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How do people change their beliefs about climate change? A qualitative study on opinion shift in the U.S. Midwest

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Abstract
Beliefs and attitudes about climate change are the building blocks from which humans create and support mitigation and adaptation strategies. In the United States, 72% of the public now believes that the earth is warming and 58% believe humans are the cause. Although these figures represent some increase since 2010, they also represent a significant remaining gap in acceptance of climate change realties. While a wealth of research has identified isolated factors that influence opinions on climate change, less attention has been given to understanding the process that changes people's opinions. Our study uniquely applies qualitative methods to examine the context and experiences underlying climate change opinion shift. We conducted in-depth interviews with 15 participants in Kansas City and its surrounding peri-urban and rural communities who had changed their beliefs on fundamental climate change realities and were purposely selected for diversity across political ideology, age, and urban/ rural residence. We inductively coded transcripts and synthesized codes into a hierarchical structure to derive themes. Findings suggest that prior to shifting beliefs, participants were similarly skeptical or rejecting of climate change, while remaining diverse in the ideologies that influenced these beliefs. For most participants, shifting beliefs were catalyzed by three key experiences: (1) distancing from ideological community, (2) desire to seek out information, and (3) solidifying experiences of gradual or epiphanic realization. Despite these common experiences, attitudes following change in beliefs remained diverse. Our framework can guide individuals and organizations in facilitating greater acceptance of climate change realities through interpersonal and public communication strategies.

Keywords Climate change · Qualitative research · Beliefs · Opinions

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1 Background

Public attitudes, opinions and beliefs[1] about climate change provide foundation for societal response to the crisis, influencing everything from individual environmental behaviors to broader support for policy-level action (Leiserowitz 2005; Weber and Stern 2011). Since 2008, Yale's Climate Change in the American Mind (CCAM) surveys have systematically assessed public attitudes, opinions and beliefs regarding climate change across the United States. The latest 2023 survey estimated that 72% [69–75%] believe "global warming is happening" and 58% [55–61%] believe it is "caused mostly by human activities" (Leiserowitz et al. 2024). While these figures represent an increase since a low point in 2010, when 57% [54%–60%] believed global warming was happening and 47% [44–50%] believed its human cause, data from CCAM and other sources suggest no substantial increase in public opinion on the fundamental realities of climate change since the early 2000s or since 2016 (Leiserowitz et al. 2024; Gallop Organization 2024). Understanding how individuals shift their opinions of these fundamental realities of climate change is critical in shaping communication strategies aimed at garnering public support for climate action.

Attitudes and beliefs about climate change are generally reflective of political, family, religious, and/or social identity (Stedman 2004; Kellstedt et al. 2008; Scannell and Gifford 2013; Brulle et al. 2012; Leviston et al. 2014; Devine-Wright et al. 2015; Carmichael and Brulle 2017; Hornsey et al. 2016; McCright et al. 2016; Shao 2016; Shao et al. 2016; Shao and Goidel 2016; Kerr and Wilson 2018; Bostrom et al. 2019). Gender and generational differences are also apparent, with women and younger generations more likely to accept realties of climate change. Beliefs can also be influenced by direct experience of the crisis, a factor becoming increasingly prevalent as 3.4 million Americans were exposed to extreme weather events in 2022 alone (Hornsey et al. 2016; Ballew et al. 2019; Brown and Hamilton 2024; U.S. Census Bureau 2023). Trust in science, exposure to media coverage, localized messaging, elite cues, perceived social norms, and interactions with others are also known to influence climate change opinions (Brulle et al. 2012; Carmichael and Brulle 2017; Ballew et al. 2022; Brown and Hamilton 2024).

This multitude of influential factors can be understood through several theoretical perspectives. McCright and colleagues (2016) identify five: (1) Values-Beliefs-Norms Theory, which explains how individuals adopt beliefs that are compatible with their worldview and values; (2) Anti Reflexivity Thesis, which claims the political Right is more dismissive of the problems caused by industrial capitalism than the political Left; (3) Gender Socialization Theory, which argues that females are more likely to be socialized toward empathy and care; (4) Postmaterialist Values Thesis, which describes how younger and more affluent individuals have stronger pro-environmental views because their other basic needs are met; and (5) Cultural Theory; which explains how various cultural worldviews and societal structure shape perceptions of environmental risk and collective action. These theories high-

[1] We use the term "attitude" to mean "a psychological tendency that is expressed by evaluating a particular entity with some degree of favor or disfavor" (Eagly and Chaiken 1993, p. 1). Generally, "beliefs" are viewed as more rigid, deeply rooted convictions closely tied to identity and values, while "opinions" are more flexible, subject to change with new information, and typically relate to more specific issues (Frankish 1998). A person's acceptance of core climate change realities (its existence and roots in human activity) could be thought of as belief, opinion, or both. In this paper, we use "belief" and "opinion" interchangeably when referring to one's acceptance of climate change realities, which is also reflective of how the terms appeared in our data.

light various influences on opinion, which as McCright and colleagues explain, can coexist or interact. While they all associate climate change beliefs with different facets of identity, they do not adequately explain how beliefs may change, if the experience of change exhibits common features across different identities and worldviews, as well as how changed beliefs are reassumed within identity and work to influence related opinions.

Despite the growing body of literature that identifies factors and theoretical underpinnings related to climate change opinion, less attention has been given to understanding the processes and experiences that *change* opinion. A 2018 supplement to the CCAM survey examined individuals that changed their mind about climate change, with the overwhelming majority reporting becoming "more concerned" about the issue versus less (Deeg et al. 2019). Although some demographic groups showed slightly higher likelihood of opinion change (women more likely than men, Democrats more likely than Independents, older adults more likely than younger), shifts in opinion were generally consistent across different age, sex, educational level, and political party groups. Reported reasons for increased concern included directly experiencing climate change impacts (21%), taking it more seriously (for unspecified reasons, 20%) and becoming more informed (20%). Notably, a full 24% did not provide a clear or complete response. Beyond CCAM, other survey-based research examining opinion shift has identified the influence of social norms and messaging (featuring political mobilization, morality appeals, and/or extreme weather). (Brulle et al. 2012; Salomon et al. 2017; Egan and Mullin 2017; Ballew et al. 2022). One large longitudinal study found opinion change was significantly associated with political ideology, party identification, relative concern about environmental conservation and economic development, and, to small extent, exposure to extreme weather events (Palm et al. 2017).

Theoretical explanations for opinion change are less developed in the literature. Palm and colleagues situate their work within the Theory of Motivated Reasoning, which explains how emotional biases and social identity serve as filters for new information (Palm et al. 2017). Social network influence, cognitive dissonance, and information processing biases have also been described within and outside of climate change literature as part of the complexities of opinion change (Nielsen et al. 2021; McGrath 2017; Dennison et al. 2023; Merry and Mattingly 2023). These theories provide valuable insights into some factors that can influence opinion shifts in a population. However, they do not offer a complete perspective of an individual's journey to opinion change, nor how multiple influential factors may appear or interact within an individual experience. Psychology's classic Transtheoretical, or "stages of change" model, has been widely applied to describe the overall process of how individuals change *behavior*, but may be problematic to apply to a change in *opinion* that could result in a variety of behavioral outcomes (Prochaska and Diclemente 1982).

While survey-based research and theoretical discourse offer some insight into climate change opinion shift, we still lack a deep understanding of the process and experiences that underly changes within individuals (Egan and Mullin 2017). Qualitative methodology- specifically grounded theory that co-constructs and analyzes in-depth interviews—is uniquely positioned to offer such insights but has rarely been applied to understanding climate change opinions. Kleinberg and Toomey (2023) were among the first to apply qualitative methodology to broadly explore climate change attitudes in the United States. Their work demonstrated the importance of uncovering the nuance and diversity underlying the quantitative data currently dominating the literature on climate change opinion. They advocate for the expanded use of qualitative methods in building a more comprehensive understanding of

environmental perspectives that can guide effective scientific communication. While Kleinberg and Toomey do apply qualitative methods to explore climate change attitudes, we have yet to see in-depth qualitative studies that examine process and construct explanatory frameworks. By applying qualitative methodology to climate change opinion shift research, we can move our understanding beyond statistical trends and offer contextual insight into how and why shifts occur. Although findings are expected to resonate with many existing theoretical explanations for opinion formation, they are also expected to offer novel insight into the dynamics of influences on climate change opinion revision via novel processual view.

While climate change opinions are infinitely more complex than the belief of its existence and its anthropogenic cause, examining how individuals come to change their beliefs on these two fundamental realities serves as an essential starting point. Understanding commonalities across experiences of individuals with changed beliefs can help align community and population-level communication strategies aiming to encourage further acceptance of climate change realities. In this study, we use qualitative methods to explore the experience of individuals in Kansas City and its surrounding communities who came to accept the existence and/or human cause of climate change after previously stating disbelief. We aimed to identify common features of their experiences and to generate an explanatory framework to better understand the overall process of individual opinion change.

2 Methods

2.1 Setting and participants

We conducted a qualitative study guided by grounded theory methodology with participants residing in Kansas City and surrounding rural and suburban communities in Kansas (KS) and Missouri (MS) (Charmaz 2006; Mfinanga et al. 2019). The region is notable for being particularly vulnerable to climate change, with extreme weather expected to decrease crop yields by 50% and quadruple the number of days over 100 degrees Fahrenheit by the year 2050 (Pryor et al. 2014). Paradoxically, the region's population tends to exhibit more conservative opinions and beliefs on climate change compared to the rest of the country. At the time we conducted our study (beginning in 2019, into 2020) both states had similar proportions of people who believed that "global warming is happening" (63% [60–66%]) and who believed that "global warming is caused mostly by human activities" (48% [45–51%]; Leiserowitz et al. 2019).

We recruited participants for initial screening using a variety of in-person (distributing flyers at grocery stores, community events) and virtual strategies (listservs, social media postings). Interested individuals were directed to an online eligibility screening. Participants were eligible if they lived within a 50-mile radius of Kansas City (determined by zip code), were 18 years of age or older, and indicated one or more changes in responses to two items from the CCAM survey: (1) "Do you think global warming is happening?" (Yes/No/Don't know) and (2) "Assuming global warming is happening, do you think it is…" (Caused mostly by human activities/ Caused mostly by natural changes in the environment/ None of the above because global warming isn't happening/ Other/ Don't know). Specifically, participants were asked to answer these questions first in past tense with the stem "Five years ago..." and then a second time in present tense. Those who indicated a shift from "Yes" to

"No" in the first item or a shift from "Caused mostly by natural changes in the environment" to "Caused mostly by human activities" in the second item were eligible. We then employed an iterative, purposive sampling strategy to invite selected participants for interviews (Charmaz 2006). We aimed for a maximum diversity of demographics to construct a sample that together provided the different perspectives necessary in gaining a holistic understanding of opinion shift in the region. We planned to recruit until we reached thematic saturation, an estimated 12–18 interviews based on established guidance (Guest et al. 2006).

2.2 Data collection

Individuals who passed the eligibility screening were invited to give their contact information if they were interested in scheduling an in-depth interview and to answer additional demographic and climate opinion questions. Interviews were conducted in-person in private spaces (e.g., private rooms at public libraries and workplaces) or by phone, according to participant preference. The first author or a trained research assistant conducted the interviews using semi-structured guides with open-ended questions and optional probes. At the start of the interview, participants were asked to describe the first thing that came to their mind when they thought of climate change. They were then asked to review their answers from the CCAM eligibility screener questions, elaborate on their shift in opinion, and reflect further on their relationship with climate change. Participants were also asked to reflect on their current attitudes and beliefs related to climate change action by answering and elaborating on additional items from the CCAM survey. Participants were required to give verbal informed consent prior to the interview and were offered a $25 gift card upon completion.

2.3 Data analysis

Analysis began alongside data collection, with interviewer debriefing and memoing to track emerging themes and diversity of perspectives (Charmaz 2006). Audio-recordings of interviews were transcribed and uploaded into Dedoose Version 9.0.17 for coding. We coded inductively, meaning we did not begin with predefined codes, but generated codes based on interpretation of raw data. To begin, both authors performed a line-by-line inductive coding to generate first-round codes on two common transcripts. We prioritized *in vivo* coding, which uses the participant's own words to create these first-round codes (e.g. "not on my radar" and "gradual realization"). We met repeatedly to compare and synthesize initial codes, apply revised codes to additional transcripts, and refine and re-arrange codes into a hierarchical structure (with codes and sub-codes). We continued coding common transcripts until intercoder consensus was reached on a codebook, which was then applied to the remaining transcripts (Cascio et al. 2019).

Codes in the final codebook were categorized as "Attitudes/Emotional Responses" (e.g. "skeptical", "worry/concern"), "Experiences" (e.g. "seeing the data", "interacting with others"), "Perceptions" (e.g. "not my responsibility", "political perceptions and self-identification"), and "Actions/Behaviors" (e.g. "seeking out information", "lifestyle changes"). We also included codes to indicate when text was related to before, during, or after the participants' opinion shift, and often applied codes in an overlapping manner. When all transcripts were coded with the final codebook, we reviewed excerpts under each code and created code summaries of the findings. We also created participant case summaries, which summarized

the codes pertaining to key events for each participant. Through memoing, reviewing of the code and case summaries, and examination of code presence by participant, we further synthesized findings (main themes and process) into an explanatory framework. To enhance credibility of the findings, we conducted an additional verification of the final explanatory framework, where both researchers reviewed the raw transcripts, case summaries, and code presence tables to evaluate the evidence for each of the main themes in each interview.

3 Results

A total of 177 individuals completed the screening survey, with 53 eligible. We conducted interviews with 15 participants (Table 1). Participants ranged in age (20–85 years), political affiliation (33.3% Democrat, 13.3% Republican, 6.7% Independent, 40% other) and residence (26.7% with zip codes situated in rural areas, 20% suburban, 40% urban, and 13.3% with zip codes spanning urban and suburban areas). Most were female (66.7%), white/non-Hispanic (86.7%), and had a college degree (93.3%). During the course of iterative sampling, fourteen other participants were invited for interviews but did not respond. A full recording was not available for one participant, so while memoing on this participant contributed to our overall analysis, the transcript was not available for direct coding. Our quali-

Table 1 Characteristics of interview participants ($n=15$)

Participant #	Age	Sex	Race/ Ethnicity	Political Affiliation	Residence[1]	Education Level
1	28	M	White/ Non-Hispanic	Other- "Democratic Socialist"	Suburban	Undergraduate degree
2	31	F	White/ Non-Hispanic	Independent	Rural	Graduate degree
3	57	F	White/ Non-Hispanic	Prefer not to answer	Urban/Suburban	Undergraduate degree
4	53	M	White/ Non-Hispanic	Other	Urban	Graduate degree
5	60	F	White/ Non-Hispanic	Democrat	Suburban	Graduate degree
6	25	F	White/ Non-Hispanic	Other- "moderate"	Urban	Graduate degree
7	63	F	Hispanic /Latino	Democrat	Rural	Graduate degree
8	60	F	Black/ African American	Democrat	Urban	High school degree or GED
9	71	M	White/ Non-Hispanic	Democrat	Urban/Suburban	Undergraduate degree
10	37	M	White/ Non-Hispanic	Republican	Urban	Undergraduate degree
11	85	M	White/ Non-Hispanic	Democrat	Urban	Graduate degree
12	31	F	White/ Non-Hispanic	Prefer not to answer	Suburban	Undergraduate degree
13	59	F	White/ Non-Hispanic	Other- "Independent leaning Libertarian"	Rural	Graduate degree
14	38	F	White/ Non-Hispanic	Republican	Rural	Undergraduate degree
15	20	F	White/ Non-Hispanic	Democrat	Urban	Undergraduate degree

[1]Residence determined by zip code. "Urban/suburban" refers to zip codes that span the municipal boarders of Kansas City and surrounding suburban communities

tative findings characterize: (1) the participants' attitudes and perceptions before changing their opinion; (2) the pattern of key experiences that catalyzed their opinion change (distancing from ideological community, desire to seek out new information, and solidifying experiences of gradual or epiphanic realization); and (3) their current views.

Figure 1 depicts these themes as a process that catalyzes individual shift in core beliefs about climate change. Of the fourteen participants whose transcripts were available for full analysis, ten generally exhibited this pattern of three key experiences, one partially fit the pattern, and three only exhibited a gradual realization.

Reflecting on the time before changing their opinion, participants described their attitudes toward climate change as skeptical, dismissive, ignorant, and/or derisive. Skepticism was most common ("I was never what you would call a denier. I would say I was skeptical" [Participant #9 (P9)]) and often fueled the other attitudes. As one participant described, skepticism led her to dismiss or "block out" climate change because it "didn't seem real" (P1). In dismissing the seriousness of the issue, some felt climate change "wasn't my responsibility" (P1), "was already solved" (P1), or simply that "other issues seemed more important at the time" (P5). Another described initial skepticism, followed by general ignorance of climate change evidence in her own surroundings.

> "I didn't really let it take up space in my mind. I just thought, 'Okay, this was a hot summer, this was a wet summer, this was a cold winter'" (P3).

Many younger participants further attributed their prior ignorance and/or dismissiveness about climate change to their stage of life, and described their opinion change as parallel to their broader coming-of-age. Some had grown up in conservative households, were not exposed to much information on climate change in school and/or reflected on their younger selves as "a little bit selfish. I feel like I mean, just like concerned with my own issues versus bigger issues that are going to affect more people" (P15).

Three participants described their former selves as derisive, or actively rejecting and ridiculing the realities of climate change. These participants were skeptical of the issue "as a politically charged item and not necessarily holding a lot of science" (P4). Some recalled having first heard about climate change from Democratic politicians (commonly Al Gore), or people who they perceived as having ulterior motives (like "somebody just trying to get to me go vegan" [P6]). In not identifying with their ideology, these participants saw messengers of climate change information as primarily motivated by political or personal gain, and thus, not credible. In rejecting information that they found unreliable, some participants

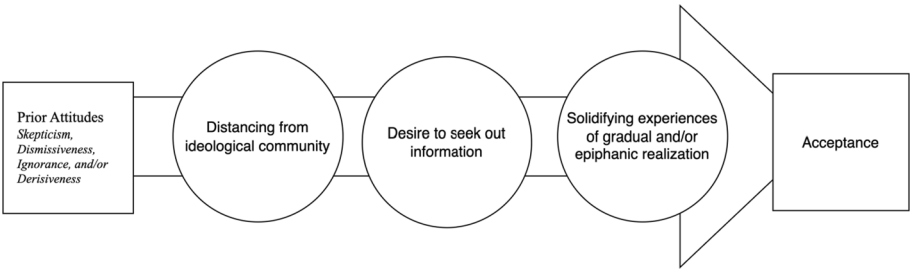

Fig. 1 Experiences that catalyze individual shift in beliefs about the existence of climate change and/or its roots in human action

decided that "climate change felt like a joke" (P4) and would actively distance themselves from climate change ideology by mocking it in their social circles ("electric cars- they're so dumb" [P7], "it just snowed five feet in Buffalo, New York. Take that global warming" [P6]).

(2) Key experiences that catalyze opinion change

In changing their opinion, most participants' experiences followed a general process of (1) distancing from their ideological community, (2) a desire to seek out information, leading to (3) a gradual or epiphanic realization that solidified their shift in opinion.

2.1. Distancing from ideological community

On the pathway to changing their opinion, participants experienced a distancing from an ideological community that had influenced their prior worldview and identity. While some participants described this experience in more depth than others, most participant narratives contained evidence that opinion shift originated with some "distancing" from family, social networks, political party and/or other group that they identified with. This distancing was not an active decision by participants to expose themselves to climate change information, but an experience they found themselves in that gave them perspective to newly question ideologies that they had come to internalize.

Sometimes, distance from their ideological community began with physical distancing, with some participants describing seminal experiences of travel, moving, or going off to college.

> "In high school, I was a theater kid. I wasn't really paying a lot of attention to politics or to biology. […] When I went to college, one of the classes I took was historical geology […] so that really sparked curiosity in me" (P15).

Yet physical distance was not required for participants to encounter new perspectives through social and/or cognitive distance from their ideological communities. Influential interactions with trusted individuals could result from participants pursuing a new interest or encountering someone from their existing networks whose opinion had shifted after their own distancing.

> "I got very interested in regenerative agriculture. […] And the more I got interested in that, again, it kind of became irrefutable to hear people who were like, 'Hey, I've been doing this type of agriculture for 20 years and crops are blooming at different times and crops are coming in at different times and I'm now growing crops that I couldn't have grown 20 years ago. […] And they have no ulterior motive in saying 'Hey, this is a problem'" (P10).
>
> "One of my very good friends who was also one of my roommates moved out to California for several years for AmeriCorps and Teach for America. And so, she was kind of just exposed to a different area of the country she'd never been to before" (P6).

> "I have a good friend who heard Joe Kennedy [current elected official] talk […], and so she became very impassioned about the environment. She started educating me, and so, gradually, I listened to her" (P5).

2.2. Desire to seek out informationWhile distancing from ideological community typically began as a passive or happenstance experience, it often created a desire in participants to actively follow up on the new perspectives they encountered by seeking out more information on climate change. Some participants sought information with the intent of defending their original stance and wound up facing cognitive dissonance.

> "If you have an opinion that's counter to what other people are saying and feeling, then you're going to want some way to back that up, and when you start looking into it, you're not going to find evidence to back that up as much as misinformation, if anything" (P1).
> "So I just wanted to genuinely know more about it and kind of understand […] Kind of in my gut, I was like, 'Okay. If we're going to be mocking it, then we need to have a good reason to mock it.' And then as I was reading more about it, I was like, 'Okay, we actually don't have a good reason to mock it. And just because it snows five feet, doesn't mean that the Earth isn't increasing in temperature'" (P4).

In seeking out information with intentionality, participants often became skeptical of sources of information they had previously encountered passively or through their original ideological communities. This further spurred their desire to identify credible information on their own; in particular, steering away from political and cultural discourse in favor of more scientific sources.

> "I stopped listening to [popular news sources] after a while because there was such a political slant to them. And it was more beneficial for me to actually read literature and learn who the leading scientists were who were studying the effects of climate change and global warming and to actually see the data and not have it interrupted through a lens that was a journalistic in a way" (P6).
> "I finally got off of my little nice little shell in suburbia and started looking around. And I used to be a teacher and I remember arguing back in 2005 with a teacher when *An Inconvenient Truth* came out. I would argue with her that that was just a bunch of bologna and that it was just cyclical. But then I started looking at what scientists were saying - because I don't consider Al Gore [a scientist]. […] And then that's when I went ahead and I started actually looking for information on my own to see" (P7).

2.3. Solidifying experiences of gradual or epiphanic realizationFollowing ideological distancing and seeking out information, participants describe one or more experiences that solidified their shift in opinion and resolved cognitive dissonance. They described their realization as either gradual or epiphanic, characterized by confirming experiences where they were able to process the new information they had gathered amid interactions with the natural and/or social world.

Repeatedly seeking out and processing information they deemed credible led some participants to "open up the worldview" (P6) and eventually accept the existence or cause of

climate change. To them, their opinion shift was “a gradual process” (P13) of “challenging a lot of ideas that had just kind of sat under the surface's assumptions” (P1).

> “I don't know if there was necessarily a moment [when my opinion changed]. I think it was just the realization seeing graphs of, "Yes. See? The temperature is steadily rising" (P6).

Other participants described a memorable, epiphanic experience where they accepted a fundamental shift in their opinion. For some, it was witnessing a change in the natural world that reflected and confirmed the new information they had encountered:

> “It seemed like it was a Democratic issue […] And so for me, it was like, well, I'm not sure I see the evidence of that as clearly as it was being presented by them […] I went to Alaska twice and so then I was able to see some things with my own eyes” (P4).

These encounters with the natural world could also be peripheral, like seeing extreme climatic events covered in the media:

> “And then the forest […] burning in Australia, and you're like, "Oh my gosh, it’s [climate change is] everywhere" (P3).

Some described epiphanies when learning about the human impact of climate change. When watching a documentary about the Solomon Islands, one participant recalls being struck with the realization, “Oh, it’s affecting people… that didn’t even enter into my equation” (P7).

Participants could experience both a gradual acceptance of the evidence they were encountering as well as epiphanic, memorable moment when their acceptance awakened them to reconsider their own role in addressing climate change.

> “As soon as you do believe that people are responsible, then it's kind of the pull-your-hair-out moment you're like, ‘Oh, we've really got to change a lot of stuff to fix this’" (P10).
> “Alexandria Ocasio-Cortez went to the [sit-in]. It made national news, people got arrested. And it was at that moment that I was like, I'm like 10 years older than most of the people there who were getting arrested, and I was like, what am I even doing? I am the adult here and I'm sitting on my couch, just worried" (P1).

2.4. Participants who did not exhibit pattern of key experiencesIn four transcripts, we did not find evidence of the pattern of key experiences described above (Table 2). One participant (P2) described distancing from ideological community but seemed to come to a gradual realization of climate change realities without evidence of actively seeking out more information (P2). Of the participants that did not exhibit distancing or seeking out information, one (P13) did not offer extensive enough responses to determine the presence of these two key experiences, while two others explained their opinion shift as purely a product of gradual realization. While participants who sought out information described data and scientific evidence as solidifying their gradual realization (Type 1, Table 2), these participants

Table 2 Participant-by-participant details of climate change opinion shift

ID	Attitudes before changing opinion [1]	Key experiences [2]				Resulting views [6]	Example quote reflecting one key experience *
		Distancing from ideological community [3]	Desire to seek out information [4]	Solidifying experience [5]			
				Gradual	*Epiphanic*		
Generally exhibited pattern of key experiences							
1	Skepticism, Dismissiveness, Ignorance	* (quote)		Type 1		+ Worried + Supportive + Active	* *"[…] around that time the Sunrise Movement [youth climate advocacy group] came across my radar."*
3	Skepticism, Ignorance	*	*	Type 1		+ Worried - Supportive + Active	*"We talk about it in our office. And I think it really became relevant in the 2016 election […] because there are some in our office that are pretty far left. […] And then I'm like, 'Well, let me think.' So then I'm like, 'I don't know that I believe that.' But then you go and you delve deeper into whatever they were speaking about."*
4	Skepticism, Derisiveness	*				+ Worried + Supportive - Active	*"[On a trip to Alaska] I was able to see with my own eyes the changes that were occurring and there was also a component of a man who gave lectures."*
5	Skepticism, Dismissiveness Ignorance,	*		Type 1		- Worried + Supportive + Active	*"I had heard multiple views on climate change. And some folks were saying that we only have weather patterns, really, for the last 100 years, and so we really didn't know if there was changes before. […] Then, for me, I had a good friend who […] became very impassioned about the environment."*
6	Skepticism, Ignorance, Derisiveness			Type 1 *		+ Worried + Supportive + Active	*"I don't know if there was necessarily a moment. I think it was just the realization seeing graphs of, 'Yes. See? The temperature is steadily rising.' Or, 'Look at this. The ozone is steadily depleting.' And then also seeing the effects of human behaviors on the ozone layer and the climate in general."*
7	Skepticism, Derisiveness		*	Type 1		- Worried + Supportive - Active	*"Instead of just saying, 'Oh, this is all cyclical and I'm not going to listen to it.' I started to say, 'Well, wait a minute. What are these scientists really talking about' And then that's when I went ahead and I started actually looking for information on my own to see."*
9	Skepticism	*	*	Type 1 *		+ Worried + Supportive - Active	*"It's been a gradual process […] I'm an amateur historian. And in fact, I'm taking classes at [local college] in history and political science. […] the things that I've read from people who have been willing to share their data and observations have kind of made me more convinced."*
10	Skepticism	*		Type 1		+ Worried + Supportive - Active	*"I got very interested in regenerative agriculture […] it kind of became irrefutable to hear people who […] have no ulterior motive in saying, 'Hey, this is a problem.'"*
12	Skepticism	*		Type 1		+ Worried + Supportive - Active	*"My mom listened to things like [conservative talk show host] Rush Limbaugh on the radio. I thought that I was heavily exposed to essentially the narrative of the sciences isn't settled, we don't know for sure yet. And then four years ago, I went to grad school and I started-- and I was in a discipline where I was exposed to a lot of people from atmospheric sciences."*
15	Dismissiveness			Type 1 *	*	+ Worried + Supportive + Active	*"Eventually I went down to the water. […] It was like when they take pictures of a beach with a bunch of stuff washed up on it […] It was odd. And that was I believe also the same year that I had the historical geology class, and he told us about the coal-fired power plants causing acidic rain. And that was a really informative year for me because I was like, 'Wow. These things are really happening, and this is happening on a much larger scale than like a chewing gum wrapper sitting on the sidewalk.'"*

described a gradual realization through observing changing weather patterns around them (Type 2, Table 2).

> "I mean it could be 70 or 80 [degrees]. And then-- the next day I know the temperature then dropped to like 30 and 40" (P8).
> "The seasons- I mean how they've changed so much drastically since I was a kid. I mean we don't really have a spring. We don't really have a fall. Winters are unpredictable […] And so, I think that's one thing that's got me" (P14).

Table 2 (continued)

Partially exhibited pattern of key experiences							
2	Ignorance, Dismissiveness			Type 1*		+ Worried + Supportive + Active	*"I didn't talk to someone or read a book or something that said—it's just kind of like I feel like I can't ignore all the signs and signals anymore, I suppose."*
Gradual realization only							
8	Ignorance			Type 2 *		- Worried - Supportive - Active	*"I mean it could be 70 or 80 [degrees]. And then-- the next day I know the temperature then dropped to like 30 and 40"*
13	Skepticism, Dismissiveness			Type 1 & Type 2 *		- Worried - Supportive - Active	*"People are noticing a difference in the land, the climate, the changes that usually come along seasonally so that, yes, it is happening in the real world."*
14	Dismissiveness			Type 1 & Type 2*		+ Worried - Supportive - Active	*"We go from winter -which I say that now and it's like 77 degrees outside right now- But I feel like we just go almost drastically from winter to summer."*

[1]Initial attitudes and perceptions: Final classifications emerged from line-by-line coding of participants' descriptions of their prior attitudes and perceptions. "Dismissive" emerged from *in vivo* codes of "not a serious problem" and "thought it was already solved." "Ignorance" emerged from codes "not on my radar" and "ignored it." "Skepticism" was the original code, a term used by participants themselves to describe their doubts regarding information on climate change. "Derisiveness" emerged from the *in vivo* code "mocked it" and represents participants who actively rejected and ridiculed climate change information

[2]Gray boxes indicate evidence of the experience in the participant's interview

[3] "Distancing from ideological community" composites of a range of original codes, including experiential codes such as "interactions with others", "professional or educational experience", "coming of age", as well as perception codes indicating participant's discussion of their community, family, religious and/or political identity

[4] "Desire to seek out information" emerged from the original *in vivo* code "seeking out information"

[5] "Gradual realization" and "Epiphanic realization" represent researcher categorization of how participant described solidifying their new opinion. Gradual: (Type 1 = through seeing data and/or absorbing information; Type 2 = through observing changes in weather or natural surroundings); Epiphanic realizations were "wake up calls," or memorable events that solidified the reality, resolved cognitive dissonance, and/or significantly raised the seriousness of the issue for the participant

[6](+) and (–) representparticipants' description of themselves after their opinion change as being (+) or not being (-): (1) "Worried" = based on CCAM questionnaire response, with + indicating "somewhat" or "very" worried and– indicating "not very" or "not at all" worried; (2) "Supportive" = based on "attitudes toward macrolevel solutions", revealing if participant was generally supportive of macrolevel solutions specified in CCAM (e.g., energy policy/regulation, electric car programs, green infrastructure, carbon tax, tax rebates); (3) "Active" = based on presence of codes indicating personal action such as "voting/activism" and "lifestyle changes"

(3) Current views

After recalibrating their identity to accept the existence and/or human cause of climate change, participants landed on a still wide spectrum of opinions and attitudes about the issue. They all, however, shared one aspect of their new self-identity– that they did not consider themselves experts on climate change. In interviews, participants often offered disclaimers about their limited knowledge, humbly recognizing their past opinions as inaccurate and expressing desire to learn more.

> "As you can probably tell, I'm still a little bit on the uncomfortable side discussing it […] I'm happy to have you interview me, but I'm not an expert. I'm just a guy" (P4).
> "I don't know a lot about but wind energy, but I want to learn more about that" (P3).

Yet other than commonly recognizing the limits of their knowledge, participants represented a wide spectrum of beliefs, attitudes, and opinions on the nuances of climate change and its solution. A majority recognized the human impact on the climate and expressed desired to be a part of the solution through voting and activism, limiting their personal carbon footprint, and educating others. However, a few who accepted the existence of climate change remained skeptical about its human cause.

> "Is it because of humans or is it an earthly cycle that we can't really impact? I guess that's where […] I'm kind of questioning" (P4).

According to their Yale Climate Attitudes survey responses, most participants reported being "very worried" ($n=6$) or "somewhat worried" ($n=5$) about the issue. In interviews, many participants described particular concern for future generations, with one explaining how climate change has made her hesitant to have children.

> "I am concerned about having my own children because as uncomfortable as I think it might get in my lifetime […] what kind of quality of life would that child have?" (P12).

This worry often translated into support for macrolevel actions to address climate change. One participant elaborated on his rejection of capitalism system entirely ("It has to cap out because we have finite resources in the world" [P1]). Many others described support for policies like taxing or regulating carbon emissions and investing in clean energy.

A few remained "not very worried" (n=2) or "not at all worried" (n=1). In explaining how switching to solar energy would be prohibitively expensive for her family, one participant explained how climate change was not among the immediate problems her family and community is concerned with.

> "We shouldn't have to stop using what we use [energy sources] because it's not all, to me my family, it's not that great of an issue here […] It's so expensive though if we're going to use the solar. But I don't think that we need to change because I don't think that there's a problem here" (P8).

Another participant described how he worried less about climate change and more about what he considered an overreaching government response.

> "I'm more concerned with government abuse justified through climate change […] don't let it be used to justify a larger government such as federal coming in and gaining control of our state land or even towns and cities" (P13).

4 Discussion

While previous studies have identified factors influencing climate opinion, ours employs grounded theory-guided qualitative methods to explore causal mechanisms of opinion change as a comprehensive process. We present our results as an explanatory framework that first interprets individuals' appraisals of their initial attitudes toward climate change as skeptical, ignorant, dismissive and/or derisive. Individuals may then have a series of experiences that catalyze opinion shifts: distancing from pre-existing ideologies, a desire to seek out credible information, and the eventual solidification of the new belief through gradual and/or epiphanic realization. Our findings also reveal the diversity of resulting opinions and attitudes toward climate change response once individuals incorporate their new beliefs into their worldview.

By elucidating processes through which individuals can change their beliefs about climate change, this study fills a critical gap in climate change public opinion literature. While quantitative analyses have identified characteristics of people most likely to change their mind on climate change, the diversity of our participants' characteristics and self-narratives before changing their opinion is a powerful reminder that people with vastly different backgrounds and ideologies can look identical in their survey responses on fundamental climate change beliefs (Deeg et al. 2019). Further, their attitudes and opinions *after* changing their mind about climate change underscore the multiplicity of ideologies that can develop from a shared core belief. In short, there is still no one-size-fits all messaging approach to garner public support for climate change action, and even individuals who have newly opened their worldview to accept climate change realities can hold diverse and nuanced opinions, attitudes, and beliefs on the issue. They also may or may not subsequently adopt pro-environmental behaviors, highlighting the potential problem of applying behavior change explanations (e.g. "stages-of-change model", Prochaska and Diclemente 1982) to these opinion change narratives.

Despite participants' diverse starting points and complex resulting opinions, we did identify powerful commonalities in the experience of changing their climate change beliefs that communication efforts could leverage. First, most had an experience of distancing from their ideological community, which is worth recognizing and capitalizing on. This finding reflects theoretical and empirical work that demonstrates how an individual's *bonding* within their social network relates to their identity, ideology, and climate change attitudes (McCright et al. 2016; Palm et al. 2017). Consistent with established Value-Belief-Norms and other established theories, our participants' narratives highlighted examples of beliefs influenced by identity and ideological communities (e.g. Anti Reflexivity Thesis, Postmaterialist Values Thesis, Gender Socialization Theory; McCright et al. 2016). Our work additionally offers the concept of "distancing" from an ideological community as a common first step in opinion change. While social network *bonding* (within-network) ties are often used to describe how climate change attitudes are formed and upheld, *bridging* ties (which connect individuals to outside social networks) deserve a closer look as potentially powerful usher of "distancing" experiences that can introduce alternative worldviews (Valente and Pitts 2017). Intentional, interactive, personal communication about climate change could be integrated into established activities that naturally serve as distancing experiences, such as tourism or community gatherings that bring together people from different networks (Nerlich et al. 2010). Future research could also explore the mechanisms and potential ben-

efits of fostering *bridging* relationships within distancing experiences. Research may also explore how distancing experiences and *bridging* may possibly reflect back into network *bonding* ties, gradually reshaping opinions of ideological communities in aggregate.

Further, designers of public messaging should recognize that some individuals who may be persuaded to change their beliefs based on facts will only do so if they are looking for the facts themselves. While some participants described changing their minds as a response to more passive observation, most exhibited a desire to actively seek out information in the midst of the process. This finding provides more context to how motivated reasoning and cognitive dissonance may arise in the experience of climate change opinion shift (Palm et al. 2017; McGrath 2017). Beyond leveraging medium that the population deems credible, efforts to communicate facts on climate change should also integrate accessible links to additional credible information, facilitating the discovery process for those on the path to changing their minds. Lastly, facilitating connection of information with personal experience can help create the gradual or epiphanic realization to affirm one's acceptance of the issue. Media, events, tourism experiences or classes presenting climate change facts and narratives should seek ways to help individuals integrate their newfound knowledge into their personal experiences, encouraging reflection on their evolving worldview.

Our findings support the influential role of interpersonal conversations in catalyzing opinion change on climate realities, extending the advice of climate scientist Katherine Hayhoe: "the most important thing you can do about climate change is talk about it" (Hayhoe 2021). The guidance she has popularized–anchoring conversations on shared values- is backed by the science of persuasive communication (Baek and Falk 2018). Additionally, our research supports the assertion that communicating with science deniers is not a hopeless endeavor, but rather a potentially pivotal event in their opinion change (McIntyre 2021). By breaking down the process of opinion change, our findings provide additional guidance for individuals hoping that they can help usher a change through conversation. First, we should recognize opportunities for effective conversations when someone experiences distance from their ideological community and is potentially open to new information. Our findings also suggest encouraging individuals to follow up with their own research may be more empowering and less polarizing than simply stating facts, and that encouragement for individuals to consider what they find within their own experiences can help to solidify their opinion change. Training on these interpersonal communication strategies may help individuals who are in strategic positions to initiate conversations about climate change but are often hesitant or unsure how to do so (Gómez-Martín et al. 2016).

On a broader scale, our work demonstrates the value of qualitative inquiry to fill outstanding and emerging gaps in climate change opinion scholarship. The past two decades of related research on climate opinion have been characterized by descriptive and experimental statistics that simply identify influential factors. Qualitative research featuring in-depth interviews and/or focus groups are vital in obtaining rich understanding of process and context but have been woefully lacking (Maxwell 2012; Kleinberg and Toomey 2023). Our research contributes to this field by diverging from the preference to identify factors and applies aspects of grounded theory to explore context and processes behind shifting climate change opinions. Our work seeks to demonstrate the value and call for the greater inclusion of constructivist, interpretative methodologies within science seeking to understand the dynamics of climate change opinion (Maxwell 2012; Kleinberg and Toomey 2023). The explanatory framework we produced can serve as a starting point to further develop theory

to understand climate opinion change and could be transformed into a testable hypothesis for future quantitative studies.

Our study is not without limitations. Qualitative inquiry is hypothesis-generating, representative of one of many possible truths, and not inherently designed to be generalizable. We recognize our conclusions may have been different if we had conducted this study in a different geographic and historical context. However, we hope that lessons learned from this study may be transferrable to other settings and continue to hold value over time, particularly in locales approaching a majority acceptance of climate change fundamental beliefs- or a "tipping point" of opinion change similar to Missouri and Kansas at the time of this study. Further, while our sample presented diversity in age, political affiliation, and urban/suburban/rural residence, it overrepresented females and was especially limited in racial/ethnic and educational diversity. Women and highly-education individuals are often more supportive of climate change action, and those that experienced opinion shift may have been more enthusiastic to participate (McCright et al. 2016). While we employed various methods of recruitment, diversifying our recruitment efforts may have resulted in an even more diverse sample, and allowed our resulting explanatory framework to be more inclusive of their voices. However, there will always be individuals who are not willing to discuss their climate change beliefs. Beyond in-depth interviews, future research may work to examine our explanatory framework through other methods. For instance, it is possible to transform the key experiences we have defined into survey items and integrate them into population-based surveys (like CCAM) to better understand their presence or absence across different demographic groups.

Our findings offer a nuanced understanding of how individuals conceptualize and shift opinions on climate change. Climate change communication programs and policies can use these findings to identify and nurture interpersonal communication opportunities, integrate climate change messaging into distancing experiences, and craft messaging that capitalize on commonalities of opinion-changing experiences. Strategic communication should also be tailored to individuals' diverse resulting attitudes and behaviors toward climate change response. We hope our investigation of opinion change inspires further qualitative research that can deepen our understanding of climate change opinions, attitudes and experiences.

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Data availability The datasets generated during and/or analyzed during the current study are not publicly available due to but are available from the corresponding author on reasonable request.

Declarations

Ethics approval The study was approved by the Institutional Review Board at Children's Mercy Kansas City.

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