts 115 times per month, or almost 4 times a day. In political science, most attention, it seems, is dedicated to phenomenon that only occur occasionally – elections, appointments, etc. Studies of belief formation and public opinion, in particular the effects of media and news, consider the effects of daily activities (Behr and Iyengar (1985); Iyengar and Kinder (2010); in a comparative context, see Curran et al. (2009)); however, these studies tend to focus primarily on the effect of political and politicized information and information sources on political beliefs and behaviors (see Prior (2007) for a notable exception). However, the majority of the information and activity of a publics daily lives may not be explicitly political. These everyday choices and actions can have distinctly political effects though. As Scott (1985, p. 35) eloquently argues about everyday resistance, "Multiplied many thousandfold, such petty acts of resistance by peasants may in the end make an utter shambles of the policies." The principle applies to everyday acts of information acquisition; they can, in the end, fundamentally change the political beliefs of individuals.

Drawing on Figure 1.1, I will first describe competing models of the individual and information processing. First, I describe a rational model of the individual and information processing. I move to describing models of the individual from public opinion which similarly emphasize the role of information, beginning with the Receive-Accept-Sample and Knowledge Deficit models. I then examine contextualist models of belief formation which emphasize environmental constraints. Next, I describe models of the individual which suggest a more stable structure of individuals' beliefs drawing on the revisionist tradition of research in public

opinion and psychology. I also review the literature on Risk Information Seeking and Processing (RISP) which draws on research in psychology, as well as communication, to examine risk information behaviors. From these theories and frameworks, I then describe the concepts of biased search and motivated reasoning in more detail. Finally, I describe a model of information processing which relies on by-product learning. Having introduced these sometimes competing (sometimes complementary) models of the individual, I proceed to discuss different types of information in belief formation, with a focus on climate change. I first discuss the role of weather information, such as forecasts, as a possible mechanism through which by-product learning may occur. I then describe the weather itself as a type of information in belief formation regarding climate change. I then examine framing, as a type of information manipulation, which greatly affects individuals reported beliefs about climate change. Important to these varying models is if individuals can shift between them; drawing on work in cognitive psychology, I describe the possibility for shifting between models of decision making and information processing. I then provide a brief description of why understanding these models of belief formation and information processing are vital to studies in political science and public policy. I conclude this introductory and theory chapter with an outline of the dissertation that follows.

1.2 Models of the Individual

1.2.1 A Rational Choice Model of the Individual and Information Processing

Rational-choice models of man rely on the primary assumption that the individual is a utility-maximizer. Underlying this assumption is another that all preferences are known and can be rank ordered in a logical and consistent manner. Therefore, individuals are able to make decisions which maximize utility based on these preferences. As a result, individuals' preferences, and the associated rank order, can be understood and reconstructed using individuals behavior also known as their revealed preference (Riker and Ordeshook, 1968; Varian, 1988, 2006). In a model of political belief formation, rational choice individuals are efficient consumers of information whose beliefs are formed based on the information received and Bayes rule (Dickson, 2006). Bayes rule states that individuals update their prior beliefs in accordance with feedback received about those beliefs. Under a rational choice model, these updates will maximize potential utility. These beliefs are more likely to be updated when the feedback signals are especially strong and consistent (Ripberger et al., 2017). Thus, differences in posterior beliefs, among the mass public, within this model are primarily attributed to either differing prior beliefs or in differing exposures to information. The literature on biased selection of information reviewed in Chapter 4 addresses many of the possibilities regarding the second of these causes broadly and within climate change beliefs. While the substantial literature on motivated reasoning, reviewed below, addresses the relationships associated with the first cause. However, as Dickson (2006) notes, the rational choice model treats these differences in prior beliefs as essentially

exogenous and has no substantial explanation for their existence. The influence of information is similarly centralized in Zallers (1992) Receive-Accept-Sample (RAS) model of survey responses and belief formation reviewed below.

1.2.2 Receive-Accept-Sample (RAS) Model of the Individual and Information Processing

Scholars of public opinion have argued that the mass public, lay people, do not have coherent ideologies or beliefs systems (Converse, 2006). Rather, responses to survey questions are the result of the set of considerations that are at the top of head when asked (Zaller, 1992). These are the received ideas in the Receive-Accept-Sample (RAS) model of public opinion. These ideas are then accepted if they are consistent with prior beliefs and applied or sampled based on their saliency. In the RAS model, these thoughts are unstable and highly subject to being influenced by political and media elites. Individuals lack strongly held attitudes or beliefs about most political or policy issues because these issues are generally peripheral to their everyday lives. Survey responses, and the beliefs they represent, are subject to the most recent information an individual has consumed on the topic. The effects of this information, then, is highly contingent upon the ideological nature of the media itself and its corresponding audience (Feldman, Hart and Milosevic, 2017). This type of prior-belief confirming reasoning, for Zaller, is primarily relevant for political sophisticates who are constantly looking to political elites to develop their partisan belief systems. The RAS model centralizes information in that political communication is inherently tied to attitude changes. Changes in attitude are built up, gradually, over time by changes in information that result in changes in the considerations, or received ideas,

available to individuals. This perspective makes predicting and explaining mass opinion and beliefs very difficult as no structure or stability of belief is posited. A similarly elite-centric view of public opinion is offered by scholars studying the Knowledge Deficit model.

1.2.3 The Knowledge Deficit Model of Individual Beliefs and Information Processing

The Knowledge Deficit (KD) model also centralizes information in the process of belief formation (Sturgis and Allum, 2004). This model posits that support for technical policy solutions is primarily explained by the public's level of knowledge of that domain. More knowledge is typically regarded as creating more support for policy while less knowledge is seen as detrimental to policy support. Thus, this model suggests that increasing public knowledge of scientific and technical policy areas will create support for policy interventions. This model has found little support in the empirical literature, however, and has faced significant criticism (Weber and Stern, 2011). Rather, the model has become something of a straw-man in empirical papers examining the relationship between knowledge and policy support. For example, Bak (2001) finds that demographic factors such as gender explain policy preferences for science and technology much better than scientific knowledge or even education. Others have employed more post-modern paradigms to criticize the model. Directly in contrast to the KD model, Kellstedt, Zahran and Vedlitz (2008) find that 'informedness' is negatively correlated with concern for global warming and personal responsibility toward it. Similarly, confidence in scientists is negatively correlated with concern and responsibility for global warming. In their study, high levels of information or knowledge are

suppressing action toward policy intervention in climate change. In response to these studies mixed findings on the effects of knowledge on belief formation, scholars have proposed a contextualist approach to understanding public opinion and beliefs about science, in particular.

1.2.4 Contextualist Models of Information Processing and Individual Belief Formation

In the contextualist perspective, as identified by Sturgis and Allum (2004), understanding of science is embedded in political, economic, social, and regulatory settings that are fundamental for explaining attitudes toward science and scientific policy. However, as opposed to abandoning the KD model completely, Sturgis and Allums' (2004) results suggest knowledge is an important determinant in attitudes toward science but is contingent on domains of science and other important contexts, such as existing programs or structures. Thus, they argue the two models be incorporated. In the particular domain of climate change, Weber and Stern (2011) term this the constructivist approach. Similar in terminology to the contextualist approach, they centralize the inherent difficulty of understanding climate change. Understanding climate change is unlike other mental tasks or mental models that individuals use daily and is therefore difficult for them to understand. Earlier work by Wynne (1996) echoes and deepens this view. They argue public understanding of risks occurs in everyday social practices and is continuously constructed through this process. These attitudes are then embedded in institutions of trust, dependency, and networked relationships. These institutions both enable and constrain attitude formation as well as subsequent actions (Beck, 1996). Bulkeley (2000) finds empirical support for

the model presented by Wynne and Beck using data from Newcastle, Australia. They argue that institutional constraints, such as existing clean energy programs that improve perceived efficacy, are more important to understanding public involvement in issues such as climate change as opposed to individual knowledge or government provision of information. While the contextualist approach centers external factors in individuals belief formation, other approaches emphasize the individual level factors that affect their belief formation.

1.2.5 Revisionist Models of Individual Belief Formation

One such approach that emphasizes individual factors in public opinion and belief formation is that of the revisionist tradition. Scholars of this approach argue that individuals have structured belief systems that allow them to process information accordingly. These previous models, RAS and KD as well as contextualist/constructivist, differ somewhat from revisionist models of public opinion and policy preferences that posit a much more stable set of attitudes and beliefs. Revisionist models of public opinion hold that individual beliefs tend to be reasonably stable and structured. Individuals typically do not succumb to whims of information flows and the top of the head considerations that happen to be cognitively accessible at a given moment. Instead they have a set of relevant heuristics and core beliefs that structure their policy preferences (Jenkins-Smith, Mitchell and Herron, 2004; Shapiro and Page, 1994). According to the KD model, these heuristics are based on a lack of information while traditionalist scholars see these as a result of the elite manipulated information environment. Revisionist scholars argue these heuristics, on the other hand, are rational (though in a bounded way) and extend beyond the simple availability heuristic implied by the RAS model.

Prospect theory and insights from bounded rationality, including satisficing, are incorporated into revisionist models (Tversky and Kahneman, 1974; Gigerenzer and Goldstein, 1996; Simon, 2013). Unlike the traditionalist and KD views of the public, revisionist scholars posit a more intelligent public. Lupia and McCubbins (1998) present evidence that suggests participation in the policy process, and formation of policy preferences, is not as cognitively taxing as thought.

Revisionist accounts of public opinion differ from traditional accounts in their idea of structured belief systems such as the three-tiered system used within the ACF (Jenkins-Smith, Nohrstedt, Weible and Sabatier, 2014). How exactly to operationalize and measure these three levels, or a structure in belief systems at all, remains a matter of debate. Some work suggests cultural theory and its accompanying grid/group dimensions may serve as system around which other beliefs revolve (Jenkins-Smith, Silva, Gupta and Ripberger, 2014; Ripberger et al., 2014; Sotirov and Winkel, 2016). In the ACF language, cultural theory accounts for deep core beliefs which are very stable and unlikely to change. The ACF model of the individual then posits a set of near core (policy core) beliefs that are fundamental policy positions and strategies for achieving deep core, normative beliefs. Finally, individuals have secondary beliefs that are very specific to particular policies and their associated mechanisms (Sabatier, 1988). The role of information, especially policy analysis, is central to the ACF model of the policy process and learning, both at an individual and institutional level. In some cases, these secondary beliefs are more important for understanding coalitions than policy core or deep core beliefs. In particular, the complexity of climate change policy and beliefs has led to groups and individuals coalescing around secondary beliefs (Kukkonen, Ylä-Anttila and Broadbent, 2017). The authors use data in which organizations beliefs, deep core and policy core, were coded based on statements in

various national newspapers. They demonstrate that three competing coalitions form around deep core beliefs, but these same coalitions coalesce into one major coalition when examining policy core beliefs (Kukkonen, Ylä-Anttila and Broadbent, 2017). These results suggest that policy mechanisms, which simultaneously appeal to multiple deep-core belief systems, may be more likely to garner support in contentious areas such as climate change. While Kukkonen, Ylä-Anttila and Broadbent (2017) primarily study the structures of belief systems, scholars of policy beliefs using revisionist models also rely on psychological heuristics, as described above, to understand information processing and belief formation.

1.2.6 Risk Information Seeking and Processing

These same tools, in particular heuristics for information processing, have been used to examined how risk information and beliefs with the Risk Information Seeking and Processing (RISP) model (Griffin, Dunwoody and Neuwirth, 1999). This model incorporates concepts from psychology such as motivated reasoning, as well as communications research to examine risk information behaviors (Griffin, Dunwoody and Yang, 2013). Research using this model has primarily examined risks from the health and environmental domains though it has recently been augmented to incorporate climate change as a relevant risk (Kahlor, 2007). The RISP model centers the idea that information insufficiency, a psychological need for information, drives these seeking and processing behaviors. This information insufficiency is a function of individual level characteristics, such as hazard experience and demographics, as well as perceived hazards characteristics and affective responses to these hazards. Information sufficiency is also a function of the informational subjective norms or the pressure individuals feel to seek

out information from their social networks. These variables help explain whether or not an individual will seek or avoid information and if they will process this information in either a heuristic or systematic manner.

A recent meta-analysis of RISP studies finds that these informational subjective norms along with current levels of knowledge explain a substantial variance in these seeking/avoiding and processing, systematic vs. heuristic, behaviors (Yang, Aloe and Feeley, 2014). Regarding climate change specifically, Kahlor (2007) finds that informational subjective norms, pressure from ones social group, contribute to when individuals are likely to seek out information. Relatedly, Yang et al. (2014) find that informational subjective norms are positively related to heuristic processing of climate change information. However, they also find that those who engage in systematic processing were more likely to support climate change mitigation policies. Therefore, social pressure to seek out climate change information may not result in more support for mitigation policies. These same individuals, those who report social pressure, also reported lower capacity to seek out information (Yang et al., 2014). Despite social pressure and information inadequacy, some individuals still used limited and therefore biased search processes to make conclusions about mitigation policy.

1.2.7 Biased Search and Information Processing

One heuristic incorporated directly into both revisionist models of belief formation and the RISP model is biased search processes. This biased search arises from what psychologists, including Kruglanski and colleagues (Kruglanski and Ajzen, 1983; Kruglanski and Klar, 1987), have described as a need for specific conclusions or structures. For them, motivation affects reasoning by directly af-

fecting which information will be considered. Motivation regarding the use of information can then be viewed as a form of satisficing and bounded rational behavior Simon (2013). These satisficing behaviors occur because information search processes require time, and energy; they are, in effect, costly for individuals. Individuals rely on a relatively small amount of information, or in Kunda's (1990) terminology a biased access of beliefs, that is accessed easily; in politics, this is often party identification. This biased access of beliefs then dictates 1) the information available, 2) the decision process, and 3) belief formation (Lodge, Taber and Galonsky, 1999*b*). Biased search processes suggest that information such as weather forecasts may be limited by the previously held beliefs and characteristics of the individual. The literature on the evidence of biased search in regard to political beliefs, including climate change, is more thoroughly reviewed in Chapter 3.

1.2.8 Motivated Reasoning and Information Processing

Among the other heuristics incorporated into both the revisionist models of belief formation and the RISP model is motivated reasoning. Motivated reasoning suggests individuals rely on a biased, constrained set of cognitive processes in decision-making. Motivation can come in a variety of forms, in political science the most common is ideological or partisan, but generally represents the idea that individuals have preferences for outcomes of processes. Kunda (1990) provides a coherent and extensive theoretical review of studies examining motivated reasoning, generally from a psychological perspective. They break motivated reasoning down into two general categories: reasoning driven by accuracy goals versus driven by directional goals. Studies of climate change in political science are pri-

marily concerned with the second type of goal. Evidence of partisan motivations in reasoning are not usually concerned with motivation to be accurate. Rather, the motivation is to reason in such a way that confirms prior beliefs, accurate or not. This type of motivated reasoning can occur through a variety of mechanisms, according to Kunda (1990). These mechanisms include biased accessing of beliefs (including self-characterizations), biased memory search, outcome dependency, biased beliefs about events, and biased selection of statistical heuristics. Within political science, foundational work by Milton Lodge and Charles Taber has incorporated many of these insights from psychology. They find that information processing is biased toward previously held positions (Lodge, Taber and Galonsky, 1999*a*).

Motivated reasoning has also been thoroughly demonstrated in the formation of beliefs about climate change. In many studies, scholars find boomerang effects in Republican respondents in which attempts to increase belief in climate change, or its human causes, actually entrench skepticism or denial of climate change or support for mitigation policies (Zhou, 2016; Hart and Nisbet, 2012). Individuals, Republicans in particular, tend to engage in motivated reasoning by assimilating information which fits their priors and disconfirming information which does not. However, some cues are stronger than others and do not result in a boomerang effect. Among skeptics such as Republicans, Feldman et al. (2012) find that where Republicans get their news from is much more influential on their climate change beliefs than where Democrats get their news from. This is true even for Republicans who get news from climate change affirming sources such as MSNBC and CNN. This research suggests Republicans are particularly sensitive to informational effects, at least regarding climate change.

Most individuals process information in this motivated manner to protect

their prior beliefs. Prior beliefs subject to these processes can be relatively specific, such as beliefs about the weather and climate, but they can also be more fundamental beliefs such as ideology or culture. Frequently, the preservation of specific beliefs, such as those surrounding climate change, is a means to an end of preserving the more fundamental belief, such as an ideology for example. The protection of these beliefs is then a form of identity protection (Corner, Whitmarsh and Xenias, 2012). Some evidence suggests motivated reasoning is most likely to occur among those most familiar with the domain (Myers et al., 2012). Whereas those with less information or familiarity with climate change are more likely to form opinions based on experience or experimentally manipulated stimuli. Motivated reasoning and the associated confirmation and disconfirmation biases have also been demonstrated to be strongest among strong ideologues and political sophisticates (Taber and Lodge, 2006).

Motivated reasoning has been shown to be a strong factor in many political decisions and beliefs including voting and candidate evaluation (Redlawsk, 2002; Redlawsk, Civettini and Emmerson, 2010) as well as in political belief formation such as that described surrounding climate change, affirmative action, and gun control (Taber and Lodge, 2006). Palm, Lewis and Feng (2017) find compelling evidence that party identification amplifies the effects of attention to news and public affairs when examining determinants of climate change beliefs (see also Hamilton (2011)). Different types of news, general vs. specific environmental news, and different sources have both been demonstrated to influence individuals climate change beliefs (Carmichael and Brulle, 2018). These studies usually ask respondents to identify news or information sources in a general and generic context. They then argue that individuals learn about climate change from these sources. Though not usually acknowledged as such, these studies are examining

the concept of by-product learning as it applies to climate change.

1.2.9 By-product Learning as a Model of Information Processing and Belief Formation

Downs (1957) describes by-product learning as the process through which individuals learn about politics in the course of their everyday lives. Downs describes two paths of by-product learning. The first occurs when political information is acquired as a side-effect of entertainment seeking behavior; the second occurs in decisions about consumption and production (purchasing, work, etc.). Developing Downs concepts, Prior (2007) conceives of the first path as obtaining political information as a result of inefficient media environments. The market or media environment is unable to produce media exactly as the consumer wants it, thus inefficiency is introduced. Thus, Prior posits that as media environments become more diverse and easier to personalize, by-product learning will decrease; Bennett and Iyengar (2008) also note this trend as well as its implications for political communications research. If individuals can choose information sources that better confirm to prior beliefs or that contain less extraneous information, by-product learning will be less likely to occur. Similarly, if individuals can choose between a large variety of sources, they can choose the one that most specifically fits their needs or desires. In the next section, I examine different types of information and their roles in these various models of the individual, with a primary focus on climate change.

1.3 Types of Information

1.3.1 Weather Information: A Route for By-product Learning about Climate Change

The use of weather information provides a particularly interesting case of examining the relationship between the everyday and the political, in this case climate change beliefs, for a number of reasons. First, the weather, our perceptions of it and the information we have about it, fundamentally structure our days and the subsequent behaviors we engage in. If we check the weather and see a forecast for rain, we may decide to bring an umbrella with us and to cancel our plans for an evening run. Second, weather is intricately and complexly related to climate. Weather is both independent of and a product of past and present climatological conditions. Weather can be defined as day-to-day, or short term, fluctuations in precipitation, temperature, and other meteorological phenomena. On the other hand, climate is typically defined as the average of these various meteorological phenomena over longer periods of time, frequently thirty years or more [1]. Thus, changes in climate, then, can result in changes in weather, but weather is also a product of short term changes in atmosphere that are independent of climate (Jones, Thornton and Heinke, 2009). Given the intricate meteorological relationship between weather and climate, it is highly likely that any attitudinal or belief link between the two will be complex as well.

While beliefs about and perceptions of the weather itself are largely considered apolitical[2], belief in climate change is highly political, ideological and partisan

[1] See https://www.ncei.noaa.gov/news/weather-vs-climate for a useful, simplified description. See https://www.americangeosciences.org/critical-issues/faq/difference-between-weather-and-climate for a more detailed description.

[2] See http://theconversation.com/the-weather-is-now-political-77791 for a discussion of the

(Hamilton et al., 2015; McCright and Dunlap, 2011*b*; Shao et al., 2014). The political nature of climate change and the concept of by-product learning suggest that the variety of information sources of weather information may allow for individuals to choose sources which reduce their contact with belief-disconfirming information. Thus, by-product learning may be low; therefore, the relationship between information seeking behaviors, which sources individuals choose, and climate change beliefs may be small.

However, the relationship between weather information and climate change is more complex than this description suggests. Rather, the use of weather information reflects a hybrid between both paths of by-product learning. Seeking weather information is not always an entertainment behavior, except for those who gain utility simply from knowing about the weather. A good example of this may be individuals who chase storms. However, a more common example may simply be the entertainment derived from watching the local newscaster discuss the forecast for tomorrow or the next day. In either case, we may expect some by-product learning about climate change to occur. Moreover, the decision to seek out weather information is not itself an economic production or consumption decision, except when individuals use weather information purchased through an app, such as RadarScope™, or a website such as AccuWeather™. In almost all cases, though, seeking out and processing weather information affects production and consumption decisions. The examples of this are endless. A rain forecast may prompt someone to purchase an umbrella or change their travel plans (Hamilton and Lau, 2005; Lise and Tol, 2002). Weather, and its relationship with climate change, has and will continue to have significant effects on individual and corporate production and consumption decisions. Thus, learning about climate from

changing nature of this statement and the potentially political nature of weather.

mundane weather information, then, can be typified as by-product learning of a potential third type.

By-product learning, in this case, comes about because of the entanglement of climate information in daily forecasts. This is similar to the second path of by-product learning, through production/consumption decisions. In this path information about the economy, usually, is learned because it is wrapped up in those decisions; however, the weather-climate type of by-product learning does not inherently rely on market mechanisms to occur. In many cases, it is simply consumption of information, absent the economic meaning of the term. Weather-climate by-product learning can occur both as a result of entertainment and consumption, both of an economic and purely informational nature. *Thus, it is possible to expect that the relationship between weather information sources and climate change beliefs may be stronger than previously described and otherwise expected.*

1.3.2 The Weather as Information and Belief Formation

On the other hand, learning from the weather itself is seen as more direct, as opposed to by-product. As such, a relatively new and robust, though somewhat atheoretical, literature has attempted to examine the relationship between weather fluctuations and climate change beliefs (Weber, 2016). Local weather and deviations from average, usually temperature or rainfall, have been demonstrated across studies as a relatively strong predictor of belief in climate change (Hornsey et al., 2016). Experiences with extreme weather, however, have a much weaker, relationship with climate change beliefs (Hornsey et al., 2016). Although both local weather variations, among temperature and precipitation, and increases in

the frequency of extreme weather events are potential results of climate change, these findings suggest type of weather event matters in explaining climate change beliefs. Specifically, it is daily deviations from temperature and weather norms that are influential in shaping climate change beliefs while anomalous events have a very limited effect. However, it is important to note that in many of these studies the effect of weather and temperature-related changes or cues are contingent (e.g. upon partisanship, see Hamilton and Stampone (2013); upon geography, see Lee et al. (2015)).

Some research in this vein examines the relationship between perceived, as opposed to actual, temperature and climate change beliefs and worry (Li, Johnson and Zaval, 2011; Zaval et al., 2014). In their cross-sectional experimental study, Zaval et al. (2014) attempt to examine the mechanism behind these findings; their experiments suggest individuals' attend to and give undue weight to more easily available information, such as today's temperature, rather than more relevant but less accessible information such as seasonal or yearly averages. Other research has shown that perceptions of local weather change, temperature or precipitation, are strongly positively related with belief in and risk perceptions of global climate change across a variety of geographic and cultural contexts (Li, Johnson and Zaval (2011), in US and Australia; Howe (2018), in Norway; Lee et al. (2015), in Africa and Asia). These studies, relying on cross-sectional survey data, have confirmed that there is a strong relationship between perceived weather patterns, belief in climate change, and the risk perceptions thereof.

Moving beyond the relationship between perceived weather and climate change beliefs, some scholars have attempted to examine the relationship between actual temperatures and climate change beliefs. Schuldt and Roh (2014*b*) find that unseasonably cold temperatures can reduce belief when the phrase global warming

is used but not when the phrase climate change is used. These experiments varying the frame or name or the underlying concept are discussed in greater detail elswhere in this chapter. They also find these effects can be induced using visual primes of unseasonable cold in a survey experiment. These effects are especially prominent among skeptics (i.e. Republicans) however they are contingent upon question wording. In a similar cross-sectional study combining experimental and observational data, Joireman, Truelove and Duell (2010) find complementary patterns to Schuldt and Roh. Specifically, they use heat exposure and heat primes to examine increased prevalence of belief in global warming.

Examining the effect of both cold and hot temperatures, Hamilton and Stampone (2013) find that unseasonably warm temperatures on the day of survey participation increase agreement with the statement that humans are causing climate change. Conversely, unseasonably cool temperatures on the day of survey participation are associated with decreased agreement with said statement. However, this effect is only present among independents, not Democratic or Republican partisans. These findings suggest Democrats and Republicans may be less sensitive to daily or momentary changes in weather in regards to their beliefs about climate change and partake in motivated reasoning regarding temperatures[3]. Partisans process the temperature as either confirming their prior belief or as irrelevant; both paths represent motivated reasoning. Independents, on the other hand, process unseasonable temperatures differently, with less bias. Similarly, Egan and Mullin (2012) use a nationwide survey to demonstrate that recent experiences of deviations from average temperatures are positively correlated with belief in global warming, even when controlling for partisanship and

[3]For example, climate scientists beliefs about climate change may not be responsive to brief weather changes or primes, due to their prior beliefs about climate change. This suggests other reasons for these differential responses may exist, such as domain knowledge.

ideology[4]. Specifically, Egan and Mullin (2012) use a measure that compares the temperature of the seven days prior to survey participation to the thirty-year average (1971-2000) and takes the average of these differences. Focusing on climate, as opposed to weather, Shao et al. (2014) find that experiencing hotter summers, over ten-years, is positively correlated with risk perceptions of climate change. In a counter example, a study of Floridians by Marlon et al. (2018) suggests that local temperature experiences have little effect on climate change risk perceptions.

In some cases, experience of extreme weather has been shown to be related to climate change beliefs. For example, Spence et al. (2011) find that experience with flooding, a potential side effect of climate change, is related to increased belief in the occurrence of climate change and its corresponding risk. However, these findings are less well established than those of the effects of temperature, either perceived or actual. A recent longitudinal study finds limited influence of natural disasters on climate change beliefs (Palm, Lewis and Feng, 2017). One year prior, an extensive meta-analysis by Hornsey et al. (2016) also found that natural disasters have a limited effect on climate change beliefs. Palm, Lewis and Feng (2017) also find limited support for the effect of drought and hot summers (in contrast to Shao et al. (2014)) but do find evidence that warm winters effect belief in climate change. The panel nature of these data represents, in some sense, an improvement over previous cross-sectional studies; however, the study relies on a crude measure of change in climate change beliefs and relies on only two waves of data collected relatively far apart in time. Using a similar panel design, but with many more iterations over regular (3-month) intervals, Ripberger et al.

[4]Most deviations from average, in this study, were positive. However, they also find deviations from average which were negative are associated with slightly lower levels of belief in global warming.

(2017) examine the relationship between observed meteorological phenomenon and perceived meteorological phenomenon. They find that individuals typically perceive anomalies in weather (temperature and rainfall) accurately, except at the most extreme liberal and conservative poles of ideologies. These studies drive home the unique and complex relationship between weather and climate change beliefs.

1.3.3 Frames as Information in Belief Formation

More directly, many studies have demonstrated how the information individuals are presented with in the survey context have large effects on their reported climate change beliefs. Findings have suggested that even small differences in information presented to individuals can affect their response to whether they believe climate change is occurring. For example, scholars have examined the framing effects of climate change vs. global warming (Schuldt, Konrath and Schwarz, 2011; Schuldt, Enns and Cavaliere, 2017). The effects of this framing or wording choice are particularly relevant for Republican respondents. In fact, research on beliefs in climate change have found that Republicans are more sensitive to various framing and informational treatments (Hart and Nisbet, 2012; Zhou, 2016; Schuldt and Roh, 2014*a*; Feldman et al., 2012). Other research by Schuldt and Pearson (2016) finds that non-White respondents were unaffected by framing (climate change vs. global warming) effects. Studies in these traditions are primarily reliant on survey experimental methods to measure opinion changes or content analysis of media to measure the frames themselves (see Chong and Druckman (2007) for an excellent review of the topic). The simplistic, traditionalist model of public opinion would suggest these framing manipulations should

affect all respondents or at affect only the less politically sophisticated. And as Chong and Druckman (2007) note, some do interpret these framing effects as support for traditionalist views of public opinion (Riker, 1986; Zaller, 1992; Bartels, 2003). However, the contingent nature of these effects, at least in the case of climate change, suggest a more complex picture. Some individuals may be more or less susceptible to small frames or information changes, suggesting individuals have distinct belief systems that are differentially manipulable.

While these experiments result in estimates of the framing effects, they do not measure changes in public opinion because they, primarily, do not rely on inter-subject responses. Rather they rely on comparing differences between experimental groups. Scheufele (1999) presents a critique of framing studies, suggesting a typology of framing effects and that these effects be viewed as a sub-type of media effects. In so doing, Scheufele acknowledges both the importance of the media broadly as well as the underlying idea that frames are, in effect, informational manipulations. Thus, studies of framing, such as the those referenced herein on the effects of question wordings, speak to the importance of information in belief formation more broadly. That is not to say other individual characteristics do not help explain individuals beliefs. Rather, these studies also demonstrate the contingencies of media and framing effects.

The synthesis of these literatures and the culmination of their reviews suggests a model with a broad conceptualization of what information is and what information matters. If even a few words in a survey question can affect reported beliefs, then usually apolitical information sources, such as weather forecasts, may also be important. The model must also incorporate both structural conceptions of belief systems as well as heuristics of processing in order to understand how individuals form specific beliefs, such as those about climate change. Incorporat-

ing structure into belief systems both allows for understanding certain heuristic processing methods, such as motivated reasoning, as well as a more systematic, deliberative methods of processing information (such as in Skilled Decision Theory, see Cokely et al. (2018) for a review). The resulting model is depicted in Figure 1.1 and provides the basis of the analyses presented throughout this dissertation.

1.4 Do Individuals Shift Between Models of Information Processing?

The applicability of the variety of models of information processing and belief formation described up to this point may be contingent on a variety of factors. Specifically, both individual differences and contextual factors may contribute to which model is most applicable in a certain situation. Research in decision-making in psychology has contributed significantly to our understanding of when different models of decision-making apply and what contributes to these contingencies (Cokely and Kelley, 2009; Aczel et al., 2015). Cokely and Kelley (2009) find that people with higher cognitive ability are more likely to make choices consistent with expected value calculations, that is follow the rational model of man. However, importantly, they note that these individuals rarely made the expected value calculations but rather relied on elaborative heuristic search processes. Those with lower cognitive ability, on the other hand, relied on fewer elaborations and simpler processes to arrive at their choices which were normatively (i.e. had lower payouts) less beneficial. Research in a similar vein by Ghazal, Cokely and Garcia-Retamero (2014) finds that individuals who were

more numerate were again more deliberative, i.e. took longer to make decisions, and therefore made more "rational" and normatively superior decisions (again, higher payouts). These findings have been consistent across both medical and financial domains (Garcia-Retamero et al., 2019). Broadly, these findings suggest that individual factors, such as numeracy and working memory, affect which type of information processing models individuals use – deliberative System Two processes as opposed to intuitive System One processes (Stanovich and West, 2000; Kahneman, 2011). Additionally, this work suggests some individuals can shift between decision-making strategies and cognitive processes.

One possible reason for these shifts may be that context matters for the cognitive strategies individuals use to make decisions (Cosmides and Tooby, 1989; Gigerenzer and Hug, 1992). Examining risky decisions, specifically Weber, Blais and Betz (2002) find that individuals are not consistently risk averse or risk seeking across five different areas such as health or finance. In particular, gender and perceptions of benefits explain participation in risk taking as opposed to direct risk perceptions. In other work, Blais and Weber (2001) find that life domains, such as the difference between plagiarizing or buying a car, affect both individuals' decision strategies and behavioral outcomes. For example, respondents were much less likely to report relying on an authority's advice for making the decision to plagiarize than they were to use emotions to help make their decision. This research suggests that certain social, relational contexts may differ from economic contexts for relatively mundane decision tasks. Another possible difference in decision-making is one from experience as opposed to decision-making from description. Hertwig et al. (2004) find that for decisions of description, such as those regarding weather forecasts, respondents overweight the probability of rare events in accordance with prospect theory, but do the opposite, underweight

the probability for rare events, for decisions from experience. However, Fox and Hadar (2006) argue that these findings are a result of sampling error and that both types of decisions are suspect to prospect theory. In another paper, Hadar and Fox (2009) further describe the situations in which the experience-description gap is smaller or larger. Specifically, the underweighting of the probability of rare events for experience decisions only occurs when rare-events, i.e. tornadoes, are never experienced. While Hertwig et al. (2004) describe weather forecasts as creating decisions from description because the probabilities of various alternatives are described, weather itself may create decisions from experience. That is, we also experience repeated iterations of weather and then come to conclusions about the likelihood of certain weather events as a result. Weather and forecasts, then, may provide a hybrid type of decision where both description, the forecast, and experience, our lived daily experiences of weather, may affect decision making. While these studies focus on particular decisions, usually measured in laboratory settings, their conclusions can, to some extent, transfer to belief formation. Specifically, taken as a whole this body of research suggests that individual and contextual differences are important for understanding decision outcomes and cognitive processes. These lessons suggest that models of belief formation described above, similar to models of decision making, may systematically apply to different individuals to different extents in different contexts.

1.5 Why Individual Information Processing Matters

1.5.1 For Weather Information

Weather information, such as forecasts, can have major implications for the enjoyment of individuals' daily lives. Having accurate forecasts that convey relevant information about fluctuations in daily temperatures, precipitation, and other meteorological phenomena allows individuals to plan their days accordingly. The number of examples in which having an accurate forecast could affect your daily life are numerous. Especially in terms of daily fluctuations, the examples are obvious. People knowing that tomorrow is going to be much colder than today allows them to wear a more appropriate coat. Similarly, we may not plan to have a picnic on a day it is likely to rain, according to a forecast, or at least we may bring an umbrella with us for the day for those tasks that are unavoidable. Beyond our daily lives, but in a similar manner, weather forecasts can have major economic effects when they may lead to the cancellation of major events or even, more commonly, school closures.

Examining why daily weather information matters from a climate perspective, the connections may be slightly more abstract but still clearly important. The first connection is to events that are especially significant deviations from the climatological average. For example, a historic high temperature that makes it unsafe to go outside may require a specific behavioral response from individuals. The description of the event in climatological terms may better convince individuals to take an appropriate action such as staying inside. Secondly, as climate change occurs, severe weather, extreme highs/lows in temperature, and

periods of drought or high rainfall are likely to occur with increasing frequency (Van Aalst, 2006). Thus, individuals who receive accurate, and climatologically framed weather information, may be more attuned to these changes. Even if the events are not severe, as the one described above, they will still have effects on people's daily lives. Having more historically hot days may lead to individuals choosing to stay inside more, for example. Individuals seek out and process this information so that they can live out their lives without suffering from the weather and wear the appropriate clothing. In the process, they may be acquiring information about the climate and climate change without necessarily recognizing it.

1.5.2 For Political Science and Public Policy

One reason information processing and belief formation is so important in political science is the relationship between public opinion, or beliefs, and policy and policy change. For example, in the ACF model, the role of public opinion is largely viewed as an environmental constraint external to the policy subsystem, in particular moments, and as a possible cause of policy change. Interestingly this conception evokes the idea others have called public mood and its relationship with policy change (Stimson, 2012; Erikson, MacKuen and Stimson, 2002; Stimson, 2018). The conception of policy mood suggests various policy preferences move in tandem in a general ideological, left-right, manner over time. The policy mood model then suggests policy moves subsequent to these changes in opinion. The thermostatic model takes this one step further suggesting policy is changed as a response to public opinion but then the public acts as a thermostat. After the initial policy change in one direction, public opinion will change in the other di-

rection to keep the policy at the "right temperature" (Wlezien, 1995; Soroka and Wlezien, 2010). These models are focused on the relationship between change in public opinion and policy change over time. In so doing, they focus on aggregate changes in public opinion that take place over time. They are relatively mute as to where these opinion changes come from, other than from negative policy feedback (Wlezien, 1995). Research by Monroe (1998) and a meta-analysis by Burstein (2003) suggest policy is responsive to public opinion in a majority of cases. Monroe (1998) found that policy outcomes matched with public opinion in 63% of cases in the 60s and 70s but only with 55% of cases in the 80s and 90s. Burstein's (2003) meta-analysis of the relationship between public opinion and policy change suggests that in 75% of the 52 relationships, across 30 studies, public opinion is significantly related to or affects policy outcomes.

These models of individual information processing are also fundamental to our understanding of the political realm and policy process because individuals make up the institutions which create these policy changes. Some scholars suggest institutions are subject to many of the constraints of individual processing described in these various models because institutions are simply aggregations of many individuals processing (Jones, 1994)[5]. In these institutions, information is frequently viewed as a resource used to mobilize support for or against a particular policy option or policy change. This information can come as a result of top-down directives or bottom-up initiatives and each information type serves different purposes (Workman, 2015). Information then is seen as an important resource to promote policy learning within institutions, individuals, and coalitions (Sabatier and Jenkins-Smith, 1993). In some instances, information is a product of routine and standard operating procedures; however, in other cases

[5]This could also be considered a description of democratic theory more generally.

information is the result of an isolated event. Following from these functions, institutions have a variety of channels for producing and processing information and institutions can simultaneously process various streams of information.

One key difference between institutions and individuals is that individuals can only serially process information, despite facing a similar abundance of information sources. Also congruent to institutional models, many models of the individual view information as a potential resource to change individual positions on policy or political beliefs. How this process occurs varies depending upon the individual as well as the information being processed and its goal. Not all information is created equal nor are all individuals created equal. Information is processed depending on its salience, valence, and domain among other characteristics. Individuals process information according to their ideologies, cultures, genders, among various other characteristics. In processing information, individuals often create knowledge which is then a resource for developing other individual beliefs (Ripberger et al., 2012, 2017). In particular, some information is more political and politicized than other information. Politicized information is of particular importance in policy domains such as climate change. As demonstrated below, scholars have devoted significant attention to the political nature of information surrounding climate change (see McCright and Dunlap (2011*b*) for a review). However, other information, such as weather forecasts, may be seen as generally less political and more neutral. Less political information is no less important than politicized information and likely makes up the bulk of information individuals interact with on a regular basis. Importantly, this information may or may not be processed in a political manner, i.e. according to ideology or partisanship.

This lack of a political nature may be one of the primary reasons weather

information, such as forecasts, has yet to be examined as a potential factor contributing to individuals beliefs about climate change. However, this information is crucial to our lives. We use it to plan our days and make decisions ranging from what to wear to whether to attend major community events. This information is also abundant, with a plethora of sources available to individuals. As information search is costly, for all information including that about the weather, individuals may rely on heuristics in their search processes. They may engage in biased search processes relying on a relatively narrow set of sources that are related to their various identities and demographics. These search processes are subsequently important as the weather information we come in contact with everyday also communicates information about the climate and its potentially changing nature. Understanding todays high temperature in terms of its relationship to the historical high relies on both weather and climate information to convey a message to the user. Weather information, thus, may sneak past motivational filters in its effect on climate change beliefs and by-product learning may take place.

This dissertation revolves around these two central ideas: search processes (and the potential for biased ones) in weather information and by-product learning that occurs about climate change in these processes. In Chapter 2, I ask if there are different patterns of weather information usage or search. I expect that individuals use a variety of search strategies when seeking out weather information. I then characterize the individual level factors, such as ideology and demographics, which help explain the use of these patterns. In Chapter 3, I then examine how these search processes are related to climate change beliefs. I expect that weather information use patterns will have a small but important relationship with these beliefs, that primarily occurs through indirect or by-product

learning. However, I also examine the possibility for motivated reasoning to be occurring at this stage. I examine the magnitude of the relationship between weather information and climate change beliefs by comparing it to other, more commonly studied types of information. This chapter considers the effects of weather information as a part of a broader information environment. In Chapter 4, I then examine how beliefs about climate change, certainty in its causes and risk perceptions, are associated with policy preferences. I also examine how the everyday, mundane experiences of weather are related to climate change risk perceptions and policy preferences. Finally, I conclude in Chapter 5 with a summary of the limitations and the implications of this research for scientists studying climate change beliefs and communication. I argue that scholars must consider this broad information environment and the routines individuals build within it to best understand climate change beliefs.

Chapter 2

Patterns of Weather Information Use and Their Predictors

2.1 Introduction

Mundane daily behaviors directly affect the construction of our society, democracy, and the state of our physical environment; yet, many of these behaviors effects on our belief systems are not well understood. One of the most frequent of those behaviors is using media to access various forms of information. We might check social networks to maintain relationships with family and friends or watch the news to know whats going on in our neighborhoods and the world around us. To some extent, these behaviors affect our beliefs about democracy and relevant policy issues. Our social media circles and our choices of news networks sometimes create echo chambers which amplify polarization (Colleoni, Rozza and Arvidsson (2014), see Jasny, Waggle and Fisher (2015) for a climate change example). In these cases, the explicit partisan nature of the information source or the information itself may be apparent. However, much of the routine

information collection we do is not explicitly partisan or even, necessarily, policy relevant.

As such, these aspects of life may not invoke active reflection from citizens themselves or study from academics. However, the daily accumulation of behavior and information over time can greatly affect individuals beliefs. This accumulation can greatly influence individuals ideologies and beliefs about policy and politics and subsequently the structure of our democracy and society. In some cases, the connections may be relatively well-established such as that between Fox News and conservative ideologies and beliefs (Stroud, 2008, 2011). With regard to the environment, daily individual behaviors such as recycling also have obvious consequences. However, in other cases, the connections between daily behavior, media environments and political beliefs may be less clear though no less important. One such area is that of the media environment for weather and its relationship with beliefs about climate change. Beliefs about climate change are especially vital to understand as it represents a wicked policy problem with a particularly long-time horizon.

These time horizons are often implicitly communicated in the weather information individuals consume. In other cases, this type of climate, and climate change, information is included explicitly to educate the viewers of broadcast meteorology, that is local television station viewers, about climate change (Zhao et al., 2014). These explicit climate change information interventions studied were effective at educating viewers to the causes and risks of climate change; however, the question arises about what happens in the absence of direct intervention. The opportunity for by-product learning still exists given the nature of the information presented; however, this is complicated by the complex media environment regarding weather in the United States. Organizations across the

public and private sector using a variety of media tools create an information rich environment.

This information rich environment is not unique to the U.S. but may be especially relevant in contexts where competition between information sources is high. Individuals face choices between an almost overwhelming number of options for information sources on any topic imaginable. Information about the weather, such as but not limited to forecasts, is no exception to this. People make choices daily about checking these many sources; however, we know very little about who uses what sources or how much they rely on these sources. Because these information sources can vary in their reliability, understanding patterns among their users has distinct implications for the creation of a weather aware public. For example, the National Weather Service is a highly reliable and scientific source of information about the weather while ones family and friends are highly informal and potentially less reliable. If certain individuals are predisposed toward using less formal or informal information sources, outreach from formal and more reliable sources may be able to target those susceptible to lacking information. Information sources are rarely used in isolation, though. Therefore, rather than focusing on sources individually, I examine how information sources are used in tandem and how this may result in various types or classes of weather information seekers.

The following chapter begins by reviewing the relevant literature on information seeking behaviors and information and information source quality and reliability. I then introduce the survey data and the measurement model, concomitant variable latent class analysis, used to examine demographic and other correlates of weather information usage. First, I uncover four distinct patterns of weather information source usage. A relatively similar proportion, approximately

0.25 to 0.30, of individuals fall into three of the four categories, suggesting no particular information pattern accounts for the majority of the sample. I find that socio-demographic characteristics, particularly age and education, help explain patterns of weather information seeking behaviors. I also find that political dispositions, especially ideology, are related to patterns of weather information search. Finally, I end with the implications of this chapter for future research on weather information and the subsequent analyses.

2.2 Literature Review

In their seminal article, Lazo, Morss and Demuth (2009) describe the process of valuing weather forecasts as four steps from sources to perceptions to uses to values. Following from this framework, I focus exclusively on examining which sources individuals use. In a later paper, Demuth, Lazo and Morss (2011) examine the first three steps of this model. In so doing, they attempt to ascertain patterns of source usages of forecast information. Regarding sources, they find no adequate factor solution, despite most individuals in their data reporting using many sources. This suggests the correlation structure of the sources they consider cannot be summarized easily. However, their method of analysis considers only correlation between the individual indicators but does not consider the patterns of use of all indicators at once, by each individual. With the exception of this group of researchers at NCAR (Lazo, Morss and Demuth, 2009; Morss, Lazo and Demuth, 2010; Demuth, Lazo and Morss, 2011), research from meteorology as well as the social sciences broadly primarily ignores the daily, routine gathering of weather information. Instead researchers in these fields are primarily interested in where individuals get severe weather information from, including but not lim-

ited to how individuals get specific NWS severe weather warning products. Thus, the majority of research on the determinants and effects of weather information takes place in a severe weather context such as tornadoes or hurricanes.

Research examining the uses of severe weather information, while potentially a different phenomenon from routine weather information, has resulted from a robust interdisciplinary tradition. In particular, scholars of emergency management and disaster response have focused on Mileti and Sorensen's (1990) model of warning systems and Lindell and Perry's model of protective action decision making (PADM) (see Lindell and Perry 2012 for an overview). Both models prioritize the provision of information from an authority and rely on trust in this authority to provoke a response from individuals. However, the recent expansion of communication technologies such as social media have made the both the information environment for warning/severe weather information and for routine/daily forecasts more complex (Reuter and Kaufhold, 2018). In particular, information is no longer communicated primarily in an authority-to-citizen (A2C) manner but also can be communicated in a citizen-to-citizen (C2C) manner.

Research in these theoretical domains has attempted to examine the plethora of available information sources and individual-level differences that are associated with differing information source usages. Studies of tornado warnings ask interview or survey participants to identify sources such as sirens, television, or friends and family (Balluz et al., 2000; Brown et al., 2002; Hammer and Schmidlin, 2002; Comstock and Mallonee, 2005; Biddle, 2007; Sherman-Morris, 2010; Paul and Stimers, 2012; Paul, Stimers and Caldas, 2015). In these studies, the most important source of information varies. Sherman-Morris (2010) finds cell phones were the most commonly reported source followed by computer messaging and interpersonal sources. Most research finds television is the the most common source

of warning information (Balluz et al., 2000; Hammer and Schmidlin, 2002). In many of these studies, including the one by Comstock and Mallonee (2005), sirens, a source unavailable in routine contexts, were the second most reported source of tornado warnings (or first, in Paul and Stimers 2012). Studying hurricanes, Drabek (2001) found that the news media was the most important source for receiving information about the storm, followed by information from contacting local officials and relatives. These studies have demonstrated that a variety of sources are used to acquire information in severe weather contexts (Robinson, Pudlo and Wehde, N.d.). Population characteristics as well as event characteristics help explain the differences in which sources are used most (Wehde, Pudlo and Robinson, 2019). While this provides an understanding of the source which may provide the widest reach, it reduces a complex process, one where many sources can be accessed, to a simple binary: most used source vs. all others.

2.2.1 Multiple Sources of Severe Weather Information

Despite the focus on the most-used source, research has suggested that the interaction of the various sources can be important for individuals response behaviors. According to a review of hazard warning systems, Sorensen (2000) finds general but limited support for the positive relationship between multiple warning sources and response to the warning. More recent research by Paul, Stimers and Caldas (2015) finds that the use of one or more information source is positively associated with compliance with the tornado warning. Even more recently, Miran, Ling and Rothfusz (2018) also find that the number of information sources, as opposed to just more than one, is positively associated with protective action. Sorensen's review and recent research suggest the use of multiple information sources is likely

an important factor in studying weather and warning systems. Given the domain, it is unsurprising these studies only examine information sources in the event of extreme or severe weather; however, understanding patterns of information usage in routine weather may set the stage for which sources are available or familiar to individuals in the event of severe weather. Also importantly, these studies do not examine what combinations of these sources are used. Even those that emphasize the importance of more than one source (Paul, Stimers and Caldas, 2015; Miran, Ling and Rothfusz, 2018) ignore exactly which sources are used; respondents could be using websites, family and friends, television or any other source that could deliver the warning or information. Though individuals are allowed to report receiving information from multiple sources, scholars have primarily focused on either the rank ordering of these sources, (see Sherman-Morris 2010, Comstock and Mallonee 2005, among others), or simply the number of sources used.

Sorensen's (2000) review also suggests that the specific warning channel may matter; some warning channels might increase protective action taking while others might actually decrease protective action taking. They find electronic and media sources have mixed effects on responses while sirens decrease responses to warnings. These sources also have differential effectiveness at reaching the population. Rogers and Sorensen (1991) find that permanent sirens combined with telephones or tone alert radios reach the population most rapidly. The news media reaches the population at the slowest rate, followed up by sirens in isolation. Though in the context of warning systems and severe weather events, these studies suggest that sources differ in their ability to provoke action quickly enough. Comstock and Mallonee (2005) suggest that when individuals receive warning or storm information from multiple sources, certain ones, such as weather

changes, are less likely to provoke protective action. They find that some sources, such as environmental cues, which are most prevalent in conveying information about the storm are the least likely to promote protective action. The differences in both reception and response are multi-faceted in that they consider the speed of information traveling, the effectiveness of communication, and the interaction of a variety of potential information sources. Given the consistency of the use of multiple sources and their varying effects, it is likely that patterns of use of weather information sources and their effects in non-severe, day-to-day settings are similarly complex.

Understanding these complexities, and their relationships with political beliefs, is important given the value of forecasts. Lazo et al (2009) estimate that forecasts in the U.S. generate over $30 billion worth of value compared to just over $5 billion in costs and those forecasts come from a plethora of sources. Echoing research on warning systems, the authors find that local tv stations are the most common source for weather forecasts, accessed approximately 34 times a month (Lazo et al 2009). Direct government sources such as the NWS webpage and NOAA Weather radio are used much less frequently, only accessed 8.3 and 2.1 times per month respectively. However, as the authors note, much of the information contained in local TV forecasts and all other forecasts is based on information created by the government. Thus it is difficult to parse out the use of government information, precisely, or its value to the consumer. Though the base information originates from the government, weather information has been, until recently, rarely politicized. Therefore, the effects of partisanship on its usage may be relatively limited. Other individual factors, such as age or race, may be more important in explaining differences in patterns of weather information source usage.

In the subsequent study, I analyze a survey of Oklahomans to examine patterns in their routine, as opposed to extreme, weather information source usage. I find evidence that information sources are not used in isolation but are used by individuals in a distinct set of theoretically and practically interesting patterns. Additionally, I then move to examining the demographic and political belief system precursors which help explain the use of these various weather information use patterns.

2.3 Data and Methods

In this study, I use data from the Meso-Scale Integrated Socio-geographic Network (M-SISNet), a longitudinal (panel) survey, using an address-based sampling frame, that continuously measures public perceptions of climatic conditions and beliefs in Oklahoma, a conservative state where a large fraction of the population is skeptical about human-caused climate change (Jenkins-Smith et al., 2017). M-SISNet surveys are administered at the end of each season (winter, spring, summer, fall). Basic values, beliefs, and political predispositions are measured once a year on the winter survey. Additionally, questions about frequency of weather information source usage are asked every quarter. Much more detailed information about the data source can be found in Jenkins-Smith et al. (2017). These questions are used to construct a measurement model using Latent Class Analysis (LCA) with concomitant variables. For the analysis in this and subsequent chapters, I rely on only wave 18 of the survey. This wave was fielded between June 4th and July 23rd of 2018 and asked questions pertaining to the preceeding spring meteorological season. A total of 2,246 individuals replied to the survey and the median completion time was approximately 33 minutes. I

rely on this wave because in it we asked a larger battery of questions related to climate change beliefs and policy.

For the construction of the classes, we specifically asked, "How frequently do you get information about the WEATHER from each of the following sources?"

Newspapers
Non-government Internet websites (such as weather.com)
Government sponsored Internet websites (such as noaa.gov, Oklahoma Mesonet)
Local TV (television) news
Cable TV (television) news (such as The Weather Channel)
Radio
Family, friends, or colleagues
Social Media, such as Facebook and Twitter
Cell phone applications or automated text messages
Other (please specify)

Individuals were able to choose from the following options for each of these sources:

Several times a day (6)
About once a day (5)
Several times per week (4)
About once per week (3)
Less than once per week (2)
Never (1)

Figure 2.1 displays the means for each of these indicators for the full analysis sample, all 1,819 individuals with data for each variable included. Local television is, by far, the most popular source for weather information across all respondents, used almost each day. On the other hand, newspapers, social media, and government websites are much less popular being used less than once per week on average. Family and friends, phone apps and the radio, on the other hand, are relatively more popular with each exceeding an average of 3, or used about once

per week, on the scale. Other websites and cable TV fill out the middle levels of usage between less than once per week and once per week.

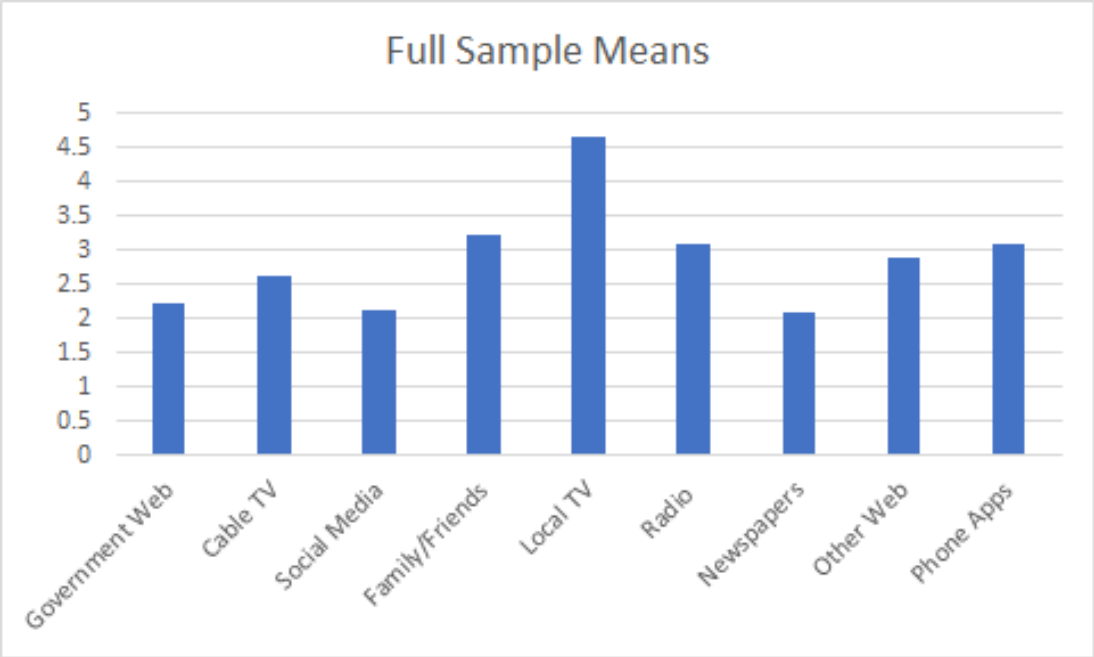


Figure 2.1: Mean Information Source Usages

LCA is used in this study for a number of purposes. First, LCA is suited for polytomous input data, such as this. Indicator or manifest variables do not have to be binary or continuous but can take on multiple categories. Second, as compared to other measurement models such as factor or principal components analyses, LCA takes advantage of correlations between patterns of responses as opposed to correlations between the responses to the individual questions themselves. This modeling technique stratifies the manifest, or observed, variables by identifying a latent, or unobserved, categorical variable to eliminate confounding between the manifest variables. This relies on the conditional or local independence assumption which states that all manifest variables are statistically independent when conditioned on the latent variable (Linzer, Lewis et al., 2011).

This latent variable is represented by a probabilistic outcome for each individual for each class (for each survey wave, in this case). Individuals can then be categorized by the class into which they more likely fall. Thus, individuals with similar sets of response will cluster into the same latent class. Finally, LCA itself does not identify the number of relevant classes or categories. Rather, because the method relies on the distributional assumptions of the manifest variables, LCA produces a series of fit statistics to determine appropriate model selection and fit. These statistics guide model selection based on parsimony, fit, and the goal of the analysis. The Bayesian Information Criterion is the most used measure for parsimony of model fit; however, improvements in log-likelihood ratios have also been used to guide model choice in the political science literature (Oser, Hooghe and Marien, 2013).

LCA can then be extended to what is sometimes called Latent Class Regression or more accurately termed LCA with concomitant variables. This means that variables not included in the measurement model can be used to explain membership in the various classes. Effectively, this allows individuals prior probability of latent class membership to vary by observed characteristics. This model can either be estimated simultaneously or through a three-step process. It should not be estimated in a two-step, classify and analyze approach, where individuals are assigned to classes and then a multinomial logistic regression is run; this results in biased parameter and standard error estimates and therefore incorrect inference (Kamata et al., 2018). Early research suggested the three-step process faced similar estimation problems (Bolck, Croon and Hagenaars, 2004); however, recent research suggests the three-step method can result in unbiased estimators (Vermunt, 2010). They describe when a three-step approach may be preferred over a one-step. In particular, studies with larges sets of covariates or more ex-

ploratory studies may prefer a 3-step estimation procedure; however, one-step procedures are typically simpler to implement. Given this study is descriptive and with a relatively small set of covariates, I use the simultaneous (one-step) estimation method.

2.4 Findings

Because I am interested in the patterns of these information sources, as opposed to correlations between each source in isolation, I apply LCA as described before. In order to do so, I first I have to determine the number of latent classes that adequately describe the sample of data. One way of assessing model fit is comparing LCA estimations to a one-class model, increasing the number of classes by one each time. In this manner, BIC is the most commonly used statistic for identifying appropriate solutions, and a smaller BIC indicates better model fit[1]. However, another approach that complements the use of a BIC statistic is to assess the percent reduction of the likelihood ratio chi-square statistic G-squared in comparison to the one-cluster model (Magidson and Vermunt 2004, for this approach in political science see Oser, Hooghe and Marien 2013). Table 2.1 lists the LCA model fit statistics for the analysis.

The BIC decreases up to the four-class model and then increases again for the five class model. Additionally, changes in the log-likelihood ratio suggest a three or four-class model may be preferable to more complex solutions. Comparing results across the three-, four-, and five- cluster models, I choose to report results for the four-class model for multiple reasons. First, of the three models it has

[1]Model fit cannot be determined using the more familiar chi-square distribution for computing the p value since data are sparse. There are 6^9 or over 10 million, possible combinations. So, information criteria like the Bayesian information criterion provide goodness-of-fit indicators that take both model fit and parsimony into account.

Table 2.1: Model Fit Statistics

Number of classes	BIC	G-squared	% change G-squared
1-class	45611	21515	
2-class	44898	20650	-4.0
3-class	44659	20149	-6.4
4-class	44647	19887	-7.6
5-class	44749	19664	-8.7

the lowest BIC. Second, the results of the five and three-cluster models generally mirror the four-cluster model but do not minimize BIC. Figure 2.2[2] presents a summary of the class outputs from the four-class solution. The y-axis represents the average for each indicator on the one to six point scale. Each bar represents the average for a respective indicator for the each class which are grouped on the x-axis. This visualization helps represent the absolute patterns of source usage by class and helps identify possible ways of naming these classes.

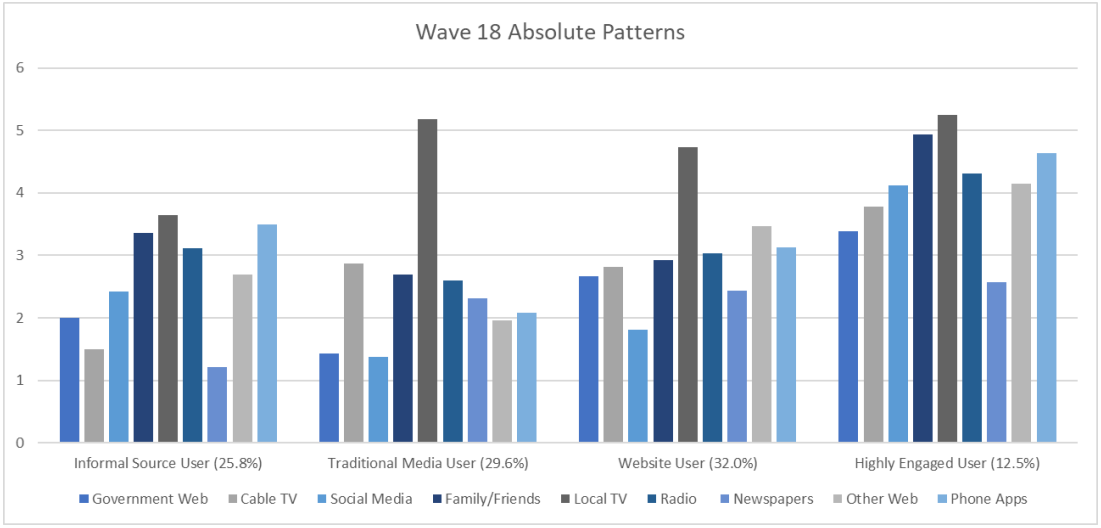


Figure 2.2: Absolute weather information use patterns by class

[2]These patterns are remarkably robust across waves. Similar analyses were conducted for waves 3 through 7 with almost identical patterns. The four class solution also looks remarkably similar when applied to the full panel data.

Another potentially useful visualization of this method is presented in Figure 2.3. This figure combines the previous two figures to graph the difference between class averages and overall averages on the x-axis. The estimated proportion of the sample in the class is in parentheses next to the class name in the legend. Each grouping of responses compares, for each information source, the class to the sample average. While the absolute values for each indicator are somewhat obscured by this visualization, it provides a better understanding of the relative differences between the different classes, by grouping the indicators and comparing each to a baseline.

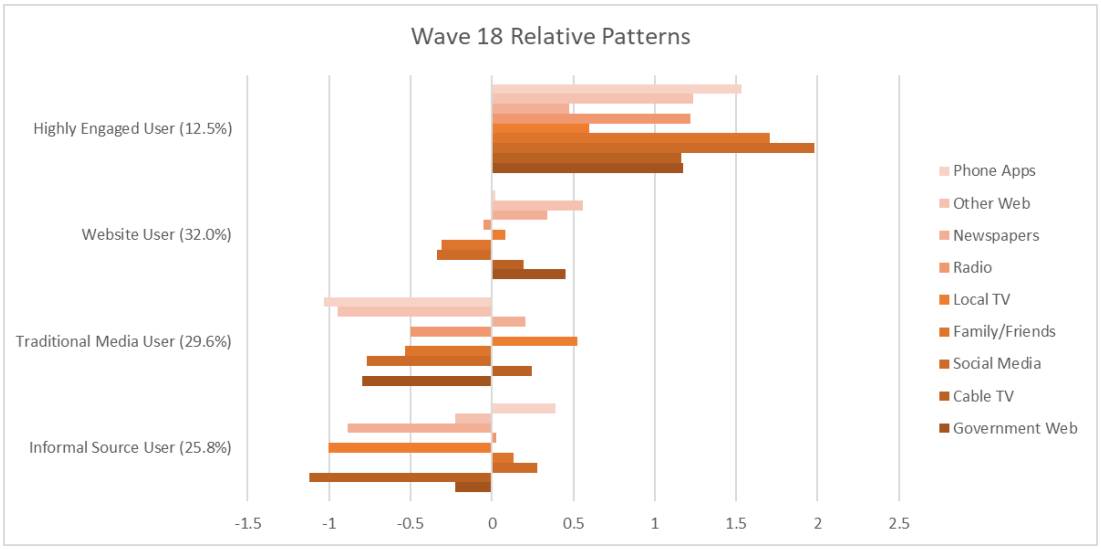


Figure 2.3: Relative weather information use patterns by class

The LCA identified four-clusters as described above, with the two middle classifications being relatively similar. These results illustrate a number of interesting patterns. First, we see that the sample is broken down into three relatively similarly sized classes and one smaller class, instead of being dominated by one class in particular. The first class that results from this analysis is the "Informal Source" Class, henceforth also known as the IS-class. This group of respondents

accounts for approximately 26% of the sample and has relatively low usage of weather information except for informal sources from their social networks such as family and friends and social media. This is especially apparent when looking at the absolute values in Figure 2.2. Even for local television, the most popular and formal source on average, IS-class members report much lower usage. "Traditional Media Users", henceforth also known as TM-class members or TM-users, account for a slightly larger percentage of respondents at almost 30%. These users are characterized by their predominant reliance on local television in an absolute sense. The next class is "Website Users" and accounts for the largest percentage of respondents. This class has a similar pattern of weather information usage as the TM-class but has a more diversified set of information sources, with particular regards to websites. If we determine classes based on second-most used sources, this class uses "other websites" second most frequently after local television. The TM-class users use cable TV second most frequently after local television. Finally, I identify a class which is highly engaged with weather information, with many sources being used several times a week or more. This class accounts for the smallest percentage of the sample at approximately 13%[3].

Examining Figure 2.3, we see that comparing class means to the overall sample mean, or effectively a one-class solution, further illuminates these patterns and class names. For the "Highly Engaged" user, it is clear that they rely on each weather information more than the average respondent. The patterns for web and TM-users also become more apparent. For TM-users, we see that the only sources which are used more than average are newspapers, local television, and cable television. These individuals also are much less likely to use website sources

[3]This finding of the "Highly Engaged" class and its prevalence is particularly robust across waves with between 12 and 14 percent of respondents being highly engaged with weather information.

than average. For Website Users on the other hand, these three sources are also used more than average as are both other websites and government websites. Finally, the IS-class members have the largest negative deviations from the overall sample averages for multiple sources. They do, also, have slight preferences for informal weather information sources such as family and friends and social media. Interestingly, they also rely slightly more than average on phone apps. Another possible interpretation of this class, as opposed to "Informal Source Users", is "Less Engaged Users" as Figure 2.2 suggests low bars for many sources and Figure 2.3 suggests the larger negative deviations for a number of sources.

Another important element of measuring these types of patterns is stability in the patterns themselves and in their classification of individuals. Therefore, I reproduce these analyses using 1,671 respondents from a wave collected exactly one year earlier, wave 14. I use this wave to hold the season of data reference and collection constant, in case seasonal differences in weather are driving usage patterns[4]. Figures 2.4 and 2.5 reproduce the visual representations of the same analyses from Wave 18.

When examining these figures, we see that the absolute patterns are especially stable across time periods. Some slight changes in the relative patterns arise, primarily driven by differences in the overall sample means. Using these two analyses, I can then measure if individuals remain in the same class across the two waves. This helps me answer the question of if individuals weather information use patterns are stable. I find that 68.3% of individuals are classified in the same class and therefore use the same pattern across time. At least one factor biases these results downwards which is that I used slightly different samples across both estimations. Using the exact same sample would provide a more

[4]Oklahoma has most severe weather in spring so this may be especially relevant in this case.

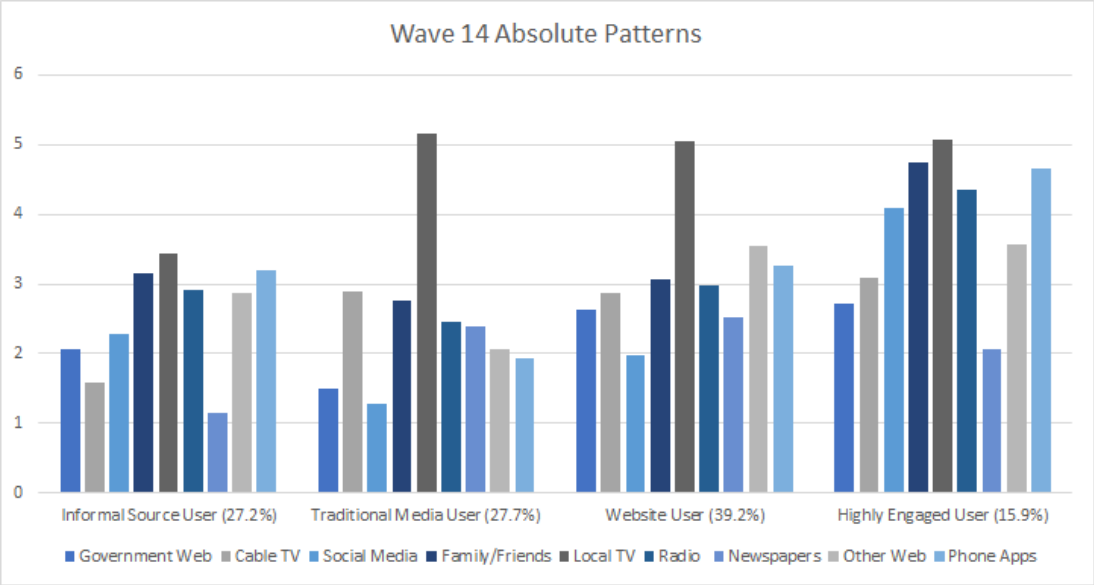


Figure 2.4: Absolute weather information use patterns by class

accurate estimate of any changes in patterns across time. The models in wave 18 relied on 1,619 responses while those in wave 14 relied on 1,671. However, across these two samples there were only 1,194 respondents in both. Given the data intensive nature of estimating these models, the strategy employed is not without its merit. Despite this limitation, these findings still strongly suggest that weather information source usage patterns are stable over time, at least for those individuals who are consistently present in the panel data.

Next I examine what demographic and other individual level factors external to the measurement model help explain classification within that model through the use of concomitant variables. In this analysis, I examine how socio-demographic variables including political dispositions help explain the patterns of weather information usage described previously in the results section.

Table 2.2 displays the estimated generalized logit coefficients from the simultaneous LCA with concomitant variables models. From this table, we can

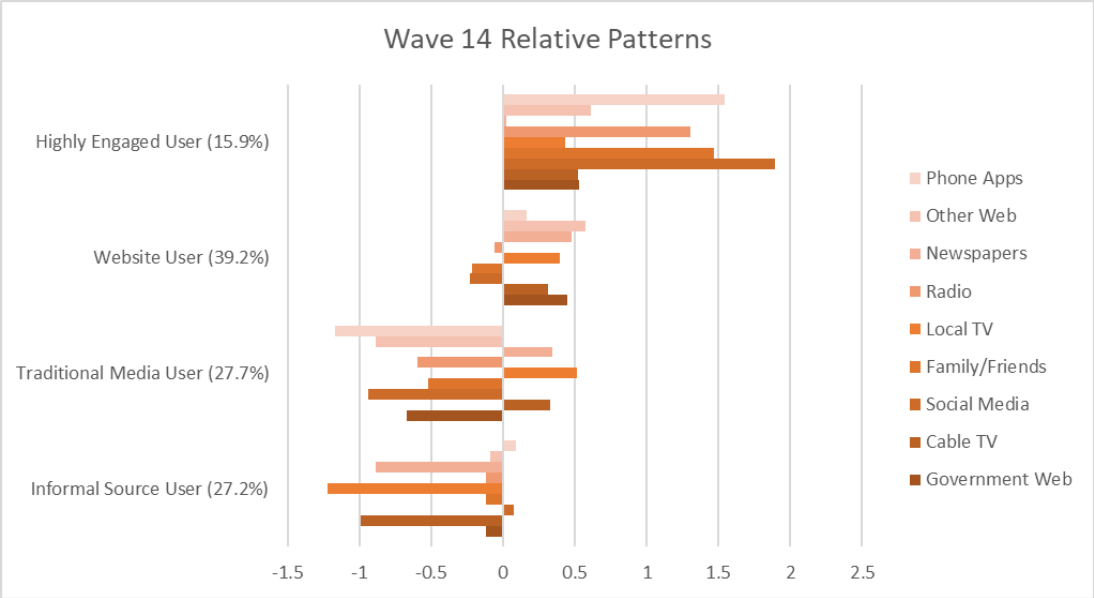


Figure 2.5: Relative weather information use patterns by class

interpret sign and significance. Table 2.2 suggests age is consistently related to an increased likelihood of belonging to all classes relative to the IS-class especially for "Traditional Media" users. Similarly, males are more likely to belong to each class other than the IS-class. Ideology has a limited relationship with class membership, though more conservative individuals are less likely to belong to the "Website User" class. Being a racial minority, in particular African American, is positively associated with being any class other than the IS-class. These relationships are especially strong for being a TM-user or a "Highly Engaged" user. Education is negatively associated with class membership as either a TM-user or "Highly Engaged" user, relative to the "Informal Source" user class.

Figure 2.6 represents the predicted probability for class membership for all four classes, across the range of data, with all other variables held at their mean or mode[5]. For "Informal Source users" and "Traditional Media users", diverging

[5]Findings for age are robust to various subsamples of the overall panel data including wave samples and overall samples.

Table 2.2: Generalized Multinomial Logit Coefficients for the External Determinants of Weather Information User Types

	Traditional Media User		Website User		Highly Engaged User	
	Coefficient	Std. error	Coefficient	Std. error	Coefficient	Std. error
Age	0.17***	0.015	0.14***	0.017	0.064***	0.012
Male	0.68**	0.27	1.3***	0.28	0.33	0.28
Ideology	-0.063	0.094	-0.18*	0.104	-0.041	0.095
Democrat	0.64*	0.34	0.27	0.38	0.47	0.34
Some College	-0.31	0.39	0.39	0.47	-0.21	0.39
Bachelors Degree	-1.10***	0.41	0.32	0.47	-0.96**	0.40
Graduate School	-1.29***	0.43	0.33	0.49	-1.38***	0.46
African American	3.20**	1.31	2.76**	1.33	2.91**	1.22
Native American	-0.095	0.61	-0.58	0.64	0.33	0.47
Other Race	0.36	0.65	0.15	0.69	0.57	0.53
Constant	-9.80***	1.07	-7.83***	1.20	-3.61***	0.80

* p-value <0.10, ** p-value <0.05, *** p-value <0.01. Reference class is IS-class.
Partisan reference category is Republicans. Education reference category is no college.
Race reference category is white. Total n = 1,619.

patterns emerge. As respondents increase in age, their probability of membership in the "Informal Source user" class decreases while their probability in the "Traditional Media user" class increases. Older individuals are less likely to use social media, in general, and therefore are less likely to use it to access weather information. For the other two classes, the relationships are somewhat more complex. The predicted probability of being in these classes increase up to a point and then decrease. However, where this point occurs differs for each class. For the "highly engaged" class, we see the youngest point of inflection, at about 57. These individuals have a predicted probability of approximately 0.15, similar to their predicted probability of being in the "Website User" class. The distribution of predicted probabilities for the "Highly Engaged" class is concentrated around the younger half of the distribution. On the other hand, the Web-user class has its highest predicted probability, of approximately 0.43 at 75 years old. Compared to the "Highly Engaged" class, which has relatively symmetrical distribution, the "Website User" class has a thick right tail suggesting older respondents are more

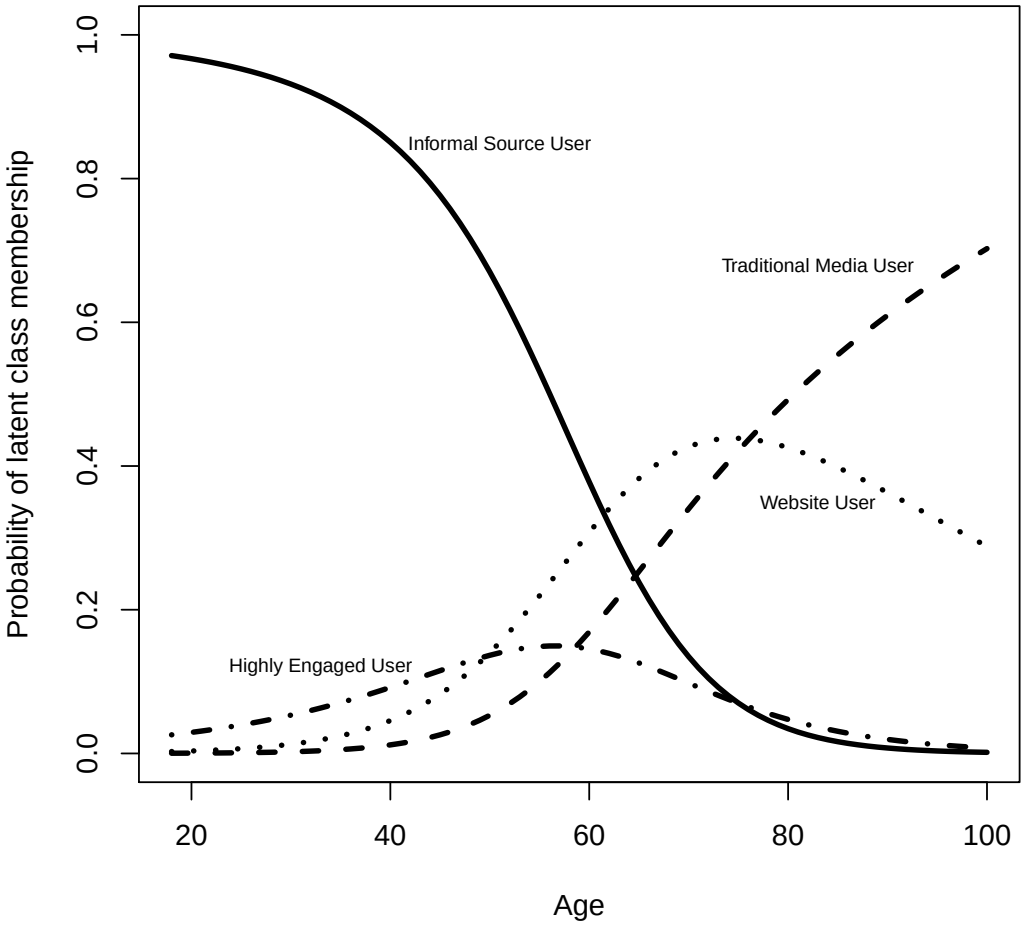


Figure 2.6: Predicted probabilities across all ages for each class

likely to belong to this class.

Being female is positively associated with membership in the "Website User" class as demonstrated in Figure 2.7. Being female is associated with an approximately 50% increase in predicted probability for membership. Males, on the other hand, are much more likely to be a member of the "Informal Source User" class, over 30% more likely than females. For the other classes, males are only slightly

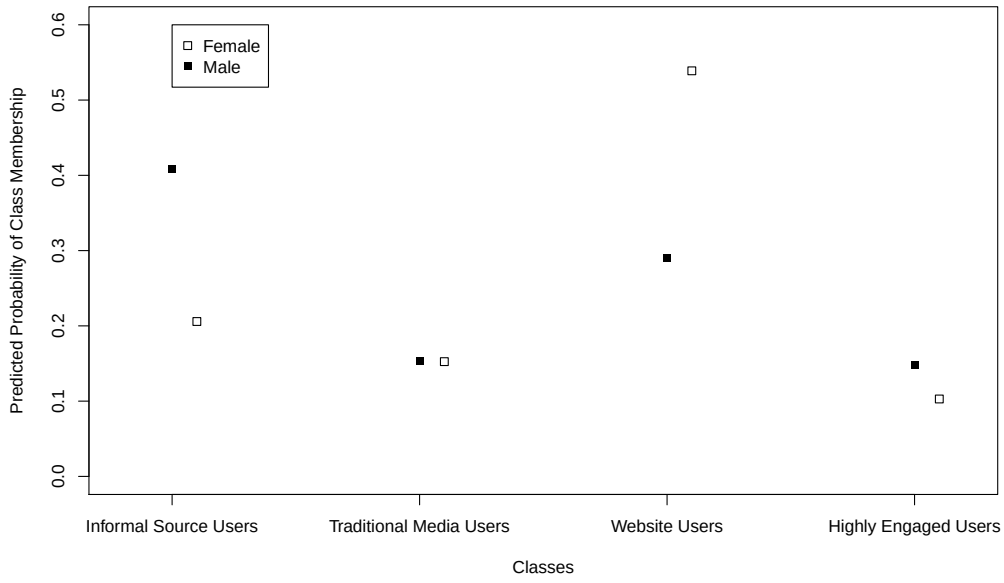


Figure 2.7: Predicted probabilities across gender for each class

more likely to be a member than females. These results in conjunction suggest males are much more likely to rely on their family and friends and social media for weather information. They also suggest females are also more likely to rely on websites than their male counterparts. Gender has a negligible role in explaining class membership in both the "Highly Engaged" class and the "Traditional Media User" class.

Relatively clear patterns also emerge when examining education, as demonstrated in Figure 2.8. For the "Highly Engaged" class, the predicted probability of membership decreases as education increases; this pattern is also present for the predicted probability of membership in the "Traditional Media Eser" class. Membership in the "Traditional media Eser" class is most strongly related to education as the wide spread of the dots in Figure 2.8 suggest. Individuals with only a high school education are significantly more likely to belong to the "TM-

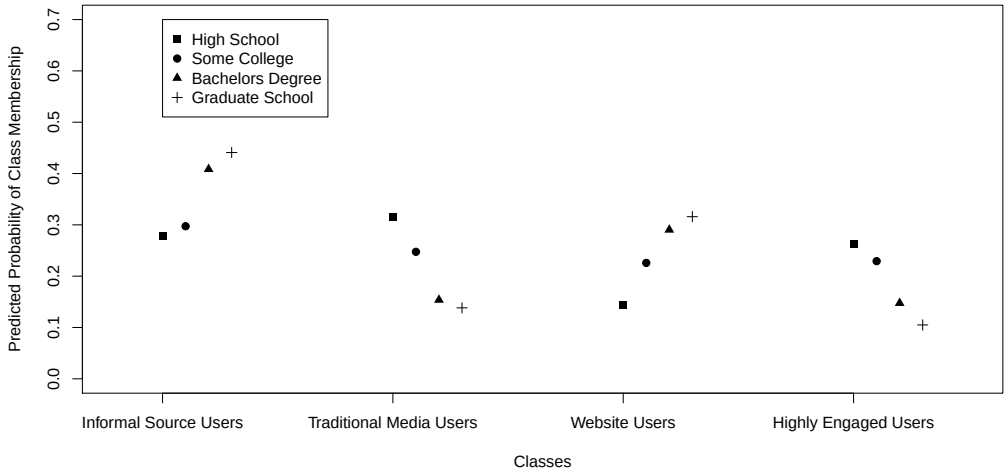


Figure 2.8: Predicted probabilities across education categories for each class

user" class than individuals of all other education levels. In fact, individuals with only a high school education are over twice as likely to be a traditional media user (0.32) as individuals with either a bachelors (0.15) or graduate degree (0.15). The reverse pattern is apparent for the "IS-user" and "Website User" classes; as education increases, so does the predicted probability of membership in these classes. This relationship is especially strong for membership in the "Website User" class with those having a graduate degree having a predicted probability of membership of 0.33 while those with only a high school education have a predicted probability of 0.14. Education has a slightly weaker relationship with membership in both the "Informal Source" class and "Highly Engaged" class, in particular.

Finally, race is associated with class membership in a number of important ways as evidenced by Figure 2.9. White respondents have the highest predicted probability for belonging to the "Informal Source User" class. Native American respondents have the highest predicted probability of belonging to the "Highly

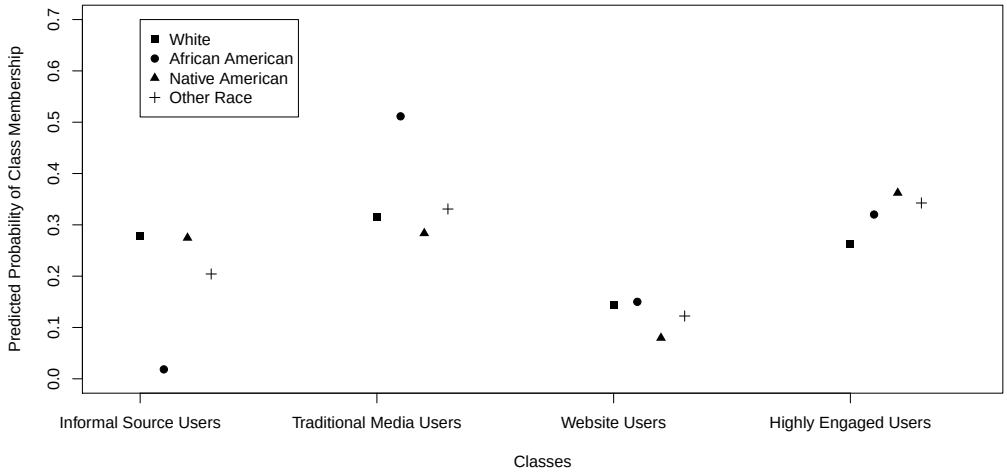


Figure 2.9: Predicted probabilities across race categories for each class

Engaged" class. African American individuals have the highest predicted probability of belonging to the "Traditional Media" class as well as the "Website User" class. In some cases, the differences in predicted probability for class membership are quite large. The predicted probability for White respondents for the "Traditional Media User" class is approximately 0.31, compared to African Americans who are approximately 40% more likely to belong to the class with a predicted probability of 0.51. Native Americans are approximately half as likely (0.07) to belong to the "Website User" class relative to all other racial groups (between 0.12 and 0.15). Native Americans, African Americans, and members of other races have predicted probabilities of membership in the "Highly Engaged" user class that are approximately 1.3 times the predicted probabilities of their white counterparts. Finally, the strongest relationship between race and class membership is for "Informal Source" users. African American respondents have a predicted probability of 0.02 of belonging in this class while White respondents have a predicted probability almost fifteen times as high at 0.28.

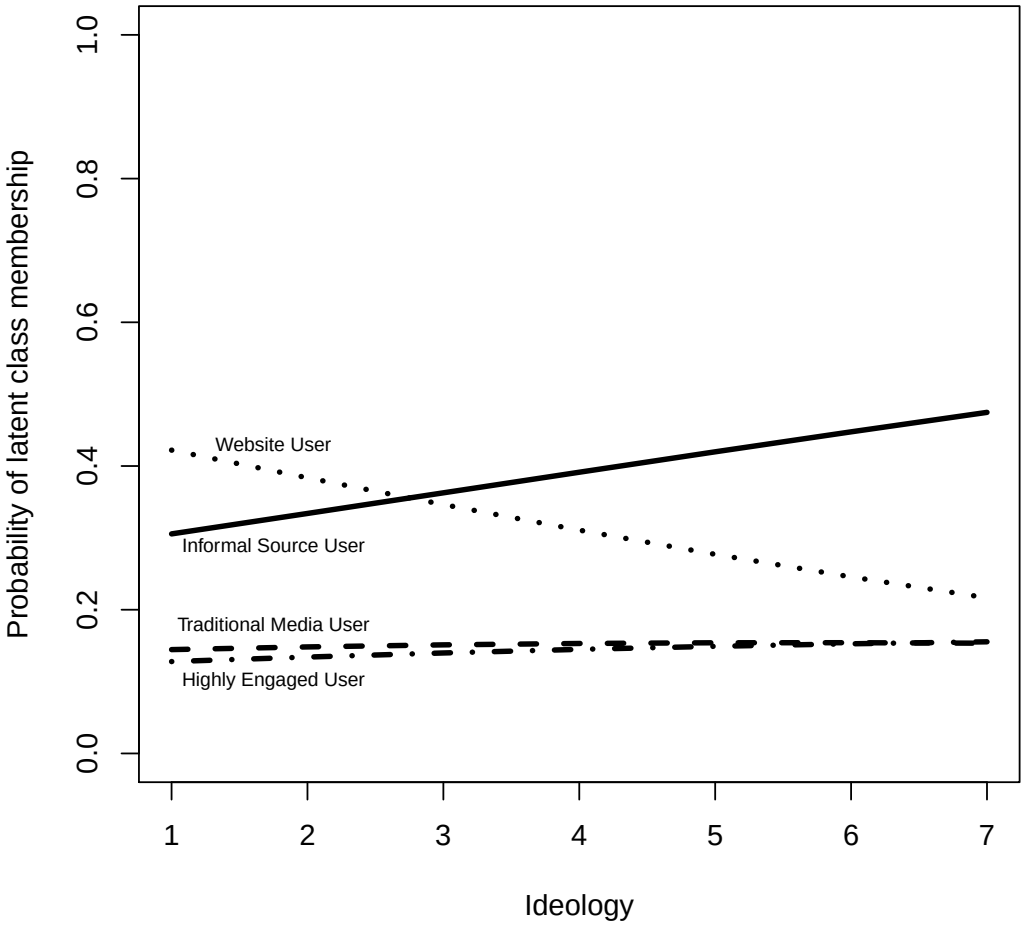


Figure 2.10: Predicted probabilities across ideology for each class

Finally, I examine the relationship between ideology and weather information source patterns visually in Figure 2.10. This figure suggests that ideology has limited association or relationship with membership in the "Traditional Media" and "Highly Engaged" user classes. On the other hand, we see diverging patterns for the "Website User" and "Informal Source User" classes. As individuals become more conservative, they are more likely to belong to the "Informal Source

User" class and less likely to belong to the "Website User" class. The slope is slightly stronger for "Website Users" as the most liberal individual (ideology = 1) has a predicted probability of approximately 0.42 while the most conservative individual (ideology = 7) has a predicted probability of approximately 50% less or 0.21. For the "Informal Source" class, this difference across the scale is an increase or slope of 1.5, from 0.31 to 0.47, as opposed to the negative slope of approximately 2 for "Website Users" on ideology.

2.5 Discussion

First, this study sought to examine patterns of weather information usage among Oklahomans. In particular, given a rich information environment, I asked can individuals be grouped based on their usage of various sources in conjunction. I find that in general distinct groups of weather information usage do emerge. In particular, I find a few important patterns of usage that deviate from the average pattern of usage across all sources of information. The largest group of individuals are classified as users of weather information found on websites, this category accounts for just over thirty percent of respondents. Other important patterns of usage emphasize other types of sources. The second largest group of individuals use a pattern of information weather usage that relies primarily on traditional weather media such as local television. The next largest group relies on their social network and informal sources such as family and friends as well as social media. Finally, a small group of individuals, less than 13% of the sample, are highly engaged with weather information sources regardless of type. Having established these four different patterns of weather information access, this study then examines who uses these patterns and belongs to these classes.

In examining how external characteristics are associated with weather information usage, I find that demographics are more strongly associated with weather information access patterns than political characteristics. Ideology is weakly associated with membership in two of the four classes. A relatively small but interesting diverging pattern with conservative ideology being negatively associated with membership in the "Website Users" class and positively associated with membership in the "Informal Source" users class. Ideology is related to a formality divide moreso than a digital divide. Given conservatives lack of trust in authorities and government, generally, these findings suggests these attitudes transfer over to weather information sources as well (Rudolph and Evans, 2005; Rudolph, 2009; Jones, 2004). Gender, on the other hand, is more strongly associated with class membership. Females are much more likely to rely on a variety of sources as opposed to males who are especially likely to rely on their network when accessing weather information. Males, however, are more likely to be highly engaged across all sources. Additionally, as females are generally more likely to have higher risk perceptions (Finucane et al., 2000; McCright and Dunlap, 2011*a*), these findings may suggest one way they address these risks, and their higher perceptions thereof, is to seek out more information, particularly on websites and through other formal informational channels.

Race and education play an especially important role in understanding weather information access patterns. Highly educated respondents are much more likely to rely on their immediate networks, including through social media, or use other internet sources such as websites. Less educated individuals, on the other hand, are much more likely to rely on traditional media, including local televisions, for weather information. They are also slightly more likely to be highly engaged across a wide variety of sources. These results suggest that the digital divide is

present for weather information, given that lower education is associated with a lower likelihood of using social media and websites. In addition to social media, less educated individuals are less likely to use informal sources such as their family and friends. Educated individuals may rely on their family and friends for weather information because their network is also highly educated. This may also explain why more highly educated individuals are less likely to be "Highly Engaged Users". They may view their network resources as sufficient in educating them about the weather. With the digital divide, less educated individuals are forced to rely on the television for their weather information. In weather, television can be a reliable source of information; however, broadcast meteorologists are more prescriptive than other sources and may give incorrect advice (Ryan, 1982; Compton, 2018).

The digital divide is also present when examining how race is associated with weather information patterns. As with less educated respondents, Racial minorities, African Americans in particular, are more likely to rely on traditional media for weather information or be highly engaged across media. White respondents, on the other hand, are much more reliant on informal sources of weather information such as their social networks than their racial minority counterparts. Age is also highly related to the digital divide and associated information source patterns. In particular, older individuals are much more likely to rely on using traditional media sources while avoiding informal and social network sources such as family and friends and social media. Younger individuals, on the other hand, are much more likely to use these informal and sometimes online weather information search patterns.

These results have important implications for understanding who has access to weather information and how reliable that information is. Additionally, re-

search has suggested that the use of multiple sources, at least during hazards, can help promote appropriate responses (Miran, Ling and Rothfusz, 2018). Thus, finding that vulnerable populations, such as racial minorities and the elderly, primarily rely on one set of sources, traditional ones such as local television, for weather information may be potentially problematic. These individuals may be less attuned to weather risks given their limited attention to information about the phenomenon. However, less educated individuals, another vulnerable group, are more likely to be highly engaged across the set of information sources which may reflect a protective behavior. Interestingly, these results suggest the opposite relationship than one might expect with the increase of leisure time to seek out a variety of weather information sources that usually comes with increased education. Rather, education is associated with increased use of trusted informal sources such as social networks for routine weather information gathering. In the next chapter, I intend to examine the relationships between these weather information source patterns and climate change beliefs (See Goebbert et al. (2012) for a related analysis). To do so, I intend to use the outputs of these models, the class memberships and predicted probabilities, as explanations for beliefs about the anthropogenic causes of climate change and certainty in that belief.

Chapter 3

The Broader Information Context: Weather Information, the News, and Global Warming Information Sources

3.1 Introduction

In the previous chapter, I reviewed research on the use of information during severe weather to inform the use of weather information during day-to-day life. I then estimated patterns or classes of this usage and the demographic factors and political dispositions that help explain use of those patterns. In this chapter, I extend these analyses by using those demographic factors, political dispositions, and the weather information sources and patterns to help explain beliefs about climate change.

In particular, I focus on these elements because information is a valuable but

increasingly abundant resource in modern society. The number of information sources has grown tremendously with the proliferation of television during the middle of the century and the advent and growth of the internet in the past few decades (Prior, 2007; Stroud, 2008). Not only have the number of sources of information increased but so have the duties of those various channels of information. Most information outlets including cable TV networks, newspapers, and social media websites disseminate information on a wide variety of topics ranging from the daily forecast to updates on current political events to coverage of popular culture.

These roles of information providers may vary over time and across the varying topics they present. Similarly, the public's usage of these information outlets may vary with respect to the content of the information they seek (Stroud, 2011). While various sources may all produce weather and political information, individuals may choose a particular subset for each different information type. These subsets of sources for particular information sources may range in their degrees of overlap, from entirely to not at all. However, the existence of these overlaps has rarely been examined nor have the implications of these overlaps for policy beliefs. One reason for this may be that only certain policy areas, those which are highly conflictual and affect large populations, are reasonably covered by such widely varying sources of information. While areas such as education and healthcare also receive significant information coverage from a variety of sources, many of these policy problems are more likely to be addressed at a local level. Policy areas such as gun control or climate change, in particular, affect a much broader swath of individuals. As such, a much wider variety of information sources for these areas may exist.

Climate change as a concept appears in news media information as well as

weather information such as forecasts (Carvalho, 2007; Boykoff, 2008; Feldman et al., 2012). Additionally, individuals may seek out information dedicated to climate change or global warming in particular (Wood and Vedlitz, 2007). Given these three potential categories of information sources, I am interested in how each is related to certainty in beliefs in the human-caused nature of climate change. In particular, I am interested in the overlap between news sources, weather sources, and climate specific sources. I am interested in examining how the context or category of a particular information source may change the relationship of that source with climate change beliefs. In the following paper, I first review the extant literature on information sources and climate change. I then introduce the data, one particular wave (18) of the M-SISNet panel survey used elsewhere in this dissertation, I use to examine these relationships and their potential contextual contingencies. Using these data, I model the relationship between a variety of information sources, in multiple contexts, and climate change beliefs. Finally, I end with the implications of this research for future studies and potential policy implications.

3.2 Literature Review

Within communications and political science, many studies of climate change beliefs have focused on the Receive Accept Sample (RAS) Model of public opinion (Zaller, 1992). Zaller argues that survey responses, and therefore public opinion, are the product of the available thoughts or ideas in an individuals head at a given time. These ideas are then accepted if they are consistent with prior beliefs and applied or sampled based on their saliency. These thoughts are unstable and highly subject to influence by political and media elites. Individuals lack strongly

held attitudes or beliefs about most political or policy issues because these issues are generally peripheral to their everyday lives. Survey responses, and the beliefs they represent, are subject to the most recent information an individual has consumed on the topic. The effects of this information, then, is highly contingent upon the ideological nature of the media itself and its corresponding audience (Feldman, Hart and Milosevic, 2017).

3.2.1 News Sources and Climate Change Beliefs

With regard to climate change, research has demonstrated that the messaging from elites and media sources is highly varied. Scholars have found that certain sources such as Fox News and the Wall Street Journal are less likely to view climate change as a problem (Feldman et al., 2012). Liberal media outlets such as CNN are more likely to present climate change as a problem with human roots. Regarding political elites such as elected officials, this relationship is maintained with Democrats being more consistent in their depictions of climate change than Republicans (Merkley and Stecula, 2018). Conservative news outlets have also been documented actively spreading doubt about the reality of climate change, its causes, and the science upon which out understanding of climate change is built (Dunlap and McCright, 2011; Feldman et al., 2012). In particular, these news sources portray the scientific consensus on climate change differently, with liberal media sources reflecting the consensus a vast majority of the time while conservative sources reflect the consensus less than half of the time (Boykoff and Boykoff, 2004, 2007). These studies correspond with a decrease in trust in scientists among political conservatives, especially with regards to climate change (Gauchat, 2012; Leiserowitz et al., 2010; Krosnick and MacInnis, 2010).

These information sources, which are already predisposed to confirming individuals' prior beliefs, are then processed in a motivated manner, further amplifying the original beliefs. This amplification of original belief then leads to increased usage of the news media that confirmed the belief, creating an entrenched feedback loop (Feldman et al., 2014). These feedback loops are especially apparent in the context of political ideology and partisanship. While many argue party identification has the strongest influence on climate change beliefs (Carmichael and Brulle, 2018), this identity is also associated with a set of news media sources. Thus, partisanship creates and reinforces a media environment that further reinforces partisan belief systems. Cultural cognition, as separate from ideology, has also been demonstrated as an important explanation for climate change beliefs across a variety of studies (Hornsey et al., 2016). Recently, scholars have suggested that selective exposure and processing, prominently explored among ideologues, is also present for differing cultural types (Newman, Nisbet and Nisbet, 2018). This creates a self-reinforcing mechanism wherein media sources produce content which is in line with their audiences predispositions in order to maintain that audience (Stroud, 2008, 2011). This results in intense competition for information provision and the creation of "niche news" for increasingly small segments of the population. Others have argued this niche news phenomenon could lead to a competitive market for information and ideas where the "best" win out (Stromer-Galley, 2003); however, most argue this provision of niche news actually leads to individuals being exposed to a more narrow set of ideas, even cutting themselves off from news entirely (Prior, 2007; Sunstein, 2009).

In Zaller's RAS model of public opinion, the processes of selective exposure to particular media sources affects the set of information in the individual has received. Moving beyond this information environment, individuals then accept the

relevant information and process it. One mechanism through which selected information processing occurs is motivated reasoning (Kunda, 1990; Taber and Lodge, 2006). Scholars in this tradition find that motivated reasoning wherein individuals selectively process information that confirms their beliefs and strongly argue against disconfirming evidence is most prevalent among respondents with strong partisan affiliation, high attention to politics, and more issue specific knowledge (Zaller, 1992; Lodge and Taber, 2013). A somewhat separate tradition of public opinion argues that individual attitudes and beliefs, reflected through survey questions, are a more stable and structured concept (see Jones and Jenkins-Smith (2009) for a brief overview of the different traditions). Despite these differences, both groups of scholars suggest that political ideologies, cultural beliefs, and cognitive shortcuts such as motivated reasoning help explain public beliefs about politics and policy, in particular those regarding climate change.

This body of research suggests, as Carmichael and Brulle (2018) and others argue, that climate change beliefs are a product of both social psychological determinants and media exposure. Within the context of climate change, research has demonstrated a particularly strong interaction between media/information and social identities such as partisanship. One area the relationship between information and partisanship is particularly stark is in framing studies comparing climate change to global warming. Results of these studies have found, consistently over time and across samples, that Republicans, on average, report lower levels of belief and concern for global warming relative to climate change (Schuldt and Roh, 2014*a*; Schuldt, Roh and Schwarz, 2015; Schuldt and Roh, 2014*b*). Additionally, these studies suggest that Republican respondents' beliefs about climate change and global warming are conceptually distinct and that beliefs about global warming are more susceptible to temperature related primes. Democrats, on the other

hand, associate both climate change and global warming with similar concepts and their opinions do not vary with temperature primes.

Not all frames affect reported beliefs in the same manner, however. In some cases, both liberals and conservatives will adapt their beliefs in ways contrary to the science being presented to them (Nisbet, Cooper and Garrett, 2015). In most cases, though, scholars find boomerang effects in Republican respondents in which attempts to increase belief in climate change actually entrench skepticism or denial of climate change or support for mitigation policies (Zhou, 2016; Hart and Nisbet, 2012). Republicans engage in motivated reasoning by assimilating information which fits their priors and disconfirming information which does not. However, some cues are stronger than others; for example, cold primes or temperatures only affect beliefs about global warming, not climate change, and only among climate change skeptics (Schuldt and Roh, 2014*b*). News media, however, can have a strong effect on climate change beliefs. Feldman et al (2012) find that where Republicans get their news from is much more influential on their climate change beliefs than where Democrats get their news from. This is true even for Republicans who get news from climate change affirming sources such as MSNBC and CNN. This research suggests Republicans are particularly sensitive to informational effects, at least regarding climate change.

3.2.2 By-product Learning and Weather Information

These studies are primarily interested in the relationship between individuals everyday lives and news consumption and climate change beliefs. The information individuals consume regarding climate change is either acquired in the process of acquiring more general news (Hmielowski et al., 2014; Feldman et al., 2012;

Carmichael and Brulle, 2018) or simply through the weather they experience (Schuldt and Roh, 2014*b*) rather than through seeking out information on climate change specifically. Thus, these studies suggest by-product learning about climate change is occurring, as opposed to direct learning. By-product learning is the idea that individuals learn about one political concept through unrelated, usually routine activities. In these studies, individuals beliefs about climate change are learned or informed by the general news sources individuals use as well as the weather they experience. This body of research prompts a set of hypotheses regarding news sources listed below:

Hypothesis 1: Individuals who use ***conservative*** *news sources, such as Fox News or the Wall Street Journal, will be more likely to believe humans are* ***not*** *causing global climate change and more certain in that belief.*

Hypothesis 2: Individuals who use more ***liberal*** *news sources, such as CNN or NPR, will be more likely to believe, and more certain in the belief, that humans* ***are*** *causing climate change.*

Moving beyond these hypotheses regarding relationships between traditional news media and climate change beliefs, by-product learning may occur through the use of weather-information, especially given the well documented relationship between weather and climate change beliefs (Egan and Mullin, 2012; Hornsey et al., 2016). Just as individuals learn about climate change through the weather they experience, they may also learn about climate change through the information they consume about that weather. This represents another, yet unexplored, pathway through which by-product learning about climate change may take place. Some research has investigated the effects of training broadcast meteorologists

in climate change communication. Using a field experiment and two-wave panel design, Zhao et al. (2014) find that respondents who viewed the climate change segments became more likely to believe in science supported beliefs about climate change. Meteorologists who took part in the *Climate Matters* program elsewhere were much more likely to report on climate change than their colleagues (Perkins IV et al., 2018). These meteorologists perceive their role as "station scientists" and not just to report the weather forecasts. McIlroy-Young and Thistlethwaite (2019) also find that climate change communication behaviors vary across meteorologists in Canada.

However, even meteorologists attitudes towards climate change vary; Maibach, Witte and Wilson (2011) find that the "Climategate" scandal decreased broadcast meteorologists' belief that climate change is occurring. Additionally, Meldrum et al. (2016) find that meteorologists differ in their knowledge of climate change and their ability to communicate climate information effectively. The meteorologists they interviewed perceived images as an effective climate change communication tool. These studies illustrate the limits on climate change and climate information communication that broadcast meteorologists face. Wilson (2009) emphasizes the obstacles including differences among broadcast meteorologists values, limited time on-air, as well as a preference for discussing climate change off-air through blogs and other media. These studies suggest weather information, and broadcast meteorology in particular, may be valuable resources for changing climate change beliefs. Therefore, I arrive at the following research question:

Research Question 1: How are weather information sources associated with belief and certainty in that belief in the human (or not) causes of global climate

change?

3.2.3 Direct Learning through Global Warming Information

Most of the research described in the previous sections asks respondents to report their general news consumption habits. They then examine the relationship between these sources and various climate change beliefs (Carmichael and Brulle, 2018; Feldman et al., 2014). Similarly, weather information, in particular through broadcast meteorologists, can be a valuable source of information about climate change (Placky et al., 2016). These categories of information are relevant to understanding individual's climate change beliefs, especially in light of the effects of partisanship and other values. These studies, primarily, rely on an implicit connection between the information and climate change beliefs, thus describing a process of by-product or indirect learning. On the other hand, individuals may directly seek out information about climate change in an effort to understand the issue. Studies which examine the more explicit and direct relationship between information seeking behaviors about climate change and climate change beliefs are less prevalent. In fact, Marquart-Pyatt et al. (2011) state that "We need to know more about where members of the public get their information about climate science and how they assess the trustworthiness of these sources."(Marquart-Pyatt et al., 2011, p. 40). Thus, I ask the following research question:

Research Question 2: What information sources do people report accessing for global warming information

Scholars of the Risk Information Seeking and Processing model have documented generic information seeking behaviors, agnostic to the specific sources,

across many specific domains (Yang, Aloe and Feeley, 2014). In the climate change domain, Kahlor (2007) finds that individuals on average report high intentions to seek out information about global warming. They also find that the average respondent reports slight information insufficiency which drives their intended information seeking behaviors. Digging into more specific information sources, Wood and Vedlitz (2007) use an open ended question on a phone survey that asked respondents to list information sources for a number of issues, including global warming. They argue that a higher number of information sources, which for their data ranged from zero to seven, is associated with more information and therefore a more accurate view of the issue, relying less on individual predispositions such as partisanship. However, they do not find a relationship between number of listed information sources and beliefs about climate change. Attention, operationalized as thinking about the issue, to climate change, however, is positively associated with concern for global warming. Believing science is unclear, a belief about a potential information source, is negatively associated with concern for global warming. On the other hand, Kellstedt, Zahran and Vedlitz (2008) find that confidence in scientists is negatively associated with concern for global warming. They also find that more informed respondents, those with knowledge about climate change, are less concerned about climate change, in contrast to the findings in Wood and Vedlitz (2007). These findings suggest a complex relationship between actual climate knowledge, information, and beliefs. In this chapter, I test a hypothesis based off Wood and Vedlitz (2007) presented below:

Hypothesis 3: Individuals who use ***more*** *information sources specifically about global warming will be* ***more likely*** *to believe that global climate change is*

caused by humans and more confident in that belief.

*Hypothesis 4: Individuals who seek out **conservative** sources for global warming information, specifically, will be **less likely** to believe humans are causing climate change and more confident in that belief.*

*Hypothesis 5: Individuals who seek out **liberal** sources for global warming information, specifically, will be **more likely** to believe humans are causing climate change and more confident in that belief.*

3.3 Data and Methods

The data for this chapter come from the single wave of the M-SISNet panel survey used throughout this dissertation. Specifically, this chapter relies on data from wave 18 of the panel. This wave was fielded between June 4th and July 23rd in 2018. The total number of respondents is 2,246 and the median completion time is 33 minutes. For this chapter, this wave is used because it includes the usual battery of information questions and two unique batteries of information questions which were not asked previously.

The battery of questions used for the analysis in Chapter One asked: "How frequently do you get information about the WEATHER from each of the following sources?". The response options were:

- Newspapers
- Non-government Internet websites (such as weather.com)
- Government sponsored Internet websites (such as noaa.gov, Oklahoma Mesonet)
- Local TV (television) news

- Cable TV (television) news (such as The Weather Channel)
- Radio
- Family, friends, or colleagues
- Social Media, such as Facebook and Twitter
- Cell phone applications or automated text message
- Other (please specify)

Individuals were able to choose various options for each of these sources:

- Several times a day (5)
- About once a day (4)
- Several times per week (3)
- About once per week (2)
- Less than once per week (1)
- Never (0)

The question used regarding news sources was very similar to the one used for weather information. The question asked, "Now we would like to know about your GENERAL NEWS HABITS. About how frequently do you get information about current news events from the following sources:". Response options were the same as weather information, but the information sources differed and are listed below:

- Fox News
- CNN
- MSNBC
- The New York Times
- The Oklahoman

- The Tulsa World
- The Wall Street Journal
- Local Television Stations (such as ABC, NBC, or CBS)
- Public Radio Stations (such as NPR)

We also included an option for respondents to list other sources of general news information not listed in the response options. Finally, we asked individuals about their use of information of global warming specifically. This question asked, "People get information about global warming in a number of ways. For example, some people talk to friends. Others go online or watch the news. Where would you say you get most of your information about global warming? Please provide as much detail as possible, such as the name of the website or news publication." This question relied entirely on respondents self-reporting their sources of global warming information in an open-ended manner. I use key-word analysis from this question to create independent variables for the analysis of climate change beliefs[1]. We also asked a standard battery of demographic and political questions which will be included as covariates in the regression models. To model climate change beliefs, I first use a dependent variable which is constructed by combining both an individual's belief in the causes of climate change and their certainty in that belief. This scale ranges from negative ten, which represents extreme certainty that climate change is not human caused, to positive ten, which represents extreme certainty that climate change is human caused. I model this belief in a series of two-step linear regressions where in the first step I include one category of information source. In the second step, I add demographic and

[1]I attempted to code responses into categories; while certain themes did emerge, most responses ended up in general, generic categories. Using key-words allows for more specificity among source identification.

political covariates which have been demonstrated to be related to climate change beliefs. Finally, I model climate change beliefs as a function of the three categories of information in conjunction with each other. All models were tested for heteroskedasticity in the residuals using the Breusch Pagan test; the null hypothesis was rejected for all models, therefore I report robust standard errors for each. I also checked Variance Inflation Factors (VIFs) for all models to assess multicollinearity. All VIFs were less than 5; therefore, no serious collinearity problems were found. Slightly high VIFs (ranging between 2.5 and 3.5) were present for party identification which is to be expected due to the inclusion of ideology as well as party. The results from these models are presented below.

3.4 Findings

The summary statistics for the subset of the sample of individuals who have complete responses to all variables used in these analyses from wave eighteen of the MSIS-Net survey are presented below in Table 3.1. The mean for the dependent variable, Certainty in (Non)Belief in Climate Change, is 1.6. For all respondents in this sample, the average belief leans slightly toward climate change is happening and caused by human activity. However, there is large variation in these beliefs for the sample, ranging the entire possible scale of the variable from negative 10, very certain climate change is not caused by the emissions of greenhouse gases, to positive 10 very certain it is caused by greenhouse gas emissions, with the mid-point of zero representing no certainty, in either belief. Next are the summary statistics for the sources of weather information in our study. The most common, as prior research including prior chapters in the dissertation would suggest, is local television stations. This average of 3.6 represents use of local

television stations approximately once a day. All other weather sources have means between 1.03 for newspapers, to 2.23 for family and friends, suggesting uses between less than once per week to about once per week. We see a similar pattern for general news sources as well. Local television stations are used for general news about once a day, mean = 3.52. All other news sources have a mean between 0.27, for the Wall Street Journal, and 1.68 for Fox News, or between zero uses per week to about once per week. Finally, examining demographics we see that the model sample is relatively wealthy, older, well-educated, white, more likely to be female, and more conservative.

The data in Table 3.1 account for all responses included in all of the following models. While the survey was completed by approximately 2,300 individuals, I use the subset of complete responses to be better able to compare across models, since the exact same sample is used in each. Regarding the relationships posited in hypotheses 1 and 2, the models in Table 3.2 present the first tests. In column one I model climate change beliefs, (un)certainty in greenhouse gas emissions as the cause, as a function of news sources. In column two, I add covariates common to the study of climate change beliefs.

Table 3.2 provides general support for hypothesis 1 which stated that conservative news sources such as Fox News and the Wall Street Journal would be associated with greater certainty in the belief climate change is not caused by greenhouse gas emissions. Specifically, in both column 1 and column two, Fox News and the Wall Street Journal have negative and significant coefficients. In column one, the coefficient on the variable representing use of Fox as a news source is the largest of the news source variables. This model, without covariates, suggests a one point change on the Fox News variable is associated with an approximately one point decrease in certainty that climate change is caused by

Table 3.1: Summary Statistics for Model Sample, n = 1,319

Statistic	Mean	St. Dev.	Min	Max
DV: Certainty in (Non)Belief in Climate Change	1.7	6.9	−10	10
Global Warming Info: Number of Sources	1.3	1	0	7
Weather Info: Cable TV	1.6	1.7	0	5
Weather Info: Social Media	1.1	1.7	0	5
Weather Info: Family/Friends	2.2	1.6	0	5
Weather Info: Radio	2.1	1.9	0	5
Weather Info: Local TV	3.7	1.5	0	5
Weather Info: Govt. Websites	1.2	1.5	0	5
Weather Info: Other Websites	1.9	1.8	0	5
Weather Info: Phone Apps	2.1	1.9	0	5
Weather Info: Newspapers	1.1	1.6	0	5
News Source: Fox	1.7	1.9	0	5
News Source: CNN	1.1	1.6	0	5
News Source: MSNBC	1.0	1.6	0	5
News Source: New York Times	0.38	0.99	0	5
News Source: The Oklahoman	0.95	1.5	0	5
News Source: Tulsa World	0.41	.0	0	5
News Source: Wall Street Journal	0.28	0.77	0	5
News Source: Local TV	3.6	1.5	0	5
News Source: NPR	1.1	1.6	0	5
Income	72,000	57,000	10,000	900,000
Male	0.43	0.5	0	1
Age	61.1	13.5	21	95
Ideology	4.6	1.7	1	7
Democrat	0.41	0.49	0	1
Some College	0.3	0.47	0	1
Bachelors Degree	0.29	0.45	0	1
Graduate Degree	0.26	0.43	0	1
African American	0.027	0.16	0	1
Native American	0.045	0.21	0	1
Other Race	0.041	0.19	0	1
Website User	0.31	0.37	0	0.999
Informal Source USer	0.26	0.37	0	1
Traditional Media User	0.29	0.4	0	1
Highly Engaged User	0.13	0.28	0	1

caused by greenhouse gas emissions (or the converse: a one point increase in the certainty climate change is NOT caused by greenhouse gas emissions). Thus, if an individual moves from never using Fox as a news source to even less than one use per week, their certainty in their beliefs about climate change will change by about 1 point on the 21 point scale. Local TV has a positive relationship with climate change beliefs. This effect of local TV could be considered as evidence in opposition to hypothesis one as many local television stations are owned by relatively conservative corporations. Additionally, Oklahomans, and this sample

Table 3.2: OLS Regression Coefficients for News Source Models

	Certainty in (Non)Belief in Climate Change	
	(1)	(2)
News Source: Fox	−1.01*** (0.09)	−0.27*** (0.09)
News Source: CNN	0.75*** (0.12)	0.32*** (0.11)
News Source: MSNBC	0.75*** (0.12)	0.27** (0.11)
News Source: New York Times	0.77*** (0.16)	0.18 (0.15)
News Source: The Oklahoman	0.08 (0.11)	0.17 (0.11)
News Source: Tulsa World	0.26 (0.16)	0.04 (0.15)
News Source: Wall Street Journal	−0.59** (0.23)	−0.40* (0.22)
News Source: Local TV	0.37*** (0.11)	0.31*** (0.10)
News Source: NPR	0.53*** (0.11)	0.30*** (0.09)
Male		−0.39 (0.30)
Age		−0.01 (0.01)
Ideology		−1.36*** (0.12)
Democrat		3.21*** (0.46)
Logged Income		−0.19 (0.24)
Some College		−0.46 (0.50)
Bachelors Degree		−0.57 (0.53)
Graduate Degree		0.40 (0.55)
African American		−1.22 (1.01)
Native American		−0.04 (0.80)
Other Race		0.59 (0.76)
Constant	−0.42 (0.47)	7.76*** (2.80)
N	1,319	1,319
R^2	0.30	0.46
Adjusted R^2	0.30	0.45
Residual Std. Error	5.83 (df = 1309)	5.14 (df = 1298)
F Statistic	63.10*** (df = 9; 1309)	55.76*** (df = 20; 1298)

*p < .1; **p < .05; ***p < .01. Robust std. errors in parentheses.
Reference categories are female, Republicans, HS or less, and White.

in particular, are on average conservative; therefore, one might expect local news sources in the state to be conservative news sources.

Regarding hypothesis two, I also find support. Specifically, more liberal news sources have positive coefficients, suggesting their use is associated with increased belief in climate change being caused by greenhouse gas emissions. All sources, other than the two previously described, present a positive relationship; however, both local newspapers, The Tulsa World and The Oklahoman, and the New York Times present null relationships with climate change beliefs, when accounting for covariates. A one unit change in any of these sources is associated with an approx-

imately 0.3 unit change in certainty of the causes climate change beliefs. Column two of Table 3.2 suggests that hypotheses one and two are supported, even when including potential individual level confounding factors such as ideology, partisanship, and demographics. Use of the New York Times switches from a large and positive effect to a null effect with the inclusion of covariates. Otherwise, the relationships between these sources and certainty in the causes of climate change are robust to the inclusion of covariates and similar across both models.

Having examined the relationships between news sources and climate change beliefs, I move to examining how weather information sources are associated with climate change beliefs. The models of the relationship between weather information sources and certainty in beliefs about the causes of climate change are presented in Table 3.3. In column one, only three sources of weather information are significantly related to beliefs about the causes of climate change. Specifically, social media and radio are associated with decreases in certainty in the belief that climate change is caused by greenhouse gas emissions, or increases in certainty it is not caused by greenhouse gas emissions. On the other hand, getting weather information from family and friends is associated with increased certainty in the belief that climate change is caused by the combustion of fossil fuels and the subsequent greenhouse gas emissions.

In column two of Table 3.3, a slightly more nuanced set of relationships between weather information sources and climate change beliefs is presented. When I account for covariates common to the study of climate change beliefs, the use of cable television as a weather information source becomes significant at the ten percent level. As researchers have extensively examined the relationship between general news sources and climate change beliefs, more strict standards of statistical significance should be adopted. However, in this more exploratory realm

Table 3.3: OLS Regression Coefficients for Weather Information Models

	Certainty in (Non)Belief in Climate Change	
	(1)	(2)
Weather Info: Cable TV	0.08 (0.12)	0.16* (0.10)
Weather Info: Social Media	−0.29** (0.12)	−0.28*** (0.10)
Weather Info: Family/Friends	0.46*** (0.13)	0.23** (0.11)
Weather Info: Radio	−0.29*** (0.10)	−0.15* (0.08)
Weather Info: Local TV	0.01 (0.14)	0.17 (0.11)
Weather Info: Govt. Websites	0.20 (0.14)	0.08 (0.11)
Weather Info: Other Websites	−0.02 (0.12)	−0.05 (0.09)
Weather Info: Phone Apps	−0.09 (0.11)	0.01 (0.08)
Weather Info: Newspapers	0.12 (0.13)	0.08 (0.11)
Male		−0.48 (0.32)
Age		−0.01 (0.01)
Ideology		−1.66*** (0.12)
Democrat		3.99*** (0.45)
Logged Income		−0.07 (0.25)
Some College		−0.34 (0.51)
Bachelors Degree		−0.34 (0.54)
Graduate Degree		0.62 (0.56)
African American		−0.97 (1.04)
Native American		−0.12 (0.79)
Other Race		0.59 (0.69)
Constant	1.34** (0.66)	8.55*** (2.88)
N	1,319	1,319
R^2	0.02	0.44
Adjusted R^2	0.01	0.43
Residual Std. Error	6.92 (df = 1309)	5.23 (df = 1298)
F Statistic	2.68*** (df = 9; 1309)	51.52*** (df = 20; 1298)

*p < .1; **p < .05; ***p < .01. Robust std. errors in parentheses.
Reference categories are female, other/independents, HS or less, and White.

of research, looking at the relationships with slightly lower levels of statistical significance can be warranted. The magnitude of this relationship is similar to the magnitude for radio as a weather information source as well, suggesting there is more variance in these effects, represented by larger standard errors. The use of cable TV as a weather information source is associated with increased cer-

tainty in the belief that climate change is caused by fossil fuel combustion and greenhouse gas emissions. When examining how weather information sources are related to climate change beliefs, including demographic and political covariates can help make the answers to research question one more clear which is that certain weather information have small but significant relationships with climate change beliefs.

Table 3.4: OLS Regression Coefficients for Weather Source Pattern Models

	Certainty in (Non)Belief in Climate Change	
	(1)	(2)
Class: Traditional Media	−0.83 (0.58)	−0.33 (0.47)
Class: Highly Engaged Users	−1.56** (0.77)	−0.94 (0.74)
Class: Informal Source Users	−1.69*** (0.63)	−0.99 (0.65)
Male		−0.61* (0.32)
Age		−0.01 (0.02)
Ideology		−1.63*** (0.12)
Democrat		4.13*** (0.44)
Logged Income		−0.06 (0.24)
Some College		−0.42 (0.51)
Bachelors Degree		−0.49 (0.55)
Graduate Degreee		0.44 (0.57)
African American		−0.92 (1.07)
Native American		0.03 (0.80)
Other Race		0.58 (0.68)
Constant	2.62*** (0.41)	9.42*** (3.04)
N	1,319	1,319
R^2	0.004	0.43
Adjusted R^2	0.001	0.43
Residual Std. Error	6.94 (df = 1315)	5.26 (df = 1304)
F-statistic	1.55 (df = 3; 1315)	71.42*** on (df = 14; 1304)

*p < .1; **p < .05; ***p < .01. Robust standard errors in parentheses
Reference categories are female, other/independents, HS or less, and White.

Table 3.4 further explicates the relationship between weather information sources and climate change beliefs by using the Latent Classes identified in the

previous chapter. These classes represent different patterns for weather information source usage. I include the predicted probabilities of class membership for three of the four classes, omitting the "Website Users" class as the reference class[2]. When not accounting for covariates, the predicted probability of being a Highly Engaged user and an Informal Source user are statistically significant and negative. Additionally, the predicted probabilities of belonging to these classes explain very little variance in climate change beliefs. Individuals who are more likely to belong to these classes have less (more) certainty in the belief that climate change is (not) human caused. However, once I account for covariates, these relationships become null. This makes sense given the estimation of the LCA models in Chapter 2 included these demographic and political variables as explanatory variables of class membership.

Next I move to examining the data which allow me to answer my second research question and to test hypotheses three through five in Table 3.5. This table provides a summary of a keyword analysis of the open ended question regarding sources of information for global warming. To conduct this analysis, I used a number of common text pre-processing methods. First, I converted all words to lower case to account for irregularities in case usage. I then stemmed all words to their basic roots which you will see for the words onlin-, nation-, newspap-, televis-, scienc-, and articl-. This allows for all forms of these words (i.e. scientific or article and articles) to count toward the frequency of the root word or stem. The word that appeared the most in the responses is by far news. Approximately 46% of respondents used this word at least once in their open-ended response about global warming information sources. One common text pre-processing step I did not take was removing punctuation. I did not

[2]I choose to omit this class because it accounts for the largest proportion of this sub-sample.

do this because in such short responses punctuation represents very little of the analyzed text, as compared to in longer documents. Additionally, because this is an open ended survey question, the use of punctuation may reflect important individual differences. It is not required, therefore its inclusion by individuals may be important.

Table 3.5: Frequency of Users with Keyword Table for Top Twenty Keywords

Word	N (%)	Word	N (%)	Word	N (%)	Word	N (%)
news	611(46.3)	nation-	85(6.4)	friend	58(4.4)	articl-	46(3.5)
","	477(36.2)	onlin-	83(6.3)	newspap-	57(4.3)	radio	43(3.3)
tv	225(17.1)	internet	80(6.1)	televi-	52(3.9)	cnn	42(3.2)
"."	184(13.9)	local	80(6.1)	scienc-	51(3.9)	watch	41(3.1)
channel	108(8.2)	weather	73(5.5)	fox	49(3.7)	talk	36(2.7)

After news, Table 3.5 demonstrates the second most common keyword or token is the comma, appearing in approximately 36% of responses, and the fourth most common is the period, appearing in just under a quarter of responses. In this case, the comma is especially interesting as it primarily represents when respondents listed more than one source for global warming information. After the top four keywords, the frequency of appearance drops off to below ten percent of responses. Many of the sources that can be constructed from this list from the open-ended global warming question mimic both the weather information sources, such as local television and weather channels, as well as general news sources such as Fox and CNN. This suggests that there is substantial overlap in the use of these sources for various information purposes.

I then use these data to examine hypotheses three through five using regression models similar to the previous ones. One important difference to note is that the variables that represent these keywords are dichotomous. If a respondent used that word or token in their response, they receive a 1 for the variable; if not, they

receive a 0. The results from these models are presented below in Table 3.6.

Table 3.6: OLS Regression Coefficients for Global Warming Source Models

	Certainty in (Non)Belief in Climate Change	
	(1)	(2)
Key Word: News	0.37 (0.42)	0.52 (0.33)
Key Word: ","	−0.01 (0.63)	−0.67 (0.50)
Key Word: TV	−0.54 (0.49)	0.42 (0.41)
Key Word: "."	1.09 (0.76)	0.44 (0.60)
Key Word: Channel	0.95 (0.72)	1.02 (0.64)
Key Word: Onlin-	0.37 (0.84)	−0.09 (0.62)
Key Word: Internet	−1.47* (0.87)	−0.50 (0.62)
Key Word: Nation	3.71*** (0.63)	2.53*** (0.57)
Key Word: Local	−1.61** (0.70)	−0.93 (0.64)
Key Word: Weather	−0.20 (0.88)	0.30 (0.71)
Key Word: Friend	−1.06 (0.96)	−0.54 (0.77)
Key Word: Newspap-	0.25 (0.84)	0.96 (0.83)
Key Word: Televis-	0.40 (0.91)	0.63 (0.75)
Key Word: Fox	−6.34*** (0.85)	−2.12*** (0.74)
Key Word: Scienc-	1.82 (1.13)	1.08 (0.84)
Key Word: CNN	2.30** (0.99)	0.57 (0.84)
Key Word: Articl-	−1.71 (1.20)	−0.45 (0.87)
Key Word: Watch	1.62 (1.00)	1.29 (0.91)
Key Word: Talk	0.07 (1.11)	0.20 (1.02)
Key Word: Radio	−3.32*** (1.16)	−1.40 (0.91)
Global Warming Info: Number of Sources	1.26*** (0.26)	0.38* (0.22)
Male		−0.26 (0.31)
Age		0.002 (0.01)
Ideology		−1.59*** (0.12)
Logged Income		−0.04 (0.24)
Democrat		3.86*** (0.45)
Some College		−0.23 (0.51)
Bachelors Degree		−0.43 (0.53)
Graduate Degree		0.40 (0.56)
African American		−0.84 (1.04)
Native American		−0.04 (0.82)
Other Race		0.42 (0.68)
Constant	−0.97 (0.62)	6.76** (2.83)
N	1,319	1,319
R^2	0.12	0.46
Adjusted R^2	0.11	0.45
Residual Std. Error	6.58 (df = 1297)	5.18 (df = 1286)
F Statistic	8.47*** (df = 21; 1297)	34.15*** (df = 32; 1286)

*p < .1; **p < .05; ***p < .01. Robust std. errors in parentheses.
Reference categories are female, Republicans, HS or less, and White.

In Table 3.6, of the twenty top keywords from the global warming information source question, six have statistically significant relationships with climate change beliefs in column one. Only two of these relationships remain significant when accounting for relevant covariates. Regarding hypothesis three I find support.

Specifically, the positive coefficient on the variable representing the number of sources identified in the open-ended global warming information source responses suggests those who seek out more information about global warming are more likely to believe it is human caused. This effect, across the range of the variable from 0 to 7, is actually quite large, covering almost three points of the 21 point scale . Regarding hypothesis four, I also find support. When individuals rely on more conservative sources for global warming information they report less(more) certainty in a belief that combustion of fossil fuels and greenhouse gas emissions are (not) causing global temperatures to rise. Individuals who report using Fox as a source for global warming information report, all else equal, more certain belief that global warming is not caused by greenhouse gas emissions by approximately 2 points, after accounting for partisanship and ideology. This is a substantial relationship, representing an effect of approximately one-tenth of the entire scale of climate change beliefs. In the model without covariates, other responses which are associated with more certainty in the belief that global warming is not caused by greenhouse gas emissions are ones that use the word local or radio. Local sources, in particular television, are likely a conservative source and therefore support hypothesis four as well.

Finally, I find support for hypothesis five, primarily before accounting for covariates. Most directly, the positive coefficient on the CNN keyword represents support for this hypothesis. Respondents who use CNN as a source for global warming information are approximately 2.3 points more certain in their belief that greenhouse gases are causing temperatures to rise. In both models, the stem-word of nation is also associated with higher certainty in the belief that global warming is caused by greenhouse gas emissions. This suggests that national news sources used for global warming information may be, on average, more liberal, especially

relative to local news sources. In fact, this effect is the largest positive coefficient for global warming sources, associated with an increase of approximately 2.5 points of certainty on the 21 point scale. Additionally, the null effect of the word news suggests that it is specific types of news such as national and local that are related to certainty in beliefs about the causes of global warming. For all three global warming information source hypotheses, I find consistent support, across both models with and without covariates.

Examining each type of information source in isolation does not reflect reality, however. Individuals are, rather, using these various sources for their various purposes in conjunction with each other. Weather information searches and sources do not exist outside of or separate from news or global warming information sources. Thus, the use of separate survey questions to measure these different sources and purposes allows for examining the effects of information across these potentially different – news, weather, and global warming specific – contexts on beliefs about global warming. The results from modeling all of these information types simultaneously are presented in Table 3.7.

For the models in Table 3.7, I included only the global warming information variables which were significant in column one of Table 3.6. This reduces the number of global warming information sources, key words, from twenty to six. Modeling all of these different types of information a the same time provides a more nuanced explanation of the ways in which information sources are associated with beliefs about global warming. For weather information sources, the relationships which were present in column one of Table 3.3 stay consistent when including all information types and covariates. Using cable news as a source of weather information is no longer significant in either model, however. The magnitudes, and direction, of these relationships is remarkably consistent across all of

Table 3.7: OLS Regression Coefficients for All Information Source Models

	Certainty in (Non)Belief in Climate Change	
	(1)	(2)
Key Word: Internet	−0.70 (0.71)	−0.37 (0.60)
Key Word: Nation-	2.95*** (0.58)	2.53*** (0.55)
Key Word: Local	−0.65 (0.64)	−0.51 (0.59)
Key Word: Fox	−1.54* (0.84)	−1.09 (0.75)
Key Word: CNN	−1.19 (0.83)	−0.50 (0.82)
Key Word: Radio	−2.34*** (0.85)	−1.53* (0.83)
Global Warming Information: Number of Sources	0.59*** (0.17)	0.27* (0.15)
Weather Info: Cable TV	0.06 (0.11)	0.12 (0.10)
Weather Info: Social Media	−0.19* (0.10)	−0.26*** (0.10)
Weather Info: Family/Friends	0.27** (0.11)	0.19* (0.10)
Weather Info: Radio	−0.25*** (0.09)	−0.18** (0.09)
Weather Info: Local TV	−0.27 (0.17)	−0.13 (0.16)
Weather Info: Govt. Websites	0.02 (0.12)	0.02 (0.10)
Weather Info: Other Websites	−0.13 (0.10)	−0.08 (0.09)
Weather Info: Phone Apps	−0.09 (0.09)	0.002 (0.08)
Weather Info: Newspapers	−0.03 (0.12)	−0.01 (0.11)
News Source: Fox	−0.88*** (0.10)	−0.22** (0.10)
News Source: CNN	0.78*** (0.13)	0.34*** (0.12)
News Source: MSNBC	0.61*** (0.12)	0.17 (0.11)
News Source: New York Times	0.68*** (0.16)	0.15 (0.15)
News Source: The Oklahoman	0.10 (0.12)	0.20* (0.11)
News Source: Tulsa World	0.31* (0.16)	0.08 (0.15)
News Source: Wall Street Journal	−0.58** (0.23)	−0.39* (0.22)
News Source: Local TV	0.48*** (0.16)	0.34** (0.15)
News Source: NPR	0.57*** (0.11)	0.35*** (0.10)
Male		−0.41 (0.32)
Age		−0.01 (0.01)
Ideology		−1.33*** (0.12)
Logged Income		−0.16 (0.24)
Democrat		3.06*** (0.46)
Some College		−0.40 (0.50)
Bachelors Degree		−0.62 (0.53)
Graduate Degree		0.19 (0.56)
African American		−1.10 (0.97)
Native American		0.05 (0.81)
Other Race		0.53 (0.75)
Constant	−0.20 (0.63)	7.87*** (2.86)
N	1,319	1,319
R^2	0.34	0.48
Adjusted R^2	0.32	0.47
Residual Std. Error	5.72 (df = 1293)	5.08 (df = 1282)
F Statistic	26.10*** (df = 28; 1466)	19.21*** (df = 40; 1454)

*p < .1; **p < .05; ***p < .01. Robust std. errors in parentheses.
Reference categories are female, Republicans, HS or less, and White.

these models. Using social media and the radio for weather information are both consistently related with decreased(increased) certainty in the belief that climate change is(not) caused by greenhouse gas emissions. Using family and friends for weather information has the opposite relationship. Echoing the relationship for weather information from the radio, using the radio as a source for global warm-

ing information is also associated with decreased(increased) certainty in the belief that climate change is(not) caused by greenhouse gas emissions.

Including Fox as both a news source and a global warming information source suggests that the effect of Fox on climate change belief occurs primarily through the use of Fox as a news source. Both the key word coefficient for Fox and the news source coefficient are statistically significant, at at least the 0.1 level, and negative in column 1 of Table 3.7. When accounting for partisanship and ideology, the effect of Fox News as a global warming information source is no longer significant. For CNN on the other hand, only the news source coefficient is significant in both models. This suggests the effect of CNN on climate change beliefs occurs primarily through those who use it for news as opposed to for global warming specifically. Similarly, the relationship of local sources to beliefs about global warming is contingent on context. When all types are included in the model, only local television as a news source is statistically significantly and positively related to certainty in the belief that global warming is caused by greenhouse gas emissions. However, local, as a global warming information key word, and local television as a weather information source have negative, though not significant, relationships with certainty in this same belief.

In this full model, the support for all hypotheses remains. Conservative sources, both news and global warming, have negative coefficients and therefore are associated with less(more) certainty that greenhouse gases are(not) causing global warming. Liberal sources, primarily through their role as news sources, are associated with the opposite relationships. I also find that the more sources reported in the open ended question on global warming information is associated with higher(lower) certainty in the (non)anthropogenic causes of climate change in support of hypothesis three. Finally, I test the relative importance of the

different sets of predictors using the models in column two of Table 3.7[3]. This method compares the sets of variables contribution to the variance explained by standardizing the variables and calculating the ratio of the effect standard deviations. A ratio of 1.0 means each set contributes equally. When comparing global warming key words and weather information, the estimate of the ratios is 1.16 but the 95% confidence interval overlaps 1.0, suggesting these two sets of variables have relatively the same effect on certainty in beliefs about the causes of climate change. News sources, on the other hand, have a much larger relative importance. The ratio of effect standard deviations comparing news sources to weather information sources is approximately 2.01 while comparing news source to global warming information sources results in a ratio of 2.33, both with 95% confidence intervals that do not overlap 1.0. This suggests news information sources are the relatively most important source of information when examining variation in climate change beliefs[4].

3.5 Discussion

In this chapter, I modeled how various types of information are related to individuals beliefs about the causes of climate change. First, I was interested in replicating various studies demonstrating the relationship between ideologically motivated news sources and these beliefs (Feldman et al., 2012; Feldman, Hart and Milosevic, 2017). Even in a relatively homogeneous sample of Oklahomans, the effects of political media on beliefs about climate change are apparent. This suggests particular support for the importance of information in models of be-

[3]I use the relimp package in R to do so (Firth, 2006).

[4]Comparing ideology and partisanship to news sources results in a ratio of effect standard deviations of 2.44, suggesting, perhaps unsurprisingly, that these political variables are possibly the most important factor in examining variation in climate change beliefs.

lief formation as compared to the social, psychological model (Carmichael and Brulle, 2018). Additionally, this further emphasizes the importance of understanding biased search processes for information, in this case general news information (Stroud, 2011). Additionally, the importance of general news information is emphasized in this research. This type of information explains the most variation in beliefs about global warming of all types examined. Once accounting for partisanship and other covariates, when sources overlap in types, the effect of a particular source, such as CNN or Fox, has a stronger and more consistent effect when reported as a general news, as opposed to global warming specific, source.

Next, this chapter examined how weather information is related with beliefs about climate change. Given that individuals' experiences of the weather help explain beliefs about climate change, this research contributes a new type of information that plausibly relates to climate beliefs (Hamilton and Stampone, 2013; Egan and Mullin, 2012). Certain weather information types are consistently related to individuals' beliefs about the certainty of the causes of global warming. Specifically, family and friends as a source of weather information is associated with increased certainty in the belief that greenhouse gases cause global warming[5]. Social media and the radio are associated with the increased certainty in the belief that cliamte change is not human caused, on the other hand. Of the types of information examined, weather information sources have less explanatory power than news sources but similar explanatory power to global warming information sources. However, given the less political and ideological nature of this information, weather information may prove a vital tool for changing beliefs about climate change. While some research has examined the effects of broad-

[5]Preliminary analysis of an open ended question about causes of change in belief about climate change provide evidence for the finding that family and friends can change attitudes.

cast meteorologist's ability to educate people about climate change (Zhao et al., 2014), future research ought to further examine how weather information can be used to educate and change beliefs about global warming. In particular, the accuracy of forecasts, and individuals' perceptions thereof, may affect how this type of information is related to climate change beliefs.

Finally, this chapter examined the effect of self-reported global warming information sources on beliefs about the causes on global warming. While some research has asked about sources of information specifically, this has primarily focused on the number of sources listed, as opposed to the specific sources themselves (Wood and Vedlitz, 2007). Individuals report seeking global warming information from many of the same sources they receive weather information and the news from. Certain sources in this type of information have an effect on beliefs about global warming independent of their effect as a general news source or weather information source. This suggests that the context of the information, or at least the survey question and its construction, matters for examining explanations of climate change beliefs. Some sources have both an indirect, through news or weather information consumption, and direct relationship with individuals' beliefs about global warming. Though limited to beliefs about global warming, the findings from this chapter suggest scholars pay attention to a wide array of information sources and information types to understand individual problem definitions and policy beliefs. Even information sources that may not seem immediately political or directly related can have strong effects on beliefs of interest.

Chapter 4

Climate Change Beliefs and Policy Preferences

In the previous chapter(s) I primarily focused on the role of information in explaining whether or not people believe climate change is caused by humans and certainty in that belief. In this chapter, I use this belief as an explanatory variable for climate change risk perceptions and policy preferences. I also include the effects peoples' everyday environments as measured through experiences of temperature and rainfall in examining support for climate change policy. In this chapter, I examine both support for policy addressing climate change generally as well as the various specific policies.

Policy solutions to the problem of climate change are numerous and multifaceted. Politicians have suggested a variety of potential mechanisms to help address the issue, emphasizing different aspects of the problem and its causes. Some emphasize market based solutions while others call for more regulatory power and control. The objects of these policies differ as well with some preferring to address individuals' actions while others see intervention at the corporate

level as potentially more palatable or effective. Policy regarding climate change has also been construed very broadly with scholars and policymakers suggesting far reaching connections to issues such as health, education, the economy and job markets. Understanding the structure of preferences for these policies and how support for them is grouped may help policy scholars examine how to address this complex issue (Leiserowitz, 2006*a*; Dietz, Dan and Shwom, 2007; Ding et al., 2011).

Similarly important to understanding the structure of policy preferences for climate change policy is understanding what explains this structure. Scholars of the policy process have adapted research which was originally conducted at the institutional or macro level to models of the individual and micro level (Wood and Vedlitz, 2007; Liu, Robinson and Vedlitz, 2016, 2017). These scholars emphasize the role of problem perceptions and definitions in explaining policy preferences. Individuals may focus on particular beliefs about policy problems when choosing among policy alternatives. Individual demographics and other factors as well as information sources, in concert with policy specific beliefs such as issue image and causality, help explain specific policy choices.

In this chapter, I extend the analyses from previous chapters to examining a variety of policy preferences regarding climate change. I first review the literature on issue image and causality, with a particular focus on climate change. Using the same data from wave 18 of the MSIS-Net panel of Oklahomans, I examine a micro-model of the policy process for climate change policies. I begin by examining the structure of preferences for these policies and then examine the determinants of policy preferences from the micro-model of policy choice. I find that risk perceptions and beliefs about causality, in conjunction, explain policy support for climate change generally. Previous research has primarily modeled support

for climate change mitigation policies either using a measure of general support or with each policy option very much in isolation. I argue, however, that climate change policies ought to be considered both generally and individually and not in isolation; this better approximates the discussion among advocacy groups and provides valuable insight into individual determinants of policy support. I end the chapter with the implications of this study for policy process research as well as science communication for climate change.

4.1 Literature Review

Scholars of the policy process have long examined how advocacy groups and other institutional actors have manipulated problem definitions and images and in order to support their preferred policy solutions (Kingdon, 1995; Baumgartner and Jones, 2010; Boydstun and Glazier, 2013; Jenkins-Smith, Nohrstedt, Weible and Sabatier, 2014; Cobb, 1983). Given that institutions are, to some extent, organized groupings of individuals, individual policy beliefs may influence institutional policy choices (Jones and Baumgartner, 2005). As such, recently, researchers have suggested individuals issue images are associated with their support for policy intervention. Issue images are the general perceptions of the issue or problem a policy is attempting to address; these images are one of the many components of problem definitions. These scholars argue individual policy choices are structured by individual policy images, demographic characteristics, and political and issue-specific beliefs (Wood and Vedlitz, 2007; Liu, Robinson and Vedlitz, 2016, 2017). Problem definitions and images themselves are structured by these same categories. In this literature review, I first focus on the determinants of risk perceptions focusing primarily on climate change,

as an element of issue image. I then review the research on individuals' policy preferences for addressing climate change, focusing on the role of risk perceptions in particular.

4.1.1 Risk Perceptions as an Element of the Issue Image of Climate Change

Issue image is just one of many elements of problem definition including problem causality, target populations, and others. Among the many dimensions of problem definition, scholars have studied how advocacy groups have used issue images to promote particular policy solutions and hopefully result in change (Stone, 1989; Kingdon, 1995; Baumgartner and Jones, 2010; Schneider and Jacoby, 2003). Issue image is often characterized as an impression of how problems can either pose harm or policies can provide assistance (Liu, Robinson and Vedlitz, 2016; Baumgartner and Jones, 1991). At an individual level, issue image can be reconceived of as the general beliefs about the benefits or detriments of a policy issue (Jones, 1994; Baumgartner and Jones, 2010; Liu, Robinson and Vedlitz, 2016). For individuals, these issue images are composed of the strength of a belief and its valence (positive or negative). Some issue images are beliefs that are hard to change, therefore strong, while others might change more easily. Again at the individual level, issue images can also be described as a distribution with some being closer to the mean or median while others are farther from the center of the distribution and therefore more extreme. Research suggests issue images help explain changes in a variety of policy domains including disability policy (Jeon and Haider-Markel, 2001) the death penalty (Baumgartner, De Boef and Boydstun, 2008), and nuclear waste siting (Sjöberg, 2003).

Issue images contain perceptions of risks, perceptions of benefits, beliefs about or descriptions of causality, and various other factors. Risk perceptions, as an element of issue image, can be explained by a variety of factors. One of the most studied explanatory factors of risk perceptions as an element of issue image is demographics. Scholars, in the tradition of Paul Slovic and colleagues, have demonstrated a consistent "white male" effect. White men have on, average, lower risk perceptions of many risks compared to their female and racial minority counterparts (Slovic, 1999; Finucane et al., 2000; Kahan et al., 2007). Education, income, and other correlated demographic traits such as numeracy have also been demonstrated to help explain individuals risk perceptions. In some studies, individuals with higher levels of education perceive higher risks of climate change (Hamilton, 2011). However, other research has found that numeracy, which is highly correlated with education, is not related with higher average concern for climate change. Rather, numeracy interacts with partisanship, particularly as a Republican, in order to inoculate individuals against concern for climate change (Kahan et al., 2012). This result has also been demonstrated with education; Republicans with higher levels of education tend to report lower levels of concern according to a study by Hamilton (2011).

Political and other beliefs are also related to risk perceptions of climate change. McCright and Dunlap (2011*a*, 2013) suggest that the white male effect on risk perceptions of climate change is primarily concentrated in conservative individuals. Measures of environmental and general risk are also associated with specific risk perceptions of climate change and help account for effect of ideology on climate change risk perceptions. Cultural values, such as egalitarianism, are also related to climate change risk perceptions (Leiserowitz, 2006*a*). Egalitarians perceive higher risks of climate change while individualists and hierarchs

perceive lower risks, on average. Beliefs about the environment, as operationalized by the New Environmetal (Ecological) Paradigm (NEP), are also related to climate change risk perceptions (O'Connor, Bord and Fisher, 1999; Dunlap et al., 2000; Brody et al., 2008; Carlton and Jacobson, 2013). Those who score higher on the NEP and therefore have more concern for the environment generally have higher risk perceptions of climate change. Those with higher concerns for economic issues, however, have lower perceptions of the risk of climate change according to Carlton and Jacobson (2013).

In a comprehensive effort to model climate change risk perceptions, Van der Linden (2015) finds support for each of these category of variables in explaining climate change risk perceptions in a sample from the UK. They find that experiential factors, such as experiences of extreme weather, and socio-cultural factors help explain risk perceptions better than socio-demographic or cognitive factors, such as knowledge of the causes of climate change or affect.

In addition, many scholars of risk and environmental studies have examined the effect of risk perception on individual attitudes and behavior toward policy choices. The measurement of risk perceptions is highly varied; however, most are scales that range from extremely low or no risk to extremely high risk, usually with a neutral position in the middle. These studies have found that higher risk perceptions are associated with individuals' behaviors and can lead to more individual support for government mitigation policies (O'Connor, Bord and Fisher, 1999; Martin, Martin and Kent, 2009; Maestas et al., 2018; Leiserowitz, 2006*a*). Additionally, numerous studies have demonstrated the effect of issue causality on individual policy choice. Scholars have found that people who believe that climate change is caused by human activities tend to support government policies regarding climate change more than those who do not (Leiserowitz, 2006*b*;

O'Connor, Bord and Fisher, 1999; Bord, Fisher and O'Connor, 1998; O'Connor et al., 2002). This review leads me to my first proposition:

Proposition One: Risk perceptions, as an element of individual issue images, will be explained by demographics, political dispositions, and issue-specific concepts and beliefs.

4.1.2 Determinants of Individuals' Policy Choices

Individuals' policy choices are complex and have many potential explanatory factors. Recently, Robinson and colleagues (2017) reviewed a broad range of existing literature regarding individuals' policy choices. As with risk perceptions, individual attitudes towards policy choice are primarily constructed by three sets of explanatory factors: demographics, political predispositions and issue specific variables.

The first set of explanatory factors is individual demographic characteristics. Public opinion and policy scholars have well documented the important contextual relationships between a large variety of demographics and individuals' policy choices or preferences. Most consider basic demographic characteristics including age, gender, and education in order to account for potential confounding effects. However, some evidence suggests that individual attributes are stable and stronger predictors than other social determinants in the formation of policy support for environmental and risky policy (Jones and Dunlap, 1992). Existing studies suggest these factors capture important individual differences that structure preferred policies. Zahran et al. (2006) relate demographics to the concept of personal capability. Those with higher capabilities to pay or take action against climate change are more likely to support mitigation policy (Berk and Schulman,

1995; Berk and Fovell, 1999). Lubell et al. (2006) find that education and knowledge increase actions taken to mitigate climate change. Zahran et al. (2006) also suggest gender is related to capability, finding that males are less likely to support climate change mitigation policies. However, as previously mentioned, these relationships are often contingent upon the policy area under consideration (Liu, Robinson and Vedlitz, 2017).

The second set of explanatory factors is political predispositions. Trust, ideology, party affiliation and other general attitudes toward government and the environment have been shown to explain individuals policy preferences across many domains (Song, Silva and Jenkins-Smith, 2014; Reckhow, Grossmann and Evans, 2015; Ding et al., 2011; Mumpower, Liu and Vedlitz, 2016). These variables serve as underlying filters through which individuals process their policy choice (Taber and Lodge, 2006; Rudolph and Evans, 2005). For instance, individual support for various policy choices has been explained by party identification and ideology (Lubell et al., 2006). Trust and beliefs about governmental knowledge, especially as they vary by level of government, have been shown to be related to individuals policy preferences (Murphy, Greer and Wu, 2018). However, for climate change, Dietz, Dan and Shwom (2007) find that trust in environmental groups and industry better explain support for climate policy than trust in government. In addition, cultural theorists have also found that individuals' views toward government authority shape individuals' policy choices and support (Dake, 1991; Leiserowitz, 2006*b*; Stoutenborough, Sturgess and Vedlitz, 2013).

Finally, more recent research examining policy preferences for certain issues has emphasized the importance of issue specific explanations (Robinson, Stoutenborough and Vedlitz, 2017). These variables include an individual's attention, knowledge, experience and specific characteristics about the issue at hand. Is-

sue attention is usually conceptualized as a time-bound activity which indicates interest or experience with a policy issue or problem; some measures of issue attention include Google search patterns (Ripberger, 2011), concern about energy supply (Liu, Robinson and Vedlitz, 2017), use of news media (Holt et al., 2013), and others. In particular, there have been multiple studies indicating that issue attention is associated with policy choices (Liu, Robinson and Vedlitz, 2017; McCright, 2008). Liu, Robinson and Vedlitz (2017) find that issue attention is associated with reduced support for nuclear energy as a solution to climate change. On the other hand, McCright (2008) finds that issue attention is associated with increased support for a variety of effective policy solutions to climate change. Another issue specific explanation is personal experience. Previous studies have shown that individuals who directly or indirectly experience disastrous events have higher risk perceptions of climate change and are highly likely to support mitigation policies addressing those events (Van der Linden, 2015; Spence et al., 2011; Slovic, 2000). Objective risk, operationalized as geographic vulnerability, to the effects of climate change as also been shown to be correlated with individuals subjective risk perceptions and policy support (Brody et al., 2008). Leiserowitz (2006*a*) finds strong evidence that experiential elements, such as affect, are related to support for climate change policy. Beliefs about causality of climate change are also strongly related to both risk perceptions and policy support (Leiserowitz, 2006*b*; O'Connor, Bord and Fisher, 1999; Bord, Fisher and O'Connor, 1998; O'Connor et al., 2002; Ding et al., 2011). However, findings in this domain are somehat mixed as Kellstedt, Zahran and Vedlitz (2008) find that 'informedness' is negatively correlated with concern for global warming and personal responsibility toward it. They find that higher confidence in science and scientists is also related to lower levels of individual action. Ding et al. (2011) find

that belief in scientific consensus mediates many of these effects on support for climate policy. Reviewing determinants of policy choice, with regards to climate change, leads me to the following propositions:

Proposition Two: Individual policy support will be explained by demographics, political dispositions, and issue-specific beliefs.

Proposition Three: Certainty in the belief that climate change is (not) caused by human activity will be associated with higher (lower) levels of policy support.

Proposition Four: Individuals with higher risk perceptions will have higher levels of support for climate policies.

4.1.3 Measurement of Climate Policy Support

Climate change is a multifaceted policy issue with a plethora of possible solutions. Some solutions emphasize industry regulation while others emphasize regulating or changing individual behaviors. Some policy solutions have more obvious costs to individuals such as regulations that raise gas prices. Other climate policies costs are more submerged such as tax credits or rebates for purchasing solar panels or electric cars. Many studies of climate change policy consider these alternatives in isolation. One of the most studied policies which would help address climate change, and is framed as such, is the use of nuclear energy. Scholars have examined how beliefs about climate change are related to support for nuclear power plants (Bickerstaff et al., 2008; Corner et al., 2011; Visschers, Keller and Siegrist, 2011). When framed as potentially mitigating the effects of climate change, individuals will support nuclear energy and power plants slightly more; however, this is also contingent upon their risk perceptions of both nuclear energy and climate change. Another policy that commonly comes up in discussions of

climate change that has been studied in isolation is a carbon tax (Avi-Yonah and Uhlmann, 2009). Studies of public opinion on carbon taxes find that support is highly contingent on the described uses of the revenues (Amdur, Rabe and Borick, 2014). Other policies which would have climate change mitigation effects include the development of renewable energy. These policies have generally high levels of support that vary by location, with most studies showing that proximity to the projects is associated with increased support as opposed to decreased (Wolsink, 2000; Devine-Wright, 2005, 2011).

Despite the various dimensions of these policies, most studies combine these various policies into a single scale. Zahran et al. (2006) combine 11 different items, or policies, into a singular scale. These range from taxes on individuals and industries to education policies regarding climate change. Ding et al. (2011) combine six different policy items when measuring policy support. Their policies include ratification of international treaties and adding surcharges to individuals electric bills. Leiserowitz (2006*a*) combines climate policies into two indexes; the first measures general climate policy preferences while the second measures preferences around tax policy. Dietz, Dan and Shwom (2007) combine 8 measures into a singular climate change support variable. Compared to other research, they attempt to define each policy in terms of trade-offs and their effects on individuals budgets. Similarly, McCright, Dunlap and Xiao (2013) combine only three measures, each of which relates to emissions standards and regulations. Across these studies, it is clear there is a variety of measurements of policy support regarding climate policy with most scholars collapsing these variables into one, maybe two, scales. These studies find desirable properties of these scales and use these properties to justify their decisions to combine measures. Following these studies, I also combine my measures of climate policy support

into a single index. However, given the variety in the designs of these policies, I also conduct separate analyses for each policy individually and ask the following:

Research Question One: How do the determinants of general climate policy support differ across the various individual climate change policies?

4.2 Data and Methods

Table 4.1 presents summary statistics for all models run in this chapter. These data come from Wave 18 of the MSIS-Net panel survey of Oklahomans described in further detail in Jenkins-Smith et al. (2017). Based on the preceding review of research on climate change risk perceptions and policy support, I arrive at the list of independent variables described below. Many of these independent variables in this study were measured in a variety of ways. Demographics were measured in usual ways. Age and income are continuous self-reports. Levels of education were recoded to dummy variables for high school or less, some college, bachelors degree, graduate school with the lowest level being omitted. Race is also coded as a set of dummy variables with white or Caucasian respondents as the omitted category. Location of home lot is coded as three dummy variables for suburban, urban, and rural with suburban omitted. Partisanship is coded as 1 for Democrat and 0 for Republican[1]. Ideology is a seven point scale where 1 represents strongly liberal while seven represents strongly conservative[2].

Certainty in the human causes of climate change is measured on a scale from negative ten to positive ten, with negative ten representing extreme certainty

[1]Independents were asked which party they leaned toward and are included as such. Respondents, n = 93, who replied Other Party are coded as NA.

[2]Both political variables were not collected in Wave 18. Therefore, I use data on these variables from Wave 17 which was fielded approximately three months earlier.

that climate change is not caused by humans and fossil fuel combustion and positive ten representing extreme certainty that it is. *Perception of temperature change* is a three point scale where 1 represents respondents who believe spring 2018 was cooler than previous springs, 2 represents those who believe it was exactly the same temperature, and 3 represents those who believe it was warmer. *Concern for energy cost and natural resource preservation* are measured on ten point scales where 0 represents no concern and 10 represents extreme concern. *Time spent outside* is measured using a 5-point scale where 0 represents no time outside on a typical spring day, 1 represents less than an hour a day, 2 represents 1-2 hours a day, 3 represents 2-4 hours a day, and 4 represents more than 4 hours a day. *Season precipitation and temperature departures* are measured using the actual weather data. Respondents were paired with the closest Mesonet station as described in Jenkins-Smith et al. (2017). The average precipitation and temperature for the past 15 years at those stations for each season were then calculated. These variables then represent the difference between the average for all springs in the preceding 15 years and the actual average, both temperature and precipitation, for spring 2018. Finally, *health status* is measured using a question about respondents general health. This measure ranges from 1 for poor, 2 for fair, 3 for good, 4 for very good, and 5 for excellent.

Dependent variables for this study were also measured in multiple ways. First, risk perceptions of global warming is measured using a ten-point scale where 0 represents no risk and 10 represents extreme risk to people and the environment. Then each of the climate change policy options were measured using a four point scale where 1 represents strongly opposed and 4 represents strongly support. These indicators where further collapsed into binary indicators, with strongly support and somewhat support coded as 1 and strongly oppose and somewhat

Table 4.1: Summary Statistics for Complete Responses, n = 1,684

Statistic	Mean	St. Dev.	Min	Max
Dependent Variables				
Risk Perceptions of Global Warming	6.06	3.03	0	10
Policy Support Scale	3.00	0.73	1.00	4.00
Four Point: CO2 Limits	2.87	0.99	1	4
Four Point: Carbon Tax	2.77	1.02	1	4
Four Point: Renewables Research	3.29	0.83	1	4
Four Point: Public Land	3.26	0.85	1	4
Four Point: Tax Rebates	3.19	0.85	1	4
Four Point: Regulate CO2	2.96	0.95	1	4
Four Points: 20% Rule	2.69	1.04	1	4
Binary: CO2 Limits	0.68	0.47	0	1
Binary: Carbon Tax	0.65	0.48	0	1
Binary: Renewables Research	0.86	0.35	0	1
Binary: Public Land	0.85	0.36	0	1
Binary: Tax Rebates	0.84	0.37	0	1
Binary: Regulate CO2	0.73	0.45	0	1
Binary: 20% Rule	0.60	0.49	0	1
Demographics				
Age	61.7	13.5	21	95
Male	0.42	0.49	0	1
Income	73,000	57,000	10,000	900,000
Some College	0.32	0.47	0	1
Bachelors Degree	0.29	0.46	0	1
Graduate School	0.26	0.44	0	1
African American	0.03	0.17	0	1
Native American	0.04	0.21	0	1
Other Race	0.04	0.20	0	1
Urban	0.19	0.39	0	1
Rural	0.38	0.49	0	1
Political Dispositions				
Democrat	0.43	0.49	0	1
Ideology (Conservative)	4.58	1.75	1	7
Issue Specific Variables				
Certainty in Human Causes of Climate Change	1.86	6.95	−10	10
Perception of Temperature Change	2.20	0.96	1	3
Concern for Energy Cost in OK	6.54	2.58	0	10
Concern for Natural Resource Preservation in OK	7.03	2.36	0	10
Time Spent Outside	2.14	0.97	0	4
Season Precipitation Departure from 15 Year Average	−3.08	1.65	−7.20	4.96
Season Temperature Departure from 15 Year Average	0.58	0.45	−0.21	1.87
Health Status	3.40	0.93	1	5

oppose coded as 0, as presented in the table. The questions for these policy preferences were presented in a random order and were as follows:

- Set strict carbon dioxide emission limits on existing coal-fired power plants

to reduce global warming and improve public health. Power plants would have to reduce their emissions and/or invest in renewable energy and energy efficiency. The cost of electricity to consumers and companies would likely increase.

- Require fossil fuel companies to pay a carbon tax and use the money to reduce other taxes (such as income tax) by an equal amount.
- Fund more research into renewable energy sources, such as solar and wind power.
- Generate renewable energy (solar and wind) on public land in the U.S.
- Provide tax rebates for people who purchase energy-efficient vehicles or solar panels.
- Regulate carbon dioxide (the primary greenhouse gas) as a pollutant.
- Require electric utilities to produce at least 20% of their electricity from wind, solar, or other renewable energy sources, even if it costs the average household an extra $100 a year.

The correlations between these policy preferences for all complete observations are presented in Table 4.2.

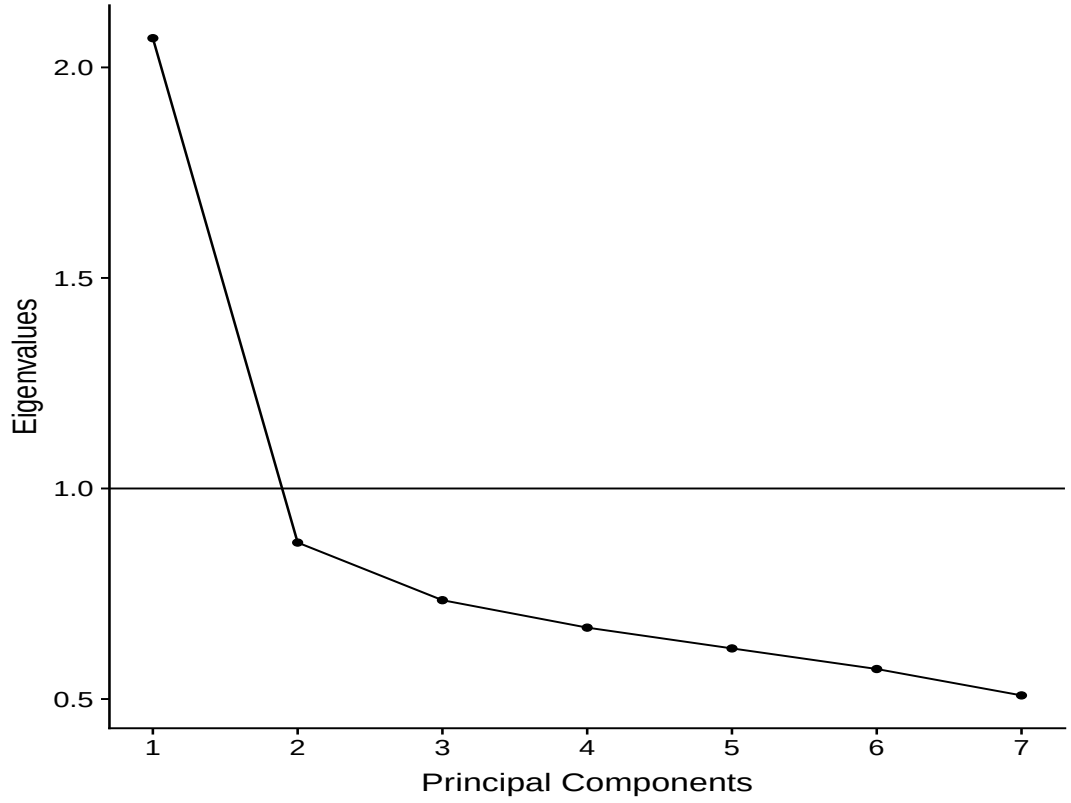
Table 4.2: Pearson correlation coefficients for all climate change policy solutions

	CO2 Limits	Carbon Tax	Renewable Research	Public Land	Tax Rebates	Regulate CO2	20% Rule
CO2 Emission Limits on Coal-fired Plants	1	0.649	0.546	0.442	0.496	0.736	0.654
Carbon Tax on Fossil Fuel Companies	0.649	1	0.496	0.436	0.503	0.667	0.539
Fund Renewable Research	0.546	0.496	1	0.597	0.542	0.533	0.559
Generate Renewables on Public Land	0.442	0.436	0.597	1	0.462	0.454	0.502
Tax Rebates on Energy Efficient Vehicles and Solar Panels	0.496	0.503	0.542	0.462	1	0.508	0.497
Regulate CO2 as Pollutant	0.736	0.667	0.533	0.454	0.508	1	0.622
Require Utilities to Produce 20% of Energy from Renewables	0.654	0.539	0.559	0.502	0.497	0.622	1

All correlations are statistically significant at the $p < 0.01$ level. n = 1,684.

Given the strong positive correlations of the policy support variables, I ran a principal components analysis to further examine the dimensionality of support for climate change policies. Examining the scree plot in Figure 4.1, only the first eigenvalue exceeds one, suggesting a unidimensional structure. The Cronbach's alpha for this scale is 0.89, removing any single policy solution reduces this score, further suggesting the intercorrelations between the policy solutions are high[3].

Figure 4.1: Plot of eigenvalues from PCA of all seven climate change policy solutions



In the following section, I first model risk perceptions of climate change as

[3]A Latent Class Analysis, similar to those estimated in Chapter 2, was also run. This analysis resulted in a minimized BIC for 4-classes; however, the largest class, accounting for 50% of respondents had high predicted probabilities of support for all policies. Future analyses might consider this method. For clarity, brevity, and diversity of analysis types, I am excluding it from this chapter.

a function of individual demographics, political dispositions, and policy/domain specific variables and beliefs. Then, given the weight of this evidence, in the next section, I model climate change policy preferences as the average of the 4-point indicators for all seven policies. I also model climate policy preferences using seven separate logit analyses to examine if the determinants of climate change policy are stable across the various alternatives.[4]

4.3 Findings

Table 4.3 presents the results from OLS regressions for both climate change risk perceptions and the policy solutions scale. Examining Model 1, a few important relationships become apparent. First, I find that certainty in the belief that fossil fuel combustion and greenhouse gas emissions cause climate change is strongly and positively related to risk perceptions of climate change. Regarding demographics, the only significant effects are related to home location; individuals in urban and rural areas have lower risk perceptions of climate change, relative to their suburban counterparts. Political party has a strong relationship with risk perceptions; Democrats have higher risk perceptions of climate change than Republicans. Ideology, on the other hand, has a negative relationship with risk perceptions. As individuals become more conservative, their risk perceptions of climate change are lower. In line with previous research, I find that perceptions of higher temperatures, as opposed to actual deviations from average, are associated with higher risk perceptions of climate change. On the other hand, everyday experiences of precipitation are associated with lower risk perceptions.

[4]Robust standard errors are presented for OLS regressions due to the presence of heteroskedasticity in the residual term as evidence by the studentized Breusch-Pagan test. VIFs were also calculated for all models; all were less than 3 indicating limited multicollinearity in the models.

This may be driven by prior experiences with drought, which is perceived as risky to crops in particular, driving positive affect toward rainfall and therefore lower risk perceptions. Finally, I find that individuals who are concerned for energy costs and natural resource preservation, in particular, in Oklahoma also report higher levels of risk associated with climate change. Thus, I find strong support for proposition one that risk perceptions are explained by demographics, political dispositions, and issue-specific beliefs and concepts.

Examining general support for policies addressing climate change, I find similar patterns in many cases and support for my second proposition. In Model 2, I model support for climate policy without the effect of climate change risk perceptions and then in Model 3 I include the effect of risk perceptions on policy support. Across both models, most effects are generally consistent. Males are significantly less likely to support climate change policy than their female counterparts. Belonging to the Democratic party is associated with higher levels of support for policies addressing climate change as is concern for natural resource preservation in Oklahoma. Conversely, the more conservative an individual is the less they support climate change policies. The effect of perceptions of higher seasonal temperatures is insignificant across both models. Similarly deviations from average precipitation are unrelated to support for climate policies. However, on the other hand, deviations from climate averages for temperature are positively associated with support for policy solutions to climate change, across both models. Regarding proposition three, climate change risk perceptions are also positively associated with support for climate policy support. A change from the minimum to the maximum across risk perceptions is associated with an almost 1-point change in policy support, or almost 25% of the support scale. While most relationships are stable across models 2 and 3, the effect of certainty in the

Table 4.3: OLS Regression Coefficients

	Climate Change Risk Perceptions	Support for Climate Policy Solutions, 4-Point Scale	
	Model 1	Model 2	Model 3
Climate Change Beliefs			
Certainty in Causes of Climate Change	0.25***	0.05***	0.03***
	(0.01)	(0.003)	(0.003)
Climate Change Risk Perceptions			0.08***
			(0.01)
Demographics			
Age	−0.001	−0.002*	−0.002*
	(0.003)	(0.001)	(0.001)
Male	−0.02	−0.16***	−0.16***
	(0.09)	(0.03)	(0.03)
Logged Income	−0.06	−0.03	−0.02
	(0.07)	(0.02)	(0.02)
Some College	0.08	0.02	0.01
	(0.16)	(0.05)	(0.04)
Bachelors Degree	0.12	0.03	0.02
	(0.16)	(0.05)	(0.04)
Graduate School	−0.01	0.06	0.06
	(0.17)	(0.05)	(0.05)
African American	0.20	−0.19**	−0.20***
	(0.26)	(0.08)	(0.08)
Native American	0.29	0.10	0.07
	(0.25)	(0.07)	(0.06)
Other Race	−0.01	0.04	0.04
	(0.21)	(0.06)	(0.06)
Urban	−0.19*	0.01	0.02
	(0.11)	(0.03)	(0.03)
Rural	−0.32***	−0.06**	−0.04
	(0.10)	(0.03)	(0.03)
Political Dispositions			
Ideology	−0.29***	−0.09***	−0.06***
	(0.04)	(0.01)	(0.01)
Democrat	0.54***	0.10***	0.06*
	(0.12)	(0.03)	(0.03)
Issue Specific Variables			
Perception of Temperature Change	0.09*	0.01	0.01
	(0.04)	(0.01)	(0.01)
Concern for Energy Cost in OK	0.05**	0.004	0.001
	(0.02)	(0.01)	(0.01)
Concern for Natural Resource Preservation in OK	0.18***	0.04***	0.03***
	(0.03)	(0.01)	(0.01)
Time Spent Outside	−0.02	−0.004	−0.003
	(0.05)	(0.01)	(0.01)
Season Precipitation Departure from 15 Year Average	−0.05**	−0.01	−0.003
	(0.03)	(0.01)	(0.01)
Season Temperature Departure from 15 Year Average	0.15	0.07**	0.05*
	(0.10)	(0.03)	(0.03)
Health Status	0.02	−0.01	−0.01
	(0.05)	(0.01)	(0.01)
Constant	5.50***	3.37***	2.93***
	(0.84)	(0.25)	(0.24)
N	1,684	1,684	1,684
Adjusted R^2	0.68	0.53	0.56
Residual Std. Error	1.72 (df = 1662)	0.50 (df = 1662)	0.48 (df = 1661)

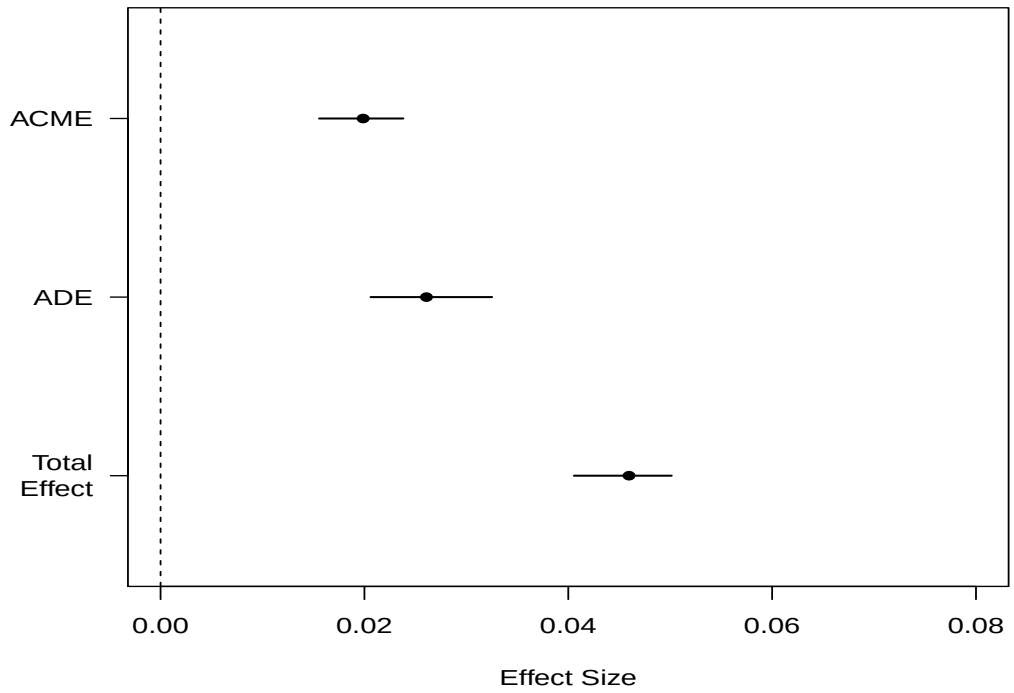
*p < .1; **p < .05; ***p < .01. Robust standard errors in parentheses. Reference categories are female, high school or less, white, suburban, and Republican.

human causes of climate is reduced by 40% with the inclusion of risk perceptions.

In order to examine the change in the coefficient on certainty in causes of climate change, I use the mediation package in R to conduct a mediation analysis (Tingley et al., 2014). Doing so, I examine how risk perceptions mediate the effect of beliefs about the causes of climate change on policy support, using Models 1 and 3 in Table 4.3. The results of this analysis are presented in Figure 4.2;

uncertainty estimates are calculated using 1000 simulations of a quasi-Bayesian Monte Carlo method based on normal approximation. Approximately 43% of the relationship between certainty in the cause of climate change and climate policy support is mediated by climate change risk perceptions. In support of proposition four, I find that the ADE or the Average Direct Effect of certainty in the causes of climate change is 0.026. However, I also find that the Average Causal Mediated Effect, mediated through risk perceptions, is 0.020. This suggests that the effect of beliefs about the causes of climate change is, in approximately equal proportions, a direct effect and an in-direct effect through risk perceptions.

Figure 4.2: Plot of effect sizes from mediation analysis of risk perception through beliefs about climate change causes



Next, to answer my resarch question, I examine the seven climate change

policy solutions individually in Table 4.4. Doing so allows me to see how the determinants of support for climate policy may differ across these various policies. In Table 4.1, the most popular policy to address climate change is increasing funds for renewable research which is the dependent variable in Model 3[5]. On the other hand, the least supported policy is the 20% rule which would require utilities to produce 20% of their electricity using renewables but raise electricity bill prices and is the dependent variable in Model 7. These differences may illuminate certain similarities and differences found in Table 4.4.

Looking across these seven models, a few patterns are apparent. Risk perceptions of climate change is consistently associated with an increase in the predicted probability of supporting climate change policy solutions. A one-point increase in risk perceptions, across the ten-point scale, is associated with a change in predicted probability of support for a climate change policy of approximately 0.02 0.04. The strongest effects are in Models 2 and 7 which may be due to the fact that these survey questions most directly address the trade-offs between the policy and the increase in benefits (costs) to the public. No other variable has a significant effect across all policy solutions. For six of seven policies, excluding the use of public land to generate renewable energy, beliefs about the human causes of climate change are also associated with positive effects and higher predicted probabilities.

Demographics have, in many cases, limited relationships with support for specific policies. One of the most consistent effects is that of being male which is associated with a lower predicted probability of approximately 0.02 to 0.18 of support for four of seven policies. Age has slight negative relationships with

[5]Another class in the LCA supports the renewables policies: tax rebates for individuals, research, and public land use. Each of these options has over 80% of the sample in support of the policy in Table 4.1

Table 4.4: Marginal Effects at the Mean for Logit Models of Policy Support

	CO2 Limits	Carbon Tax	Renewable Research	Public Land	Tax Rebates	Regulate CO2	20% Rule
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Climate Change Beliefs							
Certainty in Human Causes of Climate Change	0.02***	0.01***	0.005***	0.00	0.004**	0.01***	0.01***
	(0.002)	(0.003)	(0.001)	(0.002)	(0.002)	(0.002)	(0.003)
Risk Perceptions of Climate Change	0.03***	0.04***	0.02***	0.02***	0.02***	0.03***	0.04***
	(0.01)	(0.01)	(0.003)	(0.004)	(0.004)	(0.005)	(0.01)
Demographics							
Age	0.001	−0.002**	−0.001	−0.001	−0.003***	0.00	0.00
	(0.001)	(0.001)	(0.00)	(0.001)	(0.001)	(0.001)	(0.001)
Male	−0.12***	−0.18***	−0.02*	−0.02	−0.03*	−0.12***	−0.05*
	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Logged Income	0.02	−0.004	−0.01	−0.01	−0.02	−0.01	0.02
	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
Some College	−0.002	−0.07	−0.01	−0.01	0.02	−0.01	0.005
	(0.04)	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Bachelors Degree	−0.02	−0.11**	0.01	0.02	0.02	−0.04	0.005
	(0.04)	(0.05)	(0.02)	(0.02)	(0.02)	(0.04)	(0.05)
Graduate School	−0.01	−0.09*	0.04**	0.06***	0.02	−0.02	0.05
	(0.04)	(0.05)	(0.02)	(0.02)	(0.02)	(0.04)	(0.05)
African American	−0.16	−0.05	−0.02	−0.08	−0.13	−0.25**	−0.24***
	(0.10)	(0.10)	(0.06)	(0.07)	(0.08)	(0.11)	(0.08)
Native American	0.07	0.06	−0.02	−0.004	−0.01	0.06*	0.01
	(0.04)	(0.06)	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)
Other Race	0.05	0.02	0.03	0.01	0.04	−0.01	−0.02
	(0.06)	(0.07)	(0.02)	(0.04)	(0.03)	(0.06)	(0.07)
Urban	0.02	−0.03	0.01	0.02	0.03*	−0.02	0.02
	(0.03)	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Rural	−0.07**	−0.03	−0.01	−0.01	0.01	−0.03	−0.04
	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Political Dispositions							
Ideology (Conservative)	−0.04***	−0.03***	−0.01**	−0.02***	−0.01	−0.02**	−0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Democrat	0.13***	0.09**	0.01	−0.02	0.02	0.10***	0.06
	(0.03)	(0.04)	(0.02)	(0.02)	(0.02)	(0.03)	(0.04)
Issue Specific Variables							
Perception of Temperature Change	0.01	−0.01	−0.01	−0.003	0.00	0.01	0.002
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Concern for Energy Cost in OK	−0.005	0.02***	0.003	0.005	−0.001	0.003	−0.01
	(0.01)	(0.01)	(0.003)	(0.004)	(0.003)	(0.005)	(0.01)
Concern for Preservation in OK	0.02***	0.001	0.004	−0.01*	0.01**	0.01**	0.02**
	(0.01)	(0.01)	(0.003)	(0.004)	(0.004)	(0.005)	(0.01)
Time Spent Outside	−0.005	−0.002	−0.004	−0.01*	−0.005	0.004	0.005
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Season Precipitation Departure from 15 Year Average	−0.01*	−0.01	0.01*	0.01	0.001	−0.005	−0.01
	(0.01)	(0.01)	(0.003)	(0.004)	(0.004)	(0.01)	(0.01)
Season Temperature Departure from 15 Year Average	0.05*	0.08***	0.001	−0.02	−0.02	0.01	0.06*
	(0.03)	(0.03)	(0.01)	(0.02)	(0.02)	(0.02)	(0.03)
Health Status	−0.002	−0.01	−0.01	−0.002	0.003	−0.004	−0.03**
	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.02)
Constant	−0.27	0.25	0.27**	0.46***	0.43***	0.12	−0.13
	(0.23)	(0.26)	(0.11)	(0.15)	(0.15)	(0.20)	(0.28)
N	1,684	1,684	1,684	1,684	1,684	1,684	1,684
AIC	1,441.97	1,695.87	1,105.22	1,287.58	1,272.48	1,335.02	1,741.81

*p < .1; **p < .05; ***p < .01 Reference categories are female, high school or less, white, suburban, and Republican.

policies which are framed explicitly in terms of taxes: the carbon tax on coal-fired power plants and the tax rebates for individuals who purchase efficient vehicles or solar panels. High levels of education, especially graduate school, are associated with statistically significant increases in support for renewables polices. Interestingly, education is associated with either positive or null effects on policy support except for carbon taxes. Individuals with higher levels of education, bachelors degree or greater, report lower levels of support for carbon taxes relative to individuals with a high school education or less. Race, being

African American, has a significant effect on support for the 20% rule and the regulation of CO2. The 20% rule is the policy made most explicitly costly to the individual. These relationships suggest complexity in modeling support for climate policy not present when modeling it as a general concept as opposed to separate but possibly related policies.

Political party and ideology have generally consistent effects across policies. Conservative ideologies are generally associated with less support for each policy. The strongest relationship is for the policy most explicitly costly to individuals while the weakest relationship is for the use of tax rebates for individuals. Democratic partisanship has more mixed results. Being a Democrat, relative to a Republican, is associated with increased support for three of seven policies. For the other four, partisans are indistinguishable from each other.

Many issue specific variables also have mixed relationships with support for various policies. Perceptions of higher temperatures are not significantly related to support for any individual policy while experienced actual higher temperatures are associated with increased support for limiting CO2 emissions, carbon taxes on coal-fired plants, and a 20% renewables rule for utilities. On the other hand, deviations from average rainfall amounts are associated with decreased support for limiting CO2 emissions and increased support for renewables research. Interestingly, rainfall deviations had no statistically discernible relationship with general policy support; though what is driving these particular differences is not clear. In relationships masked in the more general model of policy support, I find that concern for energy cost is associated with policies which most directly address individuals' costs. Individuals with higher levels of concern for the cost of energy in Oklahoma are more likely to support the carbon tax policy which was described as possibly reducing personal income taxes. Concern for the preservation

of natural resources is generally positively associated with support for the climate policies and is significant in four of seven cases. On the other hand, concern for preservation is negatively associated with support for the use of public lands to generate renewables. Similarly, time spent outside has a null relationship with support for six of seven policies but is negatively associated with support for the use of public lands to generate renewables. Given the importance of public lands in preservation of natural resources and their use in recreation, these relationships provide interesting nuance in understanding the determinants of support for climate policy relative to the general policy support model.

4.4 Discussion

The findings in this chapter contribute to an extensive literature on risk perceptions, issue image, and policy support. First, I find that actual experience and perceived experiences of temperature are related to risk perceptions of climate change, in support of other strong evidence that experience matters (Van der Linden, 2015). Other environmental beliefs also help explain risk perceptions of climate change, in line with previous research. Interestingly, these beliefs and perceptions are significant in explaining risk perceptions while actual experiences or measurements of temperature and precipitation, potential side-effects of climate change, are not.

Regarding personal capability, I find similar results to previous research on the effect of education and knowledge on policy support (Zahran et al., 2006). However, I find less support regarding income, the ability to pay, and support for policy in contrast with previous research (Berk and Schulman, 1995; Berk and Fovell, 1999). In particular, I find a strong relationship between knowledge

of the causes of climate change and policy support. Importantly, though, this relationship is mediated by the relationship between risk perceptions and policy support. This suggests a complex relationship between beliefs about climate change and support for mitigation policy. The effect of causal beliefs is almost half driven by a mediated pathway through risk perceptions. This suggests improving knowledge about the causes of climate change may be less effective at creating policy support, generally, than increasing risk perceptions may be. Similarly, the results of the individual policy models suggest risk perceptions are consistently and strongly significant in explaining policy support while beliefs about causality are slightly less so.

Finally, unlike previous research by Leiserowitz (2006*a*), Dietz, Dan and Shwom (2007) and others, I disaggregate climate mitigation policies. Doing so suggests that, despite the statistically desirable structure of the index, support for policies are explained by different individual level characteristics depending on the policy characteristics. Policies, such as using public lands to generate renewables, which could have potentially negative effects on conservation, preservation, or recreation are explained differently than other more regulatory policies. Specifically, time spent outside is negatively related to support for the use of public land for renewable generation, but unrelated to other policies. Similarly, concern for natural resources is positively related to climate policies, except this one. Similar conflict regarding the development of wind power and the location of the wind farms has been termed "green on green" conflict (Warren et al., 2005). The relationship between public opinion climate change concern and nuclear energy also demonstrates a similar somewhat paradoxical pattern (Corner et al., 2011). Concern for local environmental impacts, in this case the loss of public lands, outweigh concern for the abatement of the global environmental impacts of climate

change.

Additionally, policies which explicitly discuss costs, such as the 20% rule which would increase consumer energy costs, are better explained by capability variables and concern for energy costs than other climate mitigation policies. These findings suggest the previous research using scales of policy support may be covering up interesting and important variation in policy support. For example, while policy actors may rely on environmental groups and attitudes to increase support for climate change policies, this may not work for all policies. Similarly, ability to pay and act have differential effects as the effects and costs to the public differ in their levels and visibility across policies.

These results, as with all studies, are limited by a number of factors. First, the use of a sample of Oklahomans is certainly not representative of the U.S. in general. Given these policies would likely be applied at a national level, this may also affect how respondents in Oklahoma respond. One possible benefit of this sample is the ability to examine beliefs and concern for the local area, which is held constant, are related to these national level policies. Second, this study relies on a cross sectional design and therefore I have attempted to constrain my language to that of association. These relationships are not causal; future research should use experimental and longitudinal designs to see how changes in key explanatory variables are related to changes in risk perceptions and support for policy, especially. Finally, the seven policies examined individually do not begin to account for the wide variety of potential policies addressing aspects of climate change. Additionally, the construction of the survey questions measuring support for these policies could be more consistent. Three of the seven questions discuss a trade-off as a result of the policy but the other four do not and are presented more simply. Future research ought to consider a wider variety of

policy options as well as be sure to consistently consider the trade-offs these policies present.

However, overall, the results from this chapter suggest first that understanding the determinants of risk perceptions is highly important for understanding support for policy, generally. Additionally, while one can measure support for climate change policy generally, looking at these policies individually and not in isolation provides more insight into the determinants of support for them. Scholars ought to revisit the variation in their data to better develop theories about which aspects matter for climate change policy support. Capacity may matter more than than socio-cultural beliefs and vice versa, depending on the specific policy solution. Additionally, and practically, understanding these differences in determinants will be vital to building support for climate change policy in a polarized world.

Chapter 5

Conclusions

This dissertation develops a comprehensive model of weather information and climate change beliefs and support for policy. Scholarship examining the determinants of climate change beliefs have investigated a number of different categories of factors. These categories can generally be summarized as demographic and identity factors including political identities and beliefs, environmental and experiential factors, and informational factors with an emphasis on news sources (Robinson, Stoutenborough and Vedlitz, 2017; Liu, Robinson and Vedlitz, 2017; Carmichael and Brulle, 2018; Van der Linden, 2015). While these categories are relatively comprehensive, I argue in this dissertation that they miss an important intersection of two of the categories – experience and information. In studies of climate change beliefs, experience is primarily operationalized as measured temperatures or precipitation, and in particular deviations from average, or disaster experience (Egan and Mullin, 2012; Spence et al., 2011; Van der Linden, 2015). Sometimes perceptions of temperatures deviations are also included as experience measures (Zaval et al., 2014). Regarding information, scholars have primarily focused on the news media (Carmichael and Brulle, 2018). At the intersection

of these two categories is the potential for by-product learning though weather information. Weather information, similar to the news, is consumed by individuals almost everyday. This source of information represents a yet untested, but interesting and likely, pathway for influence on climate change beliefs. In Chapter One of this dissertation, I lay out the previous research and various theories and concepts that inform my investigations into the relationship between weather information and climate change beliefs.

However, even in the weather community, everyday, mundane interactions with weather information and forecasts have been relatively understudied. Demuth, Lazo and Morss (2011) briefly describe potential patterns of mundane weather information; however, they find limited evidence of patterns and therefore do not report their potential findings. This same set of scholars has, however, have found that these very resources are highly valued by the American public (Lazo, Morss and Demuth, 2009). Scholars of weather and geography have primarily focused on the use of information in severe weather situations (Sherman-Morris, 2010; Miran, Ling and Rothfusz, 2018). These studies find that informal sources such as peers can be vital pathways of information but that individuals also seek out more formal sources for confirmation. Use of more sources is also associated with better protective action decision-making in severe weather. Therefore, understanding how these patterns might arise from mundane, daily use of weather information sources can provide insight into how to create systems which promote wide usage of weather information and confirming behaviors which then, potentially, increase protective action. Therefore, in Chapter Two of this dissertation, I examine patterns of mundane, daily weather information source usage.

Using a survey of a relatively diverse sample of Oklahomans, I find that

weather information usage can be summarized into four patterns, using Latent Class Analysis with concomitant variables. This method allows me to use the pattern of source usages of each individual and their correlations as my data points, as opposed to simply relying on correlations between the indicators themselves. This method better captures the concept of weather information patterns than similar methods such as factor analysis which rely on treating the indicators, or information sources, as individual data points. I then examine what typifies or describes these patterns and individual, demographic explanations for membership in these class. In line with prior research on information in severe weather, I find that local television is by far the most used source (Hammer and Schmidlin, 2002; Comstock and Mallonee, 2005; Sherman-Morris, 2010). However, examining the underlying patterns provides more nuance. The sample is divided into three approximately equal size classes and a fourth, smaller class. This fourth smaller class is a group of highly engaged individuals who use all sources more than average. Among the other three, each accounting for approximately 25 to 30% of the sample, the largest group is typified by their greater than average reliance on websites, both governmental and non-governmental, for weather information. These individuals are in direct contrast to those who rely on older, traditional media such as local and cable television stations and newspapers. Finally, there is a group of individuals whose pattern of information usage is reliant on above average use of informal sources of weather information such as their family and friends and social media.

Demographics are strongly associated with which group individuals belong to and their information use pattern or strategy. Age, in particular, is strongly associated with a higher likelihood of belonging to the traditional media reliant group and a lower likelihood of belonging to the informal source reliant group.

Education is associated positively with usage of the informal source and website use patterns and negatively with the traditional media and highly engaged use patterns. Race is primarily associated with use of the highly engaged pattern, with all minorities more likely to use this pattern than their white counterparts. African Americans, in particular, are also much more likely to belong to the traditional media use group and less likely to belong to the informal source use group. Finally, ideology has a limited but interesting relationship with class membership. Specifically, more conservative individuals are more likely to rely on informal sources and less likely to rely on website sources, including government websites. Given the general lack of trust in media and government among conservatives, these findings suggest this applies even to weather information use (Rudolph and Evans, 2005; Jones, 2004).

In Chapter Three of this dissertation, I then examine the relationship between these weather information use patterns, and weather information sources individually, on beliefs about the causes of global warming or climate change. I argue that this type of information represents an untapped pathway for by-product learning about climate change (Downs, 1957; Prior, 2007). Weather information is presented, often, in inherently climatological terms and therefore in the process of learning about the weather individuals may learn about climate, and climate change, as well. I present these findings in terms of the more general information environment as well which has been extensively shown to be related to climate change beliefs (Carmichael and Brulle, 2018).

I find that weather information, in conjunction with other types of information, does help explain variation in beliefs about the causes of climate change. While the patterns developed in Chapter Two are not significantly related to climate change beliefs, individual indicators of weather information are. Specifically,

I find that use of cable television and family and friends for weather information is associated with increased (decreased) certainty in the belief that climate change is (not) caused by human activities. Radio and social media, on the other hand, are associated with decreased (increased) certainty in the belief that climate change is (not) caused by human activity. These findings, except for cable television, hold even when accounting for relationships between ideology, partisanship, and use of more partisan news sources such as Fox and CNN.

Before accounting for ideology, I also find that Fox news is associated with decreased (increased) belief in the (not) human causes of cliamte change as both a general news source and specific source of information for global warming. Importantly, I find that general news sources have the highest relative importance in explaining variation in climate change beliefs, compared to weather and global warming information sources. However, the relative importance of ideology and partisanship also outweigh the importance of general news source. These findings suggest scholars of climate change beliefs consider a wide array of potential information sources. By-product learning may be occurring about climate change during the process of more daily, mundane information processing. Practically, these findings suggest individuals or groups interested in increasing belief in the human causes of climate change investigate social media and radio weather information sources more in-depth. How can individuals who communicate through these sources provide more climatologically accurate information? Are the individuals who provide weather information through these sources more politically conservative or disbelieving in the human causes of climate change than other providers of weather information? These findings also suggest that in-person social networks and information are working to increase the belief that climate change is caused by human activity.

Finally, in Chapter Four of this dissertation, I extend my analysis of climate change beliefs to include risk perceptions thereof and policy preferences for addressing climate change. In this chapter, I connect the literature on risk perceptions with a developing literature on the micro-model of policy process and public opinion (Finucane et al., 2000; Liu, Robinson and Vedlitz, 2017). Most studies model support for climate policy as an index of the many different policy options which could help address climate change (Leiserowitz, 2006*a*; Zahran et al., 2006; Dietz, Dan and Shwom, 2007; Ding et al., 2011; McCright, Dunlap and Xiao, 2013). Others study certain policies which would help address climate change individually and in isolation (Bickerstaff et al., 2008; Corner et al., 2011; Amdur, Rabe and Borick, 2014). I argue that studying support for policies which address climate change is best done both in a general manner and in a policy-by-policy manner, in conjunction not in isolation.

Regarding risk perceptions of climate change, I find that demographic and political dispositions help explain variance in similar ways to beliefs about the causality of climate change. Specifically, political variables such as ideology and partisanship as well as general environmental beliefs help explain individual risk perceptions of climate change. I find that certainty in the human causes of climate change is positively associated with support for climate change policy. I also find that risk perceptions are positively associated with general support for climate change policy. More interestingly, I find that risk perceptions mediate approximately 43% of the relationship between causal beliefs and risk perceptions. This suggests that beliefs about causality and risk perceptions, both elements of issue image, help explain policy choice in conjunction. The policies which make up the climate policy support index which possesses many good statistical properties of an index have significant variety in their designs. Therefore, I

also model the determinants of each policy individually. These models provide interesting nuance into the foundations of support for the various policies. These differences may provide insight to environmental groups or policymakers interested in building support for policies to address climate change. Specifically, I find that policies which have other environmental trade-offs are not supported by people with higher levels of local environmental concern or who spend more time outside, despite those people supporting climate policy in general. I also find that the more explicit cost trade-offs present in the policy, or at least in the survey question about the policy, the more important are variables that measure or are proxies for capability to pay or act in explaining support. These findings suggest that the combination of understanding climate policy generally, as a set of policies, and understanding those policies individually provides interesting theoretical and practical insights.

In this concluding chapter, I would like to acknowledge a few limitations of this dissertation. First, one potential limitation that will always arise is the use of data only from Oklahoma. Do I think these patterns will generalize to the U.S. as a whole? Preliminary evidence from a national survey suggest that, to some extent, they do. In future research, I intend to extend my analysis of weather information patterns to national data to compare and contrast the resulting four-class solution and its predictors. Regarding climate change beliefs, I think the results may also generalize. Given the overwhelming influence of ideology and partisanship in my study, common in studies using national data, I would argue that the much more limited but still interesting findings regarding weather information from these studies would likely hold as well. The findings from Chapter Four are also very much in line with prior findings on risk perceptions and policy support; therefore, I think the more nuanced findings I present about individual policies and their

predictors would also likely generalize.

Another potential limitation of this dissertation is the use of cross-sectional, observational data. Effectively, I am unable to make causal claims using these data and methods. The prospectus for this dissertation aimed to use the panel nature of the underlying data to bring estimates of causality to these questions that I am interested in. Given constraints, I was unable to implement these ambitions in this dissertation; however, in future work, I hope to better understand and master panel data management and analysis to eventually, hopefully be able to render claims about causality potentially. More specifically, the use of panel data will give insight into invariance in attitudes and time-order of changes, even if estimates of causality may be unattainable. Despite the lack of causal claims, these findings are still important from a descriptive stand-point, especially given how untested and innovative the connection between weather information and climate change beliefs appears to be. Future research also should consider ways of measuring the actual climate content of these different sources of weather information. While I provide evidence in this dissertation that by-product learning is occurring, I am unable to provide clear evidence of how or why. My argument relies on an assumption that these channels of weather information contain different amounts of and perspectives on climate information when communicating mundane, daily weather information. Future research, likely using machine learning or "big data" collection techniques and content analytic methods, can be used to document the existence, or non-existence, of the potentially different types of climate content in these information sources.

Despite these limitations, in this dissertation, I have modeled the development of climate change beliefs beginning with information about climate change and weather, moving to beliefs about the causes of climate change, to risk perceptions

of climate change and policy solutions thereof. Throughout, especially in Chapters Two and Three, I have attempted to emphasize the importance of everyday, mundane activities, such as searching for weather information, which might influence our political beliefs, possibly more than we even expect. In Chapter Four, I consider other elements of everyday existence such as experienced rainfall and experienced and perceived temperatures and how they relate to risk perceptions of climate change and climate change policy support. I argue that it is these daily, lived experiences that shape who we are and how we think. Despite the potentially mundane nature of daily experiences and information search processes, my research suggests that they have profound consequences for our political and policy beliefs.

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