Introduction

Science communicators have long investigated effective communication to encourage public interest and engagement. Burns et al. (2003) determined science communication seeks to incite an internal response to scientific information such as awareness, enjoyment, interest, opinion-forming, or understanding. In this landscape, climate change poses a major challenge for society, as its impacts are predicted to threaten every discipline and social facet (NASA, 2021). Particularly, climate change poses challenges for agricultural science and natural resource communicators due to the varying public perceptions surrounding climate change science and what to do in response.

Many factors influence climate change effects, and agriculture contributes approximately 11% of greenhouse gas emissions in the U.S. (U.S.D.A., 2023). In response, ambitious goals to reduce emissions from crop and livestock production have been established by both governmental agencies and agricultural sectors (Balogh, 2020; Hyland et al., 2016). Those involved in production agriculture will need support to navigate and manage the unfolding challenges associated with climate change (Wheeler & Lobley, 2021). To achieve these goals and explain the industry's efforts to mitigate and lessen climate change effects, perceptions of climate change must first be understood.

While an increasing number of Americans perceive climate change as human caused, a view shared with 98% of climate scientists (Cook, 2016), some Americans remain skeptical about the cause of climate change and perceive it as naturally occurring or not occurring at all (Marlon et al., 2024). Van der Linden (2017) called "agreement with the scientific consensus" a "gateway belief" to subsequently worrying about climate change, resulting in an increased likelihood of supporting climate conscious policies and practices. While this heuristic may connect with some people, other scholarship has noted even those who believe in human-caused climate change and acknowledge its risks, can be relatively difficult to activate toward climate action (Roser-Renouf et al., 2015). Public opinion data trends toward increasing levels of agreement that climate change is caused mostly by human activities, with 59% of the population agreeing in 2024 (Marlon et al., 2024). Many believe the public sector needs to make more drastic changes in order to meet calls from federal initiatives aiming for net zero emissions (United States Executive Office of the President, 2021) or from the scientific community to avoid further atmospheric warming (Mckay et al., 2022). Therefore, science communicators and others who wish to encourage climate-friendly behaviors or support for climate mitigation policy have focused on motivating multiple social sectors toward these behaviors, including policy makers, consumers, and other decision makers.

Science communicators face challenges when discussing many scientific topics due to their complex and occasionally controversial nature (e.g., genetic modification, vaccines, climate change, evolution). However, climate change has been noted as particularly challenging due to its seemingly distant consequences (Applebome, 2010) and political polarization (de Leon et al., 2020). Communicators must approach climate change communication strategically, beginning with identifying target audiences and describing their characteristics. When identifying unique traits among audiences, it is important to evaluate characteristics that may influence message processing and behavior change.

It is commonly offered communication advice to *know your audience*, with the National Academy of Sciences communication research agenda positing "Different audiences, different needs" (National Academies of Sciences, Engineering, and Medicine, 2017, p. 29). Agricultural and natural communications scholarship has specifically urged researchers and practitioners to

understand the characteristics of their message recipients to deliver messages to groups where the largest effect will be seen (Klockner, 2015; National Academies of Science, Engineering and Mathematics, 2017). These strategic sub-groups of a larger audience are known as target audiences. Identifying target audiences is especially important with climate change communication because of the high likelihood of adverse message effects around highly polarized and salient issues such as climate change (i.e., backfire effect; Chinn & Hart, 2021; Corner et al., 2014; Kahan et al., 2011). Because members in target audiences are grouped based on shared characteristics, they represent groups that may respond to a message in the same manner or be motivated to a similar behavior change.

One way communicators can identify target audiences is through a technique known as audience segmentation, which refers to the breakdown of an audience into unique subgroups with similar characteristics (Hine et al., 2014). This technique helps practitioners identify target audiences by grouping a population into distinctly different sub-groups based on shared values, beliefs, preferences, and demographic characteristics. This strategy has been used across social marketing and communication efforts, from climate change (Detenber & Rosenthal, 2020; Hine et al., 2014; Leiserowitz et al., 2021) to water conservation messages (Huang, 2016; Warner et al., 2017), sustainable farming (Gibson et al., 2020), and climate-friendly beef (Orton et al., 2024). These studies are based on the understanding that messages which appeal to the audiences' preexisting beliefs and characteristics can avoid cognitive dissonance and encourage positive, central message processing.

Scholars have previously determined climate change communication target audiences are based on an assortment of personal characteristics associated with how someone perceives climate change, such as the cause of climate change, their political ideology, and what mitigation efforts should be implemented (i.e., personal behavior change or public/political action; Hine at al., 2014). Constructs such as political ideology and trust in sources of climate information (e.g., media and scientists) serve as key drivers in the decision-making process and influence an individual's climate perceptions and behavioral intent, as they serve as linchpins in the decision-making process. Political ideology, for example, is a leading predeterminer of someone's perception of climate change (Arbuckle, 2016; de Leon et al. (2020). Similarly, trust in climate information sources determines how individual's process climate information. Individuals are more likely to engage with messages from trusted sources and refute information from less-trusted sources (Tam & Chan, 2018; Telg et al., 2018). Ultimately, those who perceive the climate as changing due to human activity are more likely to take adaptive or mitigatory behaviors (van der Linden et al., 2019).

In addition to these constructs, in their meta-review of climate change audience segmentation, Hine et al. (2014) called for the inclusion of more profiling variables perhaps less obviously related to climate change, such as the individual's personal values and other psychographic variables, which have been linked to support for climate change mitigation behaviors and policy preferences. Values reflect universal, inherent motivations that guide behaviors across contexts (Schwartz, 2012). Bouman et al. (2020), Corner et al. (2014), Dietz (2012), and von Borgstede (2014) have further emphasized the importance of psychographic values when engaging with climate change and other scientific messages. The study at hand answers Hine et al.'s (2014) call for more nuanced audience segmentation studies by combining some of the literature's most influential constructs (i.e., values, climate change perceptions, trust in media, trust in science, and political ideology; discussed further in Conceptual Framework) in a novel audience segmentation setting.

Understanding more about the audience members and how they perceive climate change allows practitioners and scholars to strategically address consequential misperceptions or avoid altogether areas that may cause cognitive resistance among audience members in certain groups but not in others (van der Linden et al., 2019). Experimental messaging research has demonstrated tailored messages move audience groups' perceptions closer to the scientific consensus and actions such as supporting climate change policy (Myers et al., 2012). These findings show promise for those intending to incite behavior change. However, message-testing research should build upon audience analysis studies to effectively establish, understand, and reach targeted audiences.

Purpose

Thus, this study joins the burgeoning efforts toward understanding diverse climate change perceptions and establishes a descriptive foundation for tailoring messages to unique audience segments. The purpose of this study is to identify target audience segments for strategic climate change communication and the values they hold. To do this, we established three objectives:

RO1: Identify and describe strategic target audiences for climate change communications based on participants' climate change perceptions, science trust, media trust, and political ideology.

RO2: Describe the personal values identified in each of the audience clusters.

RO3: Describe the audience members' demographic characteristics for each cluster.

Conceptual Framework

To guide the process of identifying value-based target audiences, we assembled a conceptual framework using audience segmentation and analyzed the data using K-means cluster analysis (discussed further in methodology) of participants' climate change perception, trust in science, trust in media, and political ideology. These variables were chosen based on their prevalence in literature and established relationships with climate change mitigation behaviors. We then identified the values of each target audience segment. The relevance of each of these concepts is established below.

Audience Segmentation

Audience segmentation seeks to create efficient communication campaigns that are specific to target audiences within specific realms (Slater, 1996). This process evaluates and divides heterogenous populations into various segments, or homogenous groups, where individuals share needs, characteristics, and opinions (Tuten, 2021). Grunig (1989) describes audience segmentation in simple terms: "divide a population, market, or audience into groups whose members are more like each other than members of other segments" (p. 202). Additionally, audience segmentation, often referred to as market segmentation, has been used to inform communication strategy and explain levels of knowledge, attitudes, or opinions regarding a particular topic to reshape or change one's behavior (Slater, 1996). This process allows communicators to tailor messages for distinct audiences and appeal to each segment's specific needs, preferences, and values (Slater, 1996; Orton et al., 2024).

Audience segmentation has been suggested as a strong strategic approach within social sciences to further understand how communication strategy should be tailored to directly target specific audience groups. Scholars have used this technique to provide in-depth audience analyses on a variety of topics such as climate change, water conservation, sustainable farming, meat consumption, and genetic modification (Burke et al., 2020; Gibson et al., 2020; Graham & Abrahamse, 2017; Rohling et al., 2016; Orton et al., 2024; Warner et al., 2017). It has become a more prevalent method in science communication, and there have been calls to move beyond the demographic variables and incorporate characteristics such as values, issue perceptions, and other personal characteristics (Detenber & Rosenthal, 2020; Gibson et al., 2020; Lamm et al., 2019; Hine et al., 2014; Huang, 2016; Leiserowitz et al., 2021; Sanders et al., 2023; Warner et al., 2017). Understanding psychographic characteristics and values are critically important when communicating information that may challenge an individual's scientific beliefs, as these beliefs tend to be highly polarized. The psychographic insights allow communicators to leverage shared values for informed communication strategy and message personalization (McCright et al., 2013; Orton et al., 2024). We contribute to the literature by exploring how audience members segment or group based on participants' climate change perceptions, trust in science, trust in media, and political ideology to provide recommendations for values-based communication.

Climate Change Perception

As climate change has been identified as a polarized issue with high salience in news media (Boykoff et al., 2022), most people have a preconceived set of perceptions about the topic. When people are confronted with messages on popular issues such as climate change, pre-established heuristics are triggered and summon their current perceptions and understandings. Climate change perceptions have historically been measured in the context of climate change causes, because those who do not perceive climate change as being caused by humans are unlikely to change their behavior to mitigate it (van der Linden et al., 2019). In the United States, the cause of climate change is a major point of contention, with many Americans skeptical of humans' role or climate science in general (Marlon et al., 2024; Hoffman, 2011). Therefore, how a person perceives the cause of climate change has been identified as a necessary consideration when communicating about climate change to avoid cognitive dissonance and promote thoughtful message processing (e.g., Kahan et al., 2011; Maibach et al., 2011). Perceiving climate change as being human-caused has even been called a "gateway" variable to climate-friendly action (van der Linden et al., 2019).

Trust in Science

Trust serves as the "fundamental component of all relationships between the public and specific people or groups" (Rumble et al., 2020, p. 2). Other scholarship has also acknowledged the key role trust plays in message processing when communicating science (Brewer & Ley, 2012; Cheng & Gonzalez, 2021; Robinson & Ruth, 2020). In their meta-analysis of the role of trust in climate change mitigation and adaptation behavior, Cologna and Siegrist (2020) found trust in scientists to be highly correlated with climate-friendly behavior. In the United States, distrust in scientific institutions is at an all-time high (Krishna, 2021). Opinions are particularly polarized around political issues such as climate change (Krause et al., 2019). Because individuals are unlikely to have participated in climate science themselves, they must trust the scientific process that has declared climate change a major issue caused by human activity.

When considering compelling climate change messages, those for Americans who distrust the scientific process should be met with messages that strategically address their skepticism and work to build trust in the scientific process (Nagler et al., 2023). For message development, trust in science is an essential consideration that can guide choices related to information sources (e.g., scientists vs. trusted opinion leaders).

Trust in Media

Although some exploratory research has found trust in the media significantly related to perceptions of scientific issues such as climate change (Fortner et al., 2000; Krishna, 2021; Cheng & Gonzales, 2020), media trust has seldom been included in audience segmentation. Studies that do not explicitly measure individuals' trust in media sources neglect the mass media as a major mediator of the dissemination of scientific information and the influence of trust on message processing. However, trust in media is paramount in climate change beliefs, as it has been found to be a key strategy toward improving acceptance of climate change science (Cooper, 2011). Similarly, media trust has been found to vary by political ideology, such that liberal-learning individuals have more trust in media than their conservative-leaning counterparts (Gottfried & Liedke, 2021). An individual's level of trust in the media also highly correlates to their ability to discern fact from opinion statements (Mitchell et al., 2018), perhaps due to increased self-exposure to news media and information seeking. As the goal of audience segmentation is to help inform impactful messages tailored to target audiences, trust in media is a critical consideration to inform source and channel selection in the message development process (e.g., whether to place a message on a traditional media platform) (Runge et al., 2018). Additionally, this measurement can illuminate the potential need for trust building between media and audiences, particularly in controversial contexts such as climate change.

Political Ideology

Political ideology has consistently been linked to how someone perceives climate change and their likelihood to adopt climate friendly behavior. In 2019, only 46% of Americans said human activity contributed a great deal to climate change and only 17% of Republicans held this belief (Funk & Hefferon, 2019). Several studies have found that the consumption of conservative news is associated with climate change denial (Choi & Hart, 2024; Hmielowski et al., 2013; Krishna, 2021). Content analysis studies of conservative news content and channels have consistently found an emphasis on the "debate" around climate change's impact on society and the perceived lack of scientific consensus (Dunlap & McCright, 2011). Similarly, nearly half of respondents in Krishna's (2020) study found climate change deniers reported *Fox News* as their preferred source of TV news. Furthermore, political ideology is also closely related to skepticism in institutions such as science and the media (Gottfried & Liedke, 2021; McCright et al., 2013). Political ideology has been included in virtually all climate change perception studies.

Personal Values

While climate change perceptions are heavily related to the previously described factors, this understanding alone does not provide enough insight to design compelling messages (Hine et al., 2014). Therefore, in addition to perceptions, trust, and political ideology, we examined how segments varied on their perceived important values – a critical component of an

individual's psychographic characteristics (Schwartz, 2012). Throughout the literature, it is apparent that values play a crucial role in attitude formation and messaging techniques within agricultural science and natural resources. Using Schwartz (2012) Theory of Basic Human values, a widely-used categorization of 10 basic life-guiding principles, Fischer et al. (2020) examined the role of value-based messaging when communicating to low-involvement audiences about agricultural issues; Lawson et al. (2023) explored the relationship between values and climate change beliefs; and Schultz and Zelezny (2003) indicated environmental messages should be congruent with an individual's personal values.

Values are critical in message development because they play an important role in characterizing "cultural groups, societies, and individuals, to trace change over time, and to explain the motivational bases of attitude and behavior" (Schwartz, 2012, p. 3). The personal values represent what motivates individuals as deeply held core beliefs about the world. Additionally, values serve as standards for judgements, attitudes, choices, and rationalizations (Rokeach, 1979). Values have been identified as the individual's beliefs that motivate them to act a specific way. Schwartz (2012) posited a universal value structure of human motivation – suggesting people of all cultures recognize each of the values; however, individuals and groups will differ in where they place importance on each of the value categories (Schwartz, 2021).

Schwartz Theory of Basic Human Values (2012) guided this study and provides a framework for identifying and describing ten motivational and distinct types of values that people of all cultures recognize: *power, achievement, conformity, hedonism, self-direction, stimulation, universalism, benevolence, tradition, and security.* Schwartz' value structures have been previously examined in response to climate change, with significant correlations between personal values and universalism, benevolence, self-direction, stimulation, achievement, power, and security (Lawson et al., 2023). The Schwartz (2012) values are recognized in varying cultures and geographic regions, but different groups may attribute vastly different levels of importance to specific values. While there is potential for this limitation, Schwartz's Theory of Basic Values has been applied in a variety of disciplines and contexts to explore relationships between environmental issues and values (Corner, 2014; Schwartz, 2012). The Short Schwartz (1992) Value Survey has been used in a number of studies to identify core value trends related to specific topics, such as climate change (Lawson et al., 2023).

Dietz (2012) discussed that, "It is a form of cognitive bias to think that disagreements are mostly about facts" (p. 14085). Corner et al. (2014) also supported the idea that disparaging climate change perceptions have little to do with how someone perceives science and much to do with their values, pre-existing beliefs, and motivations. They note that values determine how we process and interpret climate change messages and how this process leads to the acceptance or rejection of further action and engagement. Notably, practitioners struggle even to activate those already in agreement with the scientific consensus. The values and beliefs a person holds fundamentally pre-determine how a message will be processed and serve as a guide to message processing (Dietz, 2012). Certain values serve as strong predictors of certain climate change engagement (Corner et al., 2014) such as universalism, benevolence, self-direction, stimulation, achievement, power, and security (Lawson et al., 2023). Through messaging, these values can be targeted to activate the most behavior change potential. This understanding has led to the recommendation of tailored, value-congruent messaging that leverages upon these pre-existing personal values (Fischer et al., 2021; Schultz & Zelezny, 2003; von Borgstede et al., 2014). While more research is needed on the causal effects of value-congruent, tailored messaging (Hine et al., 2014), research has shown promising effects of messages tailored to environmental

values (Bain et al., 2012), risk perceptions (Myers et al., 2012), and climate perceptions (Kahan et al., 2011) across diverse audience segments in terms of message favorability and behavioral intent. Additionally, if these tailored messages are not delivered from trusted sources, they hold little potential to elicit message processing (Cologna & Siegrist, 2020).

Methods

An online survey instrument was used to identify audience segments based on climate change perceptions, trust in science, trust in the media, and political ideology. To identify these segments, an online Qualtrics survey instrument was distributed to 533 Texas residents from October to November of 2021. Previous researchers have used non-probability sampling techniques to explore and examine public opinion regarding emerging issues, as it provides higher response rates in comparison to probability-based methods used for random digit dialing of landline numbers (Lamm & Lamm, 2019). It has been deemed appropriate for public opinion research due to increased internet access and ease of reaching members of the population of interest (Lamm & Lamm, 2019). The data reported in this manuscript are part of a larger study on climate change and natural disasters. This larger study was deployed to assess the perspectives of Texas residents' perceptions of the climate's impact on emergent natural disasters.

Qualtrics obtained a non-probability, opt-in sample of Texas residents 18-years or older who represented the Texas census demographics for age and community type (i.e., rural, urban, and suburban) through actively managed market research panels. Qualtrics employed digital fingerprinting technology and internet protocol (IP) address checks to ensure unique responses. Respondents were disqualified if they sped through the survey, took too long, or did not have complete responses. From the sampled population, 486 usable responses remained. Additionally, prior research has indicated political ideology as a main force in shaping opinions toward climate change (Funk & Hefferon, 2019). Because political ideology was measured using an ordinal scale ranging from "very liberal" to "very conservative," participants who selected "prefer not to answer" could not be accurately placed along this continuum. As a result, these participants were excluded from the analysis, yielding a final sample size of 445. Additional demographic information was also collected to describe the respondents who participated in the study (see Table 1).

Table 1

*Demographic Characteristics of the Respondents (*N = *445)*

Demographic Variable	*f*	*%*
Gender		
Woman	222	49.8%
Man	221	49.6%
Non-binary/other	2	0.6%
Ethnicity		
White	309	69%
Hispanic or Latino	77	17%
Black or African American	51	11%
Native American/Pacific Islander	16	4%
Asian/Asian American	14	3%
Other	6	1%
Community Type		
Suburban	159	36%
Urban	147	33%
Rural	139	31%
Income		
Less than 50K	263	60%
50K to 100K	133	30%
100K+	42	10%
Age		
35-54	164	37%
55+	163	37%
18 to 34	118	26%
Education Level		
Some college	133	30%
High school graduate	113	25%
4-year degree	83	19%
2-year degree	50	11%
Master's degree	29	.06%
Some high school	26	.06%
Professional degree	3	.01%
Doctorate	7	.02%

Note: Respondents were asked to select all that apply for their ethnicity; thus, the total equals more than 100%.

Instrument

The data collected for this study were attained through a series of questions, adapted from the prior literature, distributed through an online Qualtrics questionnaire. To ensure face and content validity, a panel of experts consisting of faculty who are experts in science and agricultural communications across the United States reviewed the instrument for content, accuracy, clarity of wording, readability, and flow (Colton & Covert, 2007). Additionally, the instrument was pilot tested with 50 respondents to ensure reliability of the adapted scale items,

and all scale items were deemed reliable (Cronbach α > .80) at the time of pilot testing. To complete the questionnaire, the respondents were asked to complete the IRB consent procedures approved by Texas Tech University. After, the respondents were asked a series of questions pertaining to their climate change perceptions, trust in science, trust in media, personal values, and demographic information, including political ideology.

Climate change perceptions were measured consistently with the prior literature (Abdel-Monem et al., 2014; Funk & Heffereon, 2019; Vogt et al., 2008). Respondents were asked "which of the following best describes your perceptions about climate change," and were asked to select one the five options of: "Climate change is not happening" (1), "Climate change is happening but there is not enough evidence to determine its cause" (2), "Climate change is happening mostly because of natural changes in the atmosphere" (3), "Climate change is happening equally because of human activity and natural changes" (4), "Climate change is happening mostly because of natural changes in the atmosphere" (5). Although these climate change perceptions were measured categorically, we logically redistributed the categories along a 1-5 spectrum of agreement with the scientific consensus, with 1 representing "strongly opposed to the scientific consensus" and 5 representing "strongly support the scientific consensus."

Trust in Science (Cronbach α = .92) was measured through an adaptation of the scale produced by Nadelson et al. (2014) regarding trust in science and scientists. The respondents were asked to select their level of agreement (1 = "Strongly Disagree", 5 = "Strongly Agree") to nine statements: "We cannot trust science because it moves too slowly", "Scientific theories are trustworthy", "I trust the work of scientists can make life better for people", "I trust the work of scientists", "I trust that scientists are being honest in their work", "I trust that scientists are being ethical in their work", "People who understand science have more trust in science", "I trust scientists can find solutions to our major technological problems", and "We can trust science to find the answers that explain the natural world."

Trust in Media (Cronbach α = .91) was measured through a series of items adapted from Williams et al. (2011), Gottfried et al. (2020), and Mitchell et al. (2018) to identify the respondents' trust toward the media. Respondents were asked to select their level of agreement (1 = "Strongly Disagree", 5 = "Strongly Agree") to nine statements: "I have a great deal of trust in national news organizations", "I trust the news media to share accurate information", "I trust the news media to tell the whole story on an issue", "I trust news media organizations to wait to report a story until they have all the details", and "I do not trust the news media because it moves too quickly."

Political Ideology has been documented as a contributing factor in how individuals frame their perceptions toward climate change. To measure political ideology, respondents were asked, *"*How would you describe your political views?", with option statements of "Very Liberal", "Slightly Liberal", "Moderate", "Slightly Conservative", "Very Conservative", and "Prefer Not to Answer." Respondents who responded with "Prefer Not to Answer" were excluded from data analysis.

Personal Values (Cronbach α = .84) were measured using the Short-Schwartz value scale (Schwartz, 2012) where respondents were given a list of values and their definition and instructed, "Please rate the importance of the following values as a life-guiding principle for you" on an 8-point scale from 0 = "Opposed to My Principles" to 8 = "Of Supreme Importance to My Principles.*"* The value statements included power (i.e., social power, authority, wealth), achievement (i.e., success, capability, ambition, influence on people and events), hedonism (i.e., gratification of desires, enjoyment in life, self-indulgence), self-direction (i.e., creativity,

freedom, curiosity, independence, choosing one's own goals), universalism (i.e., broad-mindedness, beauty of nature and arts, social justice, a world at peace, equality, wisdom, unity with nature, environmental protection), benevolence (i.e., helpfulness, honesty, forgiveness, loyalty, responsibility), tradition (i.e., respect for tradition, humbleness, accepting one's position in life, devotion, politeness), and security (i.e., national security, family security, social order, cleanliness, reciprocation of favors). Due to a researcher error, we failed to include the two values of conformity and stimulation. While this error presents potential for incomplete data assessment, the researchers decided to move forward as these values were not commonly found to be significant in other studies (Lawson et al., 2023; Schultz & Zelezny, 2003) and the data at hand still provides valuable insight.

Data Analysis

Data for this study were analyzed via SPSS 28 using a two-step cluster analysis method. To complete the analysis, climate change perceptions, trust in science, trust in media, and political ideology were first converted into Z-scores to account for differences in variable measurement scales (Runge et al., 2018). Next, a Hierarchical Cluster Analysis (HCA) was conducted using Ward's method to explore how patterns emerged to segment the data through visual inspection of a dendrogram of the agglomeration schedule, resulting in five defined segments (Everitt et al., 2011). After, a K-means cluster analysis defined the five clusters and assigned each respondent to one of the five segments (Campo et al., 2012). Thus, the K-means cluster analysis created a new categorical variable in the data set for the respective assigned cluster. It is important to note that cluster analyses are not designed to test hypotheses but instead group respondents based on emergent patterns from the data, which can then be examined for statistical significant differences. Following this assignment, analyses of variance (ANOVAs) and descriptive crosstabs were performed to compare the clusters based on descriptive means and frequencies of personal values and other demographic variables (Campo et al., 2018). In addition, we followed Cohen (1988) effect size ranges for η^2 (Eta Squared): $\eta^2 = 0.01$ to < 0.06, small effect; $\eta^2 = 0.06$ to $< .14$, medium effect; $\eta^2 < .14$, large effect.

Sample sizes for cluster analyses vary. Prior scholars have indicated at least 100 observations should be used to conduct cluster analysis and note five to 10 cases per variable is often used; however, these scholars indicate more observations is better for stability of the model (Dolnicar et al., 2016; Everitt et al., 2011). To better understand the sample size required, a power analysis was conducting using G*Power (Faul et al., 2007) to determine the required sample size for one-way ANOVAs with five independent groups (i.e., the number of emergent clusters). Using a small to medium effect size ($f = 0.18$), an alpha level of .05, and desired statistical power of .80 (i.e., the probability that the study will detect an effect if there is one), the G*Power analysis indicated a total sample of size of 275 respondents would be required to detect statistical significance.

Limitations

Fundamentally, this was a post-hoc analysis—future cluster analysis should be designed inductively for audience segmentation and the key variables to consider. Due to the nature of post-hoc analysis and following prior work (e.g., McCright & Dunlap, 2011; Hamilton, 2011), we recoded a categorical item on climate change beliefs into an ordinal variable reflecting respondents' distance from the scientific consensus (i.e., that climate change is happening and

primarily caused by humans). The findings should be considered in light of this detail. Furthermore, non-probability samples have bias and limitations (e.g., potential exclusion, selection, and participation bias; Lamm & Lamm, 2019). Although we had quotas for age and community type, other census data research should be used to draw quotas that align with gender, age, income, race, etc. to make larger inferences and to make the data more representative of the population. One other limitation to the study is that the researchers only collected eight of the 10 values due to an error in the online survey. Also, due to the state-specific nature of the sample, readers should be cautioned when attempting to generalize the findings of the current study. Considering the strong need to understand audiences of all types and locations; however, we discuss the findings in consideration of these limitations below.

Results/Findings

RO1: Identify and describe strategic target audiences for climate change communications based on participants' climate change perceptions, science trust, media trust, and political ideology.

A K-means Cluster analysis was performed, which serves to segment the sample into five specified groups (Everitt et al., 2011). The K-means analysis provided the Z scores of the final centroids (Mean Z score) for the five specified clusters. Table 2 describes the average Z score of each variable within the cluster. The segments were validated using ANOVA, which indicated the segments demonstrated statistically significant variances at the $p < .001$. Each were determined to contribute to the cluster, and the clusters were deemed significantly different (Everitt et al., 2011; Runge et al., 2018).

Table 2

*Z scores of Final Cluster Analysis Centers resulting from K Means Analysis (*N *= 445)*

	1 (n = 58)	2 (n = 79)	3 (n = 79)	4 (n = 134)	5 (n = 96)	F (4,445)	p
CC View	-1.41	-.74	-.22	.62	.79	177.86	<.001
Science Trust	-1.52	.09	.03	-.09	.94	107.80	<.001
Media Trust	-1.20	.94	-.79	-.18	.85	176.30	<.001
Political Ideology	1.00	.08	1.01	.30	1.07	155.87	<.001

Note: Variables are standardized using Z Scores. For Climate Change View, a negative score indicates lack of agreement with the scientific consensus (i.e., climate change is not happening); whereas, a positive score indicates agreement with the scientific consensus (i.e., climate change is happening due to human activity). For Science Trust and Media Trust, a negative Z score represents distrust, and a positive score represents trust. For Political Ideology, a negative Z score represents a person who identifies more conservatively, and a positive Z score represents a person who identifies more liberally.

The K-means analysis illustrated five distinct audience segments that are described below and displayed visually in Figure 1. Cluster 1 (n = 58) was composed of those who indicated they were opposed to the scientific consensus (Z Score = -1.41), were distrusting of science (Z Score = -1.52) and media (Z Score = -1.2), and who identified more conservatively. Cluster 2 (n = 79) represented a group who slightly opposed to the scientific consensus (Z Score = -.74), neither trusted nor distrusted science (Z Score = .09), slightly trusted the media (Z Score = .94), and who identified as moderates. Members of Cluster 3 (n = 79) were neutral in their climate change perceptions (Z Score = .03), neutral in their trust toward science (Z Score = .03), slightly

distrusted the media (Z Score = -.49), and conservative in their political beliefs. Cluster 4 (n = 134) was composed of individuals who agreed with the scientific consensus on climate change (Z Score = .62), were relatively neutral in their trust toward science (Z Score = -.09) and the media (Z Score = -.18) and identified as moderates. Cluster 5 (n = 96) represented the group of individuals who agreed with the scientific consensus (Z Score = .79), were trusting of science (Z Score = .94) and the media (Z Score = .85), and identified as liberals.

RO2: Describe the personal values identified in each of the audience clusters.

To describe and evaluate if the audience members' personal values varied by cluster, a series of one-way ANOVAs were conducted (Table 3). In each analysis, the dependent variable was the respondent's rating of the personal value, and the independent variable was their assigned cluster membership. We found significant main effects between each personal value on each of the identified cluster segments (see Table 3). In addition to examining if the perceived values varied by cluster, the researchers also sought to evaluate the top five personal values in rank order presented in each cluster. Further, we examined the strength of the effects of cluster membership on personal values using one-way ANOVAs. A large effect was observed for Universalism, $F(4, 444) = 30.14$, $p < .001$, $\eta^2 = .22$. Participants in Cluster 5 rated Universalism highest (M = 7.49, SD = 1.64), while Cluster 1 rated it lowest (M = 3.81, SD = 2.63). Additionally, we found moderate effects of cluster membership for several values: Power, $F(4, 444) = 16.69$, $p < .001$, $\eta^2 = .13$; Hedonism, $F(4, 444) = 10.66$, $p < .001$, $\eta^2 = .09$; Benevolence, $F(4, 444) = 9.56$, $p < .001$, $\eta^2 = .08$; and Achievement, $F(4, 444) = 7.02$, $p < .001$, $\eta^2 = .06$. For example, participants in Cluster 2 placed greater importance on Power (M = 5.97, SD = 2.09) compared to those in Cluster 1 (M = 3.16, SD = 2.01). Finally, **s**mall but significant effects were observed for Self-Direction**,** $F(4, 444) = 5.54$, $p < .001$, $\eta^2 = .05$**;** Security, $F(4, 444) = 4.02$, $p = .003$, $\eta^2 = .04$; and Tradition, $F(4, 444) = 2.44$, $p = .046$, $\eta^2 = .02$. For example, mean scores for Self-Direction were highest in Cluster 5 (M = 7.16, SD = 1.60) and lowest in Cluster 2 (M = 5.90, SD = 2.06).

Table 3

*Means and Standard Deviations of Personal Values by Identified Cluster Segment (*N = *445)*

	1 (n = 58)		2 (n = 79)		3 (n = 78)		4 (n = 134)		5 (n = 96)				
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*F*(4,444)	*p*	n^2
Universalism	3.81	2.63	5.95	2.03	5.24	2.36	**6.10**	2.03	**7.49**	1.64	30.14	<.001	.22
Power	3.16	2.01	**5.97**	2.09	4.22	2.23	4.30	2.13	5.15	2.45	16.69	<.001	.13
Hedonism	3.84	2.49	5.08	2.17	3.54	2.05	4.82	2.32	5.46	2.20	10.66	<.001	.09
Benevolence	**6.05**	2.44	**6.48**	1.91	**7.14**	2.14	**6.65**	2.05	**7.82**	1.42	9.56	<.001	.08
Achievement	**4.40**	1.98	**5.97**	2.09	**5.32**	2.12	5.27	1.85	5.98	2.27	7.02	<.001	.06
Self-Direction	**5.95**	2.54	5.90	2.06	**6.36**	2.10	**6.21**	1.98	**7.16**	1.60	5.54	<.001	.05
Security	**7.41**	2.25	**6.49**	2.02	**7.22**	2.14	**6.53**	1.86	**7.18**	1.71	4.02	.003	.04
Tradition	**6.36**	2.40	**6.23**	1.94	**6.85**	1.72	**5.96**	2.02	**6.36**	2.03	2.44	.046	.02

Note. Bolded items represent top five values

Once a cluster association is generated, researchers often name and interpret segments based on their average standardized scores for the most salient profile variables (Hine et al.,

2014). By arranging segments along a spectrum from opposed to scientific consensus on climate change to support of the scientific consensus on climate change, the researchers were able to see clear patterns in distribution (Runge et al., 2018). Additionally, the researchers sought to examine how these clusters aligned with the cluster memberships personal values to inform strategic communication. The segment names were derived from a combination of the profiling values describing their climate change perception and their prioritized personal values (see Figure 1, Table 4 for segment names and descriptions).

Figure 1

Visual Illustration of Clusters

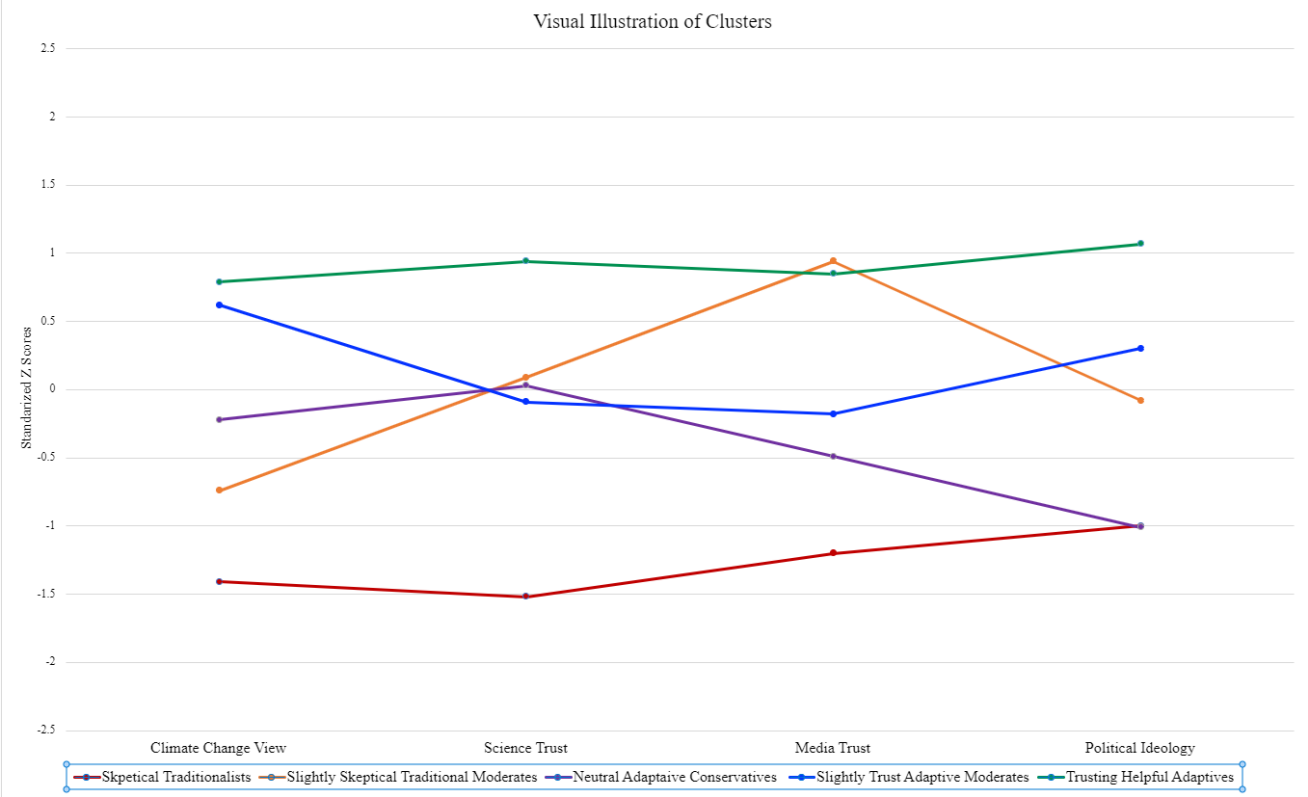

Table 4

*Description of Cluster Segment and Cluster Membership Associations with Climate Change View, Science Trust, Media Trust, Political Ideology, and Top Five Values (*N = *445)*

Cluster	CC View	Science Trust	Media Trust	Political Ideology	Top Five Values in Order
Skeptical Traditionalists (*n* = 58)	Strongly Oppose Scientific Consensus	Strongly Distrust Science	Strongly Distrust Media	Conservative	Security Tradition Benevolence Self-Direction Achievement
Slightly Skeptical Traditional Moderates (*n* = 79)	Somewhat Opposed Scientific Consensus	Neutral	Somewhat Trust Media	Moderate	Security Benevolence Tradition Achievement & Power*
Neutral Adaptive Conservatives (*n* = 78)	Neutral	Neutral	Neutral	Conservative	Security Benevolence Tradition Self-Direction Achievement
Slightly Trusting Adaptive Moderates (*n* = 134)	Somewhat Support Scientific Consensus	Neutral	Neutral	Moderate	Benevolence Security Self-Direction Universalism Tradition
Trusting Helpful Adaptives (*n* = 96)	Somewhat Support Scientific Consensus	Somewhat Trust Science	Somewhat Trust Media	Liberal	Benevolence Universalism Security Self-Direction Tradition

**Note:* In the Slightly Skeptical Traditional Moderates cluster, we found achievement and power to have equal means (5.97) and were categorized together.

RO3: Describe the audience members' demographic characteristics for each cluster segment.

The final research objective determined the demographic characteristics of the cluster memberships presented in each cluster segment. Below, the major themes of each cluster are reviewed, but full demographic data can be found in Table 5. Members of group 1, the "Skeptical Traditionalists", were found to predominately identify as male (*f* = 46, 79.31%) and rural (*f* = 34, 58.62%). Members of group 2, the *"Slightly Skeptical Traditional Moderates,"* tended to have earned less than 50,000 (*f* = 56, 70.89%). Members of group 3, the "Neutral Adaptive Conservatives," were the most educated group, with 83.06% of the population having

attended some college or more. Group 4, the "Slightly Trusting Adaptive Moderates," was predominantly female with two non-binary people represented (Woman: *f* = 87, 64.93%; Man: *f* = 45, 33.58%; Non-binary: *f* = 2, 1.49%). Group 5, the "Trusting Helpful Adaptives," were spread across the board for most variables but had the least rural members represented (*f* = 18, 18.75%).

Table 5

*Cluster Member Demographic Characteristics by Cluster Segment (*N = *445)*

	1 (*n* = 58)		2 (*n* = 79)		3 (*n* = 78)		4 (*n* = 134)		5 (*n* = 96)	
	f	%	*f*	%	*f*	%	*f*	%	*f*	%
Gender										
Man	46	79.31	41	51.90	40	51.28	45	33.58	49	51.04
Woman	12	20.69	38	48.10	38	48.72	87	64.93	47	48.96
Non-Binary	0	0.00	0	0.00	0	0.00	2	1.49	0	0.00
Age										
18-34	3	5.17	31	39.24	14	17.95	47	35.07	23	23.96
35-54	10	17.24	30	37.97	31	39.74	60	44.78	33	34.38
55+	45	77.59	18	22.78	33	42.31	27	20.15	40	41.67
Income										
Less than 50K	34	58.62	56	70.89	36	46.15	91	67.91	46	47.92
50K to 99,999	15	25.86	14	17.72	32	41.03	34	25.37	38	39.58
100K or More	9	15.52	7	8.86	8	10.26	8	5.97	10	10.42
Education										
Some High School	2	3.45	9	11.39	0	0.00	12	8.96	3	3.13
High School Graduate	15	25.86	24	30.38	11	14.10	40	29.85	23	23.96
Some College	20	34.48	25	31.65	28	35.90	35	26.12	25	26.04
2 Year Degree	7	12.07	4	5.06	9	11.54	15	11.19	15	15.63
4 Year Degree	11	18.97	12	15.19	18	23.08	18	13.43	24	25.00
Master's Degree	3	5.17	3	3.80	9	11.54	11	8.21	3	3.13
Professional Degree/Ph.D. etc	0	0.00	2	2.53	0	0.00	1	0.75	0	0.00
Race[a]										
White	52	89.66	35	44.30	66	84.62	87	64.93	69	71.88
Native American/ Pacific Islander	5	8.62	1	1.27	1	1.28	3	2.24	6	6.25
Other/Choose not to answer	0	0.00	1	1.27	0	0.00	4	2.99	2	2.08
Black or African American	0	0.00	19	24.05	6	7.69	20	14.93	6	6.25
Hispanic/Latino	5	8.62	21	26.58	5	6.41	28	20.90	18	18.75

Asian/Asian American	0	0.00	5	6.33	1	1.28	6	4.48	2	2.08
Residence Type										
Urban	10	17.24	32	40.51	19	24.36	48	35.82	38	39.58
Suburban	14	24.14	27	34.18	32	41.03	46	34.33	40	41.67
Rural	34	58.62	20	25.32	27	34.62	40	29.85	18	18.75

Note. [a] Race was measured using a *select all that apply* option, so totals may exceed the sample size.

Discussion, Conclusions, and Recommendations

This study answers two scholarly calls: to prioritize the formation target audiences for climate change communication (Bostrom et al., 2013; Hine et al. 2014; Leiserowitz et al., 2021; Roser-Renouf et al., 2015) and to consider audience member's values and psychographic characteristics (Bouman et al., 2020; Corner et al., 2014; Dietz, 2012; Graham & Abrahamse, 2017). Here we discuss our findings alongside recommendations for practice and research.

Implications and Recommendations for Practitioners

For agricultural and natural resource communicators, the importance of understanding the audience's values and psychographic characteristics cannot be understated (Dietz, 2012). Scientific topics, particularly climate change, tend to be polarizing in nature and communication to audiences must be conducted with caution (Chinn & Hart, 2021; Hine et al., 2014). To ensure messages are disseminated in a relevant manner, scholars and practitioners alike emphasize the importance of knowing the audience and their psychographics as a critical component of the strategic communication process. Demographic information informs practitioners of who is in the audience, which can provide insight to relevant media channels and message characteristics. At the same time, values can provide insight on how the audience perceives the world morally as well as what motivates them, which can also provide strategic messaging insight (Shen & Edwards, 2005).

Findings from studies delivering tailored climate messages to unique audience segments have shown significant effects. For example, messages portraying strong emotional content and economic development potential have shown positive changes among climate-skeptic groups (Bain et al., 2012; Hine et al., 2014), and messages targeting values unique to each segment (e.g., benefits to public health from climate-friendly behaviors) have also shown promising effects (Kahan et al., 2011; Myers et al., 2012). Agricultural communicators must not overlook these important factors when developing strategic communication plans and materials and should tailor climate and other environmental messages to the unique values and perceptions at play in their own audiences. Additionally, due to the pivotal role of trust in both science and media in message processing, climate-related messages should be delivered from trusted sources (Tam & Chang, 2018). Recommendations for our emergent audience segments are discussed next.

Description of Clusters

Understanding the characteristics and values of these target audiences allows practitioners to deliver palatable and value-congruent messages tailored to their psychographics and values (Fischer et al., 2020; Shen & Edwards, 2005; von Borgstede et al., 2014). We review

the key characteristics of each group and provide recommendations from other research on communicating with each group.

Skeptical Traditionalists

The Skeptical Traditionalists tended to value security and tradition, which have been categorized as conservation values, or those invested in preservation of the status quo (Schwartz, 2012). Considering these values, practitioners should avoid messages that confront individual's current understandings to avoid message resistance (Hart & Nisbet, 2012; Roser-Renouf, 2015) and instead focus on climate-conscious behaviors or perceptions that align with their current values. Roser-Renouf et al. (2015) further suggested climate change-skeptical audiences should be met with less confrontational and more indirect messages that are less likely to trigger counter-arguing and more likely to result in peripheral but positive message processing. For example, public opinion research has suggested politically conservative individuals are in favor of climate-mitigation strategies such as planting trees and providing tax credit for businesses developing carbon capture (Tyson, 2021), suggesting these actions might be received more favorably. This group would also be a prime audience for trust-building efforts, both with media and the scientific process, in order to lay the groundwork for thoughtful climate message processing.

The Moveable Middle

The three groups in the middle (Slightly Skeptical Traditional Moderates, Neutral Adaptive Conservatives, and Slightly Trusting Adaptive Moderates) could be framed as the "moveable middle," referring to audiences who are less polarized around an issue (Roser-Renouf & Maibach, 2018). Messaging strategies are often targeted at this semi-neutral audience, as they have yet to "make up their mind" about the topic (Hemphill & Shapiro, 2019; Hyland et al., 2021). Roser-Renouf and Maibach (2018) suggested those in this neutral zone are less likely to engage with "effortful" content, such as reading long blocks of text or interpreting figures. Instead, these groups are more engaged by messages that are easier to process such as those that demonstrate the local impacts of climate change as well as co-benefits of climate-friendly action that may overlap with other value-lead behaviors. Roser-Renouf et al. (2015) also suggested cues such as imagery, humor, empathic storylines, and credible sources can lead to message engagement.

Trusting Helpful Adaptives

Corner et al. (2014) and Roser-Renouf et al. (2015) suggested those already in agreement with the scientific consensus (i.e., Trusting Helpful Adaptives) may be most impacted by messages that increase self-efficacy (i.e., show them what to do/how to participate). This aligns with our findings and Schwartz's categorization of the values universalism and benevolence as "self-transcendent" values (Schwartz, 2012), which have been found to be positively related to willingness to accept policy measures (Nilsson et al., 2004). Furthermore, this group has potential to be empowered to serve in a two-step flow model of communication by acting as an opinion leader that can engage those in other groups about the importance of climate-friendly behaviors (Roser-Renouf et al., 2015).

Future Research

More granular understanding of audiences is warranted in agricultural and natural resources communication, and scholars should continue to understand the psychographic drivers toward topics in the field. Scholars should continue to expand this line of inquiry in agricultural communications. To do so, we suggest a continuation of exploring how other parallel disciplines have conducted segmentation studies including health, nutrition, and science communication (e.g., Hine et al., 2014; Runge et al., 2019). In addition, we should leverage lessons learned from studies in advertising, marketing, and agricultural economics to pair audience segmentation and persuasion literature. Given this study was limited to just one state sample, future studies should also explore audience segments from a regional and national level.

There is much potential for research to expand this study, including experimentally testing messages on these and other audience segments and investigating which other variables are influential for message processing. This study established audience segments based on personal values and other influential, climate-related cognitive constructs (e.g., trust in media and science and political ideology). We urge researchers to build upon the findings of this study by testing value-congruent messages tailored to distinct value-segmented audiences. Furthermore, it would be insightful to test how audience clusters differ in their support for various climate change policies and actions, as well as how they seek and receive information. Within agricultural and natural resource communications, audience segmentation should be applied to other technical topic areas and consider additional contextual values such as environmental values.

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