DISSERTATION

HAZE, HEAT, AND HUMAN BONDS: A MIXED METHODS STUDY OF ATTACHMENT'S INFLUENCE ON RISK INFORMATION BEHAVIOR AMONG OUTDOOR WORKERS FACING AIR QUALITY AND EXTREME HEAT HAZARDS

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In partial fulfillment of the requirements

For the Degree of Doctor of Philosophy

Colorado State University

Fort Collins, Colorado

Summer 2026

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ABSTRACT

HAZE, HEAT, AND HUMAN BONDS: A MIXED METHODS STUDY OF ATTACHMENT'S INFLUENCE ON RISK INFORMATION BEHAVIOR AMONG OUTDOOR WORKERS FACING AIR QUALITY AND EXTREME HEAT HAZARDS

Outdoor workers face disproportionate exposure to compound environmental hazards on the job, yet little is known about the factors that shape how they seek and process relevant risk information. This dissertation investigates these factors by integrating attachment theory into the risk information seeking and processing (RISP) model to examine how attachment anxiety and attachment avoidance influence outdoor workers' risk information seeking behaviors related to extreme heat and poor air quality. Using an explanatory sequential mixed-methods design, the study first employed a national online survey ($N = 220$) of outdoor workers across the United States, followed by focus groups ($N = 29$) with municipal outdoor workers in Fort Collins, Colorado.

Quantitative results from a series of hierarchical regressions and mediation analyses indicated that attachment orientations shaped key RISP model variables, though the strength and significance of these relationships varied by hazard. Specifically, attachment avoidance predicted reduced risk perception, negative affective response, and informational subjective norms in the extreme heat context, while attachment anxiety predicted increased negative affective response and informational subjective norms for extreme heat. Neither attachment anxiety nor attachment avoidance predicted information insufficiency, attitudes toward information seeking, or

perceived information seeking control across either hazard. Core RISP model pathways were broadly supported across both hazard contexts.

Qualitative findings yielded five key themes that expanded on and contextualized the quantitative results. First, workers perceived extreme heat as a more urgent and physically threatening hazard than air quality, which they often normalized or noticed only when symptoms became intolerable. Second, information seeking was shaped by peer behavior, supervisor guidance, and workplace norms; workers higher in attachment anxiety exhibited heightened sensitivity to social cues, while those higher in attachment avoidance tended to minimize risk and emphasize self-sufficiency. Third, workers expressed uncertainty about translating hazard indices, particularly the air quality index, into task-relevant decisions. Fourth, workers preferred task-specific information well in advance of hazard events to better plan protective actions into work schedules. Finally, workers expressed strong support for integrating air quality and heat information into a unified communication system to streamline workplace decision-making.

Integration of the two phases confirmed that extreme heat functions as a more powerful motivational driver than poor air quality across emotional, social, and behavioral pathways, and expands our understanding of how differences in workers' motivational responses to each hazard can be put to work through integrated communication systems that use heat engagement as an entry point for air quality awareness. Overall, these findings make theoretical contributions by demonstrating that attachment orientation functions as a meaningful individual difference variable within the RISP model by influencing risk perception, affective response, and informational subjective norms, particularly for risks perceived as immediate and salient. These findings also challenge traditional distinctions between active and passive information seeking. Practically, the findings call for risk communication strategies that are emotionally and socially attuned, task-relevant, and reconsider vulnerable population message framing. Future research should continue to examine attachment effects on risk information seeking and avoidance across additional hazard contexts and among more diverse populations.

ACKNOWLEDGEMENTS

There are so many people to thank for all that they have done that a full accounting would fill another dissertation. As I thought about how to begin, one saying kept returning to me: “I am a mosaic of everyone I’ve ever loved.” It stayed with me because I think of this dissertation as a mosaic of everyone who’s ever loved and believed in me. Although I can’t name every single person here, if your name is not explicitly listed below, please know that you are still an important part of this mosaic and there is a piece of you in this work.

To my advisor, Dr. Marilee Long: for all that you’ve done to shape me into the person and the scientist that I am today, merely saying “thank you” feels like such an understatement to convey the depth of my gratitude. Thank you for your unwavering support and guidance throughout my graduate school journey. I truly hope I have done you proud.

To my committee members, Dr. Katie Abrams, Dr. Ashley Anderson, Dr. David MacPhee, and Dr. David Most: thank you for your insightful feedback on this work, as well as your mentorship throughout my doctoral journey. Each of you has inspired me to take on challenges with confidence and curiosity for which I am eternally grateful.

To my dissertation research participants: thank you for sharing your experiences and perspectives that shaped this work, and for all you do to keep our communities safe and running. I hope you all are staying safe during this very hot and smoky summer.

To my fiancé Danny: for every “I’m just admiring you” after I would catch you staring at me as I burned up my keyboard writing this dissertation, for every “let’s take a walk,” “let’s get a patio beer,” or “let’s take a trip,” thank you. Without you, I would have absolutely worked myself into the ground. Thank you for celebrating every high, picking me back up after every low, and helping me remember my humanity throughout this process. I can’t wait to spend my life with you.

To my best friend, Dr. Zoey Rosen: If our paths had never crossed, I would not be where I am today. Without you by my side, I would never have had the confidence to start this journey or known where to begin. Thank you for being my best friend and fiercely cheering me on through my best and worst days. I can’t wait for a lifetime of citing each other’s work.

To my dear friend and colleague, Lucy Chalgren: it has been such a privilege to watch you grow on your doctoral journey. Your passion and dedication to accessible science communication continues to fuel mine. Thank you for your help with focus group data collection, and for our hours-long yap sessions and sweet treat runs.

To my brother, Harrison: thank you for your steady support and for taking an interest in my work. Your questions and curiosity along the way reminded me why this research matters beyond the pages of a dissertation. I’m so proud to call you, my brother.

To my parents, Mardee and JR: thank you for steadfastly encouraging me to pursue higher education from an early age and for supporting me on a path that was unfamiliar to all of us. As a first-generation student, I did not always have a map for how the journey would unfold, but I hope this work shows where that encouragement can lead.

To my friends: every call, text, check-in, funny meme, brunch date, celebration dinner, game night, and moment spent together helped keep me going. Thank you for reminding me that there was life outside my dissertation when it felt all-consuming.

This work was supported under assistance agreement no. 84036301-0 awarded by the U.S. Environmental Protection Agency and CDC/NIOSH T42 OH009229 Mountain and Plains Education and Research Center.

DEDICATION

This work is dedicated to a 7-year-old girl with white, blonde hair and dreams of writing and illustrating her own books someday. She wore down every shade of pink crayon she could find authoring her “Polly the Pink Poodle” anthology series. Nearly 25 years later, it doesn’t look quite like you imagined but trust me when I say—you did it, kid.

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CHAPTER 1. INTRODUCTION

1.1.Background and Problem

Extreme heat and poor air quality events are increasing in frequency, duration, and severity across the United States and are expected to continue intensifying as global temperatures rise (Bell et al., 2024; B. Ford et al., 2018). These hazards carry serious public health consequences, ranging from acute illness to chronic disease and mortality. Extreme heat contributes to heat exhaustion and heat stroke, as well as cardiovascular, respiratory, renal, and pregnancy complications (Ebi et al., 2021; J. Liu et al., 2022; Shanmugam et al., 2023; Zhu et al., 2024). Poor air quality elevates risks for respiratory and cardiovascular diseases, neurological conditions, and adverse reproductive outcomes (Behinaein et al., 2023; de Bont et al., 2022; Papadiochou et al., 2024). Both hazards are also linked to adverse mental health outcomes including heightened anxiety, depression, aggression, and suicidality (Meadows et al., 2024; Radua et al., 2024).

Although extreme heat and poor air quality each pose risks, they often occur together (Hu et al., 2025). High temperatures exacerbate ozone and particulate pollution and drive wildfires, which release smoke that further degrades air quality (Moda et al., 2019). Evidence suggests that co-exposure to both hazards is more harmful than the risks posed by either hazard alone (Austin et al., 2021; C. Chen et al., 2024; N. Rosenthal et al., 2022). As these compound hazard events grow more common, public health practitioners must develop and disseminate effective guidance for populations at greatest risk (Coker et al., 2024).

Outdoor workers are one of the most highly exposed and frequently overlooked groups in public health planning and communication efforts (Kiefer et al., 2016). They often perform essential functions in construction, utilities, agriculture, public works, delivery, and other industries (Licker et al., 2022; U.S. Bureau of Labor Statistics, 2024a). Unlike the general public, outdoor workers cannot easily limit time outside during hazardous conditions. Their jobs often involve prolonged, strenuous tasks that heighten vulnerability to heat stress and pollutant intake (Roelofs & Wegman, 2014; Schulte et al., 2016). Heavy breathing during strenuous labor accelerates pollutant intake, allowing fine particles to penetrate into the lungs and bloodstream (Giorgini et al., 2016), while intense exertion in high heat without shade, hydration, or rest increases the likelihood of heat-related illness and cognitive impairment that can lead to workplace injuries (Evoy et al., 2022; NIOSH, 2019).

Despite these risks, there are currently no enforceable federal protections for outdoor workers. The Occupational Safety and Health Administration (OSHA, 2023, 2025) issues advisory campaigns and recommendations but lacks formal standards specifying exposure thresholds or protective actions. Only a handful of states, including California, Oregon, Washington, Colorado, Maryland, and Nevada, have implemented heat protections, and fewer still regulate wildfire smoke exposure (American Industrial Hygiene Association, 2024; Szymendera, 2025). This fragmented policy landscape leaves workers to navigate complex environmental hazards with incomplete and inconsistent information that is often misaligned with workplace realities (Bice et al., 2024). Moreover, it creates ambiguity about the severity of hazards and appropriate protective actions, potentially normalizing exposure to unsafe working conditions.

Addressing the ambiguity created by this fragmented landscape requires more than providing clearer information; it necessitates a deeper understanding of the psychological and relational factors that govern how workers perceive, trust, and act on risk information within the social environment of the workplace. Research in relational risk communication confirms that factors such as trust, credibility, and the quality of relationships with risk communication institutions and other organizational actors can influence people's risk perceptions, information seeking, and behavior (Atwell Seate, 2024; Atwell Seate et al., 2025; B. F. Liu et al., 2022). However, this work often stops short of explaining *why* individuals vary so fundamentally in their capacity to form trusting relationships, regulate their emotions, and seek guidance, especially when faced with a threat.

Attachment theory offers a valuable and empirically grounded framework to address this very question. It posits that early life experiences create durable relational patterns or "attachment orientations," that systematically shape how individuals regulate emotion and interpret social cues throughout their lives (Bowlby, 1969, 1982). These orientations are often characterized along two dimensions: attachment anxiety and attachment avoidance (Mikulincer & Shaver, 2016a). Attachment anxiety reflects an increased sensitivity to potential threats, emotional reactivity, and desire for social approval (Shaver & Mikulincer, 2002). In the workplace, attachment anxiety may lead a worker to be hypervigilant and constantly seek reassurance about safety behaviors. Conversely, attachment avoidance involves dismissing threats, suppressing emotions, and avoiding closeness with others (Hazan & Shaver, 1987). In the workplace, attachment avoidance may lead a worker to dismiss hazard warnings or avoid safety discussions altogether.

These distinct relational tendencies provide a lens for understanding a worker's engagement with risk information. A worker's attachment orientation may therefore predict how they perceive workplace risks, interpret social cues from co-workers and supervisors, and ultimately seek, process, and act on information about environmental hazards. This dissertation investigates these connections by exploring the role of attachment theory in the study of risk information seeking to advance a novel framework for explaining and predicting risk communication outcomes in high-risk occupational settings.

1.2.Study Purpose and Significance

To advance a novel framework, the present study integrates attachment theory with the risk information seeking and processing (RISP) model (Griffin et al., 1999). The RISP model is a widely used framework for explaining how cognitive, affective, and social factors motivate people to seek and process risk information. By integrating these two theories, this dissertation posits that attachment orientations play a key role in fundamentally shaping the cognitive, emotional, and social norm pathways that drive information seeking among outdoor workers facing compound environmental risks on the job. To test this integrated model, this research employs an explanatory sequential mixed-method design, using a national survey of outdoor workers to test hypothesized relationships, followed by focus groups with outdoor workers in Fort Collins, Colorado.

This research makes important theoretical and practical contributions. Theoretically, it offers a novel extension of the RISP model by demonstrating how attachment theory can account for individual variations in risk information engagement. It also provides empirical insight into how this essential workforce actively and passively navigate information about compound hazards, often relying on task relevance as a key motivator. Practically, these findings can inform the development of tailored workplace hazard communication strategies that better reflect workers' experiences, social dynamics, and relational patterns.

1.3.Dissertation Organization

The remainder of this dissertation is organized into eight chapters. Chapter 2 establishes the study's conceptual foundation by reviewing literature on the psychological, social, and relational dimensions of risk, before bridging these dimensions through attachment theory. It also reviews literature on air quality and extreme heat risk information seeking in occupational settings, and RISP model.

Chapter 3 provides an overview of the study by presenting the hypotheses and research questions, outlining the explanatory mixed-methods approach, and describing how this study builds on a larger research project. Chapter 4 reports on the quantitative phase, detailing the national survey methodology and its statistical results, while Chapter 5 presents the qualitative phase, explaining how the survey findings informed the focus group design and thematic analysis.

Following the presentation of results, Chapter 6 integrates the findings from both the quantitative and qualitative phases. Chapter 7 then discusses the broader significance of the research, exploring its theoretical contributions and practical implications for occupational health communication. Finally, Chapter 8 concludes the dissertation by providing an overarching summary of the study, addressing the study's limitations, and identifying directions for future research.

CHAPTER 2. LITERATURE REVIEW

2.1.Psychological, Social, and Relational Dimensions of Risk Among Outdoor Workers

Risk is an inherent part of the human experience, and the concept of risk perception is central to understanding how individuals evaluate and respond to potential threats. Risk perception influences judgments across a range of domains, including changing weather patterns (Latif et al., 2023; van Valkengoed et al., 2024), natural hazards (Cisternas et al., 2024; Odimayomi et al., 2021; Schneiderbauer et al., 2021), and occupational safety and health (OSH) (J. L. Ford & Stephens, 2018; Fung, 2024; Real, 2008).

Risk perceptions are known as assessments regarding the presence or absence of risk, which encompasses (1) an individual's perception of the likelihood that the risk will occur, their susceptibility (i.e., physical vulnerability) and (2) the severity of the risk (Brewer et al., 2007; Deline & Kahlor, 2019; Slovic, 1987). It is important to note that risk perceptions extend beyond probability-based assessments and include a range of factors such as who or what will be impacted (e.g., self, community, environment), institutional trust, risk-benefit tradeoffs, risk immediacy, voluntariness of exposure, and emotional responses (Dickert et al., 2015; Griffin et al., 1999; Slovic, 1987; J. Z. Yang, Rickard, et al., 2014). Many of these factors are influenced by the process of risk communication, which refers to the interactions among individuals, groups, and institutions in determining, analyzing, and managing risk (Cho et al., 2015; National Research Council, 1989).

As an inherently social process, effective risk communication requires recognizing that risk perceptions are not solely determined by individual-level factors, but also by the social context in which a person is situated in (Breakwell, 2010; Douglas & Wildavsky, 1982; Russell & Babrow, 2011). Burke et al. (2009) defined social context as, "the sociocultural forces that shape people's day-to-day experiences and directly or indirectly affect health and behavior" (p. 2). These forces include personal relationships (e.g., family, friends) and institutional influences (e.g., workplaces), both of which shape risk perception and response (Burke et al., 2009; Doekhie et al., 2020). Despite the acknowledged importance of these forces, most risk communication research continues to investigate individual-level factors in isolation, often overlooking their interaction with social and relational dynamics (Jenkins et al., 2024; Perlstein, 2023; Siegrist & Árvai, 2020). This oversight results in an incomplete understanding of risk perception and limits the development of effective risk communication strategies (Y. Li & Howe, 2023).

The social amplification of risk framework (SARF; R. E. Kasperson et al., 1988) offers one lens for organizing these social dimensions. SARF models the flow of risk information using the metaphor of a broadcast system (J. X. Kasperson et al., 2003). It posits that people receive "risk signals" (i.e., messages about a hazard), either through direct experience or from "amplification stations" (R. E. Kasperson et al., 1988; Renn, 1991; Renn et al., 1992). Amplification stations refer to expert (e.g., scientist, healthcare provider) and nonexpert (e.g., family, friends, community groups) sources generating or transmitting risk information that flows through a network of formal (e.g., mass media, social media, websites, campaigns) or informal (e.g., face-to-face conversations) communication channels (J. X. Kasperson & Kasperson, 2005; R. E. Kasperson, 2012; R. E. Kasperson & Kasperson, 1996).

These stations then process and re-transmit information, either amplifying (intensifying) or attenuating (weakening) the original risk signal, which shapes whether a risk becomes a major concern or is downplayed (Fjaeran et al., 2024; Gould & Fjaeran, 2019).

SARF's framework aligns well with existing research on how outdoor workers perceive and engage with environmental hazard information. This line of work suggests that workers rely on direct experience with risk signals from their environment (e.g., the smell of smoke, the feeling of heat) and their own bodies (e.g., difficulty breathing, irritability, excessive sweating) (Bice et al., 2024; Luque et al., 2019; Rosen et al., 2023; Santana et al., 2021; Veloz et al., 2020). In the absence of such cues, they rely on indirect risk signals from a range of amplification stations, including public health authorities, news media, and mobile weather apps (Bice et al., 2024; Veloz et al., 2020). Crucially, this information is then further interpreted, amplified, or attenuated through social interactions with co-workers, supervisors, and peers, which strongly shapes workers' risk perception and protective behaviors (Luque et al., 2019; Rosen et al., 2023; Santana et al., 2021).

Although SARF effectively maps how environmental hazard information is transmitted in workers' social contexts, its utility is primarily descriptive. As Kasperson and colleagues (1988, 2022) have noted, it is an integrated approach, not a predictive theory, and is best used alongside other theories to investigate the underlying social processes that underpin risk perception and response. For instance, SARF can tell us that a supervisor or a co-worker is an amplification station, but it cannot explain the individual-level variations in that process. Specifically, why might one worker trust a supervisor's guidance while another dismisses it? What influences whether a worker will amplify a safety concern among their peers or attenuate it to maintain productivity? Answering these questions requires looking beyond a descriptive framework of social processes and toward a theory that can explain individual differences in relational patterns and information processing under stress.

2.2.Bridging Dimensions of Risk Through Attachment Theory

Attachment theory provides such a framework, offering a robust, empirically grounded explanation for individual differences in relational patterns and information processing under stress (Dykas & Cassidy, 2011; Gillath et al., 2009; Mikulincer, 1997). Originally developed by John Bowlby (1969, 1982), attachment theory explains how early experiences with caregivers shape an individual's responses to threats throughout their lifetime.

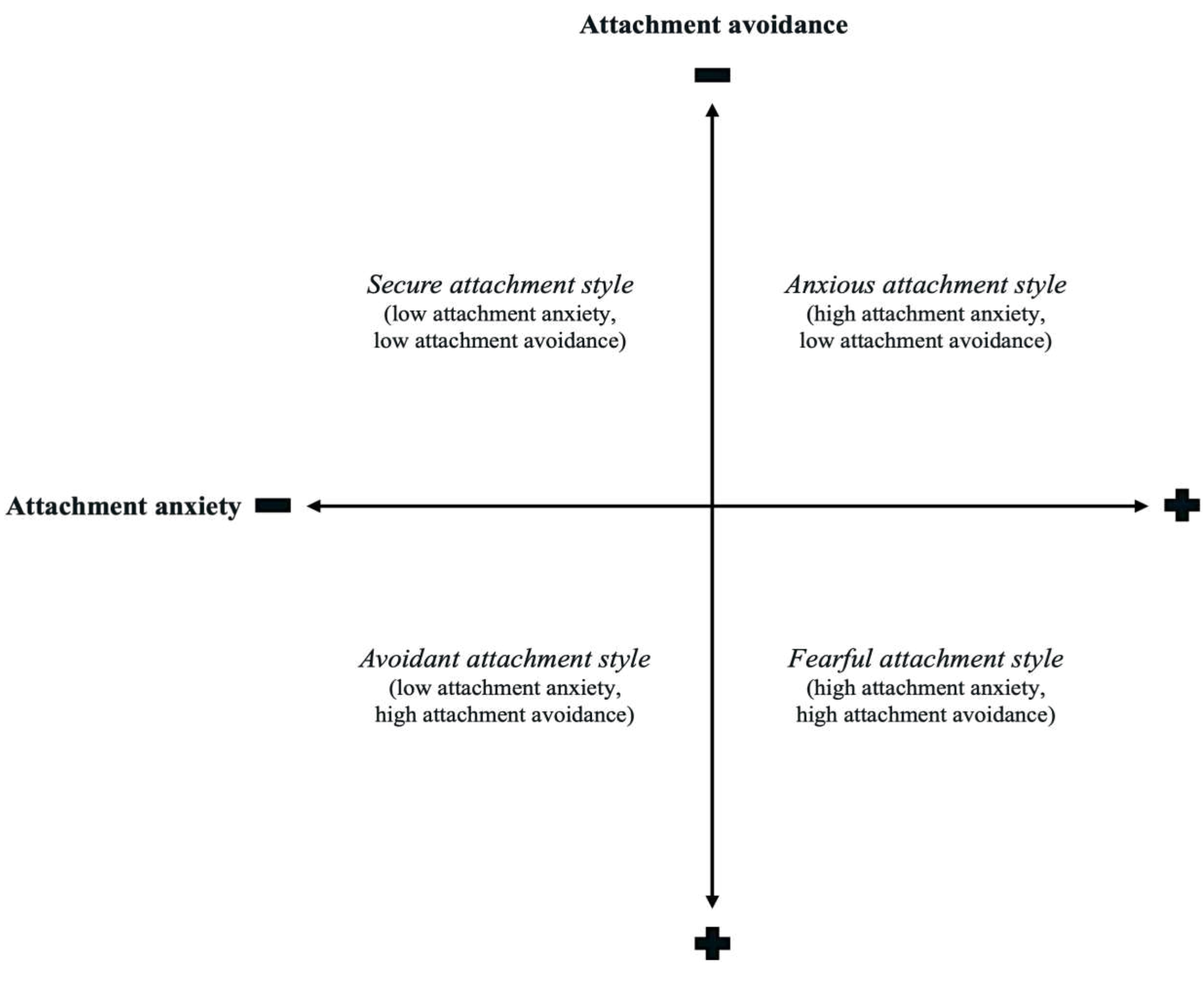
According to Bowlby, humans possess an attachment behavioral system, an innate psychobiological system that motivates them to seek support and protection from caregivers (i.e., attachment figures) when faced with threats. This system aligns with predictions of prevention or promotion theories (e.g., Higgins, 2012), as well as approach and avoidance goals (e.g., Elliott, 2008). In response to threats or stressors, the attachment behavioral system is activated and primarily functions as a prevention system that helps individuals avoid harm by seeking support or protection from others. When support or protection is received and a sense of security is achieved, the attachment behavioral system facilitates approach-oriented behaviors such as social affiliation or exploration (Mikulincer & Shaver, 2016b).

Repeated interactions of seeking support or protection from an attachment figure shape an individual’s internal working models, which refer to mental representations of the self and expectations about others' availability and responsiveness (Bowlby, 1982; Collins et al., 2004; Collins & Feeney, 2004). These models influence cognitive, emotional, and behavioral responses to threats or stress and eventually stabilize into an attachment orientation, defined as an individual’s characteristic pattern of relational experiences, emotions, and behaviors, typically formed in early relationships with parents or caregivers (Fraley & Shaver, 2000; Shaver & Mikulincer, 2009).

Although the theory initially focused on early-life development, Bowlby (1988) emphasized that attachment processes continue to influence thoughts and behaviors throughout the lifespan. In adulthood, an individual's position on two primary dimensions of attachment—anxiety and avoidance—shapes their attachment orientation, which in turn shapes differences in risk perception, coping strategies, and behavior (Brennan et al., 1998). A person's position on the attachment anxiety dimension reflects the extent to which they worry about the availability and support they will receive from an attachment figure, leading to heightened efforts to maintain closeness with them (Mikulincer & Shaver, 2012). In contrast, a person's position on the attachment avoidance dimension reflects their tendency to suppress emotion, strive for self-reliance, and distrust the goodwill of an attachment figure and their capacity to help (Mikulincer & Shaver, 2012). An individual's position on these two dimensions results in one of four attachment styles: secure (low attachment anxiety, low attachment avoidance), anxious (high attachment anxiety, low attachment avoidance), avoidant (low attachment anxiety, high attachment avoidance), or fearful (high attachment anxiety, high attachment avoidance) (Bartholomew & Horowitz, 1991) (see Figure 1).

Figure 1.

Diagram of the Attachment Anxiety and Attachment Avoidance Dimensions That Shape Four Attachment Styles



A person's position on the two-dimensional space defined by attachment anxiety and attachment avoidance reflect their underlying coping strategies for regulating emotional distress (Main, 1990; Mikulincer et al., 2003). High scores on the attachment anxiety dimension are associated with hyperactivating coping strategies, which involve intense efforts to achieve closeness and support, heightened vigilance toward threats, and excessive reassurance-seeking.

These behaviors stem from inconsistent caregiving experiences, reinforcing the belief that intense emotional efforts are the best way to obtain support from others when encountering threats (Mikulincer & Shaver, 2007).

In contrast, high scores on the attachment avoidance dimension are associated with deactivating coping strategies, which involve suppressing emotions, dismissing threats, and avoiding closeness with others to maintain self-reliance (Shaver & Mikulincer, 2002). These behaviors develop in response to unavailable or unresponsive caregivers, fostering the belief that emotional suppression and distancing from others is the best way to manage threats (Mikulincer & Shaver, 2007).

These coping strategies for regulating emotional distress also create distinct attentional biases. Research suggests that individuals with high attachment anxiety have increased attentional focus on negative or threatening stimuli, consistent with hyperactivating coping strategies (Bailey et al., 2012; Dykas & Cassidy, 2011; Ein-Dor et al., 2011; Fraley et al., 2006; Mikulincer et al., 2003). For instance, Bailey et al., (2012) found that people with high attachment anxiety exhibited longer response latencies to threatening words during an emotional Stroop task[1], suggesting they had difficulty disengaging from threat-related information. In contrast, research suggests that attachment avoidance is inversely associated with attention to threat-related words, indicating a tendency to divert attention away from threats and disengage from distressing information (Dewitte et al., 2007; Edelstein & Gillath, 2008; Peng et al., 2024). These attachment-based differences in attention have significant implications for risk

[1] A variation of the classic Stroop task, an emotional Stroop task measures how emotionally salient words interfere with cognitive processing. Participants are asked to name the color of type that emotionally charged words (e.g., death, love, danger) are presented in while ignoring their meaning, with slower response times indicating attentional bias (Bailey et al., 2012; J. M. G. Williams et al., 1996)

information processing as individuals with attachment insecurity[2] (i.e., anxious, avoidant, or fearful-avoidant styles) may be more or less likely to seek risk information, depending on their comfort with emotional arousal and trust in information sources. Thus, attachment-based differences provide critical insights into how individuals assess risks and process information.

Beyond risk information processing, attachment-based differences can emerge in broader patterns of health and organizational behavior (Hazan & Shaver, 1990; Mikulincer & Shaver, 2020; Yip et al., 2018). Regarding health behaviors, research shows that individuals with attachment insecurities tend to engage in fewer health-promoting behaviors and more risk-related behaviors, such as smoking, excessive drinking, and disordered eating (Ahrens et al., 2012; Davis et al., 2014). Moreover, attachment insecurity can interfere with adherence to medical regimens, potentially exacerbating pre-existing conditions and health risks in workplace settings (Ahrens et al., 2012; Davis et al., 2014).

In the workplace, individuals with high attachment anxiety are more likely to experience workplace insecurity, anticipate being undervalued, and hesitate to voice safety concerns (Hazan & Shaver, 1990; Jiang et al., 2019; Lanciano & Zammuner, 2014; Wu et al., 2024). In contrast, those with high levels of attachment avoidance tend to rely on self-directed decision making and engage in minimal communication, which can reduce collaboration and risk-related information sharing (Schusterschitz et al., 2018). These findings underscore the significance of attachment in shaping behaviors that are critical to managing occupational health risks.

Given its profound influence on emotional regulation, attention to threats, and communication, integrating attachment theory into risk communication research offers a novel and comprehensive perspective. Prior research often examines cognitive, affective, and social

[2] Attachment insecurity refers to higher scores on the attachment anxiety and/or attachment avoidance dimensions otherwise known as anxious, avoidant, or fearful attachment styles.

factors in isolation from one another. Attachment theory, however, provides a more parsimonious explanation that integrates these dimensions. It explains how enduring relational patterns, which are shaped by social experiences, drive individual differences in cognitive risk assessments, emotional regulation, and trust in information sources. It therefore provides a critical lens for understanding why one worker might actively seek risk information while another disengages, ultimately enabling a more effective approach to risk communication.

2.3.Air Quality and Extreme Heat Risk Information Seeking in Occupational Settings

The process of actively seeking information hazard, known as risk information seeking, is a key precursor to adopting health-protective and safety-related behaviors (Anderson et al., 2026; Eastin et al., 2015; J. L. Ford & Stephens, 2018). This process is often triggered by increased attention to threats, which amplifies risk perceptions and motivates individuals to become more receptive to seeking new information about a risk topic (Perlstein, 2023). Understanding these dynamics is especially critical in high-risk occupational settings, where outdoor workers must navigate multiple complex health and safety risks.

To understand these dynamics, it is helpful to turn to established models of information seeking. This behavior, as defined by Johnson (2003), is the “purposive acquisition of information from selected information carriers” (p. 737), has been a central focus health and environmental communication research (Kahlor, Yang, et al., 2020). Several theoretical models explain this process (see Appendix A for a review), and they consistently identify three key motivators: (1) cognitive assessments of risk, (2) emotional responses to risk, and (3) social pressures to seek information (Kahlor, Yang, et al., 2020; Slovic, 1987; J. Z. Yang, Aloe, et al., 2014). In workplace settings, these motivators are further shaped by job roles, workplace policies, and the availability of risk information, which significantly influence whether workers recognize a need for information and feel empowered to seek it (Real, 2008).

Despite the importance of risk information availability, many employers lack administrative controls[3] to ensure that workers receive timely, relevant risk information about performing work safely when faced with environmental hazards (Bice et al., 2024; Grandi et al., 2023; Pedersen et al., 2021). This problem is further exacerbated by the fact that have adopted safety standards for outdoor work during extreme heat or poor air quality conditions; instead most states rely on the General Duty Clause of the Occupational Health and Safety Act of 1970[4] (Bice et al., 2024; Parker et al., 2023).

At the national level, the Occupational Safety and Health Administration (OSHA) relies on advisory efforts rather than formal standards. For heat, OSHA continues to promote its occupational heat illness prevention campaign, which provides general recommendations but does not specify when protective actions should be implemented based on exposure thresholds or task intensity (e.g., heat index cutoffs for mandatory breaks) before the onset of heat illness symptoms (OSHA, 2025; Szymendera, 2025). For poor air quality, OSHA encourages voluntary employer and worker actions during active fire events without addressing other pollution sources, such as ozone or nonwildfire particulate matter, or specifying protective measures at defined air quality index (AQI) thresholds (Bice et al., 2024; OSHA, 2023).

Even where campaigns and policies exist, they remain fragmented and do not provide integrated guidance for employers or workers when these compound hazards occur, despite the

[3] In the field of occupational health and safety, "controls" refer to measures devised to remove or reduce hazards or hazardous exposures (e.g., water, sunglasses, cool zones, prohibiting outdoor work in high temperatures) (Pedersen et al., 2021; Rother et al., 2020).

[4] The General Duty Clause requires that all employers provide a work environment that is "free from recognized hazards that are causing or are likely to cause death or serious physical harm" (Occupational Health and Safety Act, 1970, § 5).

well-documented overlap between extreme heat and poor air quality in many regions of the United States (Evoy et al., 2022; Hu et al., 2025; Kalashnikov et al., 2022). As a result, outdoor workers are left to navigate complex heat and air quality risks with incomplete or inconsistent information. This leaves many workers relying on fragmented updates from state agencies or publicly available sources (e.g., mobile weather applications, news reports) with only broad guidance (e.g., move indoors) that is frequently impractical advice for outdoor workers (Bice et al., 2024).

The fragmented policy landscape and inconsistent guidance often place the primary responsibility of disseminating risk information to outdoor workers directly on the employer or supervisors. This reality means their motivation to seek and act on safety information is driven less by clear institutional directives and more by a complex interplay of individual and social factors. Therefore, an appropriate theoretical framework must be comprehensive enough to account for these dynamics, incorporating cognitive factors (i.e., risk perception), affective factors (i.e., emotional responses), and social factors (e.g., workplace norms).

The risk information seeking and processing (RISP) model is uniquely suited for this task. Unlike simpler frameworks, the RISP model explicitly integrates these key components through concepts such as risk perception, affective response, informational subjective norms (a measure of social pressure), and perceived information gathering capacity. Furthermore, because the RISP model is designed to explain individual-level variations in these processes, it provides the ideal theoretical structure for integrating attachment theory and investigating how enduring relational patterns influence these critical workplace risk information behaviors.

2.4. Risk Information Seeking and Processing Model

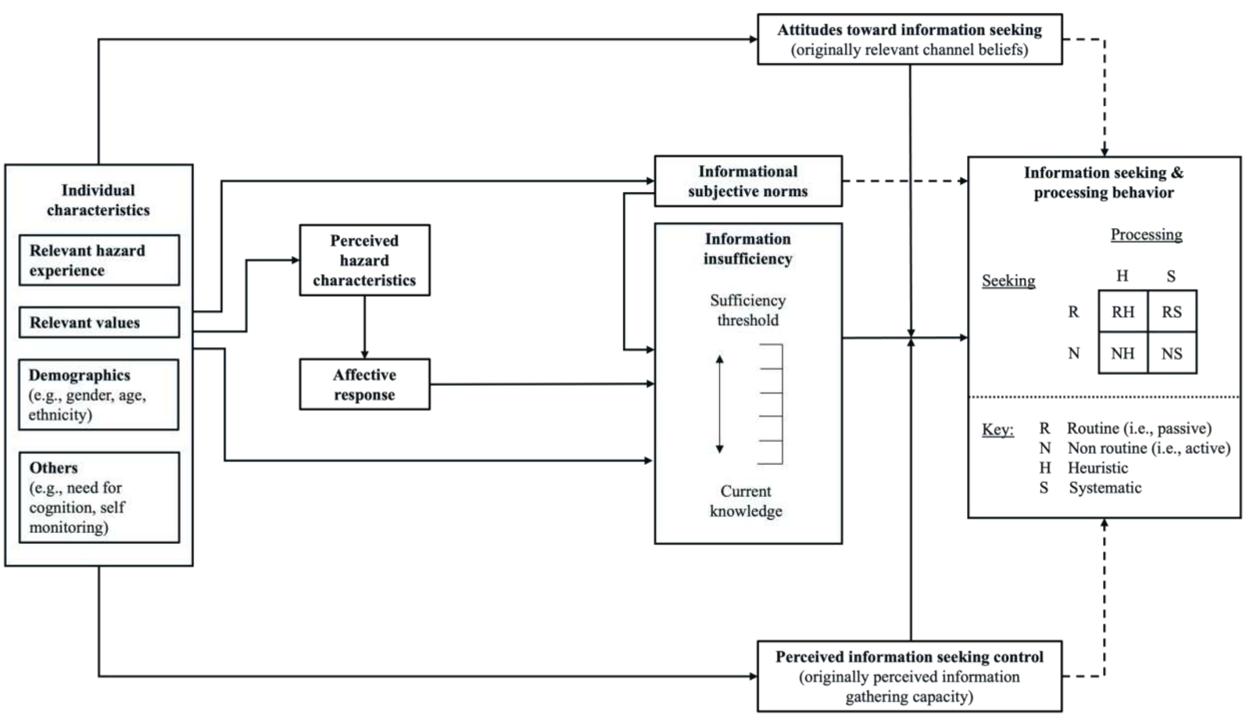
The risk information seeking and processing (RISP) model (Griffin et al., 1999) offers a comprehensive framework for understanding the aforementioned dynamics and exploring how attachment might influence outdoor workers' risk information seeking and engagement with safety resources. The RISP model integrates concepts from multiple communication theories, including the heuristic-systematic model (HSM; Eagly & Chaiken, 1993), the theory of planned behavior (TPB; Ajzen, 1991), and the extended parallel process model (EPPM; Witte, 1992). Additionally, it influenced subsequent frameworks, such as the planned risk information seeking model (PRISM; Kahlor, 2010), which expands upon the RISP model by treating information seeking as a planned behavior.

In the 25 years since its introduction, the RISP model has demonstrated its utility in explaining risk information seeking behaviors related to a variety of topics such as air pollution (e.g., H. K. Kim & Kim, 2019; Rose et al., 2017; J. Z. Yang & Huang, 2019), water quality (e.g., Ahn & Noh, 2020; Hmielowski et al., 2019), per- and polyfluoroalkyl substance (PFAS) contamination (e.g., Dong & Yang, 2023b), flooding (e.g., Griffin et al., 2008), bovine tuberculosis (e.g., Cross et al., 2018), Zika (e.g., Hubner & Hovick, 2020), influenza (e.g., Clarke & McComas, 2012; J. Z. Yang, 2012), and COVID-19 (e.g., J. L. Ford et al., 2023; Zhou et al., 2023). Additionally, the RISP model has offered a valuable framework for evaluating tailored risk communication materials. For instance, Clair et al. (2021) utilized this framework to understand how recreationists use information from avalanche bulletins to make travel decisions. Similarly, Anderson et al. (2026) applied this framework to evaluate how a communication campaign influenced air quality information seeking among outdoor workers.

The RISP model identifies seven key variables that influence risk information seeking and processing: (1) individual characteristics, (2) perceived hazard characteristics, (3) affective response, (4) information insufficiency, (5) informational subjective norms, (6) relevant channel beliefs and (7) perceived information gathering capacity (see Figure 2). According to the RISP model, these factors and the relationships among them determine the time and effort an individual devotes to searching for and evaluating risk information (Griffin et al., 1999; J. Z. Yang, Aloe, et al., 2014). Prior to an in-depth discussion of these concepts and their interrelationships, it is important to start with their definitions.

Figure 2.

Overview of the Risk Information Seeking and Processing (RISP) Model Concepts and Relationships



Note. This figure is adapted from Dunwoody and Griffin (2015) and Ford et al. (2023). The dashed paths are not a part of the original RISP model but have been tested in other empirical applications of RISP.

Starting on the left side of the model, individual characteristics are factors that play a crucial role in explaining differences in people's psychological perceptions of risk and their need for risk-related information (Griffin et al., 1999). Perceived hazard characteristics encompass an individual's multifaceted cognitive assessment of a risk, and affective response refers to the emotions evoked by the risk (Griffin et al., 1999; Slovic et al., 2004; J. Z. Yang & Kahlor, 2013). Information sufficiency refers to an individual's belief that they possess the information necessary to cope with a risk, while information insufficiency is an individual's belief that they lack sufficient knowledge to handle the risk (Griffin et al., 1999, 2013). Informational subjective norms are an individual's beliefs about the extent to which others who are important to them think that they should know about a risk (Griffin et al., 1999; Kahlor, 2007). Relevant channel beliefs involve an individual's perceptions regarding the trustworthiness and usefulness of information channels that distribute risk information (Griffin et al., 1999, 2013). Finally, perceived information gathering capacity refers to an individual's assessment of their ability to seek and process risk information to achieve their desired outcomes (Griffin et al., 2013).

The two primary outcomes of the RISP model are information seeking and processing behaviors. Information seeking refers to the effort that individuals devote to gathering information through various channels, both mediated and interpersonal. It is categorized into active (nonroutine) and passive (routine) information seeking (Griffin et al., 1999). Active information seeking involves efforts to seek information from sources that are not routinely encountered, whereas passive information seeking involves routine exposure to risk information based on media habits (Griffin et al., 1999, 2013). A key distinction between active (nonroutine) and passive (routine) information seeking lies in their goals. Active information seeking is driven by a specific objective, whereas passive information seeking is more ritualistic and follows a predetermined pattern (Kahlor et al., 2006).

The second outcome of the RISP model is information processing, which encompasses the cognitive processes involved in selecting, encoding, and storing risk information in an individual's memory (Griffin et al., 2013). Information processing is further divided into two categories: heuristic and systematic. Heuristic processing relies on cognitive shortcuts or "heuristics" to simplify information processing and reduce cognitive demands on the individual (S. Chen & Chaiken, 1999; Griffin et al., 1999). In contrast, systematic processing requires both cognitive ability and motivation to process information in a more analytical manner, placing more cognitive demands on the individual (S. Chen & Chaiken, 1999; Griffin et al., 1999). All RISP model definitions are summarized in Table 1 below.

Table 1. Glossary of RISP Model Concept Definitions

Concept	Definition
Individual characteristics	Individual-level factors that explain differences in people's psychological perceptions of risk and their need for risk-related information.
Perceived hazard characteristics	An individual's multifaceted cognitive assessment of a risk.
Affective response	The emotions experienced in response to a risk.
Informational subjective norms	The extent to which an individual believes that others who are important to them think that they should know or be informed about a risk.
Information insufficiency	An individual's confidence in the knowledge that they have about a risk to be able to adequately cope with it.
Relevant channel beliefs	Beliefs about channels of information, including their trustworthiness and usefulness.

Concept	Definition
Perceived information gathering capacity	An individual's perception of their ability to engage in the necessary steps of seeking and processing risk information to achieve the outcome that they desire.
Information seeking	The effort devoted to gathering information through a variety of mediated and interpersonal channels.
Active information seeking	Effortful information seeking from sources that may not be routinely encountered.
Passive information seeking	Routine exposure to risk information based on media use habits.
Information processing	The cognitive processes involved in the selection, encoding, and storage of risk-related information in an individual's memory.
Heuristic information processing	A type of information processing that relies on cognitive shortcuts or "heuristics" and places fewer cognitive demands on the individual.
Systematic information processing	A type of information processing that requires cognitive ability and motivation to analytically evaluate information and places more cognitive demands on the individual.

The following subsections provide more detailed descriptions of these concepts, including their theoretical origins, how they function within the model, and empirical evidence supporting the relationships between them.

2.4.1. Individual Characteristics

Positioned at the beginning of the RISP model, individual characteristics help explain differences in people's psychological perceptions of risk and their need for risk-related information (Griffin et al., 1999, 2013). These characteristics include, but are not limited to, demographic factors (e.g., age, gender, ethnicity, education), past experience with a hazard (i.e., relevant hazard experience), and relevant values or beliefs (Griffin et al., 1999, 2004). Relevant hazard experience serves as a referent criterion that guides individuals' decisions and behaviors regarding risk information seeking (Griffin et al., 2004). Although the RISP model primarily defines this as direct, personal experience with a hazard, other scholars have proposed expanding this definition to include indirect, vicarious risk experiences gained through media exposure and interpersonal sources (Lim et al., 2024; S. Rosenthal, 2022). Media exposure and interpersonal sources can provide indirect yet impactful exposure to environmental hazards beyond individuals' direct perception, thus influencing risk beliefs and shaping information seeking behavior (Ho et al., 2014; Lim et al., 2024; S. Rosenthal, 2022).

Beyond hazard experience, Griffin et al. (2013) called for further exploration of individual characteristics in the RISP model, including need for cognition and self-monitoring, as well as additional motivations for information seeking, such as impression and defense motivation. Since then, scholars have answered this call by exploring individual differences in environmental attitudes and beliefs (J. Z. Yang, Kahlor, et al., 2014; J. Z. Yang & Zhuang, 2020), cultural values (Hmielowski et al., 2018; H. K. Kim & Kim, 2019), and personality traits delineated in the Big Five model[5] (S.-C. S. Li et al., 2024). These studies demonstrate the variety of individual characteristics that can be studied within the RISP model and expand our understanding of individual differences in risk information seeking behaviors. However, it is worth noting that experiences, values, beliefs, and personality traits can fluctuate over time and across contexts (Chopik & Kitayama, 2018; Kendal & Raymond, 2019; Kyle et al., 2024; Sosnowska et al., 2021; Stepanova, 2022). The fluctuation of these factors as individual characteristics highlights a gap in RISP research on more stable individual characteristics, such

[5] The Big Five model is widely used to explain individual variations in personality and comprises five comprehensive dimensions of human personality which include extraversion, agreeableness, conscientiousness, neuroticism, and openness to experience (McCrae & John, 1992).

as attachment, that are deeply engrained and influence how individuals appraise threats, seek support, and process information across various contexts.

The RISP model posits that individual characteristics shape five key factors: perceived hazard characteristics, information insufficiency, informational subjective norms, relevant channel beliefs, and perceived information gathering capacity (Griffin et al., 1999, 2013). While many studies have consistently validated the influence of individual characteristics on the first three factors, their effect on relevant channel beliefs and perceived information gathering capacity have received less attention.

Furthermore, RISP research varies in its definition of "individual characteristics." Some studies emphasize demographic factors as predictors of these relationships (e.g., Griffin et al., 2004; Kahlor & Rosenthal, 2009; Noh et al., 2016), while others have focused on experiential or cognitive traits such as personal values or past hazard experience (e.g., Griffin et al., 2004; Kahlor & Rosenthal, 2009; Noh et al., 2016). This variation makes it challenging to determine which individual characteristics are the most reliable predictors of risk information seeking. The following sections, however, will provide an overview of how individual characteristics function as antecedents to perceived hazard characteristics, information insufficiency, and informational subjective norms and summarize the existing evidence testing these relationships.

2.4.1.1. Individual Characteristics and Perceived Hazard Characteristics

The RISP model predicts that individual characteristics will influence individual perceptions of risk (i.e., perceived hazard characteristics) (Griffin et al., 1999, 2013). For instance, regarding demographic factors, research suggests that women, people with a college education, those living in the Midwest or southern United States, and those with pre-existing health conditions (e.g., asthma or COPD) are more likely to perceive environmental hazards as a greater threat to their health than people from other parts of the United States (Parikh et al., 2022; Shin et al., 2019). Additionally, based on prior research (e.g., Griffin et al., 1998; E. J. Johnson & Tversky, 1983), Griffin et al. (1999) argued that individuals with relevant hazard experience will be more likely to have higher perceptions of the risks associated with a hazard compared to those who have not. Indeed, studies have documented this relationship for flooding (e.g., Griffin et al., 2008; Stephens et al., 2023), poor water quality (e.g., Griffin et al., 2004; Griffin & Dunwoody, 2000), hurricanes (e.g., J. Z. Yang & Zhuang, 2020), and coastal erosion (e.g., J. Huang & Ells, 2021). Relevant values or beliefs are another type of individual characteristic that may cause an individual to have increased or decreased perceptions of a particular risk. For instance, Yang and Zhuang (2020) found that those who believed the science on climate change reported greater risk perception about hurricanes. In another interesting example, Kim and Kim (2019) found that participants who scored high on egalitarianism perceived greater risks from particulate air pollution compared to participants who held individualistic or hierarchical world views.

2.4.1.2. Individual Characteristics and Information Insufficiency

The RISP model proposes that individual characteristics will directly predict how much information an individual perceives that they need about a particular topic (Griffin et al., 1999, 2013). Indeed, evidence suggests that women, racial minorities, and younger people are more likely to report a greater need for risk-related information compared to their counterparts (Griffin et al., 2004; Rose et al., 2017). Additionally, Kahlor and Rosenthal (2009) found that participants with high levels of education were more likely to perceive their current knowledge as being sufficient to adequately cope with the risks associated with climate change. These studies offer some insight into this relationship; however, many RISP studies do not test this relation.

2.4.1.3. Individual Characteristics and Informational Subjective Norms

The RISP model specifies individual characteristics as a direct antecedent of the social pressure that one may experience to stay informed about a particular risk (Griffin et al., 1999, 2013). According to the RISP model, one's positioning within their social environment may predict the social pressure they feel to be knowledgeable about a particular risk. Indeed, studies have documented this relationship. For instance, research suggests that women, minorities, and those with lower incomes are more likely to perceive social pressure to be informed about risk-related topics (Griffin et al., 2004). Additionally, in Kim and Kim's (2019) study on particulate air pollution, they found that egalitarianism as an individual characteristic emerged as a significant predictor of informational subjective norms.

2.4.2. From Perceived Hazard Characteristics to Risk Perception

In the RISP model, individual characteristics are predicted to influence perceived hazard characteristics, which represent the cognitive evaluation of a risk (J. Z. Yang & Kahlor, 2013). These cognitive evaluations, in turn, shape a person's affective (or emotional) responses. Consistent with broader risk perception literature (e.g., Rosenstock, 1974; Slovic, 1987; Witte, 1994), the RISP model theorizes that this combination of cognitive and affective response increases an individual's need for information (Griffin et al., 1999).

Griffin and colleagues (1999) argued that perceived hazard characteristics consisted of a combination of perceived susceptibility, perceived severity, institutional trust, and personal control. Perceived susceptibility is an individual's estimate of the likelihood of harm to self or others and perceived severity is their estimate of the potential seriousness of that harm (Griffin et al., 2008, 2013). Institutional trust refers to a person's trust in various entities, such as their employer, government agencies, or scientific institutions, to manage risk and protect the public from the harm (Griffin et al., 2004). Personal control is one's perceived control over their ability to prevent personal harm (Griffin et al., 2004). Initially, perceived hazard characteristics represented a combination of these four factors. However, most modern RISP studies conceptualize it more narrowly as risk perception, which is the product of only perceived susceptibility and perceived severity, often omitting institutional trust and personal control (Brinker et al., 2020; J. Z. Yang, Aloe, et al., 2014; J. Z. Yang & Kahlor, 2013). Following this tradition, the present study conceptualizes perceived hazard characteristics as risk perception.

2.4.3. Affective Response

According to the RISP model, risk perception is a direct predictor of affective response, which are the emotions that an individual experiences based on their perception of the risk (Griffin et al., 1999, 2013). In essence, because risks are often negative events that may cause injury or illness, an individual's perception of their susceptibility to and the severity of a risk often provoke a negative affective response such as worry, anxiety, fear, or anger (Hmielowski et al., 2019; J. Z. Yang, 2012; J. Z. Yang, Aloe, et al., 2014; J. Z. Yang & Kahlor, 2013). Indeed, several studies have documented a direct relationship between perceived hazard characteristics and negative affective response with evidence of individuals' emotional responses (e.g., sadness, anger, disgust, and fear) in response to a variety of health and environmental risks (e.g., Griffin et al., 2004; 2008; Kahlor, 2007; Rose et al., 2017; Yang & Huang, 2019; Yang & Kahlor, 2013). The RISP model proposes that the emotions that an individual experiences after cognitively assessing the risk causes them to evaluate if they have sufficient information to cope with the risk, otherwise known as information insufficiency (Griffin et al., 1999, 2013).

2.4.4. Information Insufficiency

Centrally positioned in the RISP model, Griffin and colleagues (1999) identified information insufficiency as a key motivator of information seeking and processing. The concept of information insufficiency is inspired by the sufficiency principle from the heuristic-systematic model (HSM; Chaiken et al., 1989). This principle posits that individuals seek a level of "sufficient understanding" to believe they can confidently cope with a given risk (Eagly & Chaiken, 1993). Based on the sufficiency principle, the RISP model theorizes that people will be motivated to seek information until they reach their sufficiency threshold (Kahlor et al., 2003). The sufficiency threshold is defined as the amount of information an individual perceives they need to be confident in their knowledge about a risk topic (Griffin et al., 2008). Accordingly, an individual achieves information sufficiency when they think that their sufficiency threshold has been met. Likewise, an individual experiences information insufficiency when they perceive a gap between their sufficiency threshold and their current knowledge. Current knowledge refers to the amount of information that an individual perceives they already have about a risk (Griffin et al., 1999). It should be noted that current knowledge is not an objective measure of how much the individual actually knows, but how informed they believe they are.

The RISP model assumes that the greater the gap an individual perceives between their current knowledge and their sufficiency threshold, the more likely they will be to seek risk information (Griffin et al., 1999, 2004). Specifically, it postulates that people who perceive a large gap between their current knowledge and their sufficiency threshold will be motivated to engage in nonroutine information seeking and systematic information processing behaviors. However, those who are satisfied with their current knowledge are predicted to engage in routine information seeking and heuristic information processing behaviors (Griffin et al., 1999, 2004).

RISP model studies have supported this prediction in studies about air pollution (e.g., H. K. Kim & Kim, 2019; J. Z. Yang & Huang, 2019), smoke emissions (e.g., Rose et al., 2017), per- and polyfluoroalkyl substance (PFAS) contamination (e.g., Dong & Yang, 2023a), and flooding (e.g., Griffin et al., 2008).

2.4.5. Informational Subjective Norms

Positioned as another direct antecedent of information insufficiency is informational subjective norms. This concept is adapted from the theory of planned behavior's (TPB; Ajzen, 1991) concept of subjective norms. Subjective norms have two dimensions: injunctive norms and descriptive norms (Ajzen, 1991; Rimal & Real, 2003). Injunctive norms refer to perceptions about whether important others approve or disapprove of a given behavior, and descriptive norms refer to perceptions of whether important others are performing the behavior (Ajzen, 1991, 2005; Cialdini et al., 1990). The RISP model predicts that when important others in an individual's social network know about a risk, that individual will be motivated to achieve information sufficiency (Griffin et al., 1999, 2013). In this pursuit, individuals may seek more information so they can compare their own skills and knowledge with others to obtain social approval (Gutteling & de Vries, 2017; Neuwirth & Frederick, 2004).

In Griffin and colleagues' (1999) original model, informational subjective norms indirectly predicted information seeking through information insufficiency. However, Griffin et al. (2013) later amended the model such that informational subjective norms are also a direct predictor of information seeking and processing behaviors. Since then, several studies have documented the role of informational subjective norms as a direct predictor of information seeking and an indirect predictor through information insufficiency (e.g., Ahn & Kahlor, 2020; J. L. Ford et al., 2023; Griffin et al., 2008; Kahlor, 2007; J. Z. Yang, Rickard, et al., 2014).

2.4.6. From Relevant Channel Beliefs to Attitudes

In its original formulation, the RISP model included relevant channel beliefs as a key variable, defined as people's beliefs about an information channel's usefulness and potential for distortion (Griffin et al., 2004, 2008). This concept was rooted in the mass media environment of the late 20th century, where channels like television and newspapers were dominant (Griffin et al., 1999; Kosicki & McLeod, 1990). The model posited that even if motivated, a person would not seek information from a channel they believed to be biased or unhelpful. However, as the information landscape has evolved, information seeking is much more likely to involve multiple channels. Consequently, empirical support for the role of relevant channel beliefs has been consistently weak (e.g., Clarke & McComas, 2012; Griffin et al., 2008; Z. J. Yang et al., 2010), largely because the concept struggled to account for the diverse channels people now use (J. Z. Yang & Kahlor, 2013).

Recognizing these limitations, Kahlor (2007, 2010) proposed a crucial update to the model by replacing relevant channel beliefs with attitudes toward information seeking. Drawing from the theory of planned behavior (Ajzen, 1991), this concept refers to an individual's positive or negative evaluation of the *act* of seeking risk information itself. The primary advantage of this approach is that it is channel-agnostic. It suggests that individuals who perceive information seeking as a worthwhile activity are more likely to engage in it, regardless of whether the source is a website, a social media post, or a news broadcast. This reconceptualization enhances the model’s utility and predictive power in the modern information environment (J. Z. Yang, Kahlor, et al., 2014; J. Z. Yang & Huang, 2019)

This revised approach has been widely adopted and validated. Numerous studies have demonstrated a strong, positive relationship between people’s attitude toward seeking and their actual information seeking and processing behaviors (J. L. Ford et al., 2023; J. L. Ford & Stephens, 2018; Ho et al., 2014; Hovick et al., 2014; H. K. Kim & Kim, 2019; J. Z. Yang & Huang, 2019; J. Z. Yang & Kahlor, 2013). These findings confirm that individuals with more positive attitudes are more likely to both seek out information and process it systematically. Given this robust empirical support, the present study will also replace relevant channel beliefs with attitudes toward information seeking.

2.4.7. From Perceived Information Gathering Capacity to Seeking Control

The RISP model initially included perceived information gathering capacity as another moderating variable situated between individual characteristics and information insufficiency. Perceived information gathering capacity is an individual's belief in their ability to locate and understand risk information (Griffin et al., 2008; Gutteling & de Vries, 2017). Griffin and colleagues (1999) explained that this concept combines both an individual's perceived ability (i.e., self-efficacy; Bandura, 1982) and their actual cognitive resources capacity (i.e., capacity; Eagly & Chaiken, 1993). Griffin et al. (1999) argue that perceived efficacy and capacity are particularly important for promoting behavioral outcomes that require more cognitive effort to seek and process information. Based on this argument, the RISP model posits that even if individuals are motivated to achieve information sufficiency, their perceptions of the ease of accessing and of their capacity to understand the information will influence their information seeking and processing behavior (Dunwoody & Griffin, 2015; J. Z. Yang & Liu, 2021).

Studies testing this relationship have yielded inconsistent results. Some studies found that more favorable perceptions of perceived information gathering capacity predicted more active information seeking and processing (e.g., Dong & Yang, 2023a; Griffin et al., 2004, 2008; Kahlor & Rosenthal, 2009; J. Z. Yang et al., 2022). Conversely, other studies did not find evidence supporting this relation (e.g., J. L. Ford et al., 2023; Hubner & Hovick, 2020; Kahlor, 2007; J. Z. Yang et al., 2011). Yang and Kahlor (2013) suggested that this inconsistency may stem from perceived information gathering capacity being conceptualized primarily as an internal process, placing responsibility solely on the individual to understand and access risk information, without acknowledging that structural factors may influence the individual's sense of control over the information seeking process. For instance, a worker might know how to access and understand information about these hazards; however, the demands of their job might prevent them from seeking that information when conditions deteriorate.

To better account for both internal and external factors that influence a person's control over information seeking, Kahlor (2007, 2010) proposed reconceptualizing "perceived information gathering capacity" as "perceived information seeking control." Drawing from the theory of planned behavior (TPB; Ajzen, 1991), Kahlor (2010) defined this reconceptualization as an individual's belief about their control over the information seeking process, which comprises both internal factors (e.g., cognitive resources, ability to understand) and external factors (e.g., lack of access to objects needed to facilitate the behavior).

According to Kahlor (2010), perceived information seeking control operates in the same way that perceived information gathering capacity operates. Essentially, even if people are motivated to achieve information sufficiency, they are more likely to seek and process information if they perceive themselves to have control over the information seeking process. Several studies have provided evidence supporting this reconceptualization (e.g., Eastin et al., 2015; J. L. Ford & Stephens, 2018; Kahlor et al., 2019; H. K. Kim & Lai, 2020). Based on these empirical findings, the present study will adopt perceived information seeking control instead of perceived information gathering capacity.

2.5.Chapter Summary

This chapter established the theoretical foundation for the present study by exploring the psychological, social, and relational dimensions of risk for outdoor workers. It began by arguing that risk perception is not solely an individual calculation but is deeply shaped by social contexts. The social amplification of risk framework (SARF) was introduced as a model for describing how risk information is transmitted and shaped by social sources, such as co-workers, peers, and supervisors. However, the chapter identified a key limitation of SARF: While it describes the flow of risk information, it cannot explain the individual-level variations in how workers trust, interpret, and act on that information. To address this limitation, the chapter introduced attachment theory as a robust framework for explaining enduring, individual differences in threat appraisal, emotional regulation, and relational patterns under stress. It outlined how distinct attachment styles (e.g., secure, anxious, avoidant, fearful avoidant) lead to different coping strategies and attentional biases, which have significant implications for health and safety behaviors in the workplace.

Finally, the chapter situated these theoretical concepts within the specific context of air quality and extreme heat risks, noting that a fragmented policy and communication landscape places the burden of risk management on workers themselves. The risk information seeking and processing (RISP) model was presented as the ideal operational framework because it integrates the key cognitive, affective, and social factors that drive information seeking. The review of RISP literature highlighted a novel contribution for the present study: while prior research has examined fluctuating individual characteristics, the role of a stable, deeply ingrained trait such as attachment has been overlooked. By integrating attachment theory as a key "individual characteristic," this study can test how these fundamental relational patterns influence the broader processes of risk information seeking.

Having established the theoretical rationale, identified a significant gap in the literature, and selected a comprehensive framework, the next chapter will translate this conceptual foundation into a formal research design. It will present the specific hypotheses and research questions that will guide the investigation into how attachment influences outdoor workers' risk information seeking and processing behaviors.

CHAPTER 3. THE PRESENT STUDY

The risk information seeking and processing (RISP) model has been widely applied in health and environmental communication research to predict risk information seeking behaviors while accounting for individual differences (Dong et al., 2024; J. Z. Yang, Aloe, et al., 2014). Over time, researchers have expanded the model by examining the influence of additional individual characteristics such as environmental attitudes and beliefs (J. Z. Yang, Kahlor, et al., 2014; J. Z. Yang & Zhuang, 2020), cultural cognition (Hmielowski et al., 2018), cultural worldviews (H. K. Kim & Kim, 2019), and personality traits (S.-C. S. Li et al., 2024). While these studies broaden our understanding of the range of individual characteristics relevant to the RISP model, these characteristics can fluctuate over time and across contexts (Chopik & Kitayama, 2018; Kyle et al., 2024; Sosnowska et al., 2021; Stepanova, 2022).

The variability of these characteristics highlights the need for RISP research to examine more deeply ingrained psychosocial characteristics. This study addresses this need by integrating attachment theory into the RISP model to operationalize enduring psychosocial individual differences that shape how people respond to threat, regulate emotion, interpret social cues, and engage with risk information. Importantly, attachment does not replace core RISP concepts; rather it helps explain variability in the motivational processes that precede risk information seeking.

The proposed hypotheses explore how individual differences in attachment anxiety and attachment avoidance affect key components of the RISP model by conceptualizing attachment as an individual characteristic within the model. Additionally, this chapter proposes hypotheses that explore the extent to which core RISP model relationships hold in the contexts of poor air quality and extreme heat. Finally, three research questions pertain to whether established RISP model relationships vary depending on the specific risk topic and how these dynamics can be effectively analyzed using qualitative methods.

3.1. Hypothesis Development

3.1.1. Integrating Attachment into the RISP Model

In adulthood, two primary dimensions of attachment (i.e., attachment anxiety and attachment avoidance) shape differences in risk perception, coping strategies, and behavior (Brennan et al., 1998). Attachment anxiety is characterized by a preoccupation with relationship security and is associated with hyperactivating coping strategies for managing emotional distress (Mikulincer et al., 2003). These strategies are manifest cognitively, emotionally, and socially. Cognitively, these strategies surface as a heightened sensitivity to threats, often causing individuals with high attachment anxiety to overestimate the severity and personal relevance of risks (Ein-Dor et al., 2011; Shaver & Mikulincer, 2002). Emotionally, these strategies increase emotional reactivity, particularly worry and fear in response to perceived dangers (Mikulincer & Shaver, 2016b). Socially, these strategies manifest as increased efforts to seek significant reassurance and validation from others, making individuals with higher attachment anxiety more attuned to the expectations and norms within their social network.

These cognitive, emotional, and social manifestations of hyperactivating coping strategies associated with attachment anxiety are expected to directly influence key components of the RISP model. First, the tendency to overestimate threats suggests that higher attachment anxiety will be positively related to risk perception (i.e., the product of perceived susceptibility and severity). Second, the pattern of heightened emotional reactivity suggests a positive relationship with negative affective response, as individuals with higher attachment anxiety are more prone to experience worry and fear. Finally, the strong need for social validation indicates a heightened sensitivity to informational subjective norms, suggesting that individuals with higher attachment anxiety will perceive greater social pressure to be informed about risks. Based on this reasoning, the following hypothesis is proposed:

> **Hypothesis 1:** Attachment anxiety is positively related to (a) risk perception, (b) negative affective response, and (c) informational subjective norms.

In contrast to attachment anxiety, attachment avoidance is associated with deactivating coping strategies for managing emotional distress (Mikulincer & Shaver, 2016b). Cognitively, these strategies emerge as tendencies to downplay threats and divert attention from risk-related cues, resulting in lower perceptions of personal susceptibility (Ein-Dor et al., 2011; Gillath et al., 2009). Emotionally, these strategies involve managing distress by actively suppressing and disengaging from negative feelings like fear and worry (Fraley & Shaver, 1997; Mikulincer et al., 2003; Mikulincer & Shaver, 2016b). Socially, these strategies emerge as a strong preference for independence and self-reliance, leading individuals with high attachment avoidance to minimize the importance of others' perspectives (Bartz & Lydon, 2006; Schusterschitz et al., 2018).

These cognitive, emotional, and social manifestations of the deactivating coping strategies associated with higher attachment avoidance are likely to negatively influence key components of the RISP model. First, the tendency to downplay and divert attention away from attention from threats suggests that higher attachment avoidance is negatively related to risk perception. Second, the active suppression of emotion suggests a negative relationship with negative affective response, as these individuals are less likely to report feelings of worry about risks. Finally, the strong preference for self-reliance suggests a negative relationship with informational subjective norms, as these individuals are less likely to be influenced by social pressure. Based on this reasoning, the following hypothesis is offered:

> **Hypothesis 2:** Attachment avoidance is negatively related to (a) risk perception, (b) negative affective response, and (c) informational subjective norms.

Attachment theory posits that an individual's relational patterns interact with their exploration system, which governs how they seek, process, and act on new information (Bowlby, 1969, 1982). Although attachment security[6] is known to foster curiosity and openness to new information or perspectives, attachment insecurity[7] undermines this process by limiting engagement with unfamiliar or challenging information (Dykas & Cassidy, 2011; Mikulincer, 1997; Mikulincer & Shaver, 2016b). This general reluctance to engage with new or challenging information is expected to reduce the likelihood that individuals with attachment insecurity will perceive gaps between their current knowledge and the knowledge needed to cope with a risk, otherwise known as information insufficiency in the RISP model. Based on this reasoning, the following hypothesis is proposed:

> **Hypothesis 3:** (a) Attachment anxiety and (b) attachment avoidance are negatively related to information insufficiency.

Building on the principle that attachment insecurity limits engagement with new information, it is likely that these relational patterns also shape an individual's overall evaluation of information seeking. Attitudes toward information seeking, defined as a person's positive or negative evaluation of the behavior, are a key predictor of information seeking intentions (J. L.

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[6] Attachment security refers to lower scores on both the attachment anxiety and attachment avoidance dimensions, otherwise known as a secure attachment style.

[7] Attachment insecurity refers to higher scores on the attachment anxiety and/or attachment avoidance dimensions, otherwise known as the anxious, avoidant, or fearful attachment styles.

Ford et al., 2023; Kahlor, 2010; Kahlor, Yang, et al., 2020). These attitudes are shaped by whether a person views the behavior as useful or distressing.

Considering that individuals with attachment insecurity tend to process information in ways that reinforce existing beliefs and reduce cognitive discomfort, they may evaluate the act of seeking new, potentially challenging information as threatening or unhelpful (Bourne et al., 2014; Mikulincer, 1997). These patterns suggest that attachment insecurity might foster more negative attitudes toward engaging in this behavior. Accordingly, this study offers the following hypothesis:

> **Hypothesis 4:** (a) Attachment anxiety and (b) attachment avoidance are negatively related to attitudes toward information seeking.

An individual's attachment orientation is also expected to influence their perceived information seeking control, which refers to their belief in their ability to access and understand risk information (Kahlor, 2010; Kahlor, Yang, et al., 2020). This concept is similar to self-efficacy, which is people's belief in their ability to successfully perform a behavior (Bandura, 1982). Self-efficacy is shaped by an individual's internal working model of the self (Kogut, 2016). Both attachment anxiety and avoidance are expected to undermine an individual's perceived control over the information seeking process, as attachment insecurity often fosters a more negative or rigid internal working model of the self.

Attachment anxiety, characterized by a negative view of the self and a general lack of confidence, is consistently linked to lower self-efficacy across various domains (Marmarosh et al., 2013; Meredith et al., 2006; Morison & Benight, 2022; Richards & Schat, 2011; Tagini et al., 2021). This suggests that individuals with attachment anxiety feel less capable of effectively seeking and processing risk information. Attachment avoidance is often linked to a strong sense of self-reliance, the specific act of information seeking may threaten an avoidant individual's sense of autonomy because it requires relying on external sources (Mikulincer, 1997). Research suggests that this with external reliance may lead them to perceive lower self-efficacy over a behavior they are uncomfortable with (Leenders et al., 2019; Maduakor et al., 2022; Mikulincer, 1997).

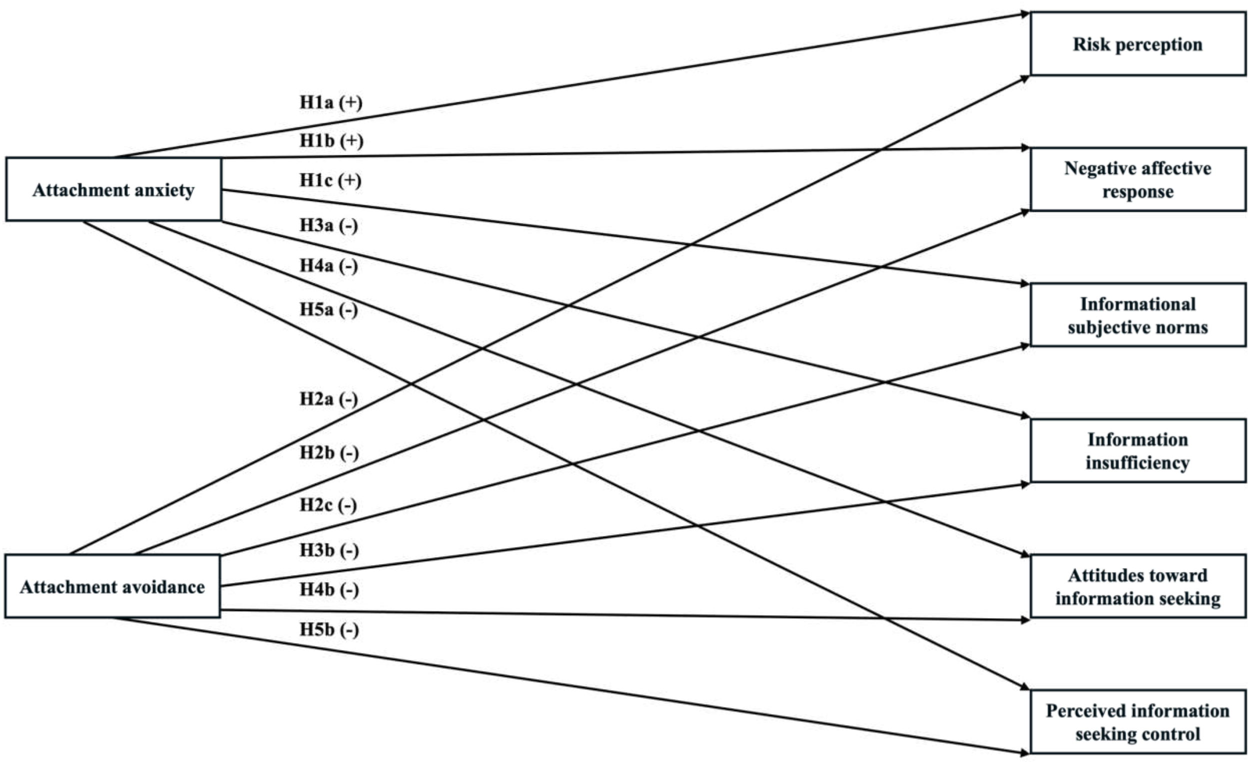
Taken together, both attachment anxiety and attachment avoidance are expected to undermine one's confidence in their ability to manage the information seeking process. Accordingly, the following hypothesis is proposed:

> **Hypothesis 5:** (a) Attachment anxiety and (b) attachment avoidance are negatively related to perceived information seeking control.

The hypothesized relationships between attachment anxiety, attachment avoidance, and RISP model variables are illustrated in Figure 3.

Figure 3.

Conceptual Model Illustrating the Hypothesized Relationships (H1-H5) Between Attachment and RISP Model Variables



Note. The (+) and (-) symbols indicate the proposed positive or negative relationships of each hypothesis.

3.1.2. Testing Core RISP Model Relationships

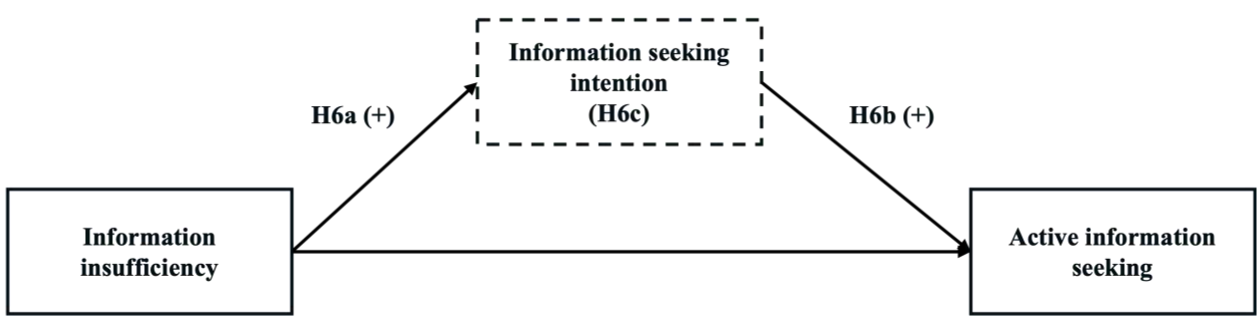
Although the preceding hypotheses extend the RISP model by integrating attachment theory, this study also provides an opportunity to test the model's core relationships in two critical and under-studied risk contexts: air quality and extreme heat. Despite its broad application, the RISP model has seen limited research concerning air quality hazards and, to the author's knowledge, has never been applied to extreme heat. Given the growing severity of these hazards, testing the model's foundational relationships in these contexts is essential for validating its applicability and refining future risk communication strategies.

A central tenet of the RISP model is that information insufficiency motivates information seeking intention (J. Z. Yang & Kahlor, 2013). Although the link between information insufficiency and information seeking intention is well-supported by prior research (e.g., Ahn & Kahlor, 2020; J. L. Ford et al., 2023; Hovick et al., 2021; H. K. Kim & Lai, 2020; Zeng et al., 2023), the subsequent role of intention in translating information insufficiency into active information seeking behavior is less understood (Kahlor, Yang, et al., 2020). Accordingly, the present study posits that information seeking intention is the key process linking the psychological state of information insufficiency to the behavioral outcome (see Figure 4). Therefore, the following hypothesis is proposed:

Hypothesis 6: (a) Information insufficiency is positively related to information seeking intention and (b) information seeking intention is positively related to active information seeking. Additionally, (c) information seeking intention mediates the relationship between information insufficiency and active information seeking.

Figure 4.

Hypothesized Relationships (H6a-H6c) for Information Insufficiency, Information Seeking Intention (Mediator), and Active Information Seeking.



Note. The (+) symbols indicate the proposed positive direction of each relationship and the dashed box indicates the proposed mediating variable.

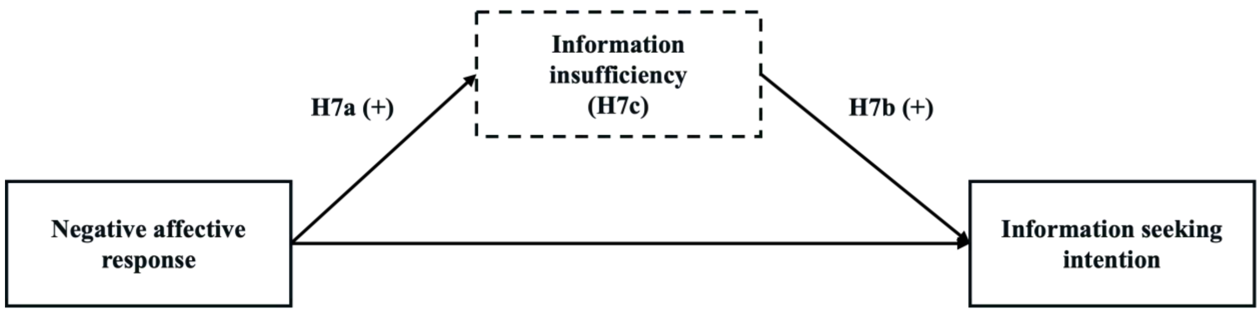
The RISP model posits that negative affective response to a risk (e.g., fear, worry) act as heuristic cues, highlighting an individual's awareness of a perceived gap between their current knowledge and the information needed to respond effectively to the risk (Griffin et al., 2008; So et al., 2019; J. Z. Yang & Kahlor, 2013). This relationship between negative affective response and information insufficiency is consistent with Nabi's (1999) cognitive functional model, which posits that negative, risk-induced emotions act as motivators for information seeking by increasing feelings of uncertainty and the need for control. Empirical studies have consistently confirmed this relationship, finding that individuals who experience heightened negative emotions in response to risk tend to have higher perceptions of information insufficiency (J. L. Ford et al., 2023; Lu et al., 2021; J. Z. Yang & Zhuang, 2020). In addition to this indirect pathway, research suggests that positive and negative affective response can also directly influence information seeking, independent of perceived knowledge gap (J. L. Ford et al., 2023; Griffin et al., 2008; Kahlor, 2010; ter Huurne et al., 2009; J. Z. Yang & Kahlor, 2013).

Although studies have found that both positive and negative emotions can directly encourage information seeking, for a few reasons the present study focuses on negative emotions. First, negative emotions are more strongly linked to an urgent need to reduce uncertainty, whereas positive emotions are typically less urgent in their influence on information seeking (Gasper & Zawadzki, 2013; Tugade et al., 2021). Second, hazards such as poor air quality and extreme heat are more likely to elicit negative emotional reactions (Campbell et al., 2022; Lim et al., 2024; J. Z. Yang & Huang, 2019). Therefore, focusing on negative affective responses provides a clearer assessment of its role in motivating information insufficiency and seeking intention. Accordingly, individuals who experience stronger negative affective response to a risk are expected to perceive greater insufficiency and stronger information seeking intention (Figure 5). Therefore, the following hypothesis is proposed:

> **Hypothesis 7:** Negative affective response is positively related to (a) information insufficiency and (b) information seeking intention. Additionally, (c) information insufficiency mediates the relationship between negative affective response and information seeking intention.

Figure 5.

Hypothesized Relationships (H7a-H7c) for Negative Affective Response, Information Insufficiency, and Information Seeking Intention



Note. The (+) symbols indicate the proposed positive direction of each relationship and the dashed box indicates the proposed mediating variable.

The RISP model also identifies informational subjective norms as another key antecedent of both information insufficiency and information seeking intention (Griffin et al., 2008, 2013). Individuals are more likely to seek risk information when they believe that important others (e.g., family, friends, or colleagues) expect them to know about a topic (Dong & Yang, 2025; Griffin et al., 1999). This perceived knowledge gap then motivates information seeking (Griffin et al., 2008).

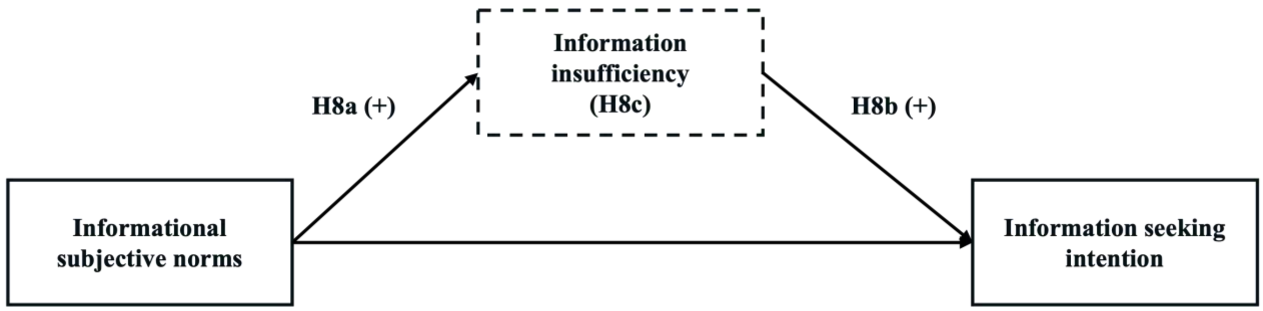
By and large, studies provide support for the relationship between informational subjective norms and information insufficiency (Fung et al., 2024; Lu et al., 2020; Park et al., 2023; J. Z. Yang, Aloe, et al., 2014). However, some inconsistencies have been observed. Of note for this study, Yang and Huang (2019) did not find a relationship between informational subjective norms and information insufficiency regarding air pollution concerns in China. The authors reasoned that individuals who already felt highly knowledgeable about the topic might not experience greater perceived insufficiency under social pressure. While they did not discuss a ceiling effect, their explanation suggests that participants' high perceived knowledge accounted for the null finding, not a limit in measurable knowledge.

Although Yang and Huang's (2019) findings suggest that social pressure may have less influence when individuals already feel knowledgeable, informational subjective norms can still motivate engagement through other pathways. Specifically, research indicates that even in the absence of perceived information insufficiency, such norms may directly drive information seeking (J. L. Ford et al., 2023; Z. Liu et al., 2022; J. Z. Yang, Kahlor, et al., 2014; J. Z. Yang & Huang, 2019). In other words, individuals may feel compelled to seek information to not only to address their own knowledge gaps, but also to align with perceived social expectations (see Figure 6). Therefore, given the consistent support for these relationships in the literature, the following hypothesis is proposed:

> **Hypothesis 8:** Informational subjective norms are positively related to (a) information insufficiency and (b) information seeking intention. Additionally, (c) information insufficiency mediates the relationship between informational subjective norms and information seeking intention.

Figure 6.

Hypothesized Relationships (H8a-Hc) for Informational Subjective Norms, Information Insufficiency (Mediator), and Information Seeking Intention



Note. The (+) symbols indicate the proposed positive direction of each relationship and the dashed box indicates the proposed mediating variable.

Building on the theory of planned behavior (TPB; Ajzen, 1991), attitudes toward information seeking refers to an individual's overall evaluation of seeking risk-related information (Kahlor, 2007, 2010). Individuals who perceive information seeking as valuable or beneficial are more likely to intend to seek it, regardless of the source or channel (Kahlor, Olson, et al., 2020). Empirical studies consistently support this relationship (J. L. Ford et al., 2023; J. L. Ford & Stephens, 2018; Kahlor, Yang, et al., 2020; H. K. Kim & Kim, 2019; J. Z. Yang & Huang, 2019). Based on this evidence and reasoning, the present study offers the following hypothesis:

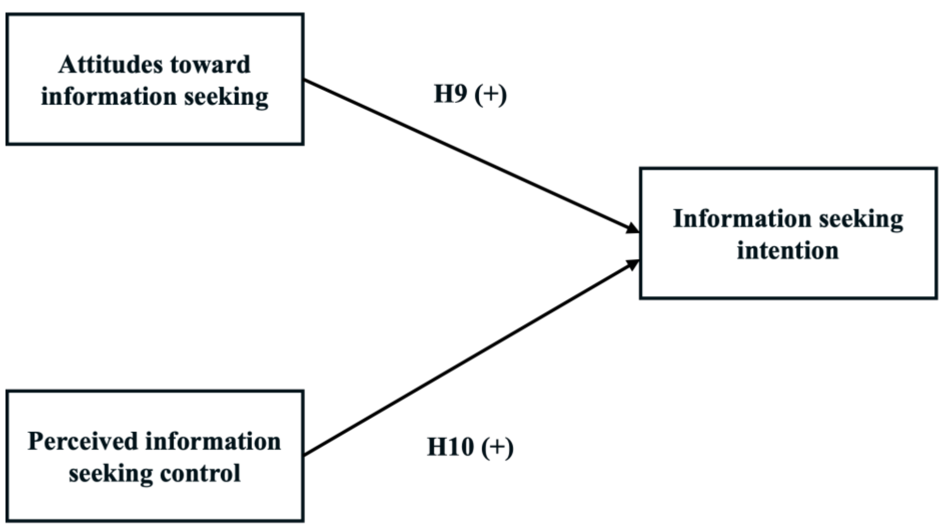
Hypothesis 9: Attitudes toward information seeking are positively related to information seeking intention.

Similarly, drawing again from the theory of planned behavior, Kahlor (2007, 2010) conceptualized perceived information seeking control as the internal (i.e., self-efficacy) and external (i.e., accessibility) factors that influence one's ability to seek information. Perceived information seeking control is particularly relevant in workplace contexts where access to risk information may be limited by organizational policies or job demands (J. L. Ford, 2019; J. L. Ford & Stephens, 2018). Studies consistently show that higher perceived control corresponds with stronger intentions to seek risk information (Eastin et al., 2015; Kahlor et al., 2019; H. K. Kim & Lai, 2020).

Hypothesis 10: Perceived information seeking control is positively related to information seeking intention.

Figure 7.

Hypothesized Direct Relationships of Attitudes Toward Information Seeking and Perceived Information Seeking Control on Information Seeking Intention



Note. The (+) symbols indicate the proposed positive direction of each relationship and the dashed box indicates the proposed mediating variable.

Together, H1 through H10 establish a foundation for testing both the extended and core RISP pathways in the contexts of air quality and extreme heat, while also allowing for comparisons across risk topics and methods employed in the following sections.

3.2. Research Questions

This study extends the RISP model to the contexts of air quality and extreme heat, two hazards that differ in salience, physiological immediacy, and regulatory attention. The following research questions address how these contextual factors may shape information-seeking processes and whether RISP pathways vary across risk topics, geographic regions, and methodological approaches.

The perceived salience of environmental and weather-related hazards plays a critical role in shaping risk perceptions and influencing engagement with risk information (Bigsby et al., 2022; Covello et al., 1986; Frewer et al., 1997; J. Z. Yang, Kahlor, et al., 2014). Salience refers to how noticeable, pressing, or psychologically engaging a risk is (J. Z. Yang, 2019). The salience of hazards, such as poor air quality and extreme heat, varies depending on geographic exposure, daily routines, and occupational demands (Dvir et al., 2024; Strauss & Orlove, 2021; Van Tol et al., 2024). A related body of research on perceptual salience suggests that people attend to environmental hazards when they become noticeable, inconvenient, or threatening (Silver, 2019; Stewart et al., 2012).

Although both air quality and extreme heat endanger outdoor workers, they differ markedly in the onset of symptoms and the availability of institutional guidance. Extreme heat often triggers rapid physical symptoms (e.g., sweating, dizziness, or nausea) making the hazard more immediately noticeable (Coker et al., 2024). In contrast, poor air quality tends to become salient more slowly because symptoms like respiratory irritation or fatigue have a slower onset

(Bice et al., 2024; Campbell et al., 2022; Santana et al., 2021). As a result, workers often rely on external information sources (e.g., AQI indices, forecasts) to assess air quality risks, whereas extreme heat can often be evaluated directly through physical sensations.

Differences in communication visibility may further contribute to this salience divide. Since 2011, the Occupational Safety and Health Administration (OSHA) has implemented national heat illness prevention campaigns that include clear guidance for safety measures at specific temperature thresholds (Morrissey et al., 2021; OSHA, 2011). In contrast, OSHA's communication regarding air quality hazards has been limited. For example, the agency has issued general recommendations through a press release that encourages employers to "plan to implement procedures to reduce exposures to smoke when necessary" (e.g., OSHA, 2023, para. 3), but without guidance specifying what types of procedures should be used at which air quality threshold. Beyond OSHA's efforts, public health campaigns focused on reducing air quality exposures remain less developed than those addressing heat illness prevention, which may make air quality hazards less salient or familiar to outdoor workers.

Taken together, these differences in perceptual cues and communication visibility suggest that air quality and extreme heat may activate distinct cognitive and motivational pathways within the RISP model. Accordingly, the present study examines whether these hazards differentially shape the relationships between attachment orientations and RISP concepts, as well as the relationships among RISP concepts.

Research Question 1: Do the proposed attachment and RISP model relationships differ when the topic is (a) poor air quality versus (b) extreme heat?

Hazard salience may also be shaped by regional differences in exposure to specific environmental risks, public health messaging, and institutional support for risk mitigation. For instance, air quality may be more salient to outdoor workers in the western United States due to recurring wildfire smoke events, whereas outdoor workers in the South may be more attuned to extreme heat risks due to the frequency of high temperatures and heat advisories in that region.

These regional exposures may influence key RISP concepts by shaping individuals' engagement with a hazard, their perceptions of what others expect them to know, and their motivation to stay informed. Studies have found that geographic proximity to a hazard (e.g., a disaster zone or pollution event) can influence how individuals perceive risks and process information (Arias et al., 2017; Balžekienė et al., 2024; Severtson & Burt, 2012; Severtson & Vatovec, 2012). Additionally, the availability and salience of regional health messaging may shape norms and perceived control over information seeking, further contributing to geographic variation in risk communication outcomes (Griffin et al., 2008; Ramírez et al., 2017; Schoenherr & Thomson, 2020). Based on these arguments, this study poses the following research question:

Research Question 2: How do recent hazard experiences, RISP concepts, and information seeking behaviors differ across U.S. regions?

Finally, there is growing interest in using qualitative methods to better understand air quality and heat-related concerns (McIntyre et al., 2024) as well as whether RISP model relationships emerge in qualitative data (Bullock, 2023; Clair et al., 2021). The quantitative studies that have been conducted may not fully capture the lived experiences, decision-making processes, and contextual barriers that shape outdoor workers' information seeking behaviors (Lindlof & Taylor, 2019; Minkler, 2008).

Qualitative research methods offer an opportunity to explore how this audience interprets these risks and articulate their information needs, perceived norms, and sense of control, providing a more nuanced and context-driven perspective that may reinforce existing quantitative studies or reveal new pathways for future targeted poor air quality, extreme heat, or RISP model quantitative studies (Clair et al., 2021; McIntyre et al., 2024; Pascal et al., 2021). For example, qualitative data may provide richer insights into structural barriers; such as workplace policies, employer communication practices, or perceived consequences of information seeking at work) that could shape information seeking behaviors in ways that have not been fully captured by the RISP model (J. L. Ford, 2019). Furthermore, workers may describe peer behaviors or informal workplace norms that constrain or facilitate their information seeking decisions and protective behavior adoption. This knowledge will offer more insights into targeted risk communication strategies that align with workplace norms. Based on this reasoning, the final research question is posed:

Research Question 3: How do qualitative findings reinforce or extend insights about risk information seeking and processing within the RISP model?

Table 2 lists the hypotheses and research questions for the present study.

Table 2.

List of Hypotheses and Research Questions

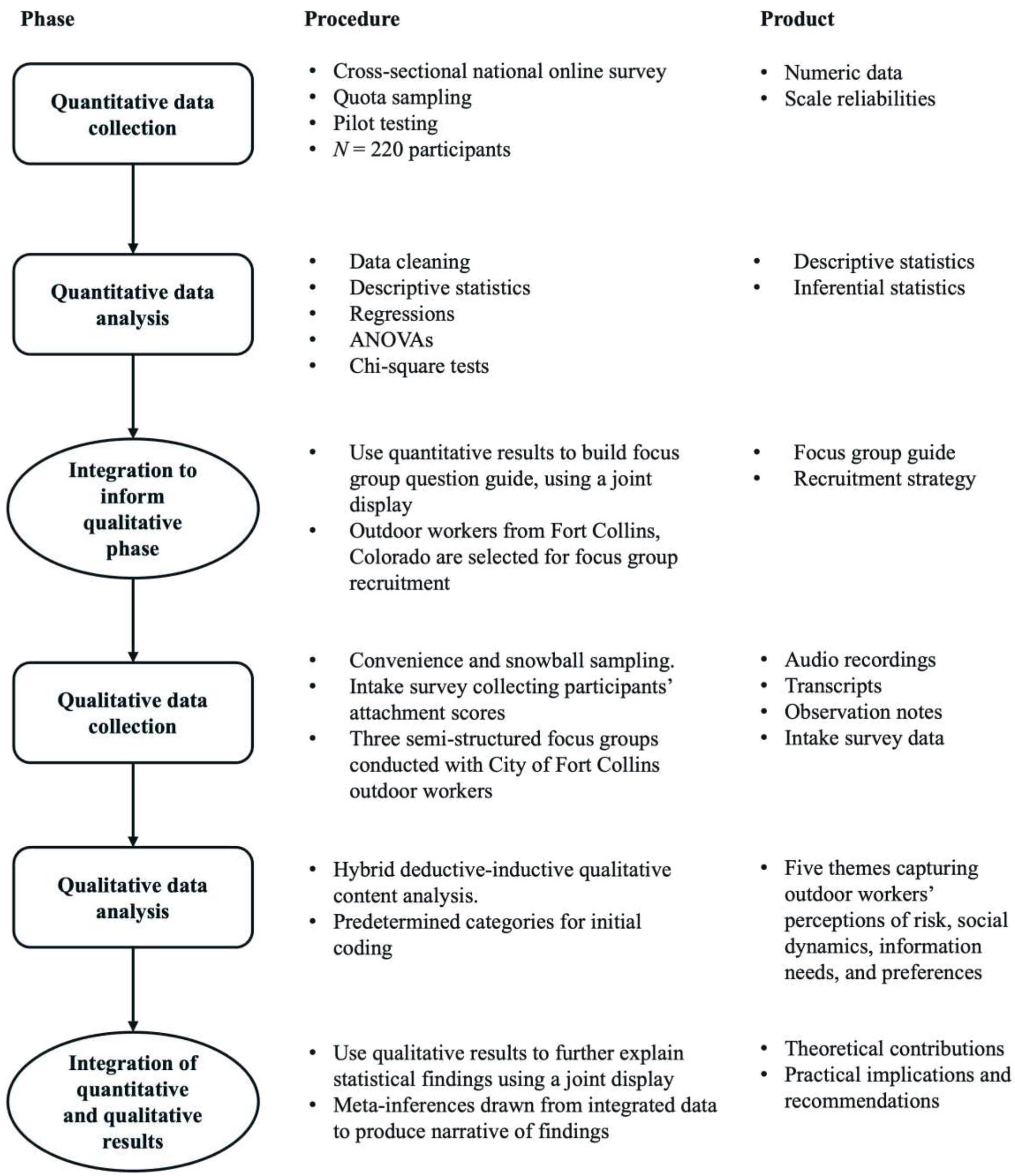
Integrating Attachment into the RISP model	
Hypothesis 1 (H1)	Attachment anxiety is positively related to (a) risk perception, (b) negative affective response, and (c) informational subjective norms.
Hypothesis 2 (H2)	Attachment avoidance is negatively related to (a) risk perception, (b) negative affective response, and (c) informational subjective norms.
Hypothesis 3 (H3)	(a) Attachment anxiety and (b) attachment avoidance are negatively related to information insufficiency.
Hypothesis 4 (H4)	(a) Attachment anxiety and (b) attachment avoidance are negatively related to attitudes toward information seeking.
Hypothesis 5 (H5)	(a) Attachment anxiety and (b) attachment avoidance are negatively related to perceived information seeking control.
Testing Core RISP Relationships	
Hypothesis 6 (H6)	(a) Information insufficiency is positively related to Information seeking intention and (b) information seeking intention is directly positively related to active information seeking. Additionally, (c) information seeking intention will mediates the relationship between information insufficiency and active information seeking.
Hypothesis 7 (H7)	Negative affective response is positively related to (a) information insufficiency and (b) information seeking intention. Additionally, (c) information insufficiency mediates the relationship between negative affective response and information seeking intention.
Hypothesis (H8)	Informational subjective norms is positively related to (a) information insufficiency and (b) information seeking intention. Additionally, (c) information insufficiency mediates the relationship between informational subjective norms and information seeking intention.
Hypothesis (H9)	Attitudes toward information seeking is positively related to information seeking intention
Hypothesis 10 (H10)	Perceived information seeking control is positively related to information seeking intention.
Research Questions	
Research question 1 (RQ1)	Do the proposed attachment and RISP model relationships change based on whether the topic is (a) poor air quality or (b) extreme heat?
Research question 2 (RQ2)	How do RISP variables and information seeking behaviors differ across U.S. regions?
Research question 3 (RQ3)	How do qualitative findings reinforce or extend insights about risk information seeking and processing within the RISP model?

3.3.Research Design

Charmaz (2006) emphasizes that research methods should be guided by the research problem itself. Accordingly, this study employed an explanatory sequential mixed-method design to examine how attachment influences outdoor workers’ risk information seeking behaviors related to air quality and heat hazards. In this design, researchers first collect and analyze quantitative data, and then use those results to inform a subsequent qualitative phase that provides deeper insight into the quantitative findings (Creswell & Creswell, 2023; Creswell & Plano Clark, 2018). Figure 8 provides a visual overview of these phases as applied in the present study.

Figure 8.

Overview of the Present Study's Explanatory Sequential Design



The quantitative phase used a survey to investigate the influence of attachment theory variables on the RISP model, while examining existing relationships within the model across two risk topics. This approach aligns with previous studies that have validated the RISP model (see Dong et al., 2024; J. Z. Yang, Aloe, et al., 2014 for reviews), including those that introduce new variables to the model (e.g., Braun & Niederdeppe, 2012; Hmielowski et al., 2018; H. K. Kim & Kim, 2019; Wang et al., 2021). However, most of these studies rely on quantitative methods, even though scholars have emphasized the need for qualitative approaches to enhance our understanding of the RISP model's mechanisms (Griffin et al., 2013; B. B. Johnson, 2005; Schemer et al., 2008). Despite these calls, only a limited number of studies have applied qualitative or mixed-methods approaches (e.g., Bullock, 2023; Clair et al., 2021; Rosen et al., 2023).

Responding to these calls for qualitative inquiry, this study used focus groups to provide contextual insights into the survey findings. Focus groups were chosen because they allow participants to engage in collective meaning-making, draw on shared experiences, and respond to each other's perspectives; a dynamic that is not achievable in one-on-one interviews (Lindlof & Taylor, 2019). This approach is particularly valuable given this study's focus on understanding how perceptions of air quality and extreme heat risks are socially constructed among outdoor workers, and how these perceptions influence their information seeking and protective behaviors.

3.4.Study Context

This study builds on a larger research effort funded by the U.S. Environmental Protection Agency (EPA), Smoke Ready Communities: Creating and Sustaining Air Quality Communication Using Targeted Communication Interventions (EPA Grant No. R840363). The broader project supported the development and evaluation of targeted air quality messaging in northern Colorado. Through this effort, the Air Aware workplace air quality communication campaign was developed in collaboration with municipal outdoor workers in Fort Collins Colorado (Anderson et al., 2026; Bice et al., 2024, 2025).

Colorado's Northern Front Range has consistently exceeded the U.S. National Ambient Air Quality Standards for ozone over the past two decades (U.S. EPA, 2024). This region, which includes Fort Collins, represents one of the state's most persistent ozone nonattainment areas. In this area, elevated ozone levels are primarily driven by a combination of vehicle emissions, oil and gas development, and large animal feeding operations, and are further intensified by wildfire smoke (deSouza & Hood, 2024; Flocke et al., 2020). For instance, the 2020 Cameron Peak and East Troublesome wildfires, which together burned more than 400,000 acres northwest of Fort Collins caused the city's air quality index (AQI) to exceed 100 (unhealthy for sensitive groups) for several consecutive days (Colorado Division of Fire Prevention & Control, 2025; U.S. EPA, 2020). These conditions posed heightened risks for outdoor workers who were expected to work through the smoke with limited protective guidance. Such experiences highlight the need for research on air quality communication interventions designed to protect this population, whose occupational exposure places them at greater risk than the general public (Licker et al., 2022).

Between May and August 2022, formative research for the Air Aware campaign included a statewide survey of Colorado outdoor workers (Bice et al., 2024) and focus groups with municipal workers in Fort Collins (Anderson et al., 2026; Bice et al., 2025). The survey revealed that higher risk perceptions, along with both self-efficacy and response efficacy beliefs about protective behaviors (e.g., rescheduling strenuous tasks, wearing masks, monitoring AQI), were associated with increased protective action. However, only efficacy beliefs, not risk perception, significantly predicted information seeking behaviors. Additionally, workers reported relying on multiple sources for air quality information, including mobile apps, media outlets, local government, public health agencies, family and friends, and the National Weather Service (Bice et al., 2024).

The focus groups with outdoor workers in Fort Collins provided further insights into the behaviors described in the state survey. Participants generally understood the health risks of poor air quality exposure and recalled heightened concern from working outdoors during the Cameron Peak Fire[8] when air quality was noticeably poor (e.g., reduced visibility, odor, physical symptoms). However, they expressed less concern about ozone exposure or the long-term health effects of cumulative exposure to poor air quality. Social norms played a key role in shaping protective behaviors, with family, friends, and a strong workplace safety culture reinforcing risk awareness and protective actions (Anderson et al., 2026; Bice et al., 2025).

Despite these positive social influences, workers identified several barriers to seeking information and adopting protective measures. Heat-related discomfort discouraged mask use, job demands limited opportunities to relocate work indoors, and poor cell service sometimes hindered access to online information. Workers expressed varied informational needs and communication preferences, ranging from visual cues (e.g., the visibility of local landmarks) to digital updates via mobile apps. Many recommended a centralized alert system, such as text or email notifications, supported by visually engaging signage and clear, actionable guidance for adjusting work activities under poor air quality conditions (Bice et al., 2025).

[8] The Cameron Peak Fire burned from August to December 2020, 14 miles west of Fort Collins, becoming the largest recorded wildfire in Colorado history (Cappucci, 2020; Colorado Division of Fire Prevention & Control, 2025)

In response, the Air Aware campaign was co-designed with municipal outdoor workers to address these needs through strategic branding, messaging, and multi-channel communication. Campaign branding incorporated recognizable local imagery and color-coded visuals aligned with AQI levels to convey risk at a glance. Messaging emphasized both short-term and long-term health consequences of poor air quality, reinforced social norms around protective behavior, and encouraged information-seeking and planning (Bice et al., 2025).

The campaign launched in June 2023 and ran through September 2023. Members of the research team introduced Air Aware during morning safety meetings with Parks and Recreation and Natural Areas employees, highlighting the region's air quality challenges, health risks, and available resources. Following this introduction, printed materials (e.g., flyers, decision charts, magnets, stickers), interactive tools, and real-time text and email alerts were deployed to sustain engagement (see Appendix B). Materials were displayed in common areas and included a QR code linking to the Air Aware Linktree, which provided local air quality conditions, forecasts, and sign-up options for alerts. Alerts were distributed at 6:30 a.m., allowing workers to plan for the day, with follow-ups at noon if conditions worsened. Employees in Parks and Recreation and Natural Areas served as the treatment group, while Utilities Department workers and employees in similar city roles formed the control group.

To evaluate campaign effectiveness, a posttest survey was conducted between September and October 2023. Workers in the treatment group reported seeking air quality information more frequently than those in the control group, indicating improved information seeking behavior. Subjective norms continued to play a strong role, with workers influenced by social networks in both seeking information and adopting protective actions. However, findings for risk perception, perceived control, and behavioral intention were mixed, suggesting that ongoing environmental, organizational, or structural barriers may have limited workers' ability to act on the information received (Anderson et al., 2026; Bice et al., 2025). Building on these findings, Air Aware was relaunched in May 2024 and extended through September 2024 with Parks and Recreation and Natural Areas employees. The campaign was also expanded to include Utilities Department staff allowing for broader participation and continued assessment of its effectiveness.

The present study builds upon this foundation by extending the RISP model to incorporate attachment theory as a framework for understanding how individual differences influence outdoor workers' risk information-seeking and protective behaviors. This line of inquiry emerged from insights gained during the Air Aware formative focus groups in 2022, where workers emphasized the importance of social influences and workplace culture in shaping their protective actions. The strong role of subjective norms observed in the 2023 campaign evaluation further highlighted the need to examine social and relational factors—such as attachment—that may underlie the risk information-seeking process among this population. In addition, workers' concerns about heat-related discomfort and illness during the 2022 focus groups motivated exploration of how extreme heat affects engagement with air quality information. Accordingly, the present study expands the scope of investigation across diverse workplace sectors and geographic regions to better capture variation in hazard experiences. Finally, the incorporation of a qualitative phase provides deeper insight into the social and contextual factors shaping workers' decisions about when and how to seek risk information and serves as an opportunity to evaluate the Air Aware campaign while considering the integration of heat-related guidance into future iterations.

3.5.Chapter Summary

Chapter 3 outlined the theoretical framework integrating attachment theory into the risk information seeking and processing (RISP) model to explain outdoor workers' responses to air quality and extreme heat hazards. Ten hypotheses and three research questions were presented, covering three focal areas: (1) integrating attachment into the RISP model (2) variations in RISP relationships across hazard topics and geographic contexts, and (3) integration of qualitative methods to explore contextual factors underlying information-seeking and protective behaviors. This integration of attachment as an individual characteristic within the RISP model provides a comprehensive approach for examining psychological, social, and relational influences on environmental hazard risk communication outcomes across a range of occupational settings and geographic areas.

CHAPTER 4. QUANTITATIVE PHASE

4.1.Survey Methods

This chapter details the quantitative phase of this study, including the survey methods, sampling, data collection, measures, and results of the quantitative analysis.

4.1.1. Sampling

This study used a quota sampling approach to ensure a geographically representative sample of outdoor workers across the United States. Quota sampling is a nonprobability sampling technique where the sample of individuals obtained matches the proportions of key demographic characteristics of the population of interest (Lamm & Lamm, 2019; Moser & Stuart, 1953). Although this approach effectively targets specific groups, it may introduce selection bias, which potentially limits the generalizability of the results (Dillman et al., 2014; Futri et al., 2022; Malhotra et al., 2017; Sarpy et al., 2012).

Quotas were established for U.S. region, gender, and age based on the U.S. Census Bureau's (2022) American Community Survey. The specific quotas for U.S. region were 17% for the Northeast, 21% for the Midwest, 38% for the South, and 24% for the West. To better reflect outdoor work demographics, quotas were adjusted to oversample participants who identified as male and those between the ages of 25-44 (U.S. Bureau of Labor Statistics, 2024a, 2024b). Specifically, the gender quota was adjusted to 70% male and 30% female. Age quotas were set to 16% for ages 18-24, 29% for ages 25-34, and 31% for ages 35-44, 14% for ages 45-54, and 10% for ages 55-64, aligning with employment data for outdoor industries (U.S. Bureau of Labor Statistics, 2024a, 2024b).

Following the methods of previous studies of the RISP model (e.g., J. Z. Yang & Liu, 2021) an a priori sample size was calculated using G*Power version 3.1.9.6 for linear multiple regression (Faul et al., 2007). Based on the anticipated effect size (0.20), the desired statistical power level (.80), the number of predictors (8), and desired probability level (0.05), the minimum required sample size was 161. For web-based surveys, it is recommended to recruit an additional 15-20% of the minimum sample size to account for potential nonresponse attrition or careless responses (Futri et al., 2022; Hochheimer et al., 2016; Jones et al., 2022; Morgan & Carcioppolo, 2014). Given this recommendation, the final sample included 220 participants.

4.1.2. Eligibility and Recruitment

Participants were recruited using CloudResearch's Connect platform. This platform was selected because research indicates it provides a more diverse and nationally representative sample compared to alternatives like Amazon Mechanical Turk (Chandler et al., 2019; Hartman et al., 2024; Peer et al., 2022). For a fee, researchers can post surveys or experiments that have been created through third-party platforms, such as Qualtrics, SurveyMonkey, or Google Forms (CloudResearch, 2024; Hartman et al., 2024). When new studies are posted, participants in the CloudResearch pool receive email invitations to participate. Those who are interested individuals can follow a link to review study details and instructions before deciding whether to participate voluntarily.

A multi-layered approach was used to ensure data quality, combining the platform's internal vetting with study-specific screening procedures. During participant onboarding, CloudResearch uses its proprietary Sentry® system, which employs technical checks (e.g., verifying unique IP addresses) and behavioral measures (e.g., assessing language comprehension). This is supplemented by continuous monitoring of the active participant pool, which has demonstrated a high attention-check pass rate (Hartman et al., 2024).

CloudResearch further ensures data quality by allowing researchers to screen their data and reject participants suspected of rushed or careless responses within 14 days of participation, provided they give a valid explanation for each rejection. Using these tools, researcher-level data quality screening was based on three criteria: (1) response to commitment request, (2) performance on embedded attention check questions in the survey, and (3) survey completion time.

After providing informed consent (see Appendix C), participants encountered a commitment request that reiterated the primary eligibility criteria (i.e., being 18 years or older and spending at least 50% of their workday outdoors) and emphasized the importance of following instructions and providing thoughtful responses. Those who confirmed that they met these criteria and could participate attentively were granted access to the full survey. Participants who did not meet the eligibility criteria or chose not to commit were given the option to exit the study.

Participants who continued with the survey were further evaluated based on attention check performance and survey completion time, following recommendations from Berinsky et al. (2021) and Desimone et al. (2015). Three attention check items were embedded within the survey (see Appendix C). These items included a nonsensical item ("Does your job require you to work 14 months per year?"), a direct instruction item ("This is an attention check, please select 'Strongly Disagree'"), and a qualitative-response prompt requiring participants to type a specific word ("If you have carefully read this question, please write the word 'purple' in the blank 'Other' box below"). Only participants who passed all three attention checks and whose completion times fell within two standard deviations of the mean were retained in the final dataset.

A total of 238 participants completed the survey. Following data screening, 18 responses were removed for rushed completion times or failed attention checks, resulting in a final sample of 220 participants. Participants whose data passed all quality checks received $5 compensation through their CloudResearch Connect account, redeemable via PayPal, direct bank transfer, or Amazon Gift Card.

4.1.3. Ethical Approval, Informed Consent, and Data Security

Before data collection began, the study received approval from Colorado State University's Institutional Review Board (IRB) [IRB # 5945]. Before starting the survey, participants gave informed consent via a formal consent document (see Appendix C). Participation was voluntary, and no identifying information was collected to ensure participant anonymity. In addition, each participant was assigned an anonymous, unique identification number through the CloudResearch recruitment platform. All survey responses were aggregated and are reported without disclosing individual data. Finally, survey data was stored on a password-protected external hard drive.

4.1.4. Data Collection Procedures

4.1.4.1. Survey Design

This study employed a cross-sectional survey design; data were collected at a single point in time to capture participants' perceptions, experiences, and behaviors related to poor air quality and extreme heat hazards at work. Although cross-sectional surveys may reveal associations among variables, they do not allow for the empirical confirmation of causality (Morgan & Carcioppolo, 2014).

After providing informed consent and responding to the commitment request, participants advanced to the survey which began with questions about their age and their job. Then participants were introduced to key definitions related to air quality and extreme heat, including descriptions of relevant indices and warning systems such as the Air Quality Index (AQI) and HeatRisk Index. At this stage, they were also given instructions on how to use hyperlinks to show these definitions throughout the survey for their reference. This feature was designed to improve clarity and minimize misinterpretation by allowing participants to access additional explanations when needed. The complete questionnaire, including the informed consent, commitment request, key definitions, and all survey measures is provided in Appendix C.

All survey items are based on the operationalizations recommended by attachment theory and RISP scholars; the language was modified to align with the context of air quality and extreme heat risks. The majority of items were rated on five-point Likert scales for consistency across response options and to reduce the cognitive burden on participants.

4.1.4.2. Pilot Testing and Refinement

To ensure the clarity, functionality, and reliability of the survey, a two-phase pilot study was conducted. The first phase, a usability test, took place between July 15-18, 2024, with members of the author's personal and professional networks. This phase focused on identifying technical issues, testing survey functionality, and ensuring that participants could read and answer questions effectively. Feedback from this test highlighted some issues such as missing labels on the negative affective response items and typos, and it provided some formatting recommendations, including the need to bold key terms. Additionally, some participants reported difficulties accessing stimulus materials on the Wix website and noted that some definition hyperlinks were broken. These issues were addressed before proceeding to the second phase, The second phase, a soft-launch pilot, was conducted on July 25, 2024, using a subset of the sample (n = 20) recruited through CloudResearch. This phase aimed to assess initial scale reliabilities and confirm that the survey functioned correctly on the platform. After confirming strong reliability scores (see Table 3) and survey functionality, the full study was launched.

Table 3.

Pilot Test Reliability Scores

Measure	Cronbach's α
RISP measures – Air quality	
Risk perception	.83
Negative affective response	.91
Information insufficiency	Not applicable
Informational subjective norms	.93
Attitudes toward information seeking	.97
Perceived information seeking control	.80
Information seeking intention	.99
Active information seeking	Not applicable
RISP measures – Extreme heat	
Risk perception	.79
Negative affective response	.90
Information insufficiency	Not applicable
Informational subjective norms	.87
Attitudes toward information seeking	.94
Perceived information seeking control	.79
Information seeking intention	.98
Active information seeking	Not applicable
Attachment measures	
Attachment anxiety	.90
Attachment avoidance	.89

4.1.5. Measurements

Participants responded to items assessing attachment, risk perception, negative affective response, informational subjective norms, information insufficiency, attitudes toward information seeking, perceived information seeking control, information seeking intention, and active information seeking. Each RISP-related concept was assessed separately for air quality and extreme heat to evaluate how participants' perceptions and behaviors differed across these two hazards. Additional measures captured participants' past experiences with air quality-related symptoms and heat illnesses, their demographic characteristics, and workplace policies related to air quality and extreme heat.

To mitigate potential order effects, the Qualtrics block randomization feature was used for all RISP measures to present participants with either the air quality or extreme heat block of RISP-related questions first. The following subsections provide a detailed overview of each measurement used in the study. Each of the following concepts were assessed separately for both air quality and extreme heat, unless otherwise noted. Descriptive statistics for each survey measure are presented in Appendix D.

4.1.5.1. Risk Perception

Participants' risk perceptions of air quality and extreme heat were measured using four items adapted from Kahlor et al. (2020) and Hovick et al. (2014). Consistent with prior RISP model studies, risk perception was assessed through two key components: perceived severity and perceived susceptibility. Perceived severity was measured by asking participants to indicate how serious they believed the health risks of working outdoors during poor air quality and extreme heat conditions were on a five-point Likert-type scale (1 = *not at all serious*, 5 = *extremely serious*). Perceived susceptibility was assessed on a similar five-point scale (1 = *not at all likely* to 5 = *extremely likely*) where participants indicated their likelihood of being negatively impacted by the health risks of working outdoors during poor air quality and extreme heat. These items achieved acceptable reliability in the full study for both air quality (α = .70, *M* = 12.34, *SD* = 5.98) and extreme heat (α = .73, *M* = 13.90, *SD* = 6.02)

Following the conventions established in prior research, (e.g., Griffin et al., 2008; H. K. Kim & Kim, 2019; J. Z. Yang, Rickard, et al., 2014), perceived severity and perceived susceptibility were multiplied to create an overall risk perception index for air quality and extreme heat.

4.1.5.2. Negative Affective Response

Risks inherently involve the chance of harm; therefore, many RISP studies measure affective responses in terms of negative emotions such as concern, worry, fear, and overwhelm (e.g., Hovick et al., 2021; J. Z. Yang, Kahlor, et al., 2014; J. Z. Yang & Kahlor, 2013). Accordingly, participants were asked to indicate the extent to which they felt worried, concerned, overwhelmed, or scared when thinking about working outdoors during poor air quality and extreme heat conditions. These responses were measured using a total of eight items (i.e., four items for air quality and four items for extreme heat) on a five-point Likert scale (1 = *none of these feelings to* 5 = *a lot of this feeling*). These items achieved good reliability in the full study for air quality (α = .91, *M* = 2.85, *SD* = 1.13) and extreme heat (α = .88, *M* = 3.29, *SD* = 1.07). Then, the four items for each hazard were averaged to create separate indices of negative affective response for air quality and extreme heat.

4.1.5.3. Information Insufficiency

Information insufficiency was operationalized as the gap between a participant's perceived current knowledge and their knowledge sufficiency threshold (Griffin et al., 2008). Although past RISP studies have used 100-point response scales for these measures (e.g., Griffin et al., 2008; Kahlor, 2010; J. Z. Yang & Kahlor, 2013), this study adopted 10-point response scales (e.g., Brinker et al., 2020; Lu, 2015) to maintain closer consistency with other response scales in the present study and reduce the cognitive burden on participants. Participants rated their current knowledge about the health risks of working outdoors during poor air quality (*M* = 5.35, *SD* = 2.34) and extreme heat (*M* = 6.70, *SD* = 1.94) on a scale of 0 (*nothing*) to 10 (*all there is to know*). They also reported their perceived sufficiency threshold for knowledge about these hazards on a similar 0- to 10-scale (poor air quality: *M* = 6.76, *SD* = 2.32; extreme heat: *M* = 7.12, *SD* = 2.25).

Consistent with more recent studies of the RISP model (e.g., Ahn & Kahlor, 2023; H. K. Kim et al., 2020; H. K. Kim & Kim, 2019), an analysis of partial variance (Cohen & Cohen, 1983) was used to calculate information insufficiency for air quality (*M* = 4.90, *SD* = 2.17) and extreme heat (*M* = 4.69, *SD* = 2.14) that contains the residual variance of the sufficiency threshold accounting for the variance of perceived current knowledge (S. Rosenthal, 2013). This approach helps address the limitations of using a raw difference score (e.g., sensitive to floor and ceiling effects) and the regressed change approach (e.g., the inflated explained variance in information insufficiency).

4.1.5.4. Informational subjective norms

Previous studies using the RISP model predominately measure information subjective norms using measures of injunctive norms (e.g., Kahlor, 2010; J. Z. Yang & Kahlor, 2013) or exclusively (e.g., Hovick et al., 2021; J. Z. Yang, 2012) without measuring descriptive norms. In line with this practice, the current study adapted items from Hovick et al. (2021). Participants indicated their level of agreement with three statements including, “Most people who are important to me think that I should seek information about air quality,” “My family expects me to seek information about air quality,” and “People that I work with expect me to seek information about air quality." These items were also presented for extreme heat. Responses were recorded on a five-point Likert scale (1 = *strongly disagree to* 5 = *strongly agree*), and scores were averaged to create separate indices for air quality and extreme heat. These measures demonstrated good reliability in the full study for air quality ($\alpha = .90$, $M = 2.90$, $SD = 1.19$) and extreme heat ($\alpha = .88$, $M = 3.33$, $SD = 1.14$).

4.1.5.5. Attachment

Attachment was measured using a modified version of the 12-item Experiences in Close Relationships-Short Form (ECR-S) by Wei et al. (2007). The ECR-S is a shortened version of the Experiences in Close Relationships (ECR) Scale developed by Brennan et al. (1998) based on a factor analysis of 323 items used in self-report attachment measures. Brennan and colleagues (1998) identified 18 items to measure attachment anxiety and 18 items to measure attachment avoidance. Wei et al. (2007) further refined this scale into the ECR-S, which consists of six items for attachment anxiety and six items for attachment avoidance. Across six validation studies, Wei and colleagues (2007) reported alphas ranging from .77 to .86 for attachment anxiety and .78 to .88 for attachment avoidance, indicating good reliability with the original ECR.

For the context of this study, to better capture attachment as an individual characteristic variable, references to romantic partners were replaced with "others" or "other people," as done in previous studies applying this measure in organizational contexts (e.g., Richards & Schat, 2011). Participants rated these items on a seven-point scale (1= *strongly disagree*, 7 = *strongly agree*) and cores were summed for anxious and avoidant attachment, separately. Sample items include, "I get frustrated when others are not available when I need them" and "I don't usually discuss my problems and concerns with other people." Six items measured anxious attachment, which demonstrated good reliability (α = .86, *M* = 19.74, *SD* = 8.08). Attachment avoidance was also assessed using six items, achieving good reliability in the full study (α = .86, *M* = 20.67, *SD* = 8.18).

4.1.5.6. Attitudes Toward Information Seeking

The operationalizations of attitudes toward seeking information about air quality and extreme heat risks were adapted from Kahlor et al. (2020), and they were measured using five-point semantic differential scales, consistent with prior research (e.g., Ajzen, 2002; Kahlor, 2010). Participants rated their perceptions of air quality and extreme heat information seeking using the five adjective pairs: "worthless/valuable," "harmful/beneficial," "unhelpful/helpful," "unproductive/productive," and "foolish/wise." Separate indices were created for air quality and extreme heat by averaging responses across these five items. The measures demonstrated good reliability in the full study for air quality (α = .95, *M* = 4.24, *SD* = 1.01) and extreme heat (α = .95, *M* = 4.28, *SD* = 1.04).

4.1.5.7. Perceived Information Seeking Control

Perceived information seeking control was measured a scale adapted from Ford (2016), aligning with the conceptualization of control in prior research (e.g., Ajzen, 2002; Kahlor, 2010). This scale captured internal (e.g., cognitive ability) and external (e.g., access to information resources) factors influencing information seeking. Participants indicated their level of agreement with three statements including, "I know where to look for information about air quality," "When it comes to information about air quality, I know where to go," and "During work, I have open access to technology that I can use to look up information about air quality." These items were also presented for extreme heat.

Participants rated their perceived control over seeking information about air quality and extreme heat at work using a five-point Likert scale (1 = *strongly disagree to* 5 = *strongly agree*). Scores were averaged to create separate indices for air quality and extreme heat, both of which demonstrated good reliability in the full study for both air quality (α = .83, M = 3.99, SD = 0.96) and extreme heat (α = .82, M = 4.25, SD = 0.81).

4.1.5.8. Information Seeking Intention

Participants' intentions to seek information about air quality and extreme heat were measured using three items adapted from Kahlor (2010) that have been widely used in RISP studies (e.g., Brinker et al., 2020; Hovick et al., 2021; Park et al., 2023; Zhou & Roberto, 2022). The three items used to measure information seeking intention for air quality were "I will try to seek information about air quality in the next three months," "I will look for information about air quality in the next three months," and "In the next three months, I am going to search for information about air quality." Identical items were used for extreme heat. Participants used a five-point Likert scale (1 = *strongly disagree to* 5 = *strongly agree*) to indicate their level of agreement with each statement. The scores were averaged to create separate indices for air quality and extreme heat. These items achieved good reliability in the full study for both air quality (α = .96, M = 3.91, SD = 1.06) and extreme heat (α = .96, M = 4.08, SD = 1.04).

4.1.5.9. Active Information Seeking

Active information seeking was assessed using measures adapted from Adebayo et al. (2020) and Hovick et al. (2021). Participants were asked whether they wanted to seek additional information about how to protect their health at work during periods of poor air quality or extreme heat. For each hazard, selecting "yes" (coded as 1; "no" coded as 0) directed participants to a corresponding website, embedded within the Qualtrics survey and hosted on Wix, that provided information about the health risks associated with working outdoors during those conditions. Participants who selected “no” for either hazard were asked to indicate their reason for not seeking additional information. Options included: “I do not have enough time to seek more information right now,” “I am already informed about this risk,” “I am not concerned about this risk,” “I do not feel like this risk is relevant to me,” “I do not feel like the information would be relevant to me,” “Seeking information about this risk is a waste of time,” or “Other” where participants could write in their reason.

The websites used in this study were designed to provide accessible and relevant health information about air quality and extreme heat hazards to interested participants. The content was adapted from sources such as the Centers for Disease Control and Prevention (2024; 2024a, U.S. CDC, 2024b), the Environmental Protection Agency (U.S. EPA, 2023a, 2023b) and the Occupational Safety and Health Administration (U.S. OSHA, 2023, 2024). Both the air quality and extreme heat informational websites used similar language, colors, fonts, icons, and imagery from the Air Aware campaign. Unlike the original campaign materials (see Appendix B), which were tailored for outdoor workers in Fort Collins, the website’s content was revised to apply more broadly across industries and geographic regions in the United States. The homepages of the websites were formatted to resemble the Air Aware Linktree landing page, which provided users with a clear navigation structure. From there, participants could explore different sections, including information on identifying hazardous air quality and extreme heat conditions, understanding their health effects, and adopting protective measures. Additional resources such as downloadable guides and external links were also provided (see Appendix E).

4.1.5.10. Recent Hazard Experiences

To assess participants' recent hazard experiences in their area, they were asked two questions about conditions in their area over the past 3 months. For example, participants were asked if they recalled "seeing or hearing about air quality alerts" and whether they "thought the air quality in [their] local area was bad." Identical questions were asked regarding extreme heat. Participants were given response options that included “yes,” “no,” “not sure.”

4.1.5.11. Workplace Hazard Experiences

To distinguish between recent general exposure and direct workplace exposure, the study also measured direct workplace hazard experiences using two “yes” or “no” questions. Participants were asked whether they had ever experienced symptoms at work they believed were due to poor air quality, and whether they had ever experienced a heat illness at work. The broader timeframe of these questions was intended to capture significant poor air quality or extreme heat impacts regardless of when or where they occurred.

4.1.5.12. Demographic Characteristics

Participants provided demographic information including state of residence, zip code, gender, education level, income, race/ethnicity, and pre-existing health conditions. Additionally, participants were asked about their employment industry and sector, the length of time that they had worked in their current job, and whether their employer had administrative controls in place for air quality and extreme heat hazards in the workplace. The administrative controls questions included response options of “yes,” “no,” or “not sure.”

4.1.6. Analysis Approach

All analyses were conducted using IBM’s Statistical Package for the Social Sciences (SPSS; 2023) version 29 for macOS. Prior to conducting inferential analyses, the data were screened for accuracy, missing data, and outliers, and tested for assumptions of linearity, homoscedasticity, normality, and multicollinearity (Hayes, 2022). No significant violations were identified. Visual inspection of scatterplots indicated linear relationships among predictors and outcomes, standardized residuals were evenly distributed, and variance inflation factor (VIF) values were below 2.5, suggesting no multicollinearity concerns. These results supported the use of hierarchical ordinary least squares (OLS) regression and PROCESS Model 4 for hypothesis testing.

After confirming that the data met assumptions for regression analysis, descriptive statistics, including means and standard deviations for continuous variables and percentages for categorical variables, were calculated to summarize participant characteristics and item-level responses. Following Buchanan et al. (2024), individual attachment items were summed to create composite scores. This process yielded two separate scores for each participant: one for anxious attachment and one for avoidant attachment. Consistent with prior studies of the RISP model, scores for each RISP-related variable were averaged to form composite scales. As detailed in the Measurements section (4.1.5) the internal consistency of each scale was assessed using Cronbach's alpha with all scales demonstrating acceptable to good reliability.

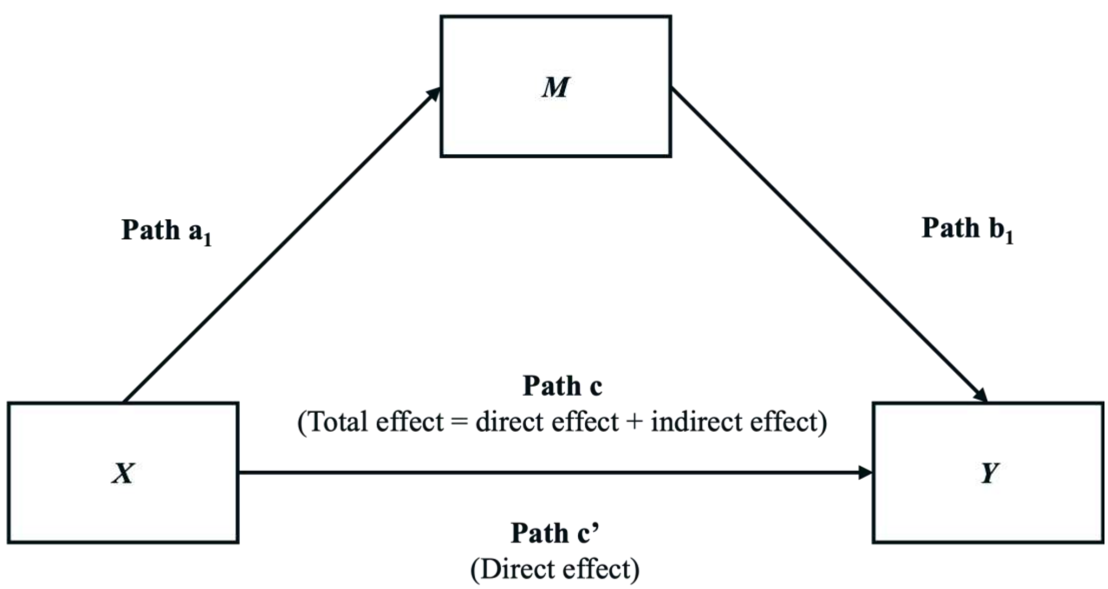
All analyses were conducted separately for air quality and extreme heat. This approach was chosen to determine whether the relationships between variables differed depending on the specific environmental hazard, as individuals' perceptions and behaviors may vary between distinct risk types.

To test H1 through H5, hierarchical ordinary least squares (OLS) regressions were conducted to estimate the incremental contribution of attachment orientations to RISP-related variables while controlling for relevant covariates. In Step 1, age, gender, education, industry sector, and hazard experience, defined as participants' prior experiences with air quality-or heat-related symptoms at work, were entered as control variables. In Step 2, anxious and avoidant attachment scores were added. This two-step approach, consistent with previous RISP research introducing new individual characteristics (e.g., H. K. Kim & Kim, 2019) and hierarchical regression best practices (see Cohen et al., 2003), allows for a clearer interpretation of the variance explained by attachment beyond demographic and occupational factors.

To test H6 through H8, mediation analyses were conducted using Hayes's (2022) PROCESS Macro (Model 4), version 5.0. This approach is used to investigate how a predictor variable (*X*) exerts it's influence on an outcome variable (*Y*) through one or more intervening variables, termed mediators (*M*). A conceptual representation of a simple mediation model with one mediator is shown in Figure 9.

Figure 9.

Conceptual Diagram of a Simple Mediation Model



The model illustrates the paths by which *X* influences *Y*. The indirect effect is the pathway through which *X* affects *Y* via the mediator (M), where path a_1 is the effect of *X* on *M* and path b_1 is the effect of *M* on *Y* (Hayes, 2022). The total effect (path c) of *X* on *Y* is the sum of the direct effect of *X* on *Y* (path c') and the indirect effect (path $a_1 * b_1$) of *X* on *Y* through *M*. Evidence for mediation is established by a significant indirect effect, indicated by a confidence interval that does not contain zero. In this study, evidence for mediation was assessed using bootstrapped, bias-corrected 95% confidence intervals (CI) from 5,000 samples (Hayes, 2022; Preacher & Hayes, 2008).

To test H9 and H10, multivariate linear regressions were used to test the direct relationships between attitudes toward information seeking and information seeking intention (H9), as well as perceived information seeking control and information seeking intention (H10). This approach was appropriate for assessing the strength and significance of these predictors while controlling for relevant covariates (Cohen et al., 2003).

To answer RQ1, which asked whether the proposed relationships varied by hazard type, a descriptive comparison of the path coefficients from the regression models for air quality and extreme heat was conducted. This approach follows the precedent of prior research that has compared model pathways across different risk contexts by examining the magnitude and significance of their respective path coefficients (e.g., Hong & Kim, 2022). This analysis was used to identify variations in the strength, direction, and statistical significance of the relationships between the two hazards by systematically comparing the beta coefficients for direct and indirect effects.

To address RQ2, the statistical approach was chosen to match the measurement level of the variables being analyzed. A series of one-way ANOVAs and chi-square tests of independence were selected as they are the standard and most appropriate methods for this type of analysis (Field, 2024; Hayes, 2005). A one-way ANOVA was used to examine regional differences in the RISP-related variables by comparing their mean scores across four U.S. regions. To analyze the categorical hazard experience variables (e.g., yes/no responses), chi-square tests of independence were conducted to determine if there was a significant association between a participant's region and their reported perceptions and behaviors.

4.2. Results

4.2.1. Sample Profile

The final sample for the quantitative phase of the study consisted of 220 participants representing all four major U.S. regions: the South (38.6%), West (25.9%), Midwest (20.5%), and Northeast (15.0%). Participants ranged in age from 18 to 64 years ($M = 36.6$, $SD = 11.0$), and the majority identified as male (70.5%), followed by female (29.1%), and nonbinary or third gender (0.5%). The final sample distributions for U.S. region, gender, and age closely aligned with the established recruitment quotas described in section 4.1.1.

The racial and ethnic composition of the sample was primarily White or Caucasian (67.3%), followed by Black or African American (15.0%), Hispanic or Latino (15.0%), Asian or Asian American (8.2%), and smaller percentages identifying as Native American or Alaska Native (0.9%) and Native Hawaiian or Pacific Islander (0.9%). Participants were able to select more than one category. Regarding educational attainment, nearly half of the sample held a bachelor's degree (45.9%), with an additional 20.5% reporting that they had some college education, but no degree, 11.8% reporting a graduate degree, and 9.5% had a high school diploma or GED. Annual household income varied widely, with the largest proportion of participants reporting incomes between $75,000 and $99,999 (23.2%), followed by $50,000 to $74,999 (19.5%), and $100,000 to $124,999 (12.3%) (see Table 4).

Table 4.

Demographic Characteristics of the Sample ($N = 220$)

	n	%
U.S. Region		
Northeast	33	15.0
Midwest	45	20.5
South	85	38.6
West	57	25.9
Gender		
Male	155	70.5
Female	64	29.1
Non-binary/Third gender	1	0.5
Age		
18-24 years	36	16.4
25-34 years	65	29.5
35-44 years	68	30.9
45-54 years	32	14.5
55-64 years	19	8.6
Race/Ethnicity		
Asian or Asian American	18	8.2
Black or African American	33	15.0
Hispanic or Latino	33	15.0
Native American or Alaska Native	2	0.9
Native Hawaiian or Pacific Islander	2	0.9
White or Caucasian	148	67.3
Education		
Less than high school	2	0.9
Completed some high school	1	0.5
High school diploma or GED	21	9.5
Job-specific training program(s) after high school	6	2.7
Some college, but no degree	45	20.5
Associate's degree	17	7.7
Bachelor's degree (such as B.A., B.S.)	101	45.9
Some graduate school, but no degree	1	0.5
Graduate degree (such as MBA, MS, M.D., Ph.D.)	26	11.8
Income		
Less than $15,000	9	4.1
$15,000 to $24,999	10	4.5
$25,000 to $34,999	14	6.4
$35,000 to $49,999	29	13.2

	n	%
$50,000 to $74,999	43	19.5
$75,000 to $99,999	51	23.2
$100,000 to $124,999	27	12.3
$125,000 to $149,999	16	7.3
$150,000 to $199,999	11	5.0
$200,000 to $249,999	5	2.3
$250,000 or more	5	2.3

The majority of participants rated their physical health as good (67.3%) or excellent (17.7%). Among diagnosed pre-existing conditions, allergies were the most common, affecting 42.3% of the sample. Approximately one-fifth of participants reported diagnoses for being overweight or obese (21.8%) or for a mental health condition (20.0%). Pre-existing conditions such as heart disease (4.1%) and lung disease (3.6%) were less common (see Table 5).

Table 5.

Health Characteristics of the Sample (N = 220)

	n	%
In general, would you say that your physical health is…?		
Excellent	39	17.7
Good	148	67.3
Fair	32	14.5
Poor	1	0.5
Have you ever been diagnosed with lung disease?		
Yes	8	3.6
No	212	96.4
Have you ever been diagnosed with heart disease?		
Yes	9	4.1
No	211	95.9
Have you ever been diagnosed with allergies?		
Yes	93	42.3
No	127	57.7
Have you ever been diagnosed with mental health conditions?		
Yes	44	20.0
No	176	80.0
Have you ever been diagnosed as being overweight or obese?		
Yes	48	21.8
No	172	78.2
Have you ever been diagnosed with a diabetes-related condition?		

	n	%
Yes	15	6.8
No	205	93.2

Most participants were employed full-time (86.4%) in the for-profit sector (86.4%). The top industries represented were construction (17.3%) agriculture, forestry, fishing and hunting (10.5%); and transportation and warehousing (8.2%). Most were established in their roles, with over half (56.4%) employed in their current job for 1 to 5 years. Regarding administrative controls, there was a notable gap between hazards: 56.8% of participants reported safety controls for extreme heat, compared to only 37.7% for poor air quality. This discrepancy was also reflected in worker uncertainty, where 15.5% were unsure about air quality protections (see Table 6).

Table 6.

Occupational Characteristics of the Sample (*N* = 220)

	n	%
Employment Status		
Employed full time	190	86.4
Employed part time	30	13.6
Industry		
Agriculture, Forestry, Fishing and Hunting	23	10.5
Arts, Entertainment, and Recreation	10	4.5
Construction	38	17.3
Couriers, Messengers, and Delivery Services	12	5.5
Educational Services	6	2.7
Food Services and Drinking Places	12	5.5
Forestry and Logging	3	1.4
Health Care and Social Assistance	16	7.3
Information	11	5.0
Manufacturing	16	7.3
Mining, Quarrying, and Oil and Gas Extraction	3	1.4
Professional and Business Services	7	3.2
Professional, Scientific, and Technical Services	9	4.1
Real Estate	7	3.2
Repair and Maintenance	13	5.9
Retail Trade	11	5.0

	n	%
Transportation and Warehousing	18	8.2
Utilities	3	1.4
Other	2	0.9
Length of Employment in Current Job		
Under 1 year	20	9.1
1 to 5 years	124	56.4
6 to 10 years	41	18.6
11 to 15 years	16	7.3
16 to 25 years	18	8.2
26+ years	1	0.5
Employment Sector		
For-profit	190	86.4
Not-for-profit	11	5.0
Local, state, or federal government	18	8.2
Are there any administrative controls in your workplace for working during poor air quality conditions?		
Yes	83	37.7
No	103	46.8
Not sure	34	15.5
Are there any administrative controls in your workplace for working during extreme heat conditions?		
Yes	125	56.8
No	74	33.6
Not sure	21	9.5

Participants reported recent experience with both environmental hazards, though exposure to extreme heat was far more prevalent than poor air quality. A vast majority of the sample recalled seeing or hearing local heat warnings (87.7%) and personally perceived the heat as bad (88.2%) within the past 3 months. In contrast, just over 60% of participants recalled air quality alerts (61.4%) and perceived the air quality as bad (60.5%) during the same period.

Table 7.

Recent Experiences with Poor Air Quality and Extreme Heat ($N = 220$)

	n	%
During the past 3 months, do you recall seeing or hearing about air quality alerts in your local area?		
Yes	135	61.4
No	72	32.7

	n	%
Not sure	13	5.9
Was there any time during the past 3 months that you thought that the air quality in your local area was bad?		
Yes	133	60.5
No	73	33.2
Not sure	14	6.4
During the past 3 months, do you recall seeing or hearing warnings about heat in your local area?		
Yes	193	87.7
No	18	8.2
Not sure	9	4.1
Was there any time during the past 3 months that you thought that the heat in your local area was bad?		
Yes	194	88.2
No	23	10.5
Not sure	3	1.4

In addition to participants' recent experiences, many participants directly felt the health impacts of these environmental hazards in the workplace. Approximately one-third of participants said they had experienced symptoms at work they attributed to poor air quality (33.6%), a figure almost identical to those who reported experiencing a heat illness at work (33.2%).

Table 8.

Workplace Experiences with Poor Air Quality and Extreme Heat (*N* = 220)

	n	%
Have you ever experienced symptoms at work that you thought could be due to poor air quality?		
Yes	73	33.6
No	147	66.4
Have you ever experienced a heat illness at work?		
Yes	74	33.2
No	146	66.8

4.2.2. Hypothesis Testing

The following section presents the results of hypothesis testing and investigates relationships among key RISP concepts and attachment theory, as well as factors that influence air quality and extreme heat information seeking behaviors. Unless otherwise noted, all reported beta coefficients (β) are standardized. Standardized coefficients function as a measure of effect size and allow for a direct comparison of the predictive strength of each variable (Siegel, 2012).

4.2.2.1. Hypotheses 1 & 2: Attachment, Risk Perception, Negative Affective Response, and Informational Subjective Norms

4.2.2.1.1. Risk Perception (H1a & H2b)

H1a focused on whether attachment anxiety positively predicts risk perception and H2a tested whether attachment avoidance negatively predicts risk perception.

For air quality, bivariate correlations indicated that attachment anxiety was significantly and positively associated with air quality risk perception ($r = .16$, $p = .020$), and attachment avoidance was not ($r = .07$, $p = .30$). However, hierarchical regression results indicated that when demographic and experiential variables were entered at Step 1, they explained a significant portion of the variance in risk perception ($R^2 = .14$, $F(7, 212) = 4.82$, $p < .001$). Adding attachment anxiety and attachment avoidance at Step 2 did not significantly improve the model ($\Delta R^2 = .01$, $\Delta F(2, 210) = 1.50$, $p = .225$). In the final model, neither attachment anxiety ($\beta = .12$, $p = .122$) nor attachment avoidance ($\beta = -.02$, $p = .822$) were significant individual predictors. These results suggest that although attachment anxiety shares a bivariate association with air quality risk perception, this relationship does not account for variance beyond demographic and experiential factors. Thus, H1a and H2a were not supported for air quality.

A similar analysis was conducted for extreme heat, where demographic and experiential variables entered at Step 1 explained 11% of the variance in risk perception (R^2= .11, $F(2, 210) = 3.78$, $p < .001$). The inclusion of attachment orientations in Step 2 significantly increased explained variance to 14% ($\Delta R^2 = .03$, $\Delta F(7, 212) = 3.78$, $p = .028$). In this model, higher attachment avoidance was a significant predictor of lower risk perception, ($\beta = -.21$, $p = .008$) whereas attachment anxiety was not significant. Overall, these results offered partial support for the hypotheses. H1a was not supported for either hazard, while H2a was supported in the context of extreme heat only.

4.2.2.1.2. Negative Affective Response (H1b & H2b)

H1b proposed that attachment anxiety positively predicts negative affective response and H2b tested whether attachment avoidance negatively predicts negative affective response.

For air quality, demographic variables and previous experience with air quality-related symptoms in Step 1, accounted for 9% of the variance ($R^2 = .09$, $F(7, 212) = 3.06$, $p = .004$). Adding attachment anxiety and attachment avoidance in Step 2 significantly improved the model ($\Delta R^2 = .03$, $\Delta F(2, 210) = 3.31$, $p = .039$), increasing explained variance to 12%. However, neither attachment anxiety ($\beta = .15$, $p = .07$) nor attachment avoidance ($\beta = .04$, $p = .61$) emerged as significant predictors on their own.

This pattern is not attributable to problematic multicollinearity; diagnostic tests confirmed that the Variance Inflation Factor (VIF) scores for attachment anxiety (1.57) and attachment avoidance (1.53), well below conventional thresholds for concern.[9] The strong

[9] The Variance Inflation Factor (VIF) measures the extent to which the variance of an estimated regression coefficient is due to multicollinearity, where scores of 2.5 or higher indicate potential concern (Thompson et al., 2017).

correlation[10] between the two attachment dimensions ($r = .56$, $p < .001$) suggests that the unique contributions of each predictor was masked. Thus, while their combined effect significantly predicted negative affective response to air quality, their individual effects could not be statistically distinguished in this model.

For extreme heat, demographic variables and previous experience in Step 1 accounted for 16% of the variance ($R^2 = .16$, $F(7, 212) = 5.63$, $p < .001$). Including attachment anxiety and attachment avoidance in Step 2 significantly increased explained variance to 23% ($\Delta R^2 = .07$, $\Delta F(2, 210) = 9.82$, $p < .001$). Attachment anxiety predicted stronger negative affective response ($\beta = .34$, $p < .001$), while attachment avoidance predicted weaker negative affective response ($\beta = -.20$, $p = .008$). These results indicate that each attachment orientation served as an independent predictor of negative affective response to extreme heat. Therefore, both H1b and H2b were supported in the extreme heat context.

4.2.2.1.3. Informational Subjective Norms (H1c & H2c)

H1c tested whether attachment anxiety positively predicts informational subjective norms and H2c tested whether attachment avoidance negatively predicts informational subjective norms.

For air quality, demographic and experiential variables in Step 1 explained 9% of the variance ($R^2 = .09$, $F(7, 212) = 2.98$, $p = .005$) in informational subjective norms. Adding attachment anxiety and attachment avoidance in Step 2 slightly increased the explained variance to 11%, though this increase was not statistically significant ($\Delta R^2 = .02$, $\Delta F(2, 210) = 2.20$, $p = .11$). Attachment anxiety emerged as a significant positive predictor of informational subjective

[10] The strength of the correlation coefficient (r) is often interpreted using established guidelines (see Cohen, 1988), though conventions may vary by discipline. Generally, correlations are considered weak when $.1 < |r| < .3$, moderate when $.3 < |r| < .5$, and strong when $|r| \geq .5$.

norms (β = .17, p = .04), suggesting that individuals with higher attachment anxiety perceived greater social expectations to stay informed about air quality risks. Attachment avoidance was not significantly related to informational subjective norms (β = -.11, p = .17). Thus, H1c was supported and H2c was not supported in the air quality context.

For extreme heat, the demographic and experiential variables in Step 1 explained 4% of the variance (R^2 = .04, $F(7, 212)$ = 1.15, p = .33)[11] in informational subjective norms. Adding attachment anxiety and attachment avoidance in Step 2 significantly improved the model (ΔR^2 = .06, $\Delta F(2, 210)$ = 7.02, p = .001), increasing the explained variance to 10%. Attachment anxiety showed a positive relationship with informational subjective norms (β = .24, p = .003), while attachment avoidance showed a negative relationship (β = -.29, p < .001). Individuals higher in attachment anxiety perceived stronger social expectations to seek information about extreme heat, whereas those higher in attachment avoidance perceived weaker social expectations. These results support H1c and H2c in the extreme heat context. Tables 9 and 10 present summaries of the regressions testing hypotheses 1 and 2.

[11] Although the block of control variables in Step 1 was not statistically significant, it was retained in the model to maintain a consistent analytical strategy across all hypotheses and provide a test of the incremental variance explained by attachment anxiety and attachment avoidance in Step 2.

Table 9.

Summary of Hierarchical Regression Analyses Testing H1-H2 (Air Quality)

	Risk perception				Negative affective response				Informational subjective norms			
	Step 1		Step 2		Step 1		Step 2		Step 1		Step 2	
Predictors	β	t	β	t	β	t	β	t	β	t	β	t
Age	-.10	-1.56	-.08	-1.15	-.14	-2.04^{*}	-.10	-1.43	-.04	-0.60	-.02	-0.28
Gender	.18	2.76^{**}	.17	2.56^{*}	.12	1.84	.10	1.54	.03	0.38	.02	0.24
Region	.08	1.17	.07	1.14	.07	0.99	.07	1.06	.06	0.89	.05	0.72
Education	.07	1.03	.06	0.86	.19	2.69^{*}	.18	2.59^{*}	.26	3.65^{***}	.23	3.26^{***}
Income	.06	0.81	.07	1.05	.05	0.74	.07	1.02	.06	0.92	.09	1.26
Industry	-.06	-0.86	-.06	-0.94	-.05	-0.69	-.06	-0.84	-.07	-0.99	-.07	-1.02
Air quality hazard experience	.25	3.71^{***}	.24	3.63^{***}	.07	1.05	.06	0.90	.00	-0.02	.00	-0.02
Attachment anxiety			.12	1.55			.15	1.81			.17	2.08^{*}
Attachment avoidance			-.02	-0.22			.04	0.51			-.11	-1.38
	$R^2 = .14, F(7, 212) = 4.82, p < .001$		$\Delta R^2 = .01, \Delta F(2, 210) = 1.50, p = .22$		$R^2 = .09, F(7, 212) = 3.06, p = .004$		$\Delta R^2 = .03, \Delta F(2, 210) = 3.31, p = .04$		$R^2 = .09, F(7, 212) = 2.98, p = .005$		$\Delta R^2 = .02, \Delta F(2, 210) = 2.20, p = .11$	

Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

Table 10.

Summary of Hierarchical Regression Analyses Testing H1-H2 (Extreme Heat)

	Risk perception				Negative affective response				Informational subjective norms			
	Step 1		Step 2		Step 1		Step 2		Step 1		Step 2	
Predictors	β	t	β	t	β	t	β	t	β	t	β	t
Age	-.03	-0.41	-.03	-0.47	-.11	-1.74	-.07	-1.06	-.02	-0.22	-.01	-0.08
Gender	.12	1.78	.12	1.86	.26	3.98^{***}	.24	3.79^{***}	.02	0.25	.02	0.23
Region	.10	1.58	.08	1.26	.06	1.00	.04	0.71	.11	1.54	.08	1.14
Education	-.08	-1.22	-.11	-1.67	.12	1.84	.08	1.17	.06	0.91	.02	0.23
Income	.04	0.62	.06	0.89	.00	0.02	.05	0.74	.05	0.68	.08	1.19
Industry	-.04	-0.67	-.04	-0.62	-.14	-2.26^{*}	-.15	-2.43^{*}	.01	0.21	.02	0.25
Heat hazard experience	.27	4.10^{***}	.28	4.25^{***}	.18	2.81^{**}	.17	2.82^{**}	.12	1.79	.13	1.91
Attachment anxiety			.13	1.61			.34	4.42^{***}			.24	2.96^{**}
Attachment avoidance			-.21	-2.69^{**}			-.20	-2.68^{**}			-.29	-3.56^{***}
	$R^2 = .11$, $F(7, 212) = 3.78$, $p < .001$		$\Delta R^2 = .03$, $\Delta F\ (2, 210) = 3.78$, $p = .03$		$R^2 = .16$, $F(7, 212) = 5.63$, $p < .001$		$\Delta R^2 = .07$, $\Delta F\ (2, 210) = 9.82$, $p < .001$		$R^2 = .04$, $F(7, 212) = 1.15$, $p = .33$		$\Delta R^2 = .06$, $\Delta F(2, 210) = 7.02$, $p = .001$	

Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

4.2.2.2. Hypothesis 3: Attachment and Information Insufficiency

H3a focused on whether attachment anxiety negatively predicts information insufficiency and H3b tested whether attachment avoidance negatively predicts information insufficiency.

For air quality, demographic and experiential variables in Step 1 explained 2% of the variance, which was not statistically significant ($R^2 = .02$, $F(7, 212) = .73$, $p = .65$). Adding attachment anxiety and attachment avoidance in Step 2 marginally increased the explained variance to 3%; but the change was not statistically significant ($\Delta R^2 = .002$, $\Delta F(2, 210) = .22$, $p = .80$). Neither attachment anxiety ($\beta = .05$, $p = .52$) nor avoidant attachment ($\beta = -.04$, $p = .61$) significantly predicted perceived information insufficiency for air quality.

For extreme heat, demographic and experiential variables in Step 1 explained 4% of the variance in information insufficiency, which was not statistically significant ($R^2 = .04$, $F\ (7, 212) = 1.26$, $p = .27$). Adding attachment anxiety and attachment avoidance in Step 2 increased the explained variance to 4.5%, but the change was not statistically significant ($\Delta R^2 = .004$, $\Delta F\ (2, 210) = .57$, $p = .57$). Neither attachment anxiety ($\beta = .02$, $p = .78$) nor attachment avoidance ($\beta = -.08$, $p = .31$) were significant predictors of perceived information insufficiency in the extreme heat context. Overall, neither attachment anxiety nor attachment avoidance predicted perceived information insufficiency for either hazard. Therefore, H3 was not supported in either context.

4.2.2.3. Hypothesis 4: Attachment and Attitudes Toward Information Seeking

H4a focused on whether attachment anxiety negatively predicts attitudes toward information seeking and H4b tested whether attachment avoidance negatively attitudes toward information seeking.

For air quality, demographic and experiential variables in Step 1, explained 4% of the variance in attitudes toward information seeking ($R^2 = .04$, $F\ (7, 212) = 1.35$, $p = .23$). Adding attachment anxiety and attachment avoidance in Step 2 significantly improved the model (ΔR^2 = .06, ΔF (2, 210) = 6.56, p = .002), increasing the explained variance to 10%. However, neither attachment anxiety (β = -.12, p = .14) nor avoidant attachment avoidance (β = -.16, p = .05) were significant predictors of attitudes toward information seeking for air quality. As was the case for H1b, this pattern reflects the strong correlation between the two attachment dimensions, rather than problematic multicollinearity.

For extreme heat, the same pattern occurred. Demographic and experiential variables entered in Step 1 which explained 7% of the variance in attitudes toward information seeking (R^2 = .07, F (7, 212) = 2.18, p = .04). Adding attachment anxiety and attachment avoidance in Step 2 significantly improved the model (ΔR^2 = .04, ΔF (2, 210) = 5.15, p = .007), increasing the explained variance to 11%. However, neither attachment anxiety (β = -.14, p = .08) nor attachment avoidance (β = -.10, p = .20) significantly predicted attitudes toward information seeking for extreme heat. In summary, the analysis indicates that attachment anxiety and attachment avoidance on their own do not significantly predict attitudes toward information seeking for either air quality or extreme heat risks. Therefore, H4 was not supported in either context.

4.2.2.4. Hypothesis 5: Attachment and Perceived Information Seeking Control

H5a tested whether attachment anxiety negatively predicts perceived information seeking control and H5b tested whether attachment avoidance negatively predicts perceived information seeking control.

For air quality, the demographic and experiential variables entered in Step 1 explained 6% of the variance (R^2 = .06, F (7, 212) = 1.84, p = .08). Adding attachment anxiety and attachment avoidance in Step 2 slightly increased the explained variance to 8%, but this change was not statistically significant ($\Delta R^2 = .02$, $\Delta F\ (2, 210) = 2.82$, $p = .06$). Neither attachment anxiety ($\beta = -.07$, $p = .43$) nor attachment avoidance ($\beta = -.12$, $p = .16$) were predictors of perceived information seeking control.

For extreme heat, the demographic and experiential variables entered in Step 1 explained 11% of the variance ($R^2 = .11$, $F\ (7, 212) = 3.66$, $p < .001$). Adding attachment anxiety and attachment avoidance in Step 2 significantly increased the explained variance to 15% ($\Delta R^2 = .04$, $\Delta F\ (7, 210) = 4.66$, $p = .01$). However, neither attachment anxiety ($\beta = -.12$, $p = .13$) nor attachment avoidance ($\beta = -.11$, $p = .17$) emerged as significant predictors. Once again, this pattern reflects the strong correlation between the two attachment dimensions, rather than problematic multicollinearity.

These results indicate that neither anxious nor avoidant attachment significantly predicts perceived information seeking control for either hazard. Therefore, H5 was not supported in either context. Tables 11 and 12 provide regression results for hypotheses 3 through 5.

Table 11.

Summary of Hierarchical Regression Analyses Testing H3- H5 (Air Quality)

	Information Insufficiency				Attitudes Toward Information Seeking				Perceived Information Seeking Control			
	Step 1		Step 2		Step 1		Step 2		Step 1		Step 2	
Predictors	β	t	β	t	β	t	β	t	β	t	β	t
Age	.09	1.32	.10	1.37	.09	1.26	.04	0.52	.21	3.07^{**}	.18	2.56^{*}
Gender	.04	0.52	.03	0.48	.15	2.20^{*}	.18	2.65^{**}	.07	0.95	.08	1.21
Region	-.01	-0.11	-.01	-0.17	-.04	-0.54	-.05	-0.79	.00	0.01	-.01	-0.17
Education	.08	1.13	.07	0.99	-.06	-0.86	-.07	-1.00	-.02	-0.28	-.03	-0.40
Income	.03	0.38	.04	0.48	.03	0.45	.02	0.24	.06	0.87	.05	0.76
Industry	.03	0.40	.03	0.39	-.01	-0.09	.01	0.12	.05	0.71	.06	0.85
Air quality hazard experience	.05	0.72	.05	0.72	.07	0.93	.08	1.23	.00	-0.01	.01	0.18
Attachment anxiety			.05	0.64			-.12	-1.46			-.07	-0.79
Attachment avoidance			-.04	-0.50			-.16	-1.94			-.12	-1.42
	$R^2 = .02, F(7, 212) = 0.73, p = .65$		$\Delta R^2 = .002, \Delta F(2, 210), =0.22, p = .80$		$R^2 = .04, F(7, 212) = 1.35, p = .23$		$\Delta R^2 = .06, \Delta F(2, 210) = 6.56, p = .002$		$R^2 = .06, F(7, 212) = 1.84, p = .08$		$\Delta R^2 = .02, \Delta F(2, 210) = 2.82, p = .06$	

Note. $^{*} p < .05$, $^{**} p < .01$, $^{***} p < .001$

Table 12.

Summary of Hierarchical Regression Analyses Testing H3-H5 (Extreme Heat)

	Information Insufficiency				Attitudes Toward Information Seeking				Perceived Information Seeking Control			
	Step 1		Step 2		Step 1		Step 2		Step 1		Step 2	
Predictors	β	t	β	t	β	t	β	t	β	t	β	t
Age	.05	0.69	.04	0.56	.07	1.01	.02	0.30	.25	3.86^{***}	.21	3.17^{**}
Gender	.12	1.69	.12	1.75	.11	1.66	.14	2.06^{*}	.09	1.29	.11	1.67
Region	-.09	-1.31	-.10	-1.42	.06	0.94	.05	0.79	-.01	-0.17	-.02	-0.35
Education	.11	1.56	.10	1.39	-.17	-2.47^{*}	-.17	-2.47^{*}	-.14	-2.02^{*}	-.14	-2.04^{*}
Income	-.07	-1.02	-.07	-0.95	.08	1.07	.06	0.81	.13	1.81	.11	1.58
Industry	-.02	-0.23	-.01	-0.19	.05	0.77	.06	0.92	.05	0.69	.05	0.84
Extreme heat hazard experience	.03	0.42	.03	0.48	.11	1.69	.13	1.95	.07	1.02	.08	1.26
Attachment anxiety			.02	0.28			-.14	-1.74			-.12	-1.51
Attachment avoidance			-.08	-1.01			-.10	-1.28			-.11	-1.37
	R^2 = .040, F (7, 212) = 1.26, p = .27		ΔR^2 = .004, ΔF(2, 210), =.57, p = .57		R^2 = .067, F(7, 212) = 2.18, p = .04		ΔR^2 = .044, ΔF(2, 210) = 5.147, p = .007		R^2 = .108, F (7, 212) = 3.662, p < .001		ΔR^2 = .038, ΔF (2, 210) = 4.656, p = .01	

Note. * $p < .05$, ** $p < .01$, $^{***}p < .001$

4.2.2.5. Hypotheses 6: Information Insufficiency, Information Seeking Intention, and Active Information Seeking

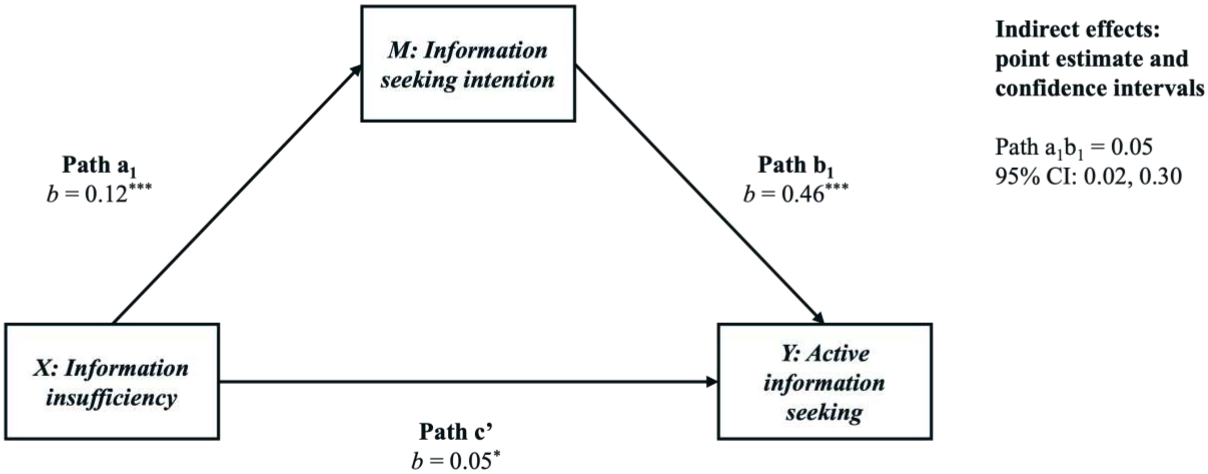
Hypothesis 6 proposed that (a) information insufficiency will be positively related to information seeking intention and (b) information seeking intention will be directly positively related to active information seeking. Additionally, (c) information seeking intention will mediate the relationship between information insufficiency and active information seeking.

For air quality, results from a logistic regression-based mediation using PROCESS Model 4 supported all three predictions. Information insufficiency significantly predicted information seeking intention (path a_1: $b = 0.12$, $SE = 0.03$, $t = 3.63$, $p < .001$, 95% CI [0.05, 0.18]). Information seeking intention, in turn, significantly predicted active information seeking (path b_1: $b = 0.46$, $SE = 0.15$, $z = 0.01$, $p = .003$, 95% CI [0.16, 0.76]). The direct effect of information insufficiency on active information seeking remained significant after controlling for information seeking intention (direct effect, path c': $b = 0.05$, $SE = 0.07$, $z = 2.99$, $p = .029$, 95% CI [0.02, 0.30]). The indirect effect of information insufficiency through information seeking intention on active information seeking was also significant, as the 95% bootstrapped confidence interval did not contain zero ($b = 0.05$, Boot$SE = 0.03$, 95% CI [0.02, 0.30]) (see Figure 10).[12]

[12] For mediation models with a binary outcome, total effect (path C) and a standardized indirect effect size is not computed, as effects are calculated and interpreted in a log-odds metric. In line with best practices for logistic regression-based mediation, the unstandardized indirect effect (*b*) and its bootstrapped 95% confidence interval are reported as the primary evidence of the effect (Hayes, 2022). The coefficient itself serves as the measure of the effect's magnitude, and significance is inferred from a confidence interval that does not contain zero.

Figure 10.

Results of Mediation Analysis for H6 (Air Quality)

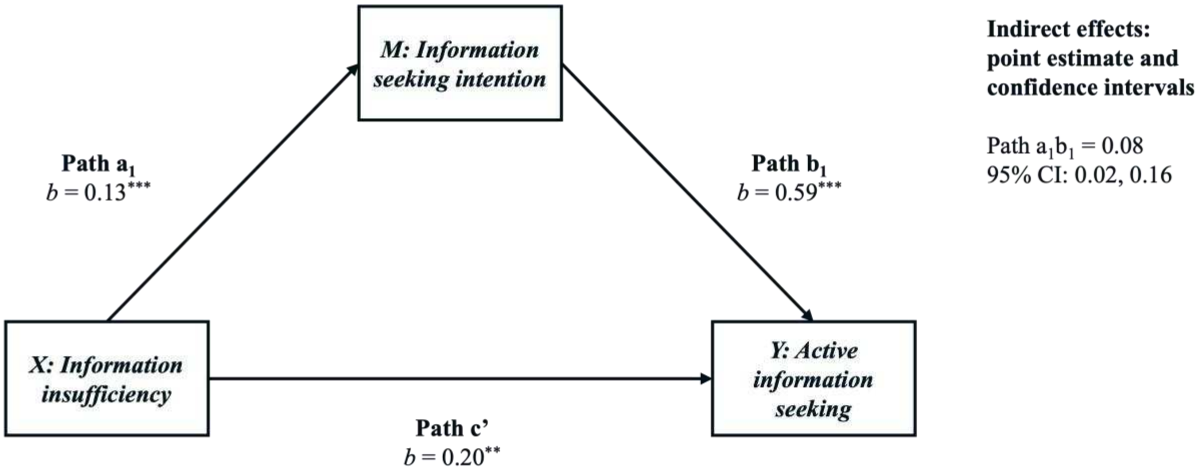


Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Similar results emerged for extreme heat. Information insufficiency significantly predicted information seeking intention (path a_1: $b = 0.13$, $SE = 0.03$, $t = 4.08$, $p < .001$, 95% CI [0.07, 0.20]), and information seeking intention significantly predicted active information seeking (path b_1: $b = 0.59$, $SE = 0.16$, $z = 3.57$, $p < .001$, 95% CI [0.26, 0.91]). The direct effect of information insufficiency on active information seeking remained significant after controlling for information seeking intention (direct effect, path c': $b = 0.20$, $SE = 0.08$, $z = 2.59$, $p = .010$, 95% CI [0.05, 0.35]). The indirect effect of information insufficiency on active information seeking through intention was also significant (path a_1b_1: $b = 0.08$, Boot$SE = 0.03$, 95% CI [0.02, 0.16]) (see Figure 11).

Figure 11.

Results of Mediation Analysis for H6 (Extreme Heat)



Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Overall, H6 was fully supported in both contexts. For air quality and extreme heat, information insufficiency was positively related to seeking intention (H6a), which was positively related to active seeking (H6b). The significant direct effect (c' path) alongside the significant indirect effect indicates that information seeking intention partially mediates the relationship between information insufficiency and active information seeking (H6c).

4.2.2.6. Hypotheses 7: Negative Affective Response, Information Insufficiency, and Information Seeking Intention

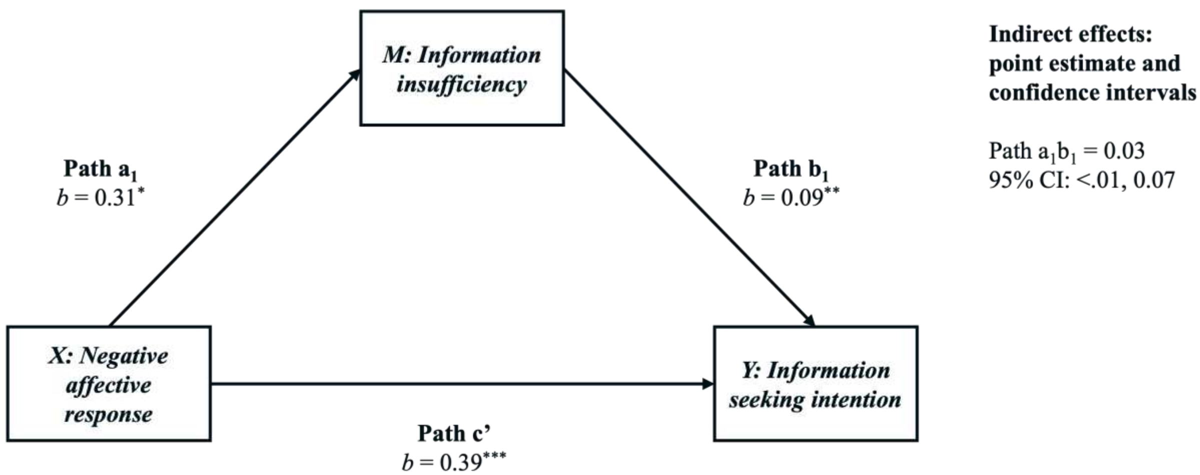
Hypothesis 7 predicted that negative affective response would be positively related to (a) information insufficiency and (b) information seeking intention, and that (c) information insufficiency would mediate this relationship.

For air quality, the results from the mediation analysis (PROCESS Model 4) supported the hypothesis. Negative affective response significantly predicted information insufficiency (path a_1: $b = 0.31$, $SE = 0.14$, $t = 2.28$, $p = .023$, 95% CI [0.04, 0.58]) and information insufficiency significantly predicted information seeking intention (path b_1: $b = 0.09$, $SE = 0.03$, $t = 2.91$, $p = .004$, 95% CI [0.03, 0.15]). The indirect effect of negative affective response on seeking intention through information insufficiency was significant, as confirmed by a bootstrapped confidence interval that did not contain zero (path a_1b_1: $b = 0.03$, Boot$SE = 0.02$, 95% CI [<.01, 0.07]). The completely standardized indirect effect was b_{cs} =.029, representing a small effect size.[13] After accounting for information insufficiency, the direct effect of negative affective response on information seeking intention remained significant (path c': $b = 0.39$, $SE = 0.06$, $t = 6.53$, $p < .001$, 95% CI [0.27, 0.50]). The presence of both a significant indirect effect and a significant direct effect indicates that information insufficiency partially mediates the relationship between negative affective response and information seeking intention in the air quality context (see Figure 12).

[13] The completely standardized indirect effect (b_{cs}) is reported as the formal measure of effect size for the mediation pathway. This metric represents the expected standard deviation change in *Y* for a one standard deviation increase in *X* through *M*. This standardized path coefficient is considered the most appropriate effect size for the indirect effect (Lachowicz et al., 2018; Preacher & Kelley, 2011)

Figure 12.

Results of Mediation Analysis for H7 (Air Quality)



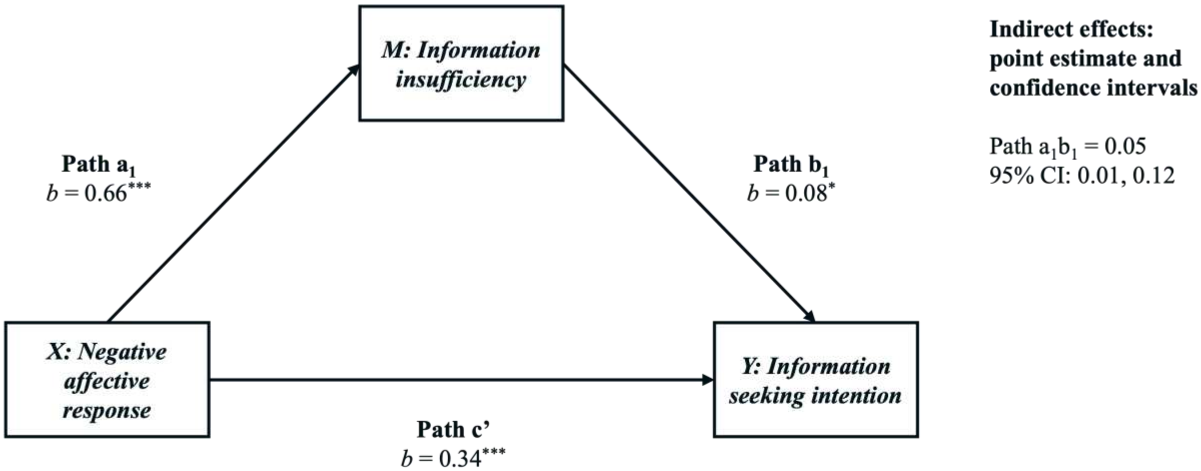
Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

For extreme heat, the results of the mediation analysis likewise supported the hypothesis. Negative affective response significantly predicted information insufficiency (path a_1: b = 0.66, SE = 0.14, $p < .001$), and information insufficiency significantly predicted information seeking intention (path b_1: b = 0.08, SE = 0.03, p = .011).

The indirect effect of negative affective response on seeking intention through information insufficiency was significant (path a_1b_1: b = 0.05, BootSE = 0.03, 95% CI [0.01, 0.12]). The completely standardized indirect effect was b_{cs} = .056, representing a small effect size. After accounting for the mediator, the direct effect of negative affective response on information seeking intention remained significant (path c': b = 0.34, SE = 0.07, $p <$ .001). As with air quality, the presence of both a significant indirect and direct effect indicates that information insufficiency partially mediates the relationship between negative affective response and information seeking intention for extreme heat (see Figure 13).

Figure 13.

Results of Mediation Analysis for H7 (Extreme Heat)



Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

In summary, H7 was fully supported, with results confirming that information insufficiency partially mediates the positive relationship between negative affective response and information seeking intention across both the air quality and extreme heat contexts.

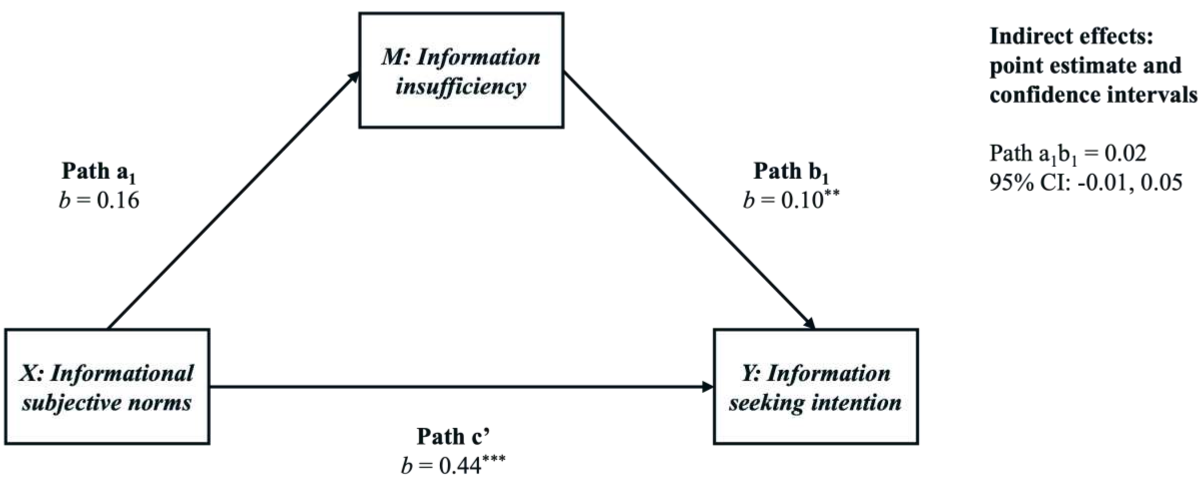
4.2.2.7. Hypotheses 8: Informational Subjective Norms, Information Insufficiency, and Information Seeking Intention

Hypothesis 8 proposed that informational subjective norms would be positively related to (a) information insufficiency and (b) information seeking intention. Additionally, it predicted that (c) information insufficiency would mediate the relationship between informational subjective norms and information seeking intention.

For air quality, the results from the mediation analysis did not support the full hypothesis. Informational subjective norms did not significantly predict information insufficiency (path a_1: $b = 0.16$, $SE = 0.13$, $p = .209$). While information insufficiency was a significant predictor of information seeking intention (path b_1: $b = 0.10$, $SE = 0.03$, $p = .001$), the indirect effect of subjective norms on seeking intention through information insufficiency was not statistically significant, as the confidence interval contained zero (path a_1b_1: $b = 0.02$, BootSE = 0.02, 95% CI [−0.01, 0.05]). However, the direct effect of informational subjective norms on information seeking intention was significant (path c': $b = 0.44$, $SE = 0.05$, $p < .001$). This pattern indicates that for air quality, information insufficiency does not function as a mediator. Instead, the relationship between informational subjective norms and seeking intention is a direct effect only (see Figure 14).

Figure 14.

Results of Mediation Analysis for H8 (Air Quality)

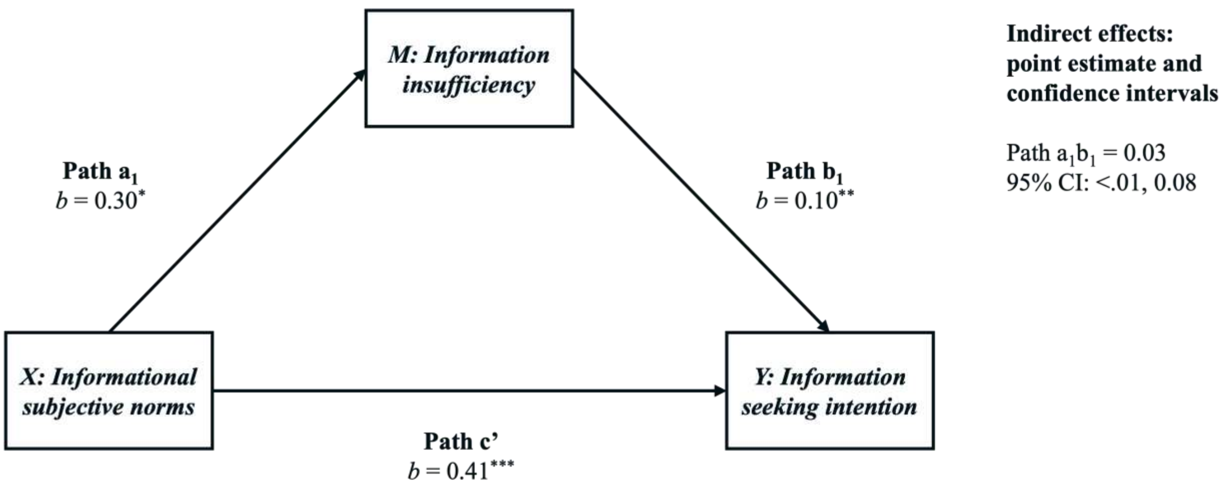


Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

For extreme heat, the results of the mediation analysis supported the hypothesis. Informational subjective norms significantly predicted information insufficiency (path a_1: $b = 0.30$, $SE = 0.13$, $p = .021$), which in turn significantly predicted information seeking intention (path b_1: $b = 0.10$, $SE = 0.03$, $p = .001$). The indirect effect of subjective norms on seeking intention through information insufficiency was significant (path a_1b_1: $b = 0.03$, BootSE = 0.02, 95% CI [<.01, 0.08]). The completely standardized indirect effect was $b_{cs} = .03$, representing a small effect size. After accounting for the mediator, the direct effect of informational subjective norms on information seeking intention also remained significant (path c': $b = 0.41$, $SE = 0.05$, $p < .001$). This presence of both a significant indirect and direct effect indicates that information insufficiency partially mediates the relationship between informational subjective norms and information seeking intention for extreme heat (see Figure 15).

Figure 15.

Results of Mediation Analysis for H8 (Extreme Heat)



Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

Overall, the findings for H8 offer partial and context-dependent support, highlighting a key difference between the two hazards. While information insufficiency partially mediated the relationship between subjective norms and seeking intention for extreme heat, this indirect path was not significant for air quality, where subjective norms influenced seeking intention through a direct effect only.

4.2.2.8. *Hypotheses 9: Attitudes Toward Information Seeking and Information Seeking Intention*

Hypothesis 9 predicted that attitudes toward information seeking would be positively related to information seeking intention. For air quality, a multiple regression analysis was conducted to examine the predictive power of attitudes toward information seeking on air quality information seeking intention, while controlling for demographic variables and experience with air quality-related symptoms. The overall model was significant, $R^2 = .22$, $F\ (8, 211) = 7.42$, $p < .001$. Attitudes toward information seeking significantly predicted information seeking intention, $\beta = .43$, $t = 6.93$, $p < .001$.

A similar regression analysis for extreme heat also yielded a significant model, $R^2 = .12$, $F\ (8, 211) = 3.55$, $p < .001$. Attitudes toward information seeking significantly predicted intention to seek information about extreme heat, $\beta = .32$, $t = 4.78$, $p < .001$. These results fully support H9 demonstrating that attitudes toward information seeking were positively related to information seeking intention in both air quality and extreme heat contexts (see Table 13).

Table 13.

Summary of Hierarchical Regression Analyses Testing H9 for Both Hazards

	Information Seeking Intention (Air Quality)		Information Seeking Intention (Extreme Heat)	
Predictors	β	t	β	t
Age	-0.15	-2.44	-0.04	-0.65
Gender	0.01	0.13	0.05	0.74
Region	0.05	0.83	-0.04	-0.60
Education	0.06	0.86	-0.02	-0.36
Income	0.07	1.05	0.02	0.28
Industry	0.09	1.43	0.01	0.08
Hazard experience	0.08	1.21	0.07	1.00
Attitudes toward information seeking	0.43	6.93^{***}	0.32	4.78^{***}
	$R^2 = .22$, $F\ (8, 211) = 7.42$, $p < .001$		$R^2 = .12$, $F\ (8, 211) = 3.55$, $p < .001$	

Note. $^{*}\ p < .05$, $^{**}\ p < .01$, $^{***}p < .001$

4.2.2.9. ***Hypotheses 10: Perceived Information Seeking Control and Information Seeking Intention***

Hypotheses 10 proposed that perceived information seeking control would be positively related to information seeking intention. For air quality, a regression analysis revealed a significant overall model, $R^2 = .10$, F (8, 211) = 2.81, $p = .006$. Perceived information seeking control significantly predicted air quality information seeking intention, $\beta = .24$, $t = 3.56$, $p < .001$. The regression model for extreme heat was also significant, $R^2 = .09$, F (8, 211) = 2.67, $p = .008$. Perceived information seeking control was a significant positive predictor of extreme heat information seeking intention, $\beta = .28$, $t = 4.00$, $p < .001$, 95% CI [0.18, 0.53]. These results fully support H10, demonstrating that perceived information seeking control predicts information seeking intention in both risk contexts (see Table 14).

Table 14.

Summary of Hierarchical Regression Analyses Testing H10 for Both Hazards

	Information Seeking Intention (Air Quality)		Information Seeking Intention (Extreme Heat)	
Predictors	β	t	β	t
Age	-0.16	-2.42^{*}	-0.09	-1.33
Gender	0.06	0.86	0.06	0.91
Region	0.03	0.52	-0.02	-0.24
Education	0.03	0.49	-0.04	-0.59
Income	0.07	0.96	0.01	0.13
Industry	0.07	1.11	0.01	0.14
Hazard experience	0.11	1.54	0.08	1.26
Perceived information seeking control	0.24	3.56^{***}	0.28	4.00^{***}
	$R^2 = .10$, F (8, 211) = 2.81, $p = .006$		$R^2 = .09$, F (8, 211) = 2.67, $p = .008$	

Note. $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$

4.2.2.10. ***Research Question 1: Hazard-Specific Differences***

RQ1 asked whether the proposed attachment and RISP model relationships varied based on the environmental hazard under consideration: poor air quality versus extreme heat. To address RQ1, a descriptive comparison was conducted between the final models for the air quality and extreme heat contexts. As outlined in the analysis approach (section 4.1.6), this involved comparing the strength, direction, and statistical significance of the beta coefficients from the regression models and mediation analyses (e.g., Hong & Kim, 2022). The overarching goal of this analysis was to identify variations in how the proposed relationships functioned across the two hazards. Further, the analysis allowed for a meaningful reflection on the magnitude of effect size differences between the two hazards, rather than focusing solely on the statistical significance of the findings. Table 15 offers a summary of these comparisons.

Table 15.

Comparison of Relationship Strength and Hypothesis Support by Hazard Type

Hypothesis (Predictor → Outcome)	**Air Quality Results (*β* / *b*)**	**Extreme Heat Results (*β* / *b*)**	**Interpretation**
H1a: Attachment anxiety → Risk perception	$\beta = .12$ (ns)	$\beta = .13$ (ns)	Not supported in either risk context.
H1b: Attachment anxiety → Negative affective response	$\beta = .15$ (ns)	$\beta = .34^{***}$	Only supported for extreme heat.
H1c: Attachment anxiety → Informational subjective norms	$\beta = .17^{*}$	$\beta = .24^{**}$	Supported in both risk contexts.
H2a: Attachment avoidance → Risk perception	$\beta = -.02$ (ns)	$\beta = -.21^{**}$	Only supported for extreme heat.
H2b: Attachment avoidance → Negative affective response	$\beta = .04$ (ns)	$\beta = -.20^{**}$	Only supported for extreme heat.
H2c: Attachment avoidance → Informational subjective norms	$\beta = -.11$ (ns)	$\beta = -.29^{***}$	Only supported for extreme heat.
H3a: Attachment avoidance → Information insufficiency	$\beta = .05$ (ns)	$\beta = .02$ (ns)	Not supported in either risk context.

Hypothesis (Predictor → Outcome)	**Air Quality Results (*β* / *b*)**	**Extreme Heat Results (*β* / *b*)**	**Interpretation**
H3b: Attachment avoidance → Information insufficiency	β = -.04 (ns)	β = -.08 (ns)	Not supported in either risk context.
H4a: Attachment anxiety → Attitudes toward information seeking	β = -.12 (ns)	β = -.14 (ns)	Not supported in either risk context.
H4b: Attachment avoidance → Attitudes toward information seeking	β = -.16 (ns)	β = -.10 (ns)	Not supported in either risk context.
H5a: Attachment anxiety → Perceived information seeking control	β = -.07 (ns)	β = -.12 (ns)	Not supported in either risk context.
H5b: Attachment avoidance → Perceived information seeking control	β = -.12 (ns)	β = -.11 (ns)	Not supported in either risk context.
H6a: Information insufficiency → Seeking intention	$b = 0.12^{***}$	$b = 0.13^{***}$	Supported in both risk contexts.
H6b: Information seeking intention → Active information seeking	$b = 0.46^{**}$	$b = 0.59^{***}$	Supported in both risk contexts, but stronger for heat.
H6c: Information insufficiency → Seeking intention → Active information seeking	***b* = 0.05**	***b* = 0.08**	Significant indirect effects in both contexts.
H7a: Negative affective response → Information insufficiency	$b = 0.31^{*}$	$b = 0.66^{***}$	Supported in both risk contexts, but stronger for heat.
H7b: Negative affective response → Information seeking intention	$b = 0.39^{***}$	$b = 0.34^{***}$	Supported in both risk contexts, but slightly stronger for air quality.
H7c: Negative affective response → Information insufficiency → Information seeking intention	***b* = 0.03**	***b* = 0.05**	Significant indirect effects in both contexts.
H8a: Informational subjective norms → Information insufficiency	b = 0.16 (ns)	$b = 0.30^{*}$	Only supported for extreme heat.

Hypothesis (Predictor → Outcome)	Air Quality Results (*β* / *b*)	Extreme Heat Results (*β* / *b*)	Interpretation
H8b: Informational subjective norms → Information seeking intention	$b = 0.44^{***}$	$b = 0.41^{***}$	Supported in both contexts, but slightly stronger for air quality.
H8c: Informational subjective norms → Information insufficiency → Information seeking intention	$b = 0.02$	$\boldsymbol{b = 0.03}$	Significant mediation only for extreme heat.
H9: Attitudes toward information seeking → Information seeking intention	$\beta = .43^{***}$	$\beta = .32^{***}$	Supported in both risk contexts, but slightly stronger for air quality.
H10: Perceived information seeking control → Information seeking intention	$\beta = .24^{***}$	$\beta = .28^{***}$	Supported in both risk contexts, but slightly stronger for heat.

Note. $^{*} = p < .05$, $^{**} = p < .01$, $^{***} = p < .001$. Significant indirect effects are in bold text.

As shown in Table 15, the most pronounced differences between the hazards were observed in the attachment-related hypotheses (H1 through H5). Attachment avoidance was a significant negative predictor of risk perception, negative affective response, and informational subjective norms for extreme heat, but not for air quality. Similarly, attachment anxiety significantly predicted negative affective response and perceptions of informational subjective norms in the extreme heat context, but not for air quality. It is also important to note, however, that attachment anxiety, nor attachment avoidance significantly predicted information insufficiency (H3), attitudes toward information seeking (H4) or perceived information seeking control (H5) for either hazard. Together, these findings suggest that although attachment may exert more influence on risk perception, negative affective response, and subjective norms in response to extreme heat, their role in predicting other RISP model variables is limited overall.

For the core RISP model pathways (H6–H10), most relationships were significant in both contexts, but the magnitude of the effects was often stronger for extreme heat. This pattern was evident in both individual paths, such as the path from information seeking intention to active seeking (H6, path b_1: b = 0.59 vs. b = 0.46) and the path from negative affective response to insufficiency (H7, path a_1: b = 0.66 vs. b = 0.31)—as well as the overall mediated effects. For instance, the completely standardized indirect effect for H7 was nearly double for extreme heat (b_{cs} = .056) as for air quality (b_{cs} = .029). Furthermore, the indirect effect for H8 was only significant in the extreme heat context (b_{cs} = .030). An exception to this pattern was the direct effect of subjective norms on intention (H8, path c'), which was slightly stronger for air quality (b = 0.44) than for extreme heat (b = 0.41).

Overall, the results presented in Table 15 address RQ1 by indicating that the general structure of the proposed model is applicable across both environmental hazards, though the strength of specific predictors varies by topic for both attachment orientations and core RISP model pathways. Specifically, extreme heat appeared to elicit stronger emotional, social, and behavioral responses. These results may be indicative of the immediate and tangible nature of extreme heat compared to poor air quality. Accordingly, these findings highlight the need for risk communication strategies that are tailored not only to the specific hazard being addressed, but also to the unique psychological drivers that motivate workers in each context.

4.2.2.11. Research Question 2: Regional Variation in Hazard Experience, RISP-Related Concepts and Active Information Seeking

RQ2 asked how RISP-related concepts differed across U.S. regions for air quality and extreme heat. To address RQ2, a series of chi-square tests were conducted to understand how recent hazard experiences and information seeking varied significantly by U.S. regions (i.e., Northeast, Midwest, South, and West regions) and one-way ANOVAs were conducted to assess whether remaining RISP-related concepts significantly differed by U.S. region.

Chi-square tests were conducted to examine how participants' recent experiences with air quality and extreme heat varied across U.S. regions (see Table 16). There were no significant differences in the proportion participants who recalled receiving air quality alerts, $\chi^2(3) = 3.79$, $p = .285$. Additionally, post-hoc z-tests of column proportions indicated that no pairwise differences were statistically significant following Bonferroni correction. Although not statistically significant, descriptive trends suggest that participants in the Northeast (80%) and the West (66%) reported the highest rates of air quality alert recall. A significant regional difference emerged in participants' perceptions of bad air quality over the past 3 months $\chi^2(3) = 15.14$, $p = .002$. Post hoc *z*-tests revealed that participants in the West (82%) were significantly more likely to report poor air quality than those in the South (52%), $p = .002$ (Bonferroni-adjusted). The other post hoc comparisons for the West—one against the Midwest (58%) and another against the Northeast (75%)—both approached significance but did not meet the Bonferroni-adjusted threshold.

There was also a significant regional difference in the proportion of participants who recalled heat warnings in their area $\chi^2(3) = 20.26$, $p < .001$. Post-hoc *z*-tests with Bonferroni correction were conducted for all six pairwise comparisons. The comparisons between the Midwest and the South, West, and Northeast were all statistically significant ($p < .05$). The remaining pairwise comparisons (South vs. West, South vs. Northeast, and West vs. Northeast) did not meet the Bonferroni-adjusted significance threshold. Finally, the chi-square test for participants who reported that heat was bad in their area approached significance $\chi^2(3) = 7.05$, $p = .070$. Descriptive trends revealed that participants in the West (95%) and South (92%) were more likely to report that the heat was bad compared to those in the Midwest (79%) and

Northeast (88%). However, no pairwise comparisons met the Bonferroni-adjusted significance threshold.

Table 16.

Chi-Square Results for Recent Hazard Experiences by U.S. Region

	Northeast *n*, (%)	Midwest *n*, (%)	South *n*, (%)	West *n*, (%)	$\chi^2(3)$	*p* value
Recalled air quality alerts within the past three months.						
Yes	24 (80%)	25 (61%)	49 (61%)	37 (66%)	3.79	.285
No	6 (20%)	16 (39%)	31 (33%)	19 (34%)		
Thought that the air quality in their local area was bad within the past three months.						
Yes	24 (75%)	22 (58%)	42 (52%)	45 (82%)	15.14	.002
No	8 (25%)	16 (48%)	39 (48%)	10 (22%)		
Recalled heat warnings within the past three months.						
Yes	31 (97%)	32 (74%)	76 (95%)	54 (96%)	20.26	.001
No	1 (3%)	11 (26%)	4 (5%)	2 (4%)		
Thought that the heat in their local area was bad within the past three months.						
Yes	29 (88%)	34 (79%)	78 (92%)	53 (95%)	7.05	0.70
No	4 (12%)	9 (21%)	7 (8%)	3 (5%)		

A series of one-way ANOVAs was conducted to test for regional differences in the core RISP concepts for both hazards. The analysis revealed that significant regional differences were specific to the air quality context; no significant differences were found for any of the concepts related to extreme heat.

As shown in Table 17, two air quality concepts had significant variations. First, attitudes toward information seeking about air quality differed significantly by region, $F(3, 216) = 3.43$, $p = .018$, $\eta^2 = .046$. Post hoc comparisons using Tukey HSD indicated that participants in the

Northeast (*M* = 4.53, *SD* = 0.72) reported significantly more positive attitudes than those in the Midwest (*M* = 3.86, *SD* = 1.24), $p = .019$.

Second, information seeking intention about air quality differed significantly by region, $F(3, 216) = 4.66$, $p = .004$, $\eta^2 = .061$. Post-hoc comparisons using Tukey HSD indicated that participants in the West (*M* = 4.25, *SD* = 0.92) reported significantly higher intention to seek information than those in the Midwest (*M* = 3.65, *SD* = 1.06), $p = .020$, and the South (*M* = 3.73, *SD* = 1.10), $p = .017$.

Table 17.

ANOVA Results for RISP concepts by U.S. Region

Variable	Northeast (n = 33) M (SD)	Midwest (n = 44) M (SD)	South (n = 85) M (SD)	West (n = 57) M (SD)	ANOVA	
					F (3, 216)	p-value
Risk perception						
Air quality	12.03 (6.018)	10.93 (6.764)	12.47 (5.887)	13.42 (5.092)	1.53	.207
Extreme heat	12.12 (5.583)	12.84 (6.179)	15.07 (6.174)	14.02 (5.643)	2.55	.056
Negative affective response						
Air quality	2.88 (1.230)	2.53 (1.190)	2.88 (1.130)	3.04 (0.996)	1.76	.156
Extreme heat	3.23 (1.090)	2.97 (1.216)	3.41 (1.057)	3.39 (0.931)	1.89	.131
Information insufficiency						
Air quality	4.92 (2.229)	4.84 (2.300)	4.95 (2.273)	4.88 (1.917)	0.03	.994
Extreme heat	5.06 (2.066)	4.77 (2.205)	4.63 (2.276)	4.51 (1.937)	0.51	.677
Informational subjective norms						
Air quality	3.04 (1.268)	2.78 (1.213)	2.76 (1.193)	3.18 (1.102)	1.65	.178
Extreme heat	4.53 (1.186)	3.24 (1.258)	3.40 (1.104)	3.46 (1.046)	1.15	.328
Attitudes toward information seeking						
Air quality	4.25 (0.717)	3.86 (1.240)	4.34 (1.193)	4.20 (1.108)	3.43	.018
Extreme heat	4.07 (1.140)	3.96 (1.314)	4.44 (0.850)	4.32 (1.009)	2.14	.096
Perceived information						

Variable	Northeast (n = 33) M (SD)	Midwest (n = 44) M (SD)	South (n = 85) M (SD)	West (n = 57) M (SD)	ANOVA F (3, 216)	p-value
seeking control						
Air quality	4.25 (0.977)	3.97 (0.931)	3.90 (0.987)	4.10 (0.949)	0.59	.622
Extreme heat	4.17 (0.759)	4.28 (0.834)	4.19 (0.769)	4.29 (0.886)	0.20	.896
Information seeking intention						
Air quality	4.33 (0.958)	3.65 (1.063)	3.72 (1.104)	4.25 (0.920)	4.66	.004
Extreme heat	3.04 (0.874)	3.89 (1.092)	4.00 (1.108)	4.21 (0.940)	1.65	.178

Note. Scales for key concepts are as follows: Risk perception is a composite index (perceived severity × perceived susceptibility) with a possible range of 1–25 and information insufficiency was measured on a 0–10 scale. All other concepts (negative affective response, subjective norms, attitudes, perceived control, and seeking intention) were measured on a 1–5 scale.

Although the majority of ANOVAs did not reach statistical significance, descriptive trends suggest meaningful variation across regions, particularly for participants in the West and South who consistently reported higher mean scores across several[14] RISP-related concepts. For example, in the context of extreme heat, participants in the South reported the highest average levels of negative affective response (M = 3.41, SD = 1.06) and attitudes toward information seeking (M = 4.46, SD = 0.80). Similarly, participants in the West reported the highest mean scores for perceived information seeking control about extreme heat (M = 4.29, SD = 0.89) and for information seeking intention (M = 4.21, SD = 0.97), as well as high scores for air quality-related negative affective response (M = 3.04, SD = 1.00). These elevated means across RISP concepts may reflect greater psychological salience of these hazards, which is likely a result of geographic proximity and more frequent personal experience with exposures such as wildfires in the West and extreme heat events in the South. Although these differences were not statistically

[14] Participants in the West scored highest on air quality risk perception, negative affective response, and informational subjective norms, as well as extreme heat seeking control and seeking intention; participants in the South scored highest on extreme heat risk perception, negative affective response, and attitudes, in addition to air quality information insufficiency and attitudes.

significant, they suggest that regional context may influence how individuals perceive and process environmental health risks.

Finally, chi-square tests were conducted to examine whether active information seeking varied by U.S. region (see Table 18). For air quality, there were no significant regional differences in the proportion of participants who reported wanting more information, $\chi^2(3) = 1.85$, $p = .604$. A similar nonsignificant result was found for extreme heat, with no regional differences in information seeking $\chi^2(3) = 0.14$, $p = .986$. Although statistical significance was not reached, descriptive trends indicated that participants in the West had the highest proportions of participants seeking more information about both hazards (air quality: 58%; extreme heat: 54%), while participants in the Midwest reported the lowest (air quality: 56%; extreme heat: 51%).

Table 18.

Chi-Square Results for Active Information Seeking by U.S. Region

	Northeast *n*, (%)	Midwest *n*, (%)	South *n*, (%)	West *n*, (%)	$\chi^2(3)$
Actively sought air quality information					
Yes	17 (52%)	25 (56%)	40 (47%)	33 (58%)	1.85
No	16 (48%)	20 (44%)	45 (53%)	24 (42%)	
Actively sought extreme heat information					
Yes	17 (52%)	23 (51%)	44 (52%)	31 (54%)	0.14
No	16 (48%)	22 (49%)	41 (48%)	26 (46%)	

Considered together, results from the chi-square tests, post-hoc *z*-tests, and ANOVAs assessing regional differences in recent hazard experiences (Table 16) and RISP-related concepts (Table 17) revealed a distinct regional pattern. Outdoor workers in the West reported significantly more frequent recent exposure to poor air quality and greater psychological engagement with the topic, evidenced by their significantly more positive attitudes and higher intentions to seek information. These findings thus provided strong quantitative support for the a priori selection of the western U.S. for the study's qualitative phase, a region well-documented in prior literature as having high occurrences of extreme heat and wildfire smoke (e.g., Hu et al., 2025; N. Rosenthal et al., 2022). Focusing on this region was intended to capture participants likely to have rich, lived experiences with these hazards, thus offering the potential for deeper insights into risk perception and information seeking behavior.

4.2.3. Chapter Summary

This chapter presented the methods and results for the quantitative phase of the study. The quantitative phase explored how attachment orientations and key concepts from the risk information seeking and processing (RISP) model shape outdoor workers' responses to air quality and extreme heat hazards. Using a national sample of outdoor workers ($N = 220$), the survey assessed psychological, social, and behavioral predictors of information seeking across both hazard contexts. Hierarchical regression analyses revealed that attachment orientations, particularly attachment avoidance, significantly influenced risk perception, affective response, and informational subjective norms for extreme heat, but not for air quality. Results from mediation models provided strong support for the core RISP pathways, with information-seeking intention serving as a consistent mediator across both hazards. Informational subjective norms, affective response, attitudes toward information seeking, and perceived control all emerged as significant predictors of information seeking intention, although the strength and significance of these predictors varied between air quality and extreme heat. Overall, the results supported the applicability of the RISP model in both contexts. The findings also demonstrated that extreme heat may elicit stronger emotional, social, and behavioral responses than air quality.

To further explore regional differences, a series of ANOVAs and chi-square tests were conducted to assess whether RISP-related concepts varied across U.S. regions. Although only two RISP concepts (i.e., attitudes and intention toward air quality information seeking) differed significantly by region, the post-hoc analyses for recent hazard experience revealed significant differences. For instance, participants in the West were significantly more likely to report recent poor air quality than those in the South, and participants in the Midwest were significantly less likely to recall heat warnings than those in all other regions.

These findings provide valuable insights for the qualitative phase of this study by highlighting the West as a region where workers reported more frequent exposure to these hazards and were also more engaged with relevant risk information. Chapter 5 builds on these results by describing the methods of the qualitative phase and presenting qualitative findings that offer deeper insight into the personal, social, and organizational dynamics that shape outdoor workers' perceptions of risk, information seeking, and protective behaviors regarding air quality and extreme heat.

CHAPTER 5. QUALITATIVE PHASE

5.1.Purpose and Rationale

The results of the quantitative phase provided insight into how attachment orientations and RISP model variables influence outdoor workers' information seeking. However, these findings also raised additional questions that invite deeper explanation. Specifically, the differences in RISP relationships by risk context and the variation in regional responses suggest a need to better understand how these concepts are interpreted and experienced in daily life.

To build on these findings, this study incorporated a qualitative phase using focus groups. This method was selected over one-on-one interviews because it allows for collective meaning-making and shared reflection; a dynamic particularly important for exploring the psychological, social, and relational dimensions of risk perception, norms, and information seeking (Cyr, 2016; Hopkins, 2007). In this context, focus group discussions offered valuable insight into how participants interpret and negotiate risk in shared outdoor work environments. This approach aligns with the study's explanatory sequential design, allowing for the triangulation of results and a deeper qualitative explanation of the quantitative findings.

5.2. Integration of Quantitative Findings into Focus Group Design

Consistent with the explanatory sequential mixed method design, the focus group design was developed to elaborate on key findings from the survey (Creswell & Plano Clark, 2018; Ivankova et al., 2006). Specifically, the qualitative phase aimed to (1) provide context for how outdoor workers perceive and experience air quality and extreme heat risks on the job, (2) investigate how these perceptions and experiences shape their information-seeking and protective behaviors, and (3) gather feedback on the effectiveness of the Air Aware campaign (see section 3.4 for campaign details) and explore the possibility of a similar campaign that integrates both air quality and extreme heat messaging.

To achieve these aims, a joint display was created to map attachment theory, RISP model concepts, and their corresponding quantitative findings to the development of each focus group question. This display, a table used to visually integrate quantitative findings with qualitative data collection (Creswell & Plano Clark, 2018; Fetters et al., 2013), ensured that the qualitative phase built on the quantitative results, probed deeper into attachment and RISP-related concepts, explored the perceived salience of different environmental hazards, effectively evaluated the Air Aware campaign, and gauged participant interest in communication strategies that integrate both air quality and heat-related information (see Table 19).

Table 19.

Joint Display Linking Quantitative Results to Focus Group Design

Theoretical Concepts	Relevant Quantitative Findings	Focus Group Measures	Purpose of Qualitative Follow-Up
Attachment anxiety, attachment avoidance	Attachment avoidance predicted lower heat risk perception (β = -.21), negative affective response (β = -.20), and subjective norms (β = -.29). Attachment anxiety predicted increased heat-related negative affective responses (β = .34), subjective norms (β = .24) and air quality-related subjective norms (β = .17).	Intake survey with attachment items from the national survey	Use participants' quantitative attachment scores (from the intake survey) to contextualize their qualitative responses and explore how attachment orientations emerge in their risk information seeking and processing behaviors.
Hazard experience, risk perception	Experience with air quality (β = .25) or heat-related (β = .28) symptoms at work predicted risk perception. Participants in the West region reported more frequent exposure to air quality and heat.	"Can you share an experience from this summer where heat or air quality affected you while you were working?"	Understand how lived experiences shape perceived risk, especially in regions with high exposure.
Risk perception, negative affective response	Stronger risk affective response for heat (M = 3.24) vs. air quality (M = 2.85); affective response significantly predicted information seeking for air quality (b = .39) and extreme heat (b = .34).	"When you think about air quality and heat, which one represents the highest risk while you are working and why?"	Explore how workers compare and perceive air quality and extreme heat risks.

Theoretical Concepts	Relevant Quantitative Findings	Focus Group Measures	Purpose of Qualitative Follow-Up
Subjective norms, attitudes toward seeking, perceived seeking control	Attitudes ($\beta_{AQ} = .43$, $\beta_{EH} = .32$) subjective norms ($\beta_{AQ} = .44$, $\beta_{EH} = .41$), and perceived control ($\beta_{AQ} = .24$, $\beta_{EH} = .28$) predicted information seeking intention.	"What factors influence whether you use heat or air quality information at work?"	Gain a deeper understanding of how internal or external factors facilitate or constrain information seeking in audiences with high information seeking intention.
Attitudes toward information seeking	Overall attitudes were high ($M_{AQ} = 4.24$, $M_{EH} = 4.28$); significantly predicted H9. Participants in the west reported more positive attitudes compared to other regions.	"What types of air quality or heat information are most useful to you while working?"	To further clarify what practical or actionable information drives positive attitudes toward information seeking.
Subjective norms—personal influences	Subjective norms predicted intention ($\beta_{AQ} = .44$, $\beta_{EH} = .41$). Participants perceived stronger expectations from interpersonal influences ($M = 2.91$) than people they worked with ($M = 2.87$) to seek air quality information.	"How do your family and friends influence how you use air quality or heat information while you're working?"	Explore interpersonal influences outside of the workplace.
Subjective norms—workplace influences	Participants perceived stronger expectations from people that they work with to seek information about heat ($M = 3.39$), than air quality ($M = 2.87$). Subjective norms were related to intention in both contexts, but mediation through information insufficiency only occurred for heat.	"What roles do your co-workers, supervisors, or the organization play in how you use air quality and heat information while you're working?"	Investigate how workplace dynamics reinforce or discourage information seeking.

Theoretical Concepts	Relevant Quantitative Findings	Focus Group Measures	Purpose of Qualitative Follow-Up
Information seeking behavior, perceived seeking control	High recall of air quality alerts in the West; perceived information seeking control predicted intention ($\beta_{AQ} = .24$, $\beta_{EH} = .28$).	"Do you recall seeing or hearing about the Air Aware campaign in your workplace this summer? If so, did you use it to stay informed about air quality at work?"	Assess how campaign materials are remembered and acted upon in a highly engaged audience. Explore how campaign delivery (e.g., text alerts, flyers, QR codes) shaped confidence and perceived control in seeking information.
Attitudes toward information seeking, information seeking behavior	Active information seeking behavior predicted by intention; attitudes significantly predicted intention ($\beta_{AQ} = .43$, $\beta_{EH} = .32$).	"What parts of the Air Aware campaign did you find useful? What could be improved?"	Identify campaign features that encouraged or discouraged information use. Refine messaging and format of materials based on user experience.
Information insufficiency, perceived information seeking control	Information insufficiency significantly predicted intention across contexts. Participants reported higher information insufficiency for air quality (*M* = 4.90) than extreme heat (*M* = 4.69).	"Was there information in the campaign that you found confusing, conflicting, or lacking in detail?"	Identify gaps in campaign content that could further address workers' information needs or preferences.
Integration of topics and RISP dimensions	Differences in model strength across topics, but stronger for extreme heat.	"What are your thoughts on a workplace campaign, similar to the Air Aware campaign, that includes both air quality and heat information?"	Explore the feasibility of integrated campaigns given high engagement across both hazards and overlapping predictors of information seeking.

5.3. Focus Group Methodology

5.3.1. Sample Selection and Participant Recruitment

Focus group participants were recruited from the City of Fort Collins, Colorado, rather than drawing from the nationwide survey sample. This decision was informed by both quantitative findings and practical considerations, including the ease of access to the population of interest through the previously established research relationships between the City of Fort Collins and the author. Although the national survey provided a broad view of outdoor workers' risk perceptions and information behaviors across U.S. regions, results from ANOVAs, chi-square tests, and post-hoc *z*-tests (see Chapter 4) revealed that participants in the West consistently reported higher engagement with relevant risk-related information, more positive attitudes toward information seeking, and more frequent exposure to environmental hazards, including poor air quality and extreme heat. Post-hoc *z*-tests revealed that these differences were the most evident for information-seeking intention, recall of heat warnings, and perceptions of poor air quality. These findings supported the decision to conduct the qualitative phase in a region where these risks are more prevalent and salient to outdoor workers.

Fort Collins was also a strategically relevant site for recruitment. As discussed in Chapter 3, Colorado's Northern Front Range Metropolitan Area (NFRMA) continues to exceed federal air quality standards due to chronic ozone pollution during the summer. This is further compounded by the heightened wildfire risks in this region, including a record-breaking wildfire season in 2020 and additional wildfire events during the summer of 2024, shortly before data collection. These conditions positioned Fort Collins as an ideal location to explore how workers perceive, respond to, and seek information about environmental hazards in high exposure settings.

In addition to its regional relevance, the City of Fort Collins had recently implemented the Air Aware campaign, a localized communication campaign designed to increase the awareness of air quality risks among outdoor municipal workers. The campaign was active during the summers of 2023 and 2024, making it highly salient to potential participants. The researcher and committee members had established relationships with the City of Fort Collins' environmental health staff and employees that worked outdoors in the Parks, Natural Areas, and Utilities departments. These relationships facilitated efficient recruitment and ensured that participants were already familiar with the campaign materials being evaluated. Eligible participants were City of Fort Collins employees who were at least 18 years of age or older, primarily worked outdoors, and had the Air Aware campaign implemented in their workplace during the summer of 2024.

Participants were recruited using a combination of convenience sampling and snowball sampling methods. Convenience sampling involves recruiting participants based on their availability, accessibility, or existing relationships (Lindlof & Taylor, 2019). Snowball sampling is a nonprobability method where existing participants or contacts help identify and refer additional participants from their network (Lindlof & Taylor, 2019; Pasikowski, 2024). These methods were appropriate for reaching a specialized population, such as outdoor workers, who are typically dispersed across different departments and worksites.

These methods allowed for efficient access to a targeted, context-relevant group, but using them does introduce some limitations. Convenience sampling may increase the risk of selection bias because those who are more accessible or engaged may be overrepresented (Andrade, 2021; Robinson, 2014). Snowball sampling can further exacerbate this bias if participants primarily refer individuals with similar views or experiences (Ahmed, 2024;

Pasikowski, 2024). To reduce selection bias, the researcher utilized the established relationships to recruit from three distinct departments: (1) Utilities, (2) Natural Areas, and (3) Parks and Recreation. These departments were selected not only for their accessibility but also because they operate in different locations, and their employees do not typically interact while on the job. This separation was intended to increase variation in job roles and experiences among participants.

Recruitment was coordinated by the lead researcher in collaboration with safety committee team leads. These team leads were emailed study details and participant information sheets, and they then shared the opportunity with eligible colleagues. Recruitment materials emphasized that participation was voluntary, and they were shared 2 weeks in advance to allow employees time to make an informed decision about whether to participate in a focus group. Participants received breakfast or lunch depending on the time of day and were compensated with a $25 Amazon gift card.

5.3.1.1. Sample Profile

A total of 29 outdoor workers participated in the focus groups. Most participants identified as male (79%), with ages ranging from 18 to over 65 years; the largest age group was 25-34 years (41%). The sample was predominantly White (86%), with a small number identifying as Hispanic or Latino (10%) or Asian or Asian American (3%). Nearly half of participants (48%) had lived in the Fort Collins area for more than 20 years. In terms of education, the majority held at least some postsecondary training, with 38% reporting a bachelor's degree and another 17% completing job-specific training programs after high school. Household incomes varied, with a concentration between $35,000 and $199,999 per year; about one-quarter (24%) reported annual incomes between $150,000 and $199,999.

Participants represented three municipal departments: Natural Areas (38%), Parks & Recreation (34%), and Utilities (28%). Most were employed year-round (76%), and 59% were hourly employees. Length of employment in their current role varied, with 41% employed for 1–5 years and 24% for less than 1 year. Job roles varied considerably, encompassing seasonal crew members, maintenance workers, senior supervisors, and safety specialists, which reflected diverse experiences with outdoor work environments.

Regarding health characteristics, 41% of participants reported being diagnosed with allergies, 35% with overweight or obesity, and 21% with a mental-health condition. Fewer participants reported diagnoses related to heart disease (10%) or diabetes (3%), while none reported a lung-disease diagnosis. A complete table of participant characteristics is provided in Appendix F.

5.3.1.2. Participant Attachment Scores and Classifications

To assess the attachment orientations of focus group participants, a brief intake survey was distributed prior to the focus groups. This survey included attachment anxiety and avoidance items from the Experiences in Close Relationships Scale-Short Form (ECR-S; Wei et al., 2007) which are further detailed in section 4.1.5.5.

Following an analysis procedure outlined by Hegarty et al. (2024), raw scores for attachment anxiety and avoidance were computed. These raw scores were then standardized into z-scores to establish a relative comparison within the focus group sample ($N = 29$). This was calculated using the equation $Z = (\text{RawScore} - M)/SD$, with the sample's mean and standard deviation for attachment anxiety ($M = 20.76$, $SD = 4.90$) and attachment avoidance ($M = 19.86$, $SD = 5.78$). Finally, these z-scores were converted into percentiles using the standard normal cumulative distribution function (CDF), providing a measure of each participant's relative standing within the group.

Participants' score on the attachment anxiety and attachment avoidance dimensions were classified as "Low," "Average," or "High," based on their group-relative percentile score. Following the thresholds provided by Hegarty et al. (2024), a participant was classified as "Low" if their percentile score was ≤ 25, "Average" if their percentile score was between 26 and 74, and "High" if their percentile score was ≥75.00 (see Table 20).

Table 20. Focus Group Participants' Attachment Scores

Participant ID	Attachment Anxiety			Attachment Avoidance		
	Raw Score	Percentile Score	Classification	Raw Score	Percentile Score	Classification
1	24.00	74.58	High	24.00	76.31	High
2	26.00	85.76	High	25.00	81.31	High
3	18.00	28.66	Average	25.00	81.31	High
4	13.00	5.66	Low	25.00	81.31	High
5	22.00	59.99	Average	23.00	70.65	Average
6	19.00	35.97	Average	11.00	6.27	Low
7	28.00	93.02	High	28.00	92.05	High
8	14.00	8.39	Low	18.00	37.38	Average
9	13.00	5.66	Low	17.00	31.04	Average
10	20.00	43.84	Average	18.00	37.38	Average
11	22.00	59.99	Average	16.00	25.21	Average
12	18.00	28.66	Average	11.00	6.27	Low
13	14.00	8.39	Low	14.00	15.53	Low
14	22.00	59.99	Average	20.00	50.97	Average
15	17.00	22.14	Low	14.00	15.53	Low
16	21.00	51.95	Average	30.00	96.03	High
17	22.00	59.99	Average	20.00	50.97	Average
18	27.00	89.86	High	19.00	44.09	Average
19	19.00	35.97	Average	16.00	25.21	Average
20	18.00	28.66	Average	20.00	50.97	Average
21	22.00	59.99	Average	13.00	11.76	Low
22	24.00	74.58	High	28.00	92.05	High
23	22.00	59.99	Average	20.00	50.97	Average
24	19.00	35.97	Average	14.00	15.53	Low

Participant ID	Attachment Anxiety			Attachment Avoidance		
	Raw Score	Percentile Score	Classification	Raw Score	Percentile Score	Classification
25	26.00	85.76	High	26.00	85.59	High
26	15.00	11.99	Low	11.00	6.27	Low
27	20.00	43.84	Average	20.00	50.97	Average
28	35.00	99.82	High	31.00	97.30	High
29	22.00	59.99	Average	19.00	44.09	Average

5.3.2. Informed Consent and Other Ethical Considerations

All qualitative procedures were approved by the Colorado State University Institutional Review Board [IRB Protocol: #5945] prior to participant recruitment and data collection. Participants were provided with a study summary and informed of their rights, including the voluntary nature of participation, confidentiality protections, and the option to withdraw at any point without penalty. Verbal informed consent was obtained at the start of each session, and participants were assigned a unique identification number to ensure anonymity in transcription and reporting.

Participants were also advised of potential risks, including the possibility of minor emotional discomfort when discussing health effects related to air quality or extreme heat exposure. All discussions were audio recorded with participants' consent and transcribed verbatim for analysis. Additional ethical considerations, including compensation and confidentiality, are outlined in the approved consent form (see Appendix G).

5.3.3. Data Collection Procedures and Materials

Three focus groups were conducted September 24 to 26, 2024, in conference rooms at City of Fort Collins buildings. Each session lasted between 45 and 60 minutes and was held during work hours with supervisor approval. All focus groups were co-facilitated by the researcher (CB), who served as moderator, and a Ph.D. student in the Department of Journalism and Media Communication (hereafter referred to as LC) who served as notetaker. This approach ensured consistency in facilitation and adherence to best practices in group moderation (Krueger & Casey, 2014). To mitigate potential power dynamics and ensure that participants felt free to speak openly, their direct supervisors were not present in focus group discussions.

At the beginning of each session, the moderator introduced the research team, reviewed the study summary, and obtained verbal informed consent (see Appendix G). Following this, participants were asked to complete a brief intake survey, which took an average of 4 minutes. The survey (see Appendix H) collected basic demographic and job-related information, as well as the same attachment anxiety and avoidance items adopted from the ECR-S (Wei et al., 2007) that were also used in the quantitative phase (see Section 4.1.5.5). Pre-printed cards (see Appendix I) were distributed to participants containing a QR code to the survey and a unique participant ID code. This ID served as the critical link between their confidential survey responses and their contributions to the focus group discussion, allowing the researcher to contextualize their qualitative comments with their quantitative attachment scores during data analysis.

After participants completed the survey, the focus group discussion began. Discussions followed a semistructured protocol (see Appendix J), allowing for both consistency across groups and flexibility to explore emerging or unexpected insights. The protocol was designed to examine participants' experiences with poor air quality and extreme heat in the workplace, perceptions of risk, and the social and structural factors influencing their use of environmental health information. Questions were informed by findings from the quantitative phase and aligned with attachment theory and core risk information seeking and processing (RISP) model concepts.

The discussion began with an icebreaker question that asked participants to describe a personal experience with either hazard. Subsequent questions explored comparative risk judgments, information-seeking motivations, perceived norms, attitudes, control, and responses to the Air Aware campaign (see Appendix J). One portion of the discussion introduced the National Weather Service's HeatRisk index to gauge participants' reactions to integrated air quality and heat messaging (see Appendix K). A total of 10 questions were asked, with follow-up probes and visual materials used to stimulate recall and engagement.

To support productive discussion and minimize group-related biases, the moderator followed best practices in focus group facilitation (Barbour, 2018; Okoko, 2023). A detailed facilitation guide (see Appendix J) was developed prior to data collection and included semistructured discussion questions and probes, and strategies for managing potential challenges (e.g., dominant participants, low engagement, or off-topic conversation). The guide also included a glossary of key terms that could be provided to participants upon request to support clarity during the discussion.

The moderator worked to build rapport with participants and maintain an inclusive and respectful group environment, creating space for open and honest dialogue. The moderator also emphasized that there were no right or wrong answers and encouraged all participants to share their ideas. Audio recordings and notetaker observations were used to ensure accurate transcription and interpretation of participant responses.

5.3.4. Analysis Approach

A hybrid deductive–inductive qualitative content analysis was used to analyze the focus group transcripts (Hsieh & Shannon, 2005; Mayring, 2015). This approach allowed the researcher to examine participant responses through the lens attachment theory and the RISP model while also allowing for emergent, context-specific themes to surface from the data (Saldaña, 2015).

Analysis was conducted using MAXQDA, a qualitative data analysis software that facilitates the organization and interpretation of large qualitative datasets through systematic coding, memo writing, and data visualization tools (J. P. Williams et al., 2017). Immediately following the focus groups, the researcher compiled observation notes and transcribed the audio recordings verbatim. All transcripts were de-identified to protect participant confidentiality. The researcher thoroughly read and re-read the transcripts and accompanying notes to establish familiarity with the data and identify initial impressions.

The initial coding process followed a deductive approach, informed by the concepts and relationships outlined in the focus group facilitation guide. The initial codebook included nine categories which aligned with the structure of focus group questions and probes. These categories included: hazard topic, hazard experience, risk perception, affective response, subjective norms, information insufficiency, attitudes toward seeking, perceived information seeking control, and information-seeking behavior. During the coding process, simultaneous coding was used, allowing a single excerpt (i.e., responses to a question or completed idea) to be assigned multiple codes (Saldaña, 2015; Spearing et al., 2022).

Given the semi-structured nature of the focus groups, participants often raised ideas and perspectives that extended beyond the predefined deductive codes. To capture these unanticipated and relevant insights, the analysis also incorporated an inductive coding process alongside the deductive approach. Inductive coding allows new codes to be developed as patterns of recurring ideas manifest during the analysis (Miles et al., 2019). In this analysis, these patterns were documented across transcripts to create the inductive codes using MAXQDA's memo features. For example, although "protective behavior" was not a focus group question, it frequently emerged in participants' narratives and was subsequently added to the final coding scheme. This iterative strategy ensured that emergent, contextually important themes entered the final coding structure and informed the analysis.

A preliminary codebook was developed by the author (CB) and presented to the focus group notetaker (LC), and three additional collaborators who were familiar with the study through an iterative process that occurred during two meetings. Once this group finalized the codebook, CB and LC first independently coded one transcript using the combined deductive and inductive coding scheme. A joint review revealed strong coding consistency between coders, and any discrepancies were resolved through discussion and consensus. Following this, CB independently coded all remaining transcripts and developed a set of proposed themes from the coded data. These themes were then presented to the full team in a final meeting for triangulation and were finalized together to enhance the credibility and reliability of the findings (Patton, 2002).

5.4. Results

5.4.1. Theme 1. Hazards in Contrast: Comparing Air Quality and Heat Risks

This theme captures how outdoor workers differentiate extreme heat and poor air quality in terms of urgency, embodied experience, and feasibility of protective action. Across focus groups, heat was generally framed as an immediate, physically threatening hazard that is intensified by work demands and PPE, whereas air quality was more often described as a chronic condition that becomes salient when symptoms become intolerable. Participants also contextualized air quality by comparing conditions across time and place, and their interpretations at times reflected patterns broadly consistent with attachment-related differences in how risk is appraised and managed.

5.4.1.1. Heat as an Immediate and Compounding Threat

Across all three focus groups, extreme heat was consistently described as a more urgent and physically threatening hazard than poor air quality. Workers explained that heat risks were often assessed using a combination of thermal cues and physiological symptoms (e.g., dehydration, headaches, and fatigue) that signaled the need for immediate protective action. Participant 7 (high anxiety, high avoidance) shared, “We work pretty physical jobs, so it’s pretty easy to get your heart rate up in a hurry. So yeah, it’s just that much faster that the signs start to show and that starts to affect you.” Similarly, Participant 22 (high anxiety, high avoidance) noted:

> Especially if [the job task] is something strenuous and you don’t have any shade and start to get dehydrated… there comes a point where if you don’t stop, you’re just going to get heat exhaustion, or even worse, heat stroke.

These perspectives align with the theoretical expectations for individuals higher in attachment anxiety, insofar as they demonstrate heightened vigilance to threat and a focus on how quickly a manageable condition can escalate into a more serious outcome. Both participants narrate heat exposure as a rapidly unfolding risk, moving from early cues (e.g., elevated heart rate, dehydration) to worst-case scenario outcomes (e.g., heat exhaustion or heat stroke). In this way, their descriptions highlight what workers with high attachment anxiety attend to when evaluating heat risks and how they mentally project the hazard’s trajectory.

Participants also emphasized how certain job tasks and required personal protective equipment (PPE) can compound heat exposure and intensify risk. Participant 8 (low anxiety, average avoidance) explained the challenge of wearing nonbreathable, flame-resistant gear: “If we’re working around energized stuff, we have these heavy-duty rubber gloves that go almost to your elbow, and that doesn’t help.” Participant 16 (average anxiety, high avoidance) similarly recounted how spraying herbicides in hot, humid conditions left them with prolonged symptoms: “When it’s hotter than 90 degrees and you’re spraying… it’s pretty hard on the applicator… I’ll go home with a headache that lingers 17 hours or something and I’ll be sick the next day because of heat stress.” These accounts show how workers across attachment orientations perceive heat risk in the context of their work demands and protective equipment requirements that directly intensify their exposure to extreme heat.

5.4.1.2. Air Quality is Tolerated to a Tipping Point

Compared to heat, air quality was described as a slower-developing, long-term concern. Participant 10 (average anxiety, average avoidance) explained:

> Heat is usually what we’re worried about right now that’s going to stop our work or something. Now, the air quality is more of a long-term aspect of what we’re thinking about. So usually, if we’re going to stop working, it’s when it's super unhealthy.

Workers linked symptoms such as respiratory discomfort, eye irritation, and fatigue to seasonal wildfires, strong winds, and smoke transported from distant states. For instance, Participant 3 (average anxiety, high avoidance) recalled a high-wind day on a dusty construction site: “We were literally going and getting the masks from the truck and pulling our shirts over our face.” He added with resignation, “Did [the dust] have a dire effect on what we did? Not really; we kind of just put up with it.” The inclination to “just put up with it” reflected a broader pattern of desensitization to routine exposure to suboptimal air quality conditions. Participant 26 (low anxiety, low avoidance) shared a similar perspective:

> Maybe I'm wrong, but this seems like about 80% of the time it's [the Air Quality Index] in the yellow [range]… it just doesn't catch anybody's attention… we lived yesterday with it in yellow, so we'll live today with it in yellow.

Although both participants described a similar pattern of desensitization to routine air quality conditions, they framed it in ways that are consistent with their attachment orientations. Participant 3's response aligns more closely with attachment avoidance, insofar as it reflects a deactivating coping strategy: He acknowledges the threat and then dismisses personal distress. Participant 26 likewise describes desensitization to air quality issues but frames it through pattern recognition by treating yellow AQI levels as a chronic baseline rather than minimizing distress. In this way, Participant 26's framing is more consistent with relatively lower attachment insecurity whereas Participant 3's framing aligns with the dismissive, self-reliant stance that is characteristic of higher attachment avoidance.

Participants described "tipping points" when air quality deteriorated enough to trigger more urgent responses. For instance, Participant 9 (low anxiety, average avoidance) defined the tipping point as, "That horrible spot [when] you can't even walk outside without getting a splitting headache from the smoke." Participant 16 (average anxiety, high avoidance) similarly emphasized reaching a personal limit: "When it [air quality] gets to that tipping point, when it's clearly bad, then it's like, I don't want to send people out or I don't want to be out."

These accounts suggest that across attachment orientations, workers' "tipping points" for action may be less tied to a specific advisory level and more tied to the moment conditions become physically intolerable. In both excerpts, the threshold is defined in experiential terms ("horrible," "clearly bad") and anchored in embodied consequences (e.g., headache, reluctance to send people out). This pattern implies that severe, unavoidable symptoms may function as a more immediate trigger for protective action than preventive guidelines alone.

Other participants vividly recalled the intense physical impacts of these events. Participant 6 (average anxiety, low avoidance) stated simply of the High Park Fire, "That... was really hard to work outside in." Participant 8 (low anxiety, average avoidance) elaborated on this experience and the resulting behavioral change:

> It was hard to breathe outside. We actually, then, did limit a little bit some of our outside work, but that just the way the wind patterns were, that had way more particulate that came into town.

These accounts suggest a pattern that is consistent with low or average attachment insecurity, in that participants openly acknowledge the physical difficulty of the experience, without dismissing it, and describe their behavioral adjustment in response. The combination of clear threat acknowledgement and problem-focused coping is broadly aligned with attachment theory's expectations of more secure, adaptive risk regulation.

5.4.1.3. Making Sense of Risk Across Time, and Place

This response may reflect how difficult it can be to recall gradual shifts in air quality over time—particularly outside of acute, memorable wildfire events—and is also consistent with the fact that Participant 5's childhood in the region largely predated more recent and severe wildfire events, such as the Hayman fire in 2002, the High Park fire in 2012, and the Cameron Peak fire in 2020 (Colorado Division of Fire Prevention & Control, 2025). More broadly, this exchange suggests that air-quality risk perception may be shaped by a combination of chronic, incremental changes in addition to distinct experiences tied to major events.

For some workers, comparisons to other locations shaped how they judged local risks. For example, Participant 8 reflected on regional differences: “Denver was famous for the brown cloud in the winter. And Fort Collins is getting it a little bit, but Denver was and still is worse.” More broadly, Participant 3 compared local air quality conditions to conditions in West Coast states: “As bad as it is here, I was just in central Oregon. It’s way worse there… They’ve had fires for 3 years now and it’s just been terrible.” These comparisons often diminished concern about local risks. In contrast, Participant 28, who had recently moved from hot, humid Florida, found Fort Collins's air quality more concerning than its heat: “Yeah, the heat doesn’t bother me much… but I definitely noticed the pollution when I got here… it’s tough to breathe.”

Alongside experiential and geographic comparisons, participants’ descriptions of air quality risks at times reflected patterns that are broadly consistent with their attachment orientations. For example, Participant 18 (high anxiety, average avoidance) recalled a shared experience of wildfire smoke while working: “The three of us all could feel like heavy, a little slower moving than we would typically be in the field doing that same work without the air quality issues.” Participant 18 also noted concerns shared by others: “[The Alexander Fire] compounded [their symptoms], from what I've heard from people that have allergies already." This participant’s focus on how others were feeling and how shared experiences shaped interpretation is consistent with theoretical expectations for higher attachment anxiety, which is often associated with heightened attention to interpersonal cues in evaluating threat.

In contrast, participants with higher attachment avoidance sometimes described managing air quality risks in ways that emphasized self-reliance or endurance, including acknowledging effects while minimizing their significance. Participant 16 (average anxiety, high avoidance) shared their first-hand experience with long-distance and local wildfire smoke by acknowledging symptoms and then downplaying them. They recounted:

> I could see [the Alexander Fire] up in the sky, but that fire didn't affect me at all. The California and Canadian fires affected me a lot. It's almost like those ones that blow in and is finer particle maybe, but that's when I have the multi-day symptoms of sluggishness and just like that [imitates cough] little cough. Yeah, but no, I didn't really feel [the effects] at first.

Later, Participant 16 elaborated on how they respond when air quality remains in a moderate range:

> When [the AQI] is in that moderate range, like okay, Alexander Fire's burning, I'm just going to deal with it and go do my work as normal and just deal with the repercussions and symptoms. Just because it's easier for me to do that than reschedule stuff and make a big deal about it. I'd just rather deal with the symptoms.

Participant 22 (high anxiety, high avoidance) described a similar movement from concern to dismissal, drawing on prior occupational experience to contextualize and downplay the risk:

> I know we had a few [wildfires] over the summer. There was one by Estes, I think a few weeks ago, so that obviously dipped down the air quality. I remember that week, Denver had the worst air quality in the nation for a few days. Me personally, I'm used to it [because] I used to do wildland fire back in Alaska.

Taken together, these examples suggest that attachment-related tendencies may help explain variability in how workers interpret and respond to air quality risk. In this sample, participants higher in attachment anxiety more often oriented to shared experiences and others' symptoms when making sense of hazard impacts, whereas participants higher in attachment avoidance more often emphasized “dealing with it” and minimizing disruption, even while acknowledging physical effects. Broadly, these patterns are consistent with theoretical expectations in which attachment anxiety heightens attention to social cues when interpreting risk and attachment avoidance is associated with deactivating, self-reliant coping strategies.

5.4.1.4. Other Environmental Concerns: UV and Cold Weather

Although the primary focus of the discussions was on extreme heat and air quality, participants also raised other environmental hazards and seasonal influences. UV exposure emerged as a concern, particularly among workers with personal or family histories of skin cancer. Participant 27 (average anxiety, average avoidance) shared, “I have a history of skin cancer in my family… so that will influence my decision to protect from UV stuff.” Similarly, Participant 9 (low anxiety, average avoidance) described proactive information engagement that guided day-to-day protective decisions:

> When I check my phone that I realize I check more often, at least for my family's history of skin cancer, is I check UV Index a lot more than I check the heat. Just because that makes more decisions on me, if I'm bringing what sunscreen and what clothing [I wear].

Together, these accounts suggest that UV risk salience is shaped in part by personal relevance, particularly family history, and that this relevance translates into concrete protective planning (e.g., sunscreen, clothing choices) supported by targeted information seeking (e.g., checking the UV Index).

Cold weather also emerged as a seasonal concern, especially during winter months when temperature inversions can trap pollutants. Participant 26 noted, “Our air quality in the wintertime can be really poor because of the temperature inversions… that’s when we really notice.” Several participants also indicated that adjusting schedules for winter hazards was more socially acceptable than doing so for summer heat. As Participant 8 put it, "It's easier to justify staying inside in zero degrees than in high heat." These reflections suggest that environmental risk appraisal is shaped not only by conditions themselves, but also by operational expectations that influence when protective adjustments feel legitimate or feasible.

5.4.1.5. Theme 1 Summary

Theme 1 ("Hazards in Contrast") shows that outdoor workers differentiate extreme heat and poor air quality risks by hazard characteristics, as well as how each hazard is experienced, interpreted, and managed in day-to-day work contexts. Across focus groups, heat was consistently treated as the more immediate and physically threatening risk, assessed through rapid-onset thermal and physiological cues (e.g., dehydration, headaches, fatigue) and intensified by job demands and PPE that directly compound exposure. In contrast, air quality was more often framed as a slower-developing, chronic condition that workers routinely tolerate until it reaches a "tipping point" that is less defined by a specific advisory level and more by physically intolerable symptoms.

Workers also made sense of air quality by comparing conditions across time (e.g., recalling whether "this" was present in childhood) and across place (e.g., Denver, the West Coast, Florida), with these comparisons sometimes diminishing concern and other times increasing it depending on prior regional experience. Within these broader patterns, participants' accounts aligned with attachment theory expectations in cautious ways: higher attachment anxiety was reflected through an increased focus on others' symptoms and shared experiences when interpreting smoke impacts, whereas higher attachment avoidance appeared in frames that emphasized endurance or self-reliance by acknowledging physical effects while minimizing personal distress. Finally, participants' attention to UV risk (especially when family history of skin cancer increased personal relevance) and to cold-weather/inversion-related air quality illustrates that hazard salience is also shaped by health history, seasonal routines, and workplace norms around what forms of schedule adjustment are viewed as legitimate or feasible.

5.4.2. Theme 2. Social Signals: The Role of Norms in Shaping Risk Information and Protective Behavior

Theme 2 captures how outdoor workers' hazard awareness and protective decisions are shaped by social and normative influences beyond individual appraisal. Across focus groups, participants described interpersonal cues from family and friends, consistent workplace safety cultures reinforced by supervisors and organizational systems, and expectations from external stakeholders. Together, these influences form a layered social context that shapes what actions workers perceive as appropriate, legitimate, and feasible during extreme heat and poor air quality.

5.4.2.1. Beyond the Workplace: Influence of Family and Friends

Workers most often linked influence of family and friends to air quality risks rather than extreme heat, and these interpersonal dynamics appeared to be filtered through participants' attachment orientations.

Participants with lower attachment insecurity (i.e., low/average attachment anxiety and low/average attachment avoidance) acknowledged that family and friends expressed concern about their well-being, but they tended to describe that concern as a cue for general awareness rather than a direct motivation to take specific protective actions at work. For instance, Participant 8 (low anxiety, average avoidance) noted, "I think my wife and my mom will occasionally be like, 'Oh, is the smoke bothering you?' But, you know, it's more of a like, 'Oh, hey, I'm concerned.'" Similarly, Participant 12 (average anxiety, low avoidance) shared, "My parents... they'll definitely be like, 'How's it going? Don't work too hard. Maybe wear a mask if you want to.'"

Participant 19 (average anxiety, average avoidance) described concern from their social circle as shaping their awareness of cumulative occupational health risks over time: "I hear the most concern from friends and family members... like asking about my health and kind of like the longevity of working outside." Across these accounts, concern from family and friends was generally received openly and appeared to function as a supportive prompt for workers' risk awareness.

This dynamic shifted for Participant 7 (high anxiety, high avoidance), whose reflections illustrate a tension that is broadly consistent with having high levels of both attachment anxiety and attachment avoidance. They first emphasized a perceived lack of concern—a sign of high relational awareness, consistent with high attachment anxiety—while describing their spouse's focus on protecting their child:

> My wife knows I have allergies and things like that, but she's more concerned with, 'Are you going to take our 4-year-old outside if the air quality is that bad?' But she's not really concerned with [me] too much. Like she knows that we've got jobs… we still have to do that.

Participant 7 then moved quickly toward a self-reliant stance that deemphasized their spouse's perspective by positioning themself as more knowledgeable about outdoor conditions: "I know my wife doesn't go outside during the day because she has an inside job, so I know more about the heat than she does." These statements reflect an interplay between heightened attention to relational concern and an effort to maintain independence; a tension that is consistent with theoretical descriptions of having both high anxiety and high avoidance.

Participant 16 (average anxiety, high avoidance) offered another example in which risk management was framed as primarily individual and separable from others. In describing their parents' precautions, they emphasized their parents' self-sufficiency and positioned their own awareness as independent of family input: "I have noticed like [my parents] are aware, but they're just taking care of themselves." They reinforced this boundary by adding, "During those times I'd probably already be aware and thinking about it. But yeah, they can take care of themselves." This framing is broadly consistent with higher attachment avoidance insofar as it locates responsibility within the self and minimizes reliance on others for risk appraisal or decision-making.

However, not all accounts of independence reflected distancing or dismissal. Participant 11 (average anxiety, average avoidance) also described taking initiative, but framed it as bringing risk awareness into shared decision making rather than separating from others: "I don't ever like hear my friends or family reach out to me... if I'm going on a bike ride with friends or something, we try to do it in the morning or in the evening. And I think that's because I'm aware of the Heat Index... I'll bring that up." In this case, independence functioned as social coordination and planning, not as withdrawal or deactivation.

Overall, workers' reflections suggest that responses to concern from family and friends may vary in ways that are broadly consistent with attachment-related tendencies. Participants with lower attachment insecurity more often described concern as supportive background context or engaged proactively with others around hazard planning. In contrast, participants higher in attachment insecurity (high anxiety and/or high avoidance) more often framed risk as a personal responsibility, emphasized self-reliance or superior knowledge, or highlighted perceived gaps in others' concern.

5.4.2.2. Workplace Norms: A Culture of Support and Shared Vigilance

Compared to social cues from family and friends, participants described workplace norms as a more consistent and actionable influence on protective behavior. Across groups and attachment orientations, workers emphasized appreciation for a culture of shared responsibility within crews and for supervisors who actively supported safety during periods of extreme heat and poor air quality. Participant 8 (low anxiety, average avoidance) summarized this ethos succinctly: “There’s a saying in the line worker community that, ‘I am my brother’s keeper.’ You’re always watching out for your coworkers… if somebody starts showing signs of heat stress, we’re kind of watching out for each other.”

This culture of vigilance was further illustrated in a discussion of heat-related illness. Participant 3 (average anxiety, high avoidance) recalled, “We've had a couple instances over at the substation and stuff. Some guys go down... not... I don't know if you'd say 'go down' but have the effects of heat exhaustion slash heat stroke.” Participant 8 extended this account by describing a shared, immediate response:

> Yeah... where we had co-workers showing the signs and we're like, 'Hey, we got to get you in the shade. We'll put ice packs on you.' Like everybody's keeping an eye on 'em. Do we need to call 911? How are they doing?

This exchange demonstrates how workplace vigilance translated into immediate and collaborative action in response to observed signs of heat stress, reinforcing the norm of quick intervention and collective care. This norm of shared responsibility was echoed more broadly by Participant 21 (average anxiety, low avoidance) who recognized a general group understanding of pacing work in response to heat: “The general consensus is that when it gets hot in the afternoon, we take it easy.” Other examples of this collective approach included rotating crews out of the sun for breaks and sharing hazard information. For instance, Participant 6 (average anxiety, low avoidance) explained, “We’re in crews of 4, so we can rotate… you don’t have to be in there the whole 4hours.”

Participants also emphasized the role supervisors and crew leads played in reinforcing these norms and making protective action feasible. Supervisors were described as proactive and attentive to workers’ needs during extreme conditions. For example, Participant 3 explained, “If it's really hot, we'll have some of the supervisors go out with ice cold Gatorade to give to the crews to help.” Participants also highlighted top-down hazard communication, particularly around air quality. Participant 14 (average anxiety, average avoidance) noted that their supervisor forwarded air quality alert emails from the Colorado Department of Public Health and Environment and encouraged task adjustments. Participant 27 (average anxiety, average avoidance) similarly described organizational monitoring and communication: “It comes top down all the way from the manager of Parks. Usually, he’ll send out pretty good communication emails, like he’s really on top of watching [weather conditions] and makes a concerted effort in that field.”

This leadership support also took the form of routine well-being check-ins and flexibility in task planning. Participant 11 (average anxiety, average avoidance) shared, “Our supervisors, I've noticed, usually check in with us when it's those really long stretches of high heat. Just checking in with how everyone's feeling and if we do need to switch up tasks or not.” Participant 13 (low anxiety, low avoidance), a Natural Areas crew lead, emphasized that health and longevity were prioritized over rigid completion timelines:

> The way I see it, nothing we do is an emergency… if it's going to be too arduous, then we'll find another task and just kind of navigate around the weather for the overall health

and safety and longevity of employees.

Beyond daily adjustments, workers described rest and recovery as another way supervisors supported well-being. Participant 12 (average anxiety, low avoidance) reflected:

> We're never not encouraged to take the next day off if we need it... Most all of our supervisors are very understanding [when we tell them], 'I don't feel good today, and I need to take a day off to physically realign myself to the work.'

Collectively, participants described these forms of support as part of a broader organizational commitment to worker well-being that extended across departments and levels of leadership; what Participant 16 described as being "top down and through every layer."

Across groups, participants consistently expressed appreciation for outreach and communication from the organization's Safety and Risk Management Department. Participant 27 (average anxiety, average avoidance) explained, "We have a good safety partner through Safety and Risk Management, who's always sending out communications and partnering with us in person too." Participant 3 (average anxiety, high avoidance) compared these efforts favorably to the private sector:

> This organization does a better job than, like, the private sector... [Safety and Risk Management] reach out to the organization as a whole to try to keep everybody safe and aware of the conditions... They send things out during heat or poor air quality times just to give everybody notice of what's going on.

Organizational support was also described in tangible terms through resources that reduced heat burden and enabled hydration and recovery (e.g., electrolyte powders, popsicles, water jugs, ice machines). Participant 6 noted, "We get liquid IVs. We get a lot of stuff to be able to help hydrate and stay aware." Participant 24 (average anxiety, low avoidance) described routine use of these resources by colleagues:

> They'll pop [electrolyte packets] in their pocket in the morning, they've got their water bottles, and working in the park, there's always a drinking fountain fairly close, so they can mix some stuff up to try to stay hydrated. And I know City Park and the downtown shops always have Gatorade and a mixture of stuff out for [the crews].

Participant 16 (average anxiety, high avoidance) emphasized how formal safety efforts were integrated into routine operations (e.g., monthly safety meetings; onboarding new staff; maintaining supplies):

> I would add that we have monthly safety meetings. And during those hot weather and sort of bad air quality seasons, then the conversation [about these hazards] does get brought up… We make sure that new staff members are aware of what we discuss and kind of some resources to kind of mitigate that stuff… the department provides good resources, like water jugs on every truck. We have a great ice machine... and we always have as much ice on hand as we need... We have electrolyte powder on hand and some seasons we'll have electrolyte popsicles... So, things like that really take the edge off.

However, Participant 16 later added, jokingly, that his team felt like "the special child that gets all the resources." Although humor can serve multiple functions in conversation, this framing may indicate some discomfort with being positioned as a recipient of support, even as they acknowledged its value which is broadly consistent with the independence-oriented stance often associated with higher attachment avoidance.

This theme of resource distribution then shifted from humor to explicit concern about equity. Participant 18 (high anxiety, average avoidance) raised questions about whether all employees—particularly those providing essential services—receive adequate protection, contrasting their own “not critical” work with those who must repair “critical infrastructure... no matter if it's 100 degrees or 5 degrees [outside].” They framed this as a safety and fairness issue: “How can you ensure that those employees are being as safe and as healthy as possible while doing it?” This emphasis on others’ well-being and on equitable protection is consistent with theoretical expectations for higher attachment anxiety, which can involve heightened attention to relational and social consequences when interpreting risk.

Responding to the equity concern, Participant 13 (low anxiety, low avoidance) shifted toward worker advocacy and structural support, emphasizing the role of documentation in enabling employees to negotiate task adjustments:

> I think it's helpful from a worker standpoint that if you don't have supportive supervisors, having documentation where, ‘It says right here we're at red, man.’ That gives [employees] more bargaining power with their supervisors to adjust work.

Rather than minimizing risk or focusing on individual endurance, this response emphasizes practical tools that enable protective action within workplace hierarchies. While attachment orientation cannot be inferred from a single excerpt, the action-oriented and empowerment-focused framing is broadly compatible with theoretical accounts of more secure coping, which emphasize flexible problem-solving and the ability to seek or mobilize support when needed. The exchange among Participants 16, 18, and 13 also illustrates how workers collectively negotiate safety culture by balancing appreciation for resources with attention to equity and empowerment.

Overall, participants described workplace norms as a consistent, actionable, and supportive influence on protective behavior, characterized by shared vigilance and organizational follow-through. Attachment-related patterns surfaced most clearly in *how* workers talked about and participated in this culture: Some accounts emphasized collective responsibility and practical problem solving; others foregrounded concern for fairness and protection for vulnerable roles; and others acknowledged strong organizational support while using humor or self-reliant language to manage discomfort with being supported. Importantly, unlike discussions of family and friends (which were more often linked to air quality), workplace norms were most frequently discussed in relation to extreme heat, suggesting that co-workers, supervisors, and organizational systems are a particularly salient layer of social influence for heat safety.

5.4.2.3. The Influence of External Stakeholders and Public Service Obligations

Participants also described how feedback from external stakeholders (e.g., volunteer groups and community members) and the public service obligations of their roles shaped how they managed environmental risks. Participant 11, for example, explained canceling a volunteer project during a poor air quality event:

> With the smoke, I had to cancel my volunteer project. I have volunteers that go out and check trail cameras for me, and it's kind of a burly hike, one of the routes that they do... and so and they're all kind of older retired folk. And so, I had to cancel that because they had expressed concern with the air quality... when there's wildfire smoke.

In this account, decision making was guided not only by the worker's own assessment of conditions but also by volunteers' expressed concern and perceived vulnerability, indicating that community feedback can shape operational choices, particularly when a worker is responsible for others' safety.

Participants in the Utility Department focus group also emphasized that, in roles tied to essential services, work sometimes continued despite extreme conditions. Participant 3 explained, “We don’t like to take people out of power,” and Participant 6 added, “If it’s a planned outage, we’re more than likely still doing it, even if it’s 100 degrees.” These comments underscore how public service obligations can establish expectations for continuity that constrain how much flexibility workers perceive they have to pause, reschedule, or modify tasks during hazardous conditions.

Overall, these perspectives suggest that workers’ risk-related decisions are shaped not only by internal workplace norms but also by external expectations and responsibilities to the public. Although these influences were discussed less consistently than co-worker and supervisor norms, they add an important layer to the social context within which workers evaluate hazards and negotiate what protective action is feasible.

5.4.2.4. Theme 2 Summary

Theme 2 (“Social Signals”) highlights how outdoor workers’ risk information and protective decisions are embedded in a multi-layered normative environment that extends beyond individual appraisal. Workers described family and friends as a more intermittent influence, most often salient for air quality, and typically functioning as a cue for general awareness. In some accounts, particularly among participants higher in attachment insecurity, these interactions were framed in more independence-oriented or relationally sensitive ways.

In contrast, workplace norms were described as the most consistent and actionable driver of protective behavior, characterized by shared vigilance (“brother’s keeper”), rapid peer intervention, and supervisor-enabled flexibility supported by organizational communication, formal safety routines, and tangible resources. Within these workplace contexts, workers’ sense-making occasionally reflected patterns broadly consistent with attachment-related tendencies (e.g., attention to equity and others' well-being versus self-reliant framing), but these interpretations remain appropriately bounded to how participants narrated their experiences.

Finally, participants identified a further layer of perceived expectations from external stakeholders and public service obligations, which could either prompt protective decisions (e.g., canceling volunteer activities during smoke) or constrain flexibility (e.g., maintaining essential services during extreme heat). Considered together, the theme underscores that workers negotiate hazard response through intersecting personal, workplace, and community-based norms that shape what protective action feels legitimate, feasible, and necessary.

5.4.3. Theme 3. "What Does Orange or Red Really Mean to Me?" Workers' Information Needs, Control, and Attitudes

This theme captures how knowledge gaps, such as uncertainty about contributors to poor air quality and challenges to interpreting severity indicators, influence workers' protective behaviors. It also highlights how access to timely, job-relevant, easily accessible information can strengthen workers' sense of control and foster more positive attitudes toward seeking and using environmental hazard information.

5.4.3.1. Unclear Contributors to Air Quality Issues

Across focus groups, workers expressed confidence in their knowledge about extreme heat and how to effectively respond to it, explaining that they often obtained this knowledge through annual trainings on heat exhaustion and heat stroke symptoms. However, some workers voiced more confusion about poor air quality, specifically what causes poor air quality and how to interpret air quality information in a way that would inform protective action. Although many participants recognized that wildfire smoke was a key contributor, they demonstrated less certainty in their knowledge about other contributors to poor air quality.

Several participants expressed uncertainty about the broader environmental and human factors that contribute to poor air quality in the region. Some questioned the role of traffic, industrial activity, and population growth in the region. For instance, Participant 8 noted:

> I mean, Fort Collins has doubled the population in the last 20 years. And the whole Front Range has just exploded in population. And so, if nothing else you got that many more cars here and that much more vehicle exhaust.

This observation sparked a broader conversation within the focus group about factors that contributed to air quality issues in the nearby city of Greeley. Participant 3 asked, "Is Greeley bad, too? Somebody said Greeley gets a lot [of poor air quality] because it sits low." Participant 1, who lived in Greeley, responded: "It isn't bad, just stay on the east side." Participant 8 followed up with a clarifying question, "Is that more the geographic location of Greeley or the meatpacking plants and slaughterhouses?" Participant 1 simply responded, "Everything."

Air quality knowledge gaps emerged in another exchange when Participant 28, who had recently moved to the area, asked the group, "Can you educate me on why air quality is so bad here?" Participants offered partial explanations referencing factors like temperature inversion, altitude, and geography. For instance, Participant 26 said, "Temperature inversion happens here very easy because of the altitude. And we sit in bowls, basically, because we built around river bottoms, so we sit in natural bowls." However, other contributors such as wildfire smoke, industrial activities, and human-made emissions were not mentioned during this exchange.

Overall, these reflections highlight a significant contrast in workers' knowledge about heat and air quality. Although workers expressed confidence in managing heat, they demonstrated considerable uncertainty regarding air quality. Although wildfire smoke was a known contributor, participants collectively speculated about the impact of other contributors such as population growth, traffic, industrial activity, and geographic factors. Without a clear understanding of key contributors to poor air quality, workers' ability to accurately assess risk may be limited and decrease their engagement in information seeking or protective behaviors.

5.4.3.2. Interpreting Risk: Gaps in Understanding Severity and Task Intensity

Across all groups, participants described difficulty interpreting the severity of air quality and extreme heat conditions, particularly when they relied on color-coded tools like the Air Quality Index (AQI) and HeatRisk. Although many appreciated the simplicity of these systems, they found the meaning of the different levels ambiguous and disconnected from relevant workplace actions.

Participant 27 noted that the AQI could be hard to interpret and offered suggestions for improvement:

> Yeah, it might be kind of nice... I don't know how you'd incorporate it, but maybe just some like real quick short facts about each [air quality level] because, I mean, just looking at the colors like it's hard for me to gauge. Like what does orange or red really mean to me? How is that [orange or red] going to impact me versus yellow?

Participant 26 built on this, suggesting a "thermometer or barometer" style visual. They explained this gauge-like display would help them see the progression of risk within a specific color (e.g., how close 'yellow' was to turning 'orange'), rather than relying on a single, static color block. Others agreed with Participant 26 and said the color-only approach made it difficult to assess how close conditions were to becoming dangerous. These recommendations highlight workers' needs for more specificity in color-coded hazard warning systems.

Workers also said they were confused about how to classify their tasks' intensity levels, especially under changing environmental conditions. Participant 18 pointed out that tasks typically considered low intensity can become high intensity depending on context: “Sometimes riding on a mower can be a lot worse than the alternative [pushing a mower] just because of the amount of dust and stuff [kicked up by the mower].” Participant 17 added that an array of factors can shift the intensity of routine tasks like digging, spraying, or operating equipment. Specifically, a task might be easy for one person but strenuous for another, manageable in the morning but exhausting in the afternoon, or simple on flat ground but difficult on a steep slope. Participants’ comments suggest the need for communication tools that convey risk levels in ways that are connected to actionable guidance tailored to the specific worker and work context.

5.4.3.3. Balancing Access and Agency

Workers described using air quality and heat information to guide how they prepared for their workday, especially when real-time updates were not available in the field. For example, Participant 13 described how workers rely on forecasts at the beginning of the day, due to limited cell phone service in the field:

> A lot of spots that we work at there’s not cell service and there’s not always an availability in the moment to see how [the weather is] looking now. So, a lot of [our work] is pre-planning with the forecast.

Similarly, Participant 8 explained, “If it’s going to be hot, people might check a weather app in the morning and make damn sure that water jugs got ice and cold water [in the trucks] before you leave the shop in the morning.”

Other participants described using Air Aware text alerts to guide daily planning or adjustments to work routines. Participant 19 shared:

> I signed up for text messages. It's super helpful just to know every day what [air quality level] it was in. And then if it seemed like it [air quality] was getting worse, I could look up the exact numbers.

When asked whether text messages prompted deeper engagement, Participant 19 replied, "Yeah, I think it just helped me make a decision about the day."

Beyond real-time awareness, participants emphasized a need for improved air quality forecasts to support more advanced planning. Participant 24 noted, "I wish the [air quality] forecast for the next day would come out a little bit sooner. There's a lot of times that doesn't get updated till after 12:00 [p.m.] ... a little more advance notice would also help." These examples highlight how timely and accessible information can strengthen workers' sense of control by allowing them to anticipate hazards, adjust their work pace, or modify break schedules proactively, rather than reacting once symptoms emerge.

Building on text message alerts, workers expressed an interest in further developing real-time, mobile-friendly solutions, such as mobile widgets that display current heat and air quality data without requiring extra steps to access. Participant 21 explained that a widget could easily become part of their morning routine alongside checking the weather or calendar. Similarly, Participant 16 suggested a mobile widget to minimize delays in accessing information and also envisioned digital signage in shared workspaces that could display real-time data from sources such as NOAA.

Taken together, these collective perspectives on forecasts, text alerts, and mobile widgets highlight the importance of workers having timely, accessible information to support pre-planning and in-the-moment decision-making throughout the workday. Overall, these findings suggest that well-designed, mobile-friendly communication tools can bridge differences in informational preferences and support consistent engagement with hazard information.

5.4.3.4. Attitudes Shaped by Perceived Relevance

Participants' attitudes toward seeking air quality or extreme heat information were shaped by its perceived relevance and accessibility. Negative attitudes emerged when workers saw risk information as irrelevant to nonnegotiable job tasks, fostering a sense of futility. Participant 6 illustrated this disconnect, explaining: "It doesn't matter if it's 100 degrees that day, we're more than likely still doing [a planned outage]. So, you can look at [air quality and extreme heat information], but we're still going to be working in [those conditions]."

Others echoed this sentiment, sharing that checking the AQI or heat index rarely changed the primary task of their day. As Participant 18 reflected:

> I try to think about it like, 'How often did it change what I was doing that day, out in the field?' And I can't really remember a time when we just stopped doing the project. If it's too hot or it's the air quality is bad, we just kind of maybe take more breaks, drink more water, do more resting. But I don't think it ultimately changes the task at hand for the day.

These perspectives illustrate that the sense of futility stemmed from the fact that the information was not powerful enough to alter the core work requirements. The task remained, even if the process of doing it was modified (e.g., more breaks).

Participants also expressed frustration with the way that public health messages are framed, especially those targeting "at-risk" or "elderly" populations. Participant 26 explained how this kind of language causes them to disengage: "If it says, 'If you've got this condition or that condition,' then I just quit reading because I don't have any of that. So, the important information is kind of missed in that." He argued this framing falls short in two ways: The general warning is 'missed' by healthy workers, and it is redundant for those who are already vulnerable: “And if somebody is compromised in some way or they already know that and they’re going to say, ‘Well it’s going to be hot today and I’d better be more careful.’” In light of this critique, Participant 26 suggested a more universal message: “Just say, ‘If you’re outside, be careful, whether its bicycling or working.’”

This desire for more relevant messaging was a key factor in participants’ attitudes. While they disengaged from messages focused on “at-risk” or “elderly” populations, participants expressed more positive attitudes toward information seeking when information was framed in ways that were job-relevant, routinely integrated into the workplace, and easy to access without requiring extra effort. For instance, workers appreciated Air Aware campaign materials such as signage, flyers, and QR codes for making risk information timely, job-relevant, and easily accessible. Participant 8 shared, “Before [the campaign] I’d pull up my weather app and ignore [air quality]. And after the campaign, I’d actually be like, ‘Oh! There’s an ozone alert today.’”

Participant 16 offered feedback on the Air Aware decision chart:

> [The Air Aware decision chart] was really helpful. We have it hanging above a few desks and I probably read it about three or four times this year just because it’s there. So when I get downtime, it’s like reading the back of a box of cereal or something. It’s eye catching so you read it throughout the year.

Participant 14 echoed this appreciation, noting the ease of accessing additional resources through the campaign materials: “It’s nice to be able to scan the QR code quick and get to the [Linktree] website and look [the current conditions] up that way.”

Participants consistently pointed to the visibility, design, and user-friendliness of Air Aware materials as key reasons for engaging with the campaign. Participant 9 commented: “One, I think the visibility of the [Air Aware] signs has been really good, and they're placed really well. Plus, the bright poppy colors, actually gets people's attention because I mean government buildings, you post signs over everywhere and no one looks at them, but these ones I actually do look at." Participant 18 agreed and emphasized the usability and content depth of the campaign's materials:

> It's very well... it's very user friendly. It's very inviting to look at the charts and all that. It's really well done. It jumps out at you a little bit too. As far as the website is, you know you can click on [wildfire and smoke] conditions.

Beyond the user-friendly design of the campaign, Participant 13 reflected on the broader impact of the consistent visibility, explaining how the Air Aware campaign materials reinforced the relevance of air quality as a workplace concern: "I think just having the [Air Aware] signs up normalizes that, 'yeah, this is a topic we should be concerned about.'" This comment illustrates how routine exposure to accessible, relevant information can foster positive attitudes toward information seeking and a shared culture of awareness and engagement, which will be explored further in the next theme.

5.4.3.5. Theme 3 Summary

This theme highlights critical knowledge gaps and workers' perceptions of information access and usability. A key knowledge gap emerged: participants felt confident managing extreme heat risks due to formal workplace training but demonstrated uncertainty about the causes of poor air quality beyond wildfire smoke, often focusing on uncontrollable geographic (e.g., altitude) or atmospheric (e.g., temperature inversions) factors.

This knowledge gap was compounded by a usability gap, as workers found that color-coded tools like the AQI seemed ambiguous and disconnected from their dynamic, context-specific job tasks. This disconnect often led to negative attitudes, including a sense of futility (e.g., "we have to work anyway") and disengagement from public health messages perceived as irrelevant (e.g., "at-risk" groups).

Conversely, participants' sense of control and attitudes shifted positively when communication was job-relevant, highly visible, and user-friendly, as seen in the *Air Aware* campaign. Workers appreciated how the campaign made air quality information timely and accessible, which allowed for "pre-planning" (e.g., using text message alerts) and strengthened their sense of agency.

These findings suggest that addressing knowledge gaps, enabling pre-planning, and job-specific information are critical elements in strengthening workers' sense of control and fostering positive attitudes toward information engagement.

5.4.4. Theme 4. Translating Information into Action: Workers' Information Engagement, Preferences, and Recommendations for Communication Design

This theme explores workers' specific pathways for engaging with environmental hazard information. It details how their active and passive information seeking is shaped by the specific hazard and their job tasks. It also analyzes workers' feedback on the Air Aware campaign to offer recommendations for worker-informed communication design.

5.4.4.1. One Search, Two Insights: Active and Passive Information Pathways

Participants described distinct patterns of information engagement when seeking extreme heat and air quality information. Overall, workers described more active information seeking behaviors related to extreme heat than air quality. For instance, Participant 11 explained, "Yeah, if we have like the crew doing like a physically strenuous like project for long periods of time, I usually try to keep my eye on the Heat Index a little more, just so... if it's like day four in a row, we can maybe take a break and do a different project that's not as strenuous.” Participant 16 agreed, “That’s really true. We keep an eye on the Heat Index more. I don’t look at the air quality nearly as much but [the] heat… If it’s in the 90s, then yeah, we’re monitoring it every day it seems like, looking forward into the forecast.” Other participants echoed this perspective, emphasizing that having heat forecasts gave them more flexibility in adjusting work schedules for the day and week ahead. However, this information-planning behavior for heat information was in sharp contrast with how participants described their engagement with air quality information. That information was often accessed in reaction to visible environmental cues. As Participant 2 explained, “When I actually check [the air quality], it’s because like you look at the Front Range and you can barely see it and it’s hazy or something.”

For several other participants, air quality information was passively absorbed as they were seeking heat information. Participant 8 remarked:

> We pay more attention to the heat than the air quality. So, with this you might be pulling it up [on your phone] to see what the heat is and then say, 'Oh, the air quality is going to suck today, too.'

Similarly, Participant 3 and Participant 6 mentioned checking the weather app out of habit, initiating the information-seeking process to prepare for extreme heat and then noticing air quality alerts during the process. Participant 8 followed up, “Some of the weather apps also now will give you an air quality alert. So, you sort of secondhand pay attention to air quality. But I think our biggest concern is the heat.” This layered information seeking behavior suggests a clear hierarchy: heat, as the more immediate and physically intense threat prompts active engagement, while air quality is a secondary concern, sought reactively or absorbed passively.

Participants frequently described how job-related tasks and policies served as an entry point for broader risk awareness. In this pattern, workers engaged with hazard information for operational reasons—such as planning irrigation or complying with a fuel mandate—which then "trickled down" to heighten their personal health awareness.

For instance, Participant 27 explained “You're constantly worried about park sites for irrigation reasons… you're also looking for heat… but then that [worry] also will, you know, trickle down into your own personal well-being.” They added, “[Personal well-being] should be a regular daily conversation… regardless of if they're [workers] paying attention to it or not.”

In other cases, formal workplace policies prompted information engagement which then led to broader awareness and engagement. For example, Participant 24 discussed how mandates on fuel usage during Ozone Alert Days pushed crews to adopt new habits and pay more attention to air quality. What began as a compliance requirement (i.e., “don’t run the gas equipment after noon.”) eventually filtered into daily routines and decision-making. Participant 24 explained, “Now it’s [knowledge about fuel usage mandates] being, you know, it’s filtering down where everybody should be aware of it by now.”

5.4.4.2. Worker-Informed Communication Design

Although workers’ information-seeking behaviors were shaped by job tasks and perceived urgency, participants also provided valuable insights into how air quality and heat information could be communicated more effectively. Reflecting on their experiences with the Air Aware campaign, they discussed what aspects resonated most which focused primarily on in-person campaign presentations, magnets, QR codes, and text message notifications. During these discussions, workers offered valuable suggestions for improving the design, delivery, and integration of risk communication into their daily work routines.

Participants who attended the in-person campaign presentations consistently reflected on their impact. For instance, Participant 6 shared, “Even myself... like until you guys gave that presentation, I never even thought about air quality other than the smoke is in the air. You notice it... But never even thought about air quality before that.” Similarly, Participant 8 echoed the importance of in-person engagement, emphasizing that presentations had a greater effect than passive materials alone: “I think the biggest overall impact... was when your group came and talked to us and kind of explained more into detail rather than just seeing a little flyer. I think your talk kind of had more of an awareness impact.” Participant 8 also recommended incorporating periodic check-ins to maintain awareness throughout the season: “Maybe you do your initial kick off and then do a midway through… just a quick little like, ‘Hey, are you guys actually checking? Are you aware?’ I think the human experience has more of an impact.”

Building on the campaign’s interpersonal components, participants shared their experiences with the campaign’s physical materials, including the Air Aware dial magnet indicators. While some workers found the magnets helpful immediately following the in-person presentations, they observed that engagement with them declined over time. Participant 11 reflected, “In the beginning, like right after you came out, we were pretty good about adjusting that dial… but it definitely fell off the radar after a month and a half or so.” Participant 14 similarly noted that during fire season, “People were moving it. It ended up typically just staying in the red… they were like, ‘well, we’ll just be overly cautious.’”

Other participants raised concerns about the practicality of maintaining the magnets. Participant 7 remarked, “That’s a neat idea, but you’ve got to have somebody constantly checking it…’” Participant 8 was more straightforward: “No more magnets.” This feedback from Participants 7 and 8, who worked in the Utilities roles, contrasted feedback from the workers in the Parks and Recreation roles who reported that they continued using the magnets as part of their daily routine. Participant 26 confirmed, “Yeah we’re on it” affirming that they regularly updated the magnets throughout the summer and into the fall. However, even among consistent users, some described frustration with coworkers misusing the magnets. For instance, Participant 23 noted, “I have some people that think it’s a toy… I’m constantly going and fixing it [the indicator] because they move it.”

In response to negative feedback about the usability of the magnets, participants proposed digital alternatives, such as mobile widgets or display boards that would automatically update them on air quality and heat conditions. For instance, Participant 16 envisioned a large, self-updating display board in shops:

> It could be attached to NOAA’s weather updates. So, if there’s like a flash flood warning, that’s the main thing it’s talking about for the day. If there’s no big, major thing, it’s just kind of the temperature or if lightning storms are coming, and then the air quality and heat index would be a big part of that. Then that way we don’t drop off on trying to move the little lever or the ratings [on the magnets].

He acknowledged that this alternative would take time and investment but believed that these systems could offer long-term consistency and engagement.

Participants saw the potential in QR codes but offered specific suggestions to improve their placement and visibility and prevent them from being "ignored there after a while," as Participant 3 warned. For example, Participant 7 suggested adding QR codes to the air quality dial magnets as a way to encourage magnet usage. This led to a discussion about consistency, with Participant 6 pointing out that QR codes were already on some materials, while Participants 3 and 8 suggested placing them on campaign materials in a larger and more visible manner.

Participant 8 concluded the point by advocating for QR codes as a flexible option that respects worker autonomy: “A QR code is passive, so if people don’t want to be bothered with it, they won’t scan it. But if they’re interested, they will scan it. So, my vote would be QR codes.”

This range of reactions mirrored discussions about other communication channels, such as digital text message alerts. Some participants signed up for these alerts and appreciated their convenience and immediacy. For instance, Participant 19, who identified as part of the "sensitive group," explained, "I just change what I'm doing for the day if I'm concerned about myself.” Participant 20 agreed, calling the text messages "very convenient" and adding, "I probably wouldn’t change it. I would keep it as is.” Participant 25 also noted that the alerts complemented physical tools, serving as "a reminder for me to check our magnets.”

However, other participants said they preferred seeking information independently, rather than receiving alerts, to avoid information overload. As Participant 3 noted, “You get overloaded with that kind of stuff.” Participant 11 echoed a similar sentiment: “I think personally, I just don't like having my phone blow up a lot, so the text message just wasn't my preferred way. But I know a lot of people did prefer that... I feel like I would rather like, go out of my way and search the Air Quality Index or the Heat Index, as opposed to getting a text every day.”

To accommodate these diverse needs and preferences, several participants suggested a more customizable text message alert system. For instance, Participant 8 proposed a tiered system that would allow workers to choose the frequency and threshold of receiving notifications: “Maybe, when you’re signing up for the texts, you could say... ‘I only want to be notified when it gets too extreme,’... So, you can select how many texts you're getting, so to speak.” Similarly, Participant 11 suggested limiting messages to "extreme situations... like when there's like wildfire evacuations in the area." Participant 16 emphasized the importance of individual tailoring based on health conditions: “Someone with severe asthma probably wants to know even if its moderate, whereas I don’t really care unless it’s very unhealthy.” Building on these ideas, Participant 9 proposed changing the language of alerts to make them more actionable and relevant: “Maybe, ‘Be aware today. It’s Unhealthy for Sensitive Groups.’ Texts like that, rather than, ‘Today’s Moderate.’”

Participants also emphasized the need for year-round communication, extending on conversations about air quality risks persisting beyond summer wildfire season. As mentioned in Theme 1 (section 5.4.1), workers noted that winter temperature inversions trap pollution and cause conditions such as, “the brown cloud.” In one focus group, this prompted Participant 28 to ask, “So, is there a reason you don’t do [text messages] in the winter?” Participant 26 followed up, “Yeah, that’s my question.” The moderator explained that the Air Aware campaign was a summer pilot program and that text messages were limited to this period, in part to prevent information overload. After providing this explanation, the moderator asked this group to confirm whether messaging should continue year-round. Participant 26, emphatically replied, “Year-round… 100%” Others in the group, including Participants 20 and 28, expressed strong agreement. When probed further about whether year-round messaging would be overwhelming, Participant 26 explained, “It’s just one more [notification]. I mean, we get a lot anyway, but the ones that carry information keep our attention and that’s an area we need.”

Participants' feedback about customizable alerts and this suggestion for year-round messaging illustrate a preference for communication strategies that are flexible, relevant, and consistently integrated into workplace routines. These insights reinforce that effective risk communication must empower workers by aligning with their daily experiences and needs.

5.4.4.3. Theme 4 Summary

This theme captured workers' engagement with environmental hazard information, revealing a clear hierarchy in their information-seeking behaviors. Participants were active and proactive in seeking heat information to plan their work, treating it as an immediate threat. In contrast, air quality information was sought passively or reactively; often as a "secondhand" discovery when checking the weather, or in response to visible cues like smoke. The primary exception was when job tasks, such as irrigation planning or fuel mandates, created an operational "entry point" that "trickled down" into personal awareness.

This tendency to passively receive air quality data heavily informed participants' communication design preferences. Feedback on the Air Aware campaign showed that in-person presentations were effective for initial buy-in. For long-term engagement, workers appreciated static campaign materials that aided daily decision-making (e.g., Air Aware decision charts), but many participants noted that their engagement waned with materials (e.g., Air Aware dial magnet) that required manual updates. Instead, they advocated for automated digital solutions that could be available year-round such as QR codes and digital screens or dashboards. Additionally, they were interested in more customization options for text message alerts, that would allow them to opt-in to receive text messages at specific air quality or heat thresholds.

5.4.5. Theme 5. Making it Work Together in a "One-Stop Shop" Support for Integrated Hazard Messaging

This theme builds on Theme 4 by capturing participants' recommendations for integrating air quality and extreme heat information into a single workplace campaign. Overall, participants strongly supported this direction, frequently describing the integration of hazard information as creating "a one-stop shop" for understanding risks, simplifying information access, and improving daily decision making. Across all three focus groups, workers perceived integrating air quality and heat information as a practical solution for increasing the availability, consistency, and clarity of risk communication.

5.4.5.1. Strong Endorsement for Combined Messaging

Across all focus groups, participants endorsed expanding the Air Aware campaign to include heat information. For instance, Participant 28, said, “Yeah, absolutely! Why wouldn’t you want it?” He added, while looking around the room at his co-workers, “I don’t know about you guys, but I think it would be great because then you would have everything right there.” Participant 8 echoed this view: “I think you might have a little more impact having them combined than just the air quality. And like we said earlier, I think people pay attention more to... our biggest concern is the heat.” Participant 11 noted, “I think it's definitely nice to have it communicated together, but it's just like a one-stop shop to see both in one area from a reliable source.” Participant 13 agreed: “I like having them together as a one-stop shop.”

Others emphasized that combining hazard information allows workers to prioritize what matters most to them. For instance, Participant 18 explained, “If somebody has asthma or respiratory issues, they can focus on air quality maybe a little bit more, or if they’re less heat tolerant for whatever reason, it gives them a choice.” Participant 17 agreed, adding, “Yeah, if they’re together, at least if you don’t want to read it, don’t read it. But if it’s there at least you have it.”

Several participants suggested expanding the messaging beyond air quality and extreme heat to include other environmental hazards, such as the UV Index. For instance, Participant 9 suggested adding UV Index data: “I think [the UV index] would be something that could be added to the Air Quality Index or Heat Index… I think that’s something that’s important.”

Participant 16 similarly supported this idea, emphasizing the value of information customization: “It’s good for things you could set it to like you've set it to UV and to Heat Index. So, you could kind of tweak it a little bit for what you want.”

5.4.5.2. Preferences for HeatRisk vs. the Heat Index

To understand how workers might use combined hazard information, participants were shown the AQI, the National Weather Service’s HeatRisk tool, and the traditional Heat Index (see Appendix L), and asked which they preferred. Across focus groups, participants expressed a strong preference for HeatRisk over the Heat Index, citing its visual simplicity, intuitive layout, and compatibility with workplace needs. For instance, Participant 21 noted, “The Heat Index is a lot to digest, so HeatRisk is a lot more simple and communicates it more effectively.” Participant 20 similarly appreciated that HeatRisk included short descriptions of each threshold and the associated risks—an element missing from the traditional Heat Index. Participant 11, with average anxious and avoidant attachment, echoed this preference for visual simplicity, stating, “I think visually the Heat Index is just like too much going on. And so just having the HeatRisk, if it's relaying the same general information, then I'd prefer that.”

Several workers also emphasized how HeatRisk enabled quicker, at-a-glance assessments. Participant 22 explained, “Definitely HeatRisk. That way I don’t have to go on my phone and look up temperature and humidity.” Similarly, Participant 8 remarked, “HeatRisk is going to get more use. They’re not going to want to go, ‘Okay, I got to go to this line and this line.’ So, HeatRisk will be easier and quicker.” This preference for quick reference tools suggests reducing cognitive load and minimizing uncertainty during the workday was highly valued.

Workers also described how HeatRisk would better guide risk decision making. Participant 13 shared how HeatRisk could address challenges with assessing volunteer risks: “We’ve run into issues with volunteers getting heat illness but the only direction we have is off the Heat Index... that doesn’t account for all the various factors that get factored into HeatRisk.” Participant 12 further emphasized the intuitive advantage of HeatRisk’s color-coding system, noting it helped create a logical link between heat and air quality messaging.

Building on this strong preference for HeatRisk, participants across groups also offered several suggestions to improve its clarity and integration. Participant 13 recommended making the color schemes between AQI and HeatRisk more consistent to avoid confusion. Additionally, several participants, such as Participant 16, stressed the need for specific temperature thresholds to ground risk levels more concretely: “If it’s above 90 because we need to know if it’s 90 or 95.” Participant 18 agreed, adding, “Tightening up the parameters on HeatRisk… I need something I can fall back on which are those hard numbers on the Heat Index.”

Although most participants favored HeatRisk overall, a few workers preferred the traditional Heat Index for its precision. Participant 28 explained, “I prefer to know exactly what I’m dealing with in that range… the simplicity [of HeatRisk] is great, but I want to know exactly.” Similarly, Participant 29 raised concerns about HeatRisk’s repetitive descriptions contributing to “sign fatigue.” They observed, “It’s like… am I a person without adequate hydration today? Signs point to yes.” These comments suggest that for some workers, the raw, uninterpreted data of the Heat Index provided a greater sense of control than HeatRisk’s simplified categories.

Recognizing the value of both tools, several participants recommended a combined approach. Participant 26 summarized this idea: “If you need more information, you can always go to the Heat Index, but yeah, HeatRisk is good as just a basic, 'Watch out while you're out there' kind of thing." This balanced recommendation emphasizes an approach where simple cues are sufficient for daily routines, but more detailed information remains accessible for those who seek it.

5.4.5.3. Theme 5 Summary

This theme demonstrates workers' strong, unanimous support for integrating environmental hazard information into a single "one-stop shop." Workers across all focus groups endorsed expanding the Air Aware campaign to include extreme heat, which they identified as their primary hazard. They reasoned this would not only streamline access but also leverage their high concern for heat to increase engagement with air quality. Participants also valued that an integrated tool would allow for personalization, enabling workers to focus on the specific hazard (e.g., air quality for asthma, heat, or UV Index) most relevant to them.

When evaluating how to integrate heat data, participants preferred the new HeatRisk tool over the traditional Heat Index, appreciating its visual simplicity, at-a-glance readability, and actionable descriptions. However, they also offered clear suggestions for improvement, such as aligning its color coding with the AQI and adding specific temperature thresholds to ground the general risk categories. A few participants still preferred the precision of the Heat Index, noting its raw data provided a greater sense of control. As summarized by several participants, the ideal solution is a combined, "layered" approach that uses the HeatRisk tool for daily, at-a-glance awareness, but keeps the Heat Index accessible for those who need more specific heat information.

5.4.6. Chapter Summary

This chapter presented the qualitative phase of an explanatory sequential mixed methods design, using three focus groups with City of Fort Collins outdoor workers to elaborate on survey findings related to attachment orientations and RISP model concepts. Focus groups were conducted September 24–26, 2024, followed a semi-structured protocol informed by the quantitative results, and were designed to capture how workers experience poor air quality and extreme heat on the job, how social and organizational contexts shape their information use and protective decisions, and how workers evaluate and refine workplace risk communication (including feedback on the Air Aware campaign and reactions to HeatRisk as a potential integrated messaging element).

Across analyses, five themes summarized workers' lived experiences of compound hazards and the communication conditions that support protective action. Theme 1 ("Hazards in Contrast") showed that heat was most often constructed as an immediate, embodied threat that escalated quickly through physiological cues and exacerbated by work demands. In contrast, quality was more commonly framed as a chronic condition tolerated until it reaches a symptom-driven "tipping point;" workers also interpreted air quality risk by comparing conditions across time and place, with some narratives aligning attachment-consistent patterns in risk appraisal (e.g., heightened attention to others' symptoms versus endurance/self-reliance frames).

Theme 2 ("Social Signals") further demonstrated that workers' decisions were embedded in a multi-layered normative environment: family and friends were described as a more intermittent influence (often salient for air quality), while workplace norms were portrayed as the most consistent and actionable driver of protective behavior through shared vigilance, supervisor-enabled flexibility, and organizational follow-through; participants also identified external stakeholder expectations and public service obligations as an additional layer that could either prompt protective decisions or constrain flexibility during extreme conditions.

Themes 3–5 shifted from risk appraisal and interpersonal norms to the information features that enable or constrain workers in taking protective action. Theme 3 (“What Does Orange or Red Really Mean to Me?”) highlighted workers’ uncertainty about contributors to poor air quality beyond wildfire smoke and confusion in translating the color-coded severity indicators of the AQI into job-specific decisions. This theme also revealed that timely, visible, and job-relevant information can strengthen workers’ perceived control and more positive attitudes toward information use. Theme 4 focused on workers’ information engagement patterns and communication design preferences, indicating that heat information was typically sought proactively for planning, whereas air quality was often discovered passively or reactively; this theme also highlighted workers’ preference for more automated, accessible, and customizable communication formats to sustain engagement over time.

Finally, Theme 5 showed strong support for integrating hazards into a single, workplace-facing “one-stop shop,” with many workers favoring HeatRisk for its at-a-glance clarity while also recommending a layered approach that preserves access to more precise metrics (e.g., Heat Index thresholds) for those who want or need additional detail. Taken together, these qualitative findings provide a context-rich explanation of how outdoor workers perceive compound hazard risks and how social norms, and communication design features influence what protective action feels legitimate, feasible, and necessary in daily work settings.

CHAPTER 6. INTEGRATION OF QUANTITATIVE AND QUALITATIVE PHASES

After the qualitative analysis was completed, the quantitative and qualitative findings were integrated, consistent with Fetters et al.'s (2013) framework for data integration. The goal of this "mixing" is to analyze the data holistically and draw meta-inferences (Fetters et al., 2013; Guetterman et al., 2015). Meta-inferences are interpretive conclusions that integrate the insights from the quantitative and qualitative procedures of a study and go beyond what each procedure can explain individually (Creswell & Plano Clark, 2018).

This mixed methods analytical approach can yield three types of integrated findings: confirmation, expansion, and discordance (Fetters et al., 2013; Younas et al., 2023). Confirmation occurs when both data sources support the same conclusion, thereby enhancing the credibility of the finding. Expansion occurs when the qualitative findings extend or deepen the quantitative findings, thus generating a more comprehensive understanding of the phenomenon. Finally, discordance reflects inconsistencies or contradictions between the datasets, prompting further interpretation or reconsideration (Fetters et al., 2013; Younas et al., 2023).

Integration can be carried out using several strategies, including integration through narrative, data transformation, or joint displays (Fetters et al., 2013). For this study, integration involved constructing a side-by-side joint display. First, relevant survey findings were added to the display, with a summary of the corresponding focus group findings in the adjacent column. This side-by-side analysis yielded meta-inferences, which are documented in the display's final column (see Table 21). The following subsections then use a "weaving" approach to narratively interlace these quantitative and qualitative findings, according to themes or concepts to provide a richer, more cohesive interpretation (Fetters et al., 2013).

Table 21. Integrated Quantitative and Qualitative Results & Meta-Inferences

Theme & Relevant Hypotheses/RQs	Quantitative Findings	Qualitative Findings	Meta-Inferences
Hazards in Contrast: Comparisons of Risks at Work (Related to H1a, H1b, H2a, H2b, RQ1)	Extreme heat was perceived as a more severe risk, with higher scores[15] for both risk perception (*M* = 13.90) and affective responses (*M* = 3.29) compared to air quality risk perception (*M* = 12.34) and affective response (*M* = 2.85) (RQ1). Attachment avoidance significantly predicted lower heat risk perception (β = -.21; H2a) and affective response (β = -.20; H2b), while attachment anxiety significantly predicted higher affective response for heat only (β = .34; H1b).	Heat was consistently described as an immediate, embodied, and fast-escalating threat. In contrast, air quality was seen as a slower-developing, long-term concern workers tolerated until conditions became physically intolerable or were made salient by strong sensory cues. Workers also compared air quality across time and place to interpret local conditions, sometimes normalizing "moderate" conditions as a baseline. Across these narratives, some descriptions were consistent with attachment-related tendencies (e.g., heightened vigilance to escalations or others' symptoms vs. endurance/self-reliance framing).	**Confirmation**: Workers generally perceive heat as a more severe and affectively salient hazard than air quality (RQ1). Attachment influences risk perception and negative affective response (H1a-b, H2a-b). **Expansion:** The qualitative findings explain why workers perceive heat as a more severe threat, due to its immediacy and intensity (RQ1). The data also reveal how attachment may be expressed in hazard sense-making: Workers' narratives sometimes reflected attention to escalation and social cues versus deactivating/self-reliant framing (H1a-b, H2a-b).

[15] Risk perception is an index created by multiplying perceived severity and susceptibility items.

Theme & Relevant Hypotheses/RQs	Quantitative Findings	Qualitative Findings	Meta-Inferences
Social Signals: The Role of Norms in Shaping Risk Information and Protective Behavior (Related to H1c, H2c, H8a, H8b, RQ1)	Attachment anxiety was significantly positively related to subjective norms for both hazards (H1c). Attachment avoidance was significantly negatively related to norms only for heat (H2c). Subjective norms were positively related to information insufficiency only for heat (b = 0.30) (H8a). Workers who perceived greater social expectations to stay informed reported stronger intentions to seek information about both air quality (β = .44) and extreme heat (β = .41) (H8b).	Workers described a layered normative context influencing information use and protective actions. Family and friends were discussed as a cue for general air quality awareness rather than a direct driver of worksite behavior. In contrast, workplace norms were described as the most consistent and actionable influence, particularly for heat through shared vigilance (monitoring one another for heat illness), supervisor-enabled flexibility, and organizational follow-through (communication, safety routines, and resources). Participants also identified expectations from external stakeholders (e.g., volunteers/community members) and public service obligations as an additional layer of influence. Attachment appeared to shape how workers perceived these norms (e.g., openness to support vs. self-reliant distancing)	**Confirmation:** The quantitative results show that attachment anxiety is associated with stronger perceived informational norms across hazards (H1c), and subjective norms predict information seeking intention in both contexts (H8b). Norms also relate to insufficiency in the heat context (H8a), aligning with participants' frequent descriptions of heat as a shared responsibility requiring vigilance and action. **Expansion:** Qualitative data illustrate where norms are most salient and what form they take: Heat norms are often task- and symptom-linked (watching for heat illness; pacing work), which may make knowledge gaps more visible and time-sensitive—helping explain the norms → insufficiency pathway for heat. Air quality norms were expressed through diffuse interpersonal concern (i.e., awareness raising)

Theme & Relevant Hypotheses/RQs	**Quantitative Findings**	**Qualitative Findings**	**Meta-Inferences**
"What Does Orange or Red Really Mean to Me?" Workers' Information Needs, Control, and Attitudes (Related to H3, H4, H5, H6a, H8c, H9, H10, RQ1)	H3, H4, and H5 (linking attachment to insufficiency, attitudes, and control) were not supported for either hazard. Information insufficiency was positively related to information seeking for both hazards (H6a). Insufficiency only mediated the relationship between subjective norms and intention for heat ($b = 0.03$) (H8c). Attitudes were positively related to seeking intention for both hazards (H9), but the relationship was stronger for air quality ($\beta = .43$) than heat ($\beta = .32$). Perceived control was also positively related to seeking intention for both air quality ($\beta = .24$) and extreme heat ($\beta = .28$) (H10).	Workers demonstrated confidence in their knowledge of heat risks and symptoms, which was reinforced through annual heat trainings and shared routines. In contrast, air quality information insufficiency was more evident through group uncertainty and speculation. Workers often posed questions about AQI interpretation and pollution sources. Positive attitudes and perceptions of control were often shaped by job-relevant information and information accessibility	**Confirmation:** Information insufficiency, attitudes, and perceived control influence information seeking. Workers were more confident in their knowledge about heat than air quality. **Expansion:** Perceptions of collective uncertainty may weaken the relationship between subjective norms and insufficiency. Job-relevant and accessible information are important factors in shaping attitudes and perceived control, which in turn drives information seeking intention.
Translating Information into Action: Workers' Information Engagement, Preferences, and Recommendations for	The path from intention → active seeking (H6b) was stronger for heat ($b = 0.59$) than for air quality ($b = 0.46$). Insufficiency → intention → active seeking (H6b) was fully supported for both hazards. Negative affective response had a stronger positive relationship	Workers perceived heat as a greater threat, leading them to describe heat information seeking as necessary for them to proactively plan for the workday. In contrast, engagement with air quality information was described as reactive, often triggered by sensory cues or symptoms. For both hazards,	**Confirmation:** The stronger statistical pathways for heat regarding active seeking (H6b, RQ1) and the link between affect → insufficiency → intention (H7, RQ1) aligns with the qualitative finding that heat drives a stronger perceived need for information to plan for the day.

Theme & Relevant Hypotheses/RQs	Quantitative Findings	Qualitative Findings	Meta-Inferences
Communication Design (Related to H6b, H6c, H7, RQ1, RQ2)	with insufficiency for heat (*b* = 0.66) than for air quality (*b* = 0.31) (H7). Workers in the western U.S. reported higher intentions to seek air quality information than those in the Midwest and South (RQ2).	workers explained that seeking information to help them complete job tasks (e.g., irrigation planning, fuel mandates) was another key motivator, which served as an entry point that 'trickled down' into awareness of implications of these hazards on their personal well-being. Workers advocated for automated solutions (e.g., digital screens) and expressed interest in more customizable solutions, such as tiered opt-in text message alerts based on specific risk thresholds.	**Expansion:** Workers' reliance on sensory cues to trigger air quality information seeking helps explain why workers in the western U.S. (who are more frequently exposed to visible smoke) reported higher seeking intentions (RQ2). Workers' perspectives on information engagement also being motivated by completing job tasks before "trickling down" to personal well-being provides additional insight into the insufficiency → intention → active seeking pathway (H6).
Making it Work Together in a "One-Stop Shop": Support for Integrated Hazard Messaging (Related to H7, H8, H9, RQ1, RQ3)	All RISP model pathways were supported for both hazard contexts, with most effects stronger for heat (RQ1). Negative affective response had a stronger positive relationship with insufficiency for heat (*b* = .66) than for air quality (*b* = .31). Subjective norms → information insufficiency → information seeking mediation only observed for extreme heat (H8c). However, attitudes → intention (H9) and norms →	Across focus groups, workers expressed strong, unanimous support for an integrated one-stop shop for environmental hazard information (e.g., AQI, heat, UV index). Workers explained that combining this information would streamline information access and simplify decision-making. Generally, workers preferred the visual simplicity of HeatRisk but still wanted the option to access the Heat Index for its precise temperature thresholds.	**Confirmation:** The RISP model relationships hold across both risk contexts. **Expansion:** The qualitative data explains why workers perceive heat as more severe and provides an actionable recommendation (RQ3): Build upon workers strong engagement with heat information to introduce air quality information. This strategy aligns with workers expressed desire for unified, multi-hazard

Theme & Relevant Hypotheses/RQs	Quantitative Findings	Qualitative Findings	Meta-Inferences
	intention (H8b) were slightly stronger for air quality.		information that supports decision making for compound hazards.

6.1. Hazards in Contrast: Comparing Air Quality and Heat Risks

The first integrated theme synthesizes quantitative and qualitative findings to understand how outdoor workers evaluate and compare the risks associated with poor air quality and extreme heat. This theme addresses which asked whether attachment and RISP model relationships differ by hazard, as well as the hypotheses linking attachment orientations to risk perception (H1a, H2a) and affective response (H1b, H2b). The integrated results reveal distinct differences in how workers evaluate the risks of each hazard. Workers consistently perceive extreme heat as an urgent, emotionally salient threat, whereas poor air quality is viewed as a chronic, tolerable risk. These differences also offer an explanation for why attachment, which informs responses to threat and distress, played a statistically significant role in the heat context but remained largely dormant in the air quality context.

In the quantitative phase, workers reported higher risk perception and stronger negative affective response for extreme heat compared to poor air quality, providing a direct answer to RQ1. On average, heat was rated as a more serious risk and elicited more intense emotional reactions (e.g., worry, fear, concern) than air quality. These differences were evident both in mean-level comparisons and in the strength of relationships between key predictors and outcomes summarized in Table 15. In addition, attachment avoidance significantly predicted lower risk perception for heat, whereas attachment anxiety did not significantly predict risk perception for either hazard. Thus, H1a was not supported for air quality or heat, while H2a received partial support in the extreme heat context only.

The pattern for negative affective response further highlights the hazard-specific differences related to RQ1. For air quality, adding attachment anxiety and attachment avoidance to the regression models improved overall model fit, but neither predictor emerged as a significant unique predictor of affective response once shared variance was accounted for. In contrast, for extreme heat, both attachment dimensions significantly predicted negative affective response: attachment anxiety was positively associated with stronger emotional reactions to heat, and attachment avoidance was negatively associated with these reactions. Together, these findings provide support for H1b and H2b in the heat context but not in the air quality context. In other words, attachment orientations were more consequential for how workers felt about extreme heat than how they felt about poor air quality. This pattern offers more context for RQ1 by suggesting that the relationship between attachment and negative affective response is more robust when the hazard is perceived as being immediate, intense, and highly embodied, such as extreme heat.

The qualitative findings deepen these patterns by clarifying how workers experience and appraise the two hazards in everyday work contexts. Across focus groups, extreme heat was typically described as immediate and embodied, with workers relying on thermal cues and rapid-onset physiological symptoms (e.g., dehydration, headaches, fatigue) to assess urgency and determine when protective action was needed. Participants also emphasized how work demands and required PPE can compound heat exposure, making the hazard feel especially time-sensitive and difficult to avoid during specific tasks. These narratives help explain why heat elicited higher risk perception and stronger affective responses in the survey: Heat was perceived as an acute, unavoidable hazard that “you feel right away” on the job.

In contrast, poor air quality was more often framed as a slower-developing, longer-term concern that could become normalized through routine exposure. Workers frequently described “putting up with” suboptimal conditions until symptoms became physically intolerable or conditions were made salient through strong sensory cues (e.g., visible smoke, respiratory irritation). This tendency to tolerate moderate discomfort and wait for more extreme cues aligns with the comparatively lower average risk perception and affective response to poor air quality in the survey. Thus, the qualitative data offer a deeper interpretation of the quantitative differences related to RQ1: Because heat is felt as an immediate threat with clear bodily indicators, workers are more likely to appraise it as severe and respond emotionally, whereas air quality risks are easier to ignore until conditions become extreme.

The qualitative patterns also help contextualize the attachment-related relationships observed in the survey. Consistent with the quantitative support for H1b and H2b in the extreme heat context, narratives reflected patterns broadly consistent with attachment-related tendencies in risk regulation. For example, workers with high attachment anxiety demonstrated greater attention to symptom escalation and consequences or to others' symptoms, versus workers with high attachment avoidance who often framed risk by emphasizing self-reliance or endurance. Importantly, the qualitative accounts suggest that attachment-related differences may be more prominent when hazards are perceived as being more immediate, embodied, and disruptive to work routines (as with heat), compared to the gradual nature of air quality risk.

In summary, integration of findings for Theme 1 yields meta-inferences of confirmation and expansion. Both phases converge in indicating that extreme heat is generally perceived as more severe and affectively salient than air quality, while the qualitative data expand on why by highlighting heat's bodily immediacy and clearer cues for action. In contrast, air quality was more often treated as a chronic exposure that becomes motivating primarily at symptom-driven "tipping points," helping explain why risk appraisal and attachment-related tendencies were less consistently activated for air quality in the quantitative models.

6.2. Social Signals: The Role of Norms in Shaping Risk Information and Protective Behavior

The second integrated theme brings together the quantitative and qualitative findings to examine how social norms shape outdoor workers' engagement with air quality and extreme heat information and how these processes relate to RQ1 and hypotheses H1c, H2c, H8a, and H8b. RQ1 asked whether the proposed attachment and RISP model relationships differed when the topic was poor air quality versus extreme heat. H1c–H2c predicted that attachment anxiety and avoidance would shape informational subjective norms, and H8 proposed that these norms would influence information insufficiency (H8a) and information seeking intention (H8b). The integrated findings show that attachment plays a meaningful role in how workers perceive and navigate social pressures to stay informed about air quality and extreme heat. Additionally, subjective norms are a strong and consistent predictor of information seeking intentions across both hazards, although the sources, strength, and downstream effects of normative influence are more complex in the heat context.

In the quantitative data, attachment anxiety was significantly positively related to informational subjective norms for both hazards, supporting H1c. In contrast, attachment avoidance was significantly negatively related to subjective norms only for heat, providing partial support for H2c. Thus, workers higher in attachment anxiety tended to perceive stronger social expectations to stay informed across both topics, whereas workers higher in attachment avoidance perceived weaker social expectations around heat information, even as norms grew stronger overall in this context. These patterns address RQ1 by showing that attachment orientations shape normative perceptions more strongly for extreme heat than for air quality.

Subjective norms also played different roles in the RISP pathways across hazards. For extreme heat, informational subjective norms were positively related to information insufficiency ($b = 0.30$), offering partial support for H8a. Workers who perceived greater social expectations around staying informed about heat reported feeling that they still needed more information, which in turn was related to stronger intentions to seek information. For both air quality and extreme heat, workers who perceived greater social expectations to stay informed reported stronger intentions to seek information ($\beta = .44$ for air quality; $\beta = .41$ for heat), supporting H8b in both contexts. These findings indicate that subjective norms directly motivate information seeking across hazards, but only in the heat context do they also heighten workers' sense that their current knowledge is insufficient.

The qualitative data provide deeper insight into these normative patterns by specifying where norms are the most salient. Workers described a layered normative environment that includes (a) intermittent cues from family and friends, (b) consistent and actionable workplace norms reinforced by co-workers and supervisors, and (c) more variable expectations from external stakeholders and public service obligations.

Discussions of air quality–related norms were more often tied to concern from family and friends and were typically framed as prompts for general awareness rather than direct drivers of workplace behavior. Participants described loved ones worrying about smoke or expressing concern about longer-term health effects, but they less often described clear expectations for what they should know or do on the job during poor air quality events. In this way, air quality norms often appeared diffuse and relational, raising salience without consistently crystallizing into concrete, task-linked information needs. This pattern helps explain why subjective norms for air quality were strongly associated with intentions to seek information in the survey models but did not correspond as clearly with perceived information insufficiency.

In a subset of accounts, participants' framing suggested greater sensitivity to relational cues, which is broadly consistent with attachment theory's expectation that higher attachment anxiety is associated with heightened attention to social concern and interpersonal signals. In other accounts, participants higher in attachment avoidance emphasized managing risk independently or positioned themselves as more knowledgeable about outdoor conditions—framing that aligns with theory describing avoidance as more self-reliant, deactivating coping. Taken together, these narratives provide qualitative context for the survey pattern in the heat models: attachment anxiety was associated with stronger perceived informational norms, whereas attachment avoidance was associated with weaker perceived informational norms.

Across attachment orientations, workplace norms emerged as the most consistent and actionable source of influence. Participants described monitoring one another for signs of heat illness, pacing work, rotating crews, and intervening quickly when symptoms appeared. They also emphasized supervisor-enabled flexibility and organizational follow-through (e.g., proactive check-ins, task adjustments, safety communication, and resources such as hydration supports). Workers repeatedly described these norms as embedded in routine practice and reinforced across leadership levels. This pattern helps explain why subjective norms were more strongly linked to information insufficiency in the heat context in the quantitative models. Qualitatively, heat-related norms were often described in task- and symptom-linked terms (e.g., knowing what to watch for, when to slow down, and how to respond), which may make knowledge needs feel more immediate and concrete. In other words, when norms require rapid recognition and response, workers may be more likely to notice gaps in what they or their team needs to know to act effectively.

Beyond the quantitative findings, the qualitative data revealed external stakeholders and public service obligations as an additional layer of influence that shaped workers' decisions about protecting others and maintaining services during hazardous conditions. Participants in Natural Areas roles described canceling activities to protect community volunteers during smoke events, while utilities staff emphasized continuity expectations tied to essential public service. These accounts indicate that workers' hazard decisions are shaped not only by internal workplace norms but also by perceived responsibilities to community members and service recipients, which can either enable or constrain protective action.

Overall, integration of findings for Theme 2 yields meta-inferences of confirmation and expansion related to H1c, H2c, H8a, H8b, and RQ1. The two phases converge in showing that norms are a meaningful driver of information engagement and protective action, with attachment anxiety associated with stronger perceived norms in the survey and qualitative accounts illustrating how interpersonal concern can enter workers' hazard sense-making. The qualitative findings expand the quantitative results by clarifying that workplace norms tend to be the most consistent and actionable, while family/friend cues, external stakeholder expectations, and public service obligations add additional layers that can either prompt protective decisions or constrain flexibility during hazardous conditions.

6.3. "What Does Orange or Red Really Mean to Me?" Workers' Information Needs, Control, and Attitudes

The third integrated theme pertains to how outdoor workers assess their knowledge about air quality and extreme heat, how much more they feel they need to know, and how these appraisals relate to their attitudes, perceived control, and intentions to seek information. This theme is most directly related to H3, H4, and H5 (linking attachment to information insufficiency, attitudes, and control), H6a (information insufficiency → information seeking intention), H8c (subjective norms → insufficiency → intention mediation), and H9 and H10 (attitudes and perceived control as predictors of seeking intention). RQ1 asked whether the proposed attachment and RISP model relationships differed when the topic was poor air quality versus extreme heat. The integrated findings show that although attachment did not directly predict information insufficiency, attitudes, or perceived control, information insufficiency, attitudes, and control each play important roles in shaping information seeking. Moreover, the integrated findings suggest that workers perceive greater knowledge gaps related to air quality than heat and that perceptions of shared uncertainty may diminish individuals' motivation to address perceived knowledge gaps. Moreover, information relevance and accessibility are critical in shaping workers' attitudes and perceived control, which in turn drive information seeking.

In the quantitative data, H3, H4, and H5 were not supported for either hazard: Attachment anxiety and avoidance did not significantly predict information insufficiency, attitudes, or perceived control. Instead, information seeking intention was more directly shaped by RISP-related concepts. Information insufficiency was positively related to information seeking intention for both air quality and extreme heat, supporting H6a. Workers who believed that they did not know enough about either hazard reported stronger intentions to seek additional information. In addition, information insufficiency mediated the relationship between subjective norms and information seeking intention only for heat ($b = 0.03$), providing support for H8c in the heat context. This pattern suggests that, for extreme heat, feeling that others expect one to stay informed is partially translated into stronger intentions through heightened recognition of informational gaps, whereas this pathway does not operate in the same way for air quality.

Attitudes and perceived control also showed the expected positive relationships with information seeking intention across both hazards. Attitudes were positively related to information seeking intention for both air quality and extreme heat, with a stronger relationship for air quality ($\beta = .43$) than for heat ($\beta = .32$), supporting H9. Perceived control was positively related to information seeking intention for both air quality ($\beta = .24$) and extreme heat ($\beta = .28$), supporting H10. Together, these findings confirm that workers are more likely to seek information when they hold favorable attitudes toward doing so and feel capable of acting on what they learn. The stronger attitudes-to-intention link for air quality and slightly stronger perceived control-to-intention link for heat also indicate that the motivational roles of attitudes and control are not uniform across hazards, offering further insight into RQ1.

The qualitative findings deepen these patterns by showing how workers' sense of information insufficiency is tied to familiarity, shared uncertainty, and the perceived relevance of hazard information for their daily work. Across focus groups, workers described feeling relatively confident in their knowledge of heat risks and symptoms. This confidence was reinforced through annual heat trainings and shared routines for preventing heat illness, such as hydrating, taking breaks, and adjusting schedules. Workers often referenced specific signs of heat illness (e.g., confusion, fatigue, dizziness) and described how crews "watch each other" for these symptoms, suggesting both individual familiarity and shared expectations about what to look for.

In contrast, air quality information insufficiency surfaced through moments of group uncertainty and speculation. Workers frequently posed questions to each other about the different contributors to poor air quality, how to interpret AQI categories, and what specific AQI values mean for physically demanding outdoor work. These questions often went unanswered in the discussion, highlighting that air quality-related knowledge gaps were experienced both individually and collectively.

These qualitative patterns help explain the mediation findings for H8c and provide more nuance to H6a. For extreme heat, norms to stay informed are embedded in familiar, training-based expectations and shared routines. In this context, when workers feel that others expect them to know how to recognize and respond to heat illness, it is easier for them to identify specific gaps in their knowledge (e.g., early symptoms, thresholds for stopping work), which in turn motivates information seeking. This pattern aligns with the observed pathway between subjective norms, insufficiency, and intention for heat. For air quality, however, workers' perceptions of collective uncertainty may weaken this mechanism. When workers perceive that no one around them has a clear answer about how to interpret AQI or what to do at specific levels, social expectations to "stay informed" do not crystallize into individual feelings of information insufficiency in the same way, even if norms still directly motivate information seeking.

The qualitative data also show that positive attitudes toward hazard information and perceived control are closely tied to the job relevance and accessibility of information. Workers described more positive attitudes toward information that was relevant and clearly connected decision-making in the workplace. Training materials, practical decision tools, and clear explanations from supervisors or trusted sources strengthened workers' sense that information was useful, which in turn reinforced their willingness to seek it out. Similarly, perceived control was strengthened when information was accompanied by realistic, job-relevant options for action, such as changing work–rest cycles, modifying tasks, or making small adjustments to gear or location.

In contrast, when workers perceived air quality information as abstract, technical, or disconnected from the realities of outdoor work, they were less convinced that seeking more information would improve their situation. In these cases, they questioned how much control they truly had over exposure and how much information would change their day-to-day decisions. This helps explain why, despite strong positive relationships between attitudes, control, and information seeking in the survey, some workers still expressed skepticism or resignation in the focus groups when discussing air quality information. It also highlights the role of job-relevant and accessible information in strengthening the attitudes and perceptions of control that drive information seeking across both hazards, as captured in H9 and H10.

Overall, the integrated findings for Theme 3 yield meta-inferences of confirmation and expansion related to H6a, H8c, H9, and H10 by clarifying the factors (e.g., collective uncertainty, information relevance and accessibility) that shape information insufficiency, attitudes, and perceived control, rather than attachment (H3–H5). Quantitatively, information insufficiency, attitudes, and perceived control all contribute to workers' intentions to seek hazard information, with information insufficiency mediating the norms → intention relationship only for heat. Qualitatively, workers' perspectives reveal that heat is a more familiar, procedurally supported hazard, whereas air quality is marked by collective uncertainty and ongoing questions about contributors to poor air quality and the interpretation of information about protective actions. These patterns suggest that risk communication efforts will be most effective when they highlight the existence of hazards through job-relevant, accessible information that reduces collective uncertainty.

6.4. Translating Information into Action: Workers' Information Engagement, Preferences, and Recommendations for Communication Design

The fourth integrated theme synthesizes findings regarding how outdoor workers engage with environmental hazard information and how these behaviors inform their preferences for communication design. This theme addresses H6b and H6c, which tested whether information seeking intention directly predicts active information seeking and whether intention mediates the relationship between information insufficiency and active seeking; H7, which examined the role of negative affective responses in shaping information insufficiency and intention; and RQ1 and RQ2, which asked whether these relationships differ across hazards and regions. The integrated results demonstrate that core RISP pathways are robust for both hazards, but that information seeking is shaped by hazard-specific perceptions, available cues, and workplace communication infrastructures.

The quantitative data supports H6b for both hazards, confirming that information seeking intention positively predicts active information seeking. Additionally, consistent with the patterns observed for RQ1, this relationship was stronger for extreme heat ($b = 0.59$) than for air quality ($b = 0.46$). The qualitative findings provide the necessary context to explain this statistical difference. Focus group participants described heat information seeking as a necessary, proactive step for daily survival and operational planning. Workers noted that they checked heat forecasts specifically to "monitor it every day" to make decisions about the hydration resources (e.g., ice and water jugs) to pack for the day and how to pace their work. In contrast, engagement with air quality information was frequently described as "secondhand" where workers often absorbed passively while checking the weather for heat or discovered reactively in response to visual cues like smoke. Thus, the stronger statistical link between intention and action for heat reflects the hazard's status as a primary driver of daily logistical planning, whereas air quality information is often incidental.

This distinction is further reinforced by the integrated findings for H7, which predicted that negative affective response would lead to information insufficiency. In the quantitative data, this relationship was significant for both hazards but notably stronger for extreme heat ($b = 0.66$) than for air quality ($b = 0.31$). In the qualitative data, workers explained that heat is an immediate, visceral threat that compels them to acknowledge what they do not know about the day's conditions to prevent rapid physical deterioration. Air quality, conversely, was viewed as a chronic annoyance often tolerated until a “tipping point” of visibility or symptom severity was reached. This suggests that the emotional urgency of heat drives a more robust recognition of information gaps, which thereby fuels the active seeking behaviors observed in the quantitative phase.

Regional differences in information seeking (RQ2) also gain clarity through data integration. The survey results indicated that workers in the western United States reported significantly higher intentions to seek air quality information compared to those in the Midwest and South. Although the survey could identify that this difference existed, the focus group discussions, conducted in the West, explain why. Participants repeatedly described visual sensory cues, such as "seeing haze" over the Front Range, as the primary trigger for checking air quality data. Given that the western region experiences frequent, visible wildfire smoke events, workers in this area encounter more environmental prompts that trigger information seeking. This expands upon the quantitative findings by suggesting that the higher intention in the West is likely driven by the frequency of visible environmental cues.

The qualitative data also expand upon the mediation pathway proposed in H6c (information insufficiency → intention → active seeking). Although the statistical model confirms this pathway exists, the qualitative findings illustrate a practical mechanism through which it operates: operational tasks. Workers described how job-specific mandates, such as restrictions on fuel usage during Ozone Alert Days or irrigation planning based on evapotranspiration rates, served as "entry points" for information engagement. Participants noted that monitoring conditions for compliance or task completion often "trickled down" into personal awareness of health risks. This suggests that organizational protocols function as a structural form of " insufficiency" when a worker perceives a gap between what they know and what they need to know to do their job, which motivates information-seeking behavior.

Finally, these behavioral insights directly informed workers' recommendations for communication design. The largely passive nature of air quality seeking led workers to express fatigue with manual communication tools, such as the Air Aware dial magnets, which required active maintenance and eventually “fell off the radar.” Instead, aligning with their preference for streamlined and timely information access, workers advocated for automated solutions such as digital displays linked to NOAA feeds and mobile widgets that provide at-a-glance information without requiring active searching. Furthermore, regarding text message alerts, workers expressed a desire to balance their need for awareness with a desire to avoid information overload. Workers’ suggestions for "tiered" or customizable alerts, where they could opt-in to notifications only at specific hazard severity thresholds, reflect a desire to stay informed while maintaining control over their information environment.

In summary, the integrated findings for Theme 4 yield meta-inferences of confirmation and expansion. These findings confirm that heat drives of active information seeking, while expanding our understanding of the reactive nature of air quality information engagement. The quantitative strength of heat-related information seeking pathways is corroborated by qualitative descriptions of seeking information out of logistical necessity, while regional variations in air quality seeking are evidenced by workers' reliance on visual environmental cues. Importantly, these patterns suggest that workplace risk communication efforts for environmental hazards that are perceived as less severe, like air quality, may be more effective when paired with information about another hazard that is perceived as more severe, such as extreme heat. These patterns also suggest that framing air quality and extreme heat information in terms of its relevance to workers' daily tasks may further motivate information seeking.

6.5. Making it Work Together in a "One-Stop Shop": Support for Integrated Hazard Messaging

The fifth and final integrated theme synthesizes the findings regarding the feasibility and desirability of combining air quality and extreme heat information into a unified communication strategy. This theme addresses RQ1 and RQ3, while contextualizing the comparative strength of the RISP model pathways observed for each hazard (H7, H8, H9). The integrated results demonstrate that the quantitative strength of RISP-related concepts in the context of heat validates workers' recommendation for a "one-stop shop" approach to communication design in the qualitative phase. Workers framed the integration of hazard information more as a strategic way to harness their high engagement with heat to increase their air quality awareness, rather than simply a matter of convenience.

Findings from the quantitative phase showed that the RISP model pathways were supported for both hazards, however the relationships were consistently stronger or more complex for extreme heat, directly addressing RQ1. Specifically, the relationship between negative affective response and information insufficiency (H7) was more than twice as strong for heat (b = 0.66) as it was for air quality (b = 0.31). Furthermore, the mediation pathway from subjective norms to information seeking intention via information insufficiency (H8c) was significant only for extreme heat. These statistical patterns suggest that heat triggers a more robust psychological process where emotional arousal and social pressure successfully translate into a recognized need for information. In contrast, while attitudes toward seeking air quality information were slightly more positive (β = .43) than for heat (β = .32), the qualitative data suggest this positive attitude may reflect a general openness to air quality information rather than the urgent and purposive nature of seeking heat-related information.

The qualitative findings explain these statistical disparities and offer a practical path forward (RQ3). Workers explicitly endorsed an integrated air quality and heat communication campaign. They reasoned that their urgent need to check heat conditions would naturally pull air quality information into their field of view. This qualitative insight expands upon the quantitative findings: the strong statistical link between heat-related affective response and insufficiency suggests that heat acts as a powerful motivational "hook." Accordingly, a “one-stop shop” strategy capitalizes on this hook, using the strong negative affective responses to heat to ensure that air quality information, which had a weaker negative affective response to insufficiency link in the quantitative findings, is seen and processed.

This preference for integration also extended to specific visualization tools. When presented with options, workers overwhelmingly preferred HeatRisk over the traditional Heat Index due to its visual simplicity and color-coded alignment with the Air Quality Index. This preference aligns with the qualitative findings in Theme 3 regarding collective uncertainty;

workers favored tools that reduced cognitive load and provided "at-a-glance" assessments. However, consistent with the high perceived control associated with heat (H10), some workers insisted on retaining access to the precise data of the Heat Index. This suggests a layered preference for information; workers want simplified, integrated visual cues (like HeatRisk alongside AQI) for routine decision-making, with the option to access more detailed data for complex planning.

In summary, the integration of findings for Theme 5 yield meta-inferences of confirmation and expansion. The quantitative results confirm that heat is the stronger driver of information insufficiency and active seeking, while the qualitative data emphasizes information integration as the mechanism to transfer that engagement to air quality. The slight statistical edge in positive attitudes toward air quality seeking observed in the quantitative phase likely indicates that workers are not resistant to air quality information but rather need it to be delivered through the channels they already prioritize. Thus, the meta-inference drawn from this theme is one of expansion. The distinct psychological processing of each hazard suggests that they are not competing for attention, but can be complementary, where the urgency of heat ensures the visibility of air quality in a unified, worker-centered communication system.

CHAPTER 7. DISCUSSION

7.1. Theoretical Contributions

This dissertation advances risk communication theory by extending the risk information seeking and processing (RISP) model in two ways. First, it integrates attachment theory as an individual difference within the RISP model to understand why some individuals are more or less emotionally reactive to hazards and attuned to social expectations for being informed. Second, by testing the RISP model across two hazard contexts using an explanatory sequential mixed methods design, the study clarifies which core RISP pathways are robust, and which are context dependent.

7.1.1. Impact of Attachment on the RISP Model

A central contribution of this dissertation is an expanded understanding of the psychosocial individual differences that shape risk information engagement. The RISP model theorizes that individuals bring pre-existing traits and capacities to risk situations through the model's "individual characteristics" component (Griffin et al., 1999). However, within the RISP literature, comparatively fewer studies specify which psychosocial characteristics reliably shape information engagement and through which RISP pathways. This study is among the first to integrate attachment theory into the RISP model, offering a novel psychosocial perspective on individual-level differences in risk information seeking behavior. The findings suggest that attachment orientations are useful for clarifying how and why RISP pathways may operate differently across individuals who face similar exposure conditions but differ in their coping tendencies.

7.1.1.1. Attachment Anxiety and Affective-Normative Pathways in the RISP Model

H1a which predicted that attachment anxiety would be positively related to risk perception was not supported for either air quality or extreme heat. However, higher attachment anxiety was associated with stronger negative affective response in the extreme heat context, offering partial support for H1b. This pattern is consistent with prior work suggesting that individuals higher in attachment anxiety experience threat as more emotionally activating (Mikulincer & Shaver, 2016a; Read et al., 2018). Focus group accounts reinforce the quantitative findings by providing insight on how attachment anxiety emerges in workplace settings. Specifically, participants with high attachment anxiety emphasized worst-case heat illness trajectories, describing escalation from early symptoms to severe consequences. This emphasis is broadly consistent with research linking attachment anxiety to emotion-focused coping and rumination about negative emotions or outcomes (Lanciano et al., 2012; Mikulincer & Shaver, 2016a).

Together, the integrated findings suggest that attachment anxiety in this study operated primarily through emotional activation rather than heightened cognitive appraisal of risk severity. When risks are perceived as immediate and physically consequential, as extreme heat was in this study, individuals higher in attachment anxiety may be especially likely to experience the hazard as emotionally salient, with information engagement driven more by affective response and anticipatory concern than by shifts in risk judgments.

Beyond risk perception and affect, attachment anxiety was positively informational subjective norms (H1c) in both hazard contexts. The qualitative accounts reinforced these findings as participants with high attachment anxiety often described assessing air quality and extreme heat risks through observations of others’ symptoms, concerns, and job responsibilities, rather than their own experience. The integrated findings suggest that individuals higher in attachment anxiety appear to monitor social cues closely, often interpreting risk through others' experiences, concerns, and responsibilities, rather than relying solely on their own symptoms or judgments. These findings are consistent with prior work linking attachment anxiety to heightened sensitivity to interpersonal cues (Ein-Dor et al., 2011; Fraley et al., 2006).

From a RISP perspective, these results suggest that attachment anxiety may amplify affective and socially mediated drivers of information engagement, rather than directly increasing perceived risk. Therefore, risk information may be particularly engaging for individuals high in attachment anxiety when it validates concern and situates risks within a shared social context by emphasizing collective vulnerability, responsibility for others, or the consequences of inaction.

7.1.1.2. Attachment Avoidance and Deactivating Pathways in the RISP Model

The hypotheses linking attachment avoidance to risk perception (H2a), affective response (H2b), and informational subjective norms (H2c) were supported only in the extreme heat context. This pattern aligns with attachment theory's expectation that individuals with high attachment avoidance are more likely to divert attention away from risk-related cues (Ein-Dor et al., 2011), suppress negative feelings (Mikulincer & Shaver, 2016a), and emphasize independence and self-reliance (Schusterschitz et al., 2018). The qualitative findings provide complementary evidence for how these tendencies can manifest in occupational settings. Workers with high attachment avoidance acknowledged physical discomfort or symptoms in response to extreme heat, but then quickly minimized their perspective by emphasizing their own endurance or self-sufficiency. This narrative pattern is consistent with deactivating coping strategies and autonomy-oriented coping described in attachment research (Cassidy & Kobak, 1988; Edelstein & Shaver, 2004; Mikulincer & Shaver, 2016a). Taken together, the integrated results suggest that individuals higher in attachment avoidance notice risk-related cues (e.g., physical discomfort, symptoms) but are less likely to elaborate on those cues in ways that acknowledge their personal vulnerability, emotional concern, or social responsiveness.

From a RISP perspective, this pattern helps explain why attachment avoidance was associated with lower heat risk perception (H2a), weaker negative affect (H2b), and weaker informational subjective norms (H2c). By reframing risks as tolerable, suppressing concern, and emphasizing endurance and self-sufficiency, attachment avoidance may attenuate three motivational inputs that RISP theorizes as drivers of information engagement. Importantly, this pattern does not imply that individuals high in attachment avoidance will ignore risk information altogether, but rather that messages emphasizing personal vulnerability, emotional amplification, or social response may be less effective because they conflict with a preferred mode of self-reliant threat regulation. Consistent with this interpretation, risk messages may be most engaging for this group when they provide clear, actionable guidance that supports independent decision-making.

7.1.1.3. Boundary Conditions for Attachment Effects Across Hazards

The findings for H1a-c and H2a-c carry implications for RQ1. Across analyses, attachment-related relationships were more consistently supported in the context of extreme heat than poor air quality. This hazard-contingent pattern suggests that risks experienced as immediate and physically consequential may be more likely to activate attachment-related processes. In contrast, risks that are experienced as chronic or delayed may provide fewer triggers for attachment-related processes to exert a consistent influence on risk information engagement.

At the same time, hypotheses predicting direct associations between attachment and information insufficiency, attitudes toward seeking, and perceived control (H3–H5) were not supported. Qualitative accounts help contextualize these null findings by indicating that workers' perceived information needs, evaluations of information seeking, and sense of control were strongly shaped by whether available information was interpretable, job-relevant, and actionable; conditions influenced more by message design and workplace feasibility than by attachment orientation alone. Taken together, these results delineate boundary conditions for integrating attachment into risk information theories. In this study, attachment is most plausibly conceptualized as shaping upstream affective and normative processes (and, in the case of heat, risk perception), rather than directly determining knowledge-gap appraisals, attitudes toward seeking, or perceived control.

7.1.2. Advancing the RISP Model

Beyond demonstrating how attachment influences key motivational drivers of risk information seeking, this dissertation advances our understanding of the RISP model in three ways. First, it is among the first to apply the RISP model to extreme heat, an increasing occupational and public health hazard that has received comparatively less attention in RISP scholarship. Second, it extends prior applications of RISP to air pollution and wildfire smoke events (e.g., H. K. Kim & Kim, 2019; Lim et al., 2024; J. Z. Yang & Huang, 2019) by testing whether core pathways function similarly or differently by topic. Finally, by pairing survey-based hypothesis tests with qualitative evidence, this study clarifies where refinements may be necessary in occupational contexts where recurring compound hazards are present.

7.1.2.1. Dynamic Pathways of Risk Information Engagement

This study both confirms and extends a core, and sometimes underexamined, RISP proposition: information seeking intention predicts active information seeking behavior, and information insufficiency predicts behavior indirectly through intention (H6). This mediated structure is consistent with RISP's theorized architecture (Griffin et al., 1999) and parallel planned behavior models (Ajzen, 1991; Kahlor, 2010). However, the qualitative results complicate the strict dichotomies that often categorize information seeking and processing in the RISP model; particularly, the distinctions between active versus passive information seeking and heuristic versus systematic information processing (S. Chen & Chaiken, 1999; Griffin et al., 1999; Kahlor et al., 2006).

Workers frequently described checking heat forecasts as part of their routine morning practice, but doing so with explicit, goal-directed intentions related to hydration, equipment, and task pacing. This pattern suggests that information seeking can be both active and passive, blurring traditional categorizations of active versus passive information seeking (Griffin et al., 1999, 2013; Kahlor et al., 2006). Workers also described the process of incidentally encountering air quality information while intentionally seeking heat information through a mobile weather app. In some cases, these encounters prompted deeper reflection and subsequent protective decisions, illustrating incidental exposure can serve as an entry point to more systematic processing.

These patterns carry implications for RQ3, suggesting two possible RISP model refinements. First, information seeking in occupational settings appears strongly task-cued: workers were more likely to act on perceived information needs when information seeking would support their immediate job tasks or responsibilities. Consistent with research on task-based information behavior (e.g., J. Liu et al., 2019; Sigaard & Skov, 2015), this pattern suggests that incorporating perceived task relevance as a motivational variable could strengthen RISP's capacity to explain information behavior in workplace environments.

Second, individuals may shift between information seeking modes and processing styles in bundled risk information environments, such as mobile weather apps and dashboards. When information about multiple hazards is presented in a single interface, intentional seeking for one risk (e.g., heat) may generate incidental exposure of related risk information (e.g., air quality) that transitions into more systematic processing. This pattern suggests that active and passive seeking, as well as heuristic and systematic processing may function less as stable categories and more as dynamic states shaped by information design and situational demands.

7.1.2.2. Affective Pathways Under Immediate and Chronic Risk Conditions

Consistent with prior RISP research (e.g., J. L. Ford et al., 2023; Griffin et al., 2008; J. Z. Yang & Huang, 2019), negative affective response significantly predicted both perceived information insufficiency and information seeking intention across hazards (H7a–H7b), and the indirect pathway through information through information insufficiency was significant in both contexts (H7c). However, the relative strength of these relationships differed by pathway. Negative affective response had a notably stronger relationship with information insufficiency in the extreme heat context compared to poor air quality, suggesting that heat may more readily translate into a felt need for additional information to effectively respond. In contrast, the relationship between negative affective response and information seeking intention was slightly stronger in the poor air quality context, compared to extreme heat, indicating that negative affective responses to poor air quality can motivate information seeking even when they do not translate as strongly into perceived insufficiency.

Qualitative findings help contextualize these hazard differences. Workers' descriptions of extreme heat were grounded in immediate physiological experiences (e.g., dehydration, headaches, fatigue), compounded by task conditions (e.g., required PPE, strenuous activity) that can quickly interrupt work. In this sense, heat is often experienced as an immediate hazard with clear operational implications, which may help explain why negative affective response more strongly translated into information insufficiency and a somewhat larger indirect effect through information insufficiency in the heat context. Although workers also described symptom-based experiences with poor air quality and wildfire smoke, they more frequently framed air quality as a background condition that had become normalized through repeated exposure, with ongoing uncertainty about when conditions crossed a threshold warranting protective action. Taken together, this pattern suggests that negative affect can motivate engagement with risk information in multiple ways, but under conditions of chronic or recurring hazard exposure, it may be less consistently channeled through perceived information gaps, especially when risk information is perceived as difficult to interpret in actionable terms (Bradford & O'Sullivan, 2013; Fung et al., 2018; Vaughan, 1993).

7.1.2.3. Group-Level Uncertainty and the Limits of Informational Norms

This study clarifies a relationship that has been inconsistently supported in RISP research: the link between informational subjective norms and perceived information insufficiency. Although prior studies report positive associations between norms and insufficiency (e.g., Ahn & Kahlor, 2023; Fung et al., 2024; Park et al., 2023), the present study replicated this relationship for extreme heat, but not for air quality.

This divergence parallels prior RISP work in air pollution contexts (e.g., J. Z. Yang & Huang, 2019), but the present findings point to a different interpretation. Yang and Huang (2019) suggested that norms may fail to increase insufficiency when individuals already perceive themselves as knowledgeable about air pollution. In this study, however, workers reported high familiarity with extreme heat, yet subjective norms still predicted heat-related information insufficiency. For air quality, this pattern was reversed: respondents reported comparatively higher insufficiency, but norms did not predict insufficiency.

Focus group discussions help contextualize this result. Conversations about air quality were frequently characterized by shared uncertainty among workers regarding pollution sources, exposure meaning, and appropriate health guidance. This pattern suggests that the norms to insufficiency pathway may not be suppressed by high individual knowledge, but by shared uncertainty within the reference group itself. Put differently, when coworkers and peers are also perceived as being unsure, expectations to "be informed" may lack the motivational clarity needed to highlight personal knowledge gaps. Thus, group-level uncertainty may represent an important, and currently under-theorized, influence on this pathway. This refinement shifts the explanation away from an individual ceiling effect to an informational ecology perspective, in which norms are less effective at activating perceived information insufficiency when uncertainty is shared and normalized within the reference group.

7.1.2.4. Attitudes and Perceived Control as Drivers of Risk Information Seeking

Consistent with prior research (e.g., J. L. Ford et al., 2023; J. L. Ford & Stephens, 2018; Kahlor, Yang, et al., 2020), attitudes toward information seeking was a consistent predictor of seeking intention across hazards (H9), reinforcing its important role in the RISP model. The qualitative findings help explain how these attitudes are formed. Workers expressed more positive attitudes toward seeking when information was perceived as personally relevant and clearly connected to workplace decision-making. Conversely, workers' attitudes became negative as they reflected their disengagement with messages framed primarily around risks to "the elderly," "children," or "vulnerable populations." Participants noted that such language positioned them outside the intended audience, reducing their willingness to seek additional information. This pattern aligns with emerging evidence that vulnerability framing in heat and air quality messaging inadvertently create psychological distance and diminish perceived personal relevance (Y. Li & Howe, 2023; Ramírez et al., 2019). These findings suggest that perceived informational relevance may be a particularly important influence on attitudes toward information seeking.

In addition to attitudes, workers' sense of control over accessing and using information played an important role in shaping information seeking behavior. Consistent with prior work showing that perceived control is a strong predictor of information seeking intention (Eastin et al., 2015; Kahlor et al., 2019; H. K. Kim & Lai, 2020), perceived control predicted seeking intention in both hazard contexts (H10), but was slightly stronger for extreme heat. The qualitative findings help explain why control may have been stronger for extreme heat in the quantitative phase. In focus groups, workers described heat forecasts as easy to access through familiar channels (e.g., mobile weather apps) and, importantly, as usable for advance planning. They reported using multi-day forecasts to shift task timing and work schedules several days ahead of extreme heat events.

For air quality, participants reported knowing where to find information, yet they expressed a reduced sense of control over using it. Shorter forecast windows (often about 24 hours) and guidance that felt less task-specific made air quality information harder for workers to integrate into task planning and work schedules. In this sense, workers' perceptions of control were not only shaped by confidence in their internal ability to locate and understand information, but whether the information environment supported the ability to use such information in a timely manner. This distinction reinforces the value of perceived information seeking control, especially in workplace settings, because it captures both individual capacity and the external feasibility conditions (e.g., access, advanced notice, interpretability, and task compatibility) (J. L. Ford & Stephens, 2018). Viewed in this way, the mixed findings in prior RISP research on perceived information gathering capacity (e.g., J. L. Ford et al., 2023; Hubner & Hovick, 2020) may reflect the limits of treating capacity as primarily internal, without accounting for the structural and temporal constraints that determine whether the information can be acted upon when it matters.

7.2. Practical Implications

Building on the theoretical contributions outlined above, this section translates key findings into actionable guidance for environmental and occupational risk communication. Across these implications, the results highlight the importance of aligning messages with attachment orientations, prioritizing task-relevant and integrated hazard information, and designing flexible communication systems that support engagement and readiness year-round. Together, these recommendations position risk communication as an ongoing, workplace safety practice, rather than a one-time or seasonal intervention.

7.2.1. Designing for Attachment-Related Differences in Risk Engagement

A central practical implication of this study is the demonstration that risk communication strategies may be more effective when they align with individuals' underlying emotional and relational orientations. Consistent with prior research showing that aligning communication with coping styles can improve engagement and promote behavior change (e.g., Hawkins et al., 2008; M. Kim & Choi, 2017; Latimer et al., 2005), the findings of this study suggest that attachment-informed communication offers a promising pathway for improving engagement and promoting behavior change.

Focus group data illustrate workers with high attachment anxiety often interpreted through others' experiences, concerns, and responsibilities, rather than relying solely on their own symptoms or judgments. For these individuals, messages that emphasize shared experience, collective responsibility, or social validation may be particularly engaging. Narrative formats, such as short peer testimonials or short examples of how workers adapt their routines in response to conditions, may help reinforce perceived relevance and emotional resonance while normalizing protective action.

In contrast, workers with high attachment avoidance frequently minimized personal risk and instead emphasized endurance or self-sufficiency. For these audiences, risk communication may be more effective when it frames protective behaviors as autonomous, self-directed decisions that support independence rather than dependency or shared vulnerability. For example, messages that position protective action as a self-directed choice to maintain stamina across the workday or avoid unnecessary disruptions may be more engaging than messages focused on personal susceptibility or social validation.

7.2.2. Moving Beyond "Vulnerable Populations" Framing

The findings also point to a critical limitation of vulnerability-based framing in environmental health risk communication. Participants consistently reported disengaging from air quality or heat messages framed primarily around risks to "vulnerable populations" (e.g., older adults, children, individuals with pre-existing conditions). Rather than increasing concern, workers explained that this language often positioned them outside of the intended audience, reducing perceived relevance and motivation to seek additional information. These insights align with prior scholarship cautioning that vulnerability framing can create psychological distance and undermine engagement (Y. Li & Howe, 2023; Ramírez et al., 2019; Sampson et al., 2013). In contexts where individuals—such as outdoor workers, athletes, or recreationalists—may view themselves as healthy or accustomed to environmental exposure, this framing may be especially counterproductive.

Instead, campaign messages should emphasize how environmental hazards directly affect stamina, recovery time, and safety, regardless of health status. In occupational settings, messages that focus on how conditions affect stamina, recovery time, heat strain, respiratory irritation, or the ability to safely complete physically demanding tasks may be more likely to resonate. Rather than anchoring messages in who is vulnerable, workplace communication should normalize the idea that environmental hazards are operational safety conditions that affect everyone on the crew. Messages that link hazard conditions to job-specific consequences, such as, "Today's air quality level can slow recovery time and increase fatigue—plan for extra breaks," may be more likely to capture attention and prompt follow-through.

7.2.3. Prioritize Integrated, Task-Cued Hazard Information

Workers in this study often described engaging with risk information in "bundled" ways. When they intentionally sought information about one hazard for planning purposes (most commonly heat), they frequently encountered information about other hazards (e.g., air quality, UV) incidentally through the same apps or websites. This pattern aligns with a core theoretical contribution: information seeking in occupational contexts is strongly task-cued and can shift between goal-directed seeking and passive exposure depending on situational demands. Practically, this pattern suggests that workplaces can increase reach and usability by integrating multiple environmental hazards into a single communication system rather than messaging about each hazard separately.

Integrated communication systems can reduce cognitive burden and support more efficient decisions when workers are navigating multiple exposure conditions at once. This recommendation is consistent with research showing that integrated risk communication can enhance comprehension, reduce confusion, and improve message engagement in multi-risk contexts (Coker et al., 2024; Dallo & Marti, 2021). Similarly, Landrum et al. (2024) found that bundling information about more abstract risks with more salient or immediate risks, can improve comprehension and increased perceived urgency.

In practice, integrating hazard information can be implemented at different levels. At a foundational level, organizations can include brief air quality, heat, and UV updates in daily briefings and post simple, color-coded charts in shared spaces (e.g., near time clocks, in bathrooms, breakrooms, or meeting rooms). Organizations with more advanced infrastructure can use real-time digital dashboards that could accessed via work-issued devices (e.g., cell phones or tablets) displayed in shared spaces. These dashboards could display AQI, HeatRisk, and UV data together and include behavioral recommendations linked to job type or department, streamlining decision-making when faced with compound hazards. Across implementation levels, the goal is not simply providing more information, but information structured around task-relevant cues that help workers translate hazard conditions into concrete behaviors (e.g., pacing, hydration, rescheduling tasks).

7.2.4. Multi-Channel Delivery Without Overload

Participants described clear differences in how they prefer to access hazard information. Some workers gravitated toward interpersonal formats, such as in-person presentations or check-ins from supervisors and peers, which offered opportunities for discussion and social reinforcement. Others preferred autonomous, on-demand formats, such as passive displays, QR codes, or unobtrusive mobile alerts that allowed them to engage with information on their own time and terms. These preferences align with prior evidence showing that offering multiple delivery formats increase reach and message salience (Lundgren & McMakin, 2018; MacIntyre et al., 2019), and that multi-channel strategies can influence risk perception and efficacy beliefs (Jang & Park, 2018; Lundgren & McMakin, 2018).

At the same time, participants' discussions related to message fatigue and information overload suggest that multi-channel strategies are paired with design features that preserve audience autonomy. Practically, this means combining print, digital, and interpersonal touchpoints while also allowing user-controlled customization where possible. For instance, regarding text message or email notification systems, participants frequently recommended the ability to adjust alert frequency and thresholds. This recommendation is consistent with research showing that customizable alert systems can reduce message fatigue, support timely decision-making, and improve both message retention and follow-through (Dallo et al., 2022; Pretolesi et al., 2025).

7.2.5. Maintain Year-Round Environmental Hazard Communication

In the pursuit of sustained information engagement, participants stressed that outdoor work continues year-round, yet hazard communication fades during fall and winter even though risks such as poor air quality, extreme temperatures, and UV can persist. Year-round communication can help workers prepare for out-of-season hazards and reinforce environmental risk awareness as a routine safety practice rather than a seasonal exception.

This recommendation is increasingly relevant as hazard timing becomes less predictable. For example, the California wildfires in January 2025, which were linked to extended drought conditions that uncharacteristically overlapped with the Santa Ana wind season, generated serious midwinter air quality impacts and increased risk for outdoor workers (Lindsey et al., 2025; Perez, 2025). Without consistent communication beyond conventional hazard seasons, workers may be unprepared for emerging conditions.

In practice, year-round communication strategies can be implemented in various ways. At a foundational level, organizations can keep signage posted year-round or include environmental risk updates as a standing agenda item at routine meetings. As an intermediate step, organizations could also incorporate guidance on recognizing and responding to hazards across seasons into onboarding materials or refresher safety trainings. In higher-resource organizational settings, mobile alert systems could be programmed to deliver forecasts and behavioral recommendations year-round and adjust messages based on location or anticipated exposure. These year-round communication strategies can normalize engagement, reduce complacency, and support readiness in an increasingly variable risk landscape.

7.2.6. Standardize Communication About Protective Resources Across Crews

Finally, participants described uneven awareness about protective resources across crews, departments, and locations. In some cases, certain teams had access to cooling neck towels or ice machines, while others were unaware that these resources existed at all. These examples highlight the importance of standardizing communication about what resources are available, where they are located, and when they should be used. Consistent resource communication in the workplace is essential for effective risk reduction, while also boosting morale and fostering a more unified safety culture across the organization (Hass & Orstad, 2025; Pandit et al., 2018; Schwatka et al., 2019).

Organizations can take practical steps to achieve standardized communication about protective resources at multiple levels. At a basic level, laminated flyers displayed near supply areas can list available materials (e.g., hydration supplies, shade structures) and specify use conditions. Organizations can also maintain protective resource inventory lists for employees to contribute to that track supplies and prompt restocking. These checklists can also be reviewed during regular meetings to serve as both a reminder for employees and an accountability system for supervisors or crew leads. In higher-capacity settings, organizations could implement digital inventory systems that track supply levels across locations in real-time, and trigger alerts when supplies run low or when forecasted conditions require increased readiness.

CHAPTER 8. CONCLUSION

This dissertation set out to advance our understanding of how outdoor workers perceive, seek, and act upon risk information related to two increasingly urgent and compound environmental hazards: poor air quality and extreme heat. Drawing on the social amplification of risk framework (SARF; R. E. Kasperson et al., 1988), attachment theory (Bowlby, 1969), and the risk information seeking and processing (RISP) model (Griffin et al., 1999), the study examined how cognitive, emotional, and social factors collectively shape outdoor workers' risk perceptions and information seeking behaviors in occupational settings. Most empirical tests of the RISP model are quantitative (Dong et al., 2024), and only a handful of studies have applied qualitative or mixed methods approaches (e.g., Bullock, 2023; Clair et al., 2021). A key strength of this study's design is its capacity to link qualitative accounts to quantitative relationships, clarifying what might be driving patterns in risk information seeking among outdoor workers, beyond declarations of statistical significance.

Through an explanatory sequential mixed-methods design, national survey data were complemented by qualitative insights from focus groups with municipal outdoor workers in Colorado. The survey offered a broad understanding of RISP model relationships across a demographically diverse national sample, while the focus groups illuminated how these pathways unfold within workers' daily routines and social environments. The integration of findings from both phases reveals how environmental context, social influence, and task relevance challenge traditional distinctions between active and passive information seeking and between heuristic and systematic processing, and how these dynamics shape outdoor workers' engagement with risk information in practice.

From a theoretical standpoint, this research makes two primary contributions. First, it introduces and tests attachment theory as a novel framework for explaining individual differences in risk information behavior, offering evidence that an individual's relational tendencies, specifically attachment anxiety and attachment avoidance, shape how workers perceive risk, interpret social norms, and respond emotionally to environmental hazards. Individuals with high levels of attachment anxiety heavily relied on social cues to interpret risk and were more sensitive to peer and family concern, whereas individuals with high levels of attachment avoidance tended to minimize risk and distance themselves from social support. These patterns extend the RISP model's capacity to account for individual differences in relational dispositions that influence information engagement.

Second, this dissertation extends the application of the RISP model to the underexplored context of extreme heat and further examines its relevance in compound hazard scenarios. While many core RISP pathways were affirmed across both hazards, notable nuances emerged. Informational subjective norms did not consistently predict information insufficiency across hazards in the quantitative phase, and qualitative insights suggested that when individuals perceive a group or trusted social network as collectively uncertain about a hazard's causes and consequences, their motivation to resolve personal knowledge gaps may be weakened. Additionally, workers described information engagement as closely tied to task planning and operational decision-making, suggesting that task relevance may serve as an important but understudied driver of information seeking in occupational contexts.

Practically, this dissertation offers actionable guidance for designing more effective environmental health communication campaigns and workplace interventions. The findings call for integrating hazard information into unified systems that reflect the layered reality of overlapping risks, moving beyond generic warnings to prioritize job-relevant, task-specific guidance that resonates with workers' day-to-day decision-making. They also underscore the value of participatory approaches to campaign design, in which involving target audiences in developing, evaluating, and refining materials can enhance credibility, usability, trust, and sustained engagement over time.

8.1. Limitations

Although this study used an explanatory sequential mixed-methods approach, it deviated from the standard protocol of this design by recruiting separate samples for the quantitative and qualitative phases. In traditional explanatory sequential designs, participants from the quantitative phase are typically invited to participate in qualitative follow-up interviews, allowing for direct linkages to be made between individual-level quantitative responses and qualitative accounts (Creswell & Plano Clark, 2018). Due to practical and logistical constraints, however, focus group participants were recruited from a different, though related, population: outdoor workers employed by a municipality in Colorado rather than from the national survey sample. This decision limited the ability to link individual-level quantitative and qualitative data and may have reduced the depth of integration across methods.

This divergence also introduced important inconsistencies in participant characteristics across the two phases, which affect the overall generalizability of the findings. The national survey achieved broader variation than the focus groups. For example, 30% of survey participants identified as women or non-binary, compared to 21% in the focus groups; and 33% of survey participants identified as non-White or Hispanic/Latino, compared to 14% of focus group participants who identified as non-White. Survey participants also represented a wider range of industries and geographic regions across the United States, while the focus group sample was drawn exclusively from municipal parks, natural resources, and utility outdoor workers within a single city.

Socioeconomic characteristics also differed between samples. While survey participants were relatively evenly distributed across educational backgrounds, focus group participants were more likely to have completed an associate or bachelor's degree. The survey sample also included a larger proportion of respondents earning less than $50,000 annually, whereas the focus group sample skewed toward higher household incomes, with many reporting earnings between $75,000 and $99,999. These differences suggest that the qualitative findings likely reflect the views of outdoor workers who are more educated and economically stable, and who are employed by organizations with greater institutional resources; factors that shape perceptions of organizational support, safety norms, and health information seeking behavior (Fung, 2024; Gyekye & Salminen, 2009; S. S. Kim, 2019; Sinclair et al., 2021).

Selection bias is an additional limitation in both phases. The national survey used quota sampling to ensure broader representation across demographic and regional characteristics, rather than a probability-based approach such as stratified random sampling, which would have required a reliable sampling frame for U.S. outdoor workers that does not currently exist. Participants were instead recruited through an online panel with predetermined demographic targets, which limits the extent to which the sample reflects the full diversity of the U.S. outdoor workforce. Using an online platform may have further favored workers with more reliable internet access and higher digital literacy, potentially underrepresenting outdoor workers in more precarious or remote employment contexts (Fernandes et al., 2024).

The qualitative phase was also subject to selection biases. Workers who volunteered to participate in focus groups may have been more engaged with environmental health risks than their peers, potentially overrepresenting individuals who are more informed or motivated. Additionally, because focus group members were co-workers who knew one another, pre-existing workplace relationships and hierarchies were present in the room. Although moderators made every effort to encourage open and honest discussion and to emphasize participant confidentiality, these dynamics may have reduced some participants' willingness to share dissenting or vulnerable viewpoints in a group setting. Further, although focus group participants were drawn from three distinct divisions of the workforce (i.e., parks, natural resources, utilities), all were employed by a single organization, the City of Fort Collins, which may limit the extent to which findings reflect outdoor workers who are employed elsewhere.

Differential exposure to Air Aware, a workplace air quality communication campaign, represents another limitation of this study. Compared to survey respondents who only briefly encountered the Air Aware campaign's imagery, colors, and messaging through a study website, focus group participants had two summers of exposure to the campaign through various digital and print materials. This extended exposure likely allowed focus group participants to draw on a richer, real-world familiarity with the campaign when discussing risk information. However, it also limits the comparability of findings across phases, as greater familiarity with the campaign's branding could have shaped what workers recognized, recalled, or chose to discuss relative to the survey respondents with minimal exposure.

Another limitation involves the timing of data collection. The national survey was deployed during a period of active wildfires and widespread heat alerts across several areas of the United States, which likely heightened the salience of these hazards and elevated engagement with relevant information beyond typical baseline levels. Although this timing provided valuable insight into information seeking during periods of high hazard salience, it may not capture workers' engagement during more routine or low-salience conditions. Conducting focus groups two months later, near the end of summer, allowed for some exploration of risk perceptions when hazard salience was lower; however, the mismatch in timing and sampling limits the ability to draw direct comparisons across the two phases.

Both phases also relied on self-reported data, which are subject to cognitive and motivational biases. Participants may have misremembered how often they engaged with forecast information, overstated their information-seeking behaviors, or underreported actions perceived as less socially desirable, such as avoiding messages or ignoring health-protective guidance. These limitations are common in survey and focus group methodologies, where recall and social desirability concerns can influence the accuracy and reliability of responses (Bergen & Labonté, 2020; Wu-Ouyang & Chan, 2023).

Finally, the operationalization of risk perception may have limited the robustness of this study’s findings. The measures used focused primarily on perceived severity and susceptibility but did not include a measure of risk immediacy; a dimension that prior research suggests can meaningfully distinguish how people appraise and respond to different types of hazards (S.-C. S. Li et al., 2024). Incorporating immediacy into future operationalizations of risk perception may yield more sensitive and reliable measures, particularly when comparing hazards that differ in how immediate and noticeable their effects are, as is the case with air quality and extreme heat.

Collectively, these limitations call for careful interpretation of the study's findings with respect to their generalizability to the broader outdoor workforce. At the same time, these limitations highlight several productive directions for improving future research in this area, as outlined in the following section.

8.2. Future Research

Several opportunities emerge from both the contributions and limitations of this study to refine, extend, and deepen future research on risk communication and information behavior in environmental health and occupational safety contexts.

Building on the theoretical contributions of this study, future research should continue testing attachment theory as a framework for understanding individual differences in risk information behavior. This study provided evidence that attachment anxiety and avoidance are meaningfully related to risk perception, affective response, and informational subjective norms, particularly in the context of extreme heat. Follow-up studies should continue testing attachment orientations as predictors and moderators within the RISP model across a broader range of environmental and health risk topics, including emerging public health crises, natural disasters, and other chronic hazards. For example, one open question is whether attachment orientations predict risk information seeking and avoidance behaviors similarly across hazards that differ in immediacy and controllability, such as wildfire evacuations vs. chronic exposure to ambient air pollution, or flash flooding vs. ground-water contamination. A survey that presents participants with scenarios regarding two similar hazards that differ in their immediacy and controllability could help address this question. From there, attachment orientations could be tested as independent variables and RISP-related concepts as dependent variables could test whether similar patterns emerge across hazard types. Semi-structured interviews with individuals who have lived experience across hazard types could complement this approach by illuminating how attachment orientations shape information behaviors in ways that survey instruments alone may not fully capture. Future work addressing this question would help establish whether the patterns observed here extend beyond occupational settings and whether attachment functions more powerfully as a predictor of information seeking and avoidance behaviors independent of other RISP variables.

Future work might also explore how attachment anxiety and attachment avoidance interact to influence risk information seeking and processing. For instance, fearful-avoidant individuals (high on both dimensions) may experience internal conflict when confronted with risk, with high levels of attachment anxiety generating intense worry while high levels of attachment avoidance activate emotional suppression. Future research could address questions such as how fearful-avoidant individuals resolve this internal conflict when deciding whether to seek or avoid risk information and whether this resolution pattern differs for individuals high on only one attachment dimension. A mixed methods approach could be well-suited to answering these questions. Specifically, a survey using established attachment measures could compare risk information outcomes across attachment groups, while follow-up interviews or think-aloud protocols with fearful-avoidant individuals could capture how this conflict is experienced and resolved in real time. A deeper exploration of the interaction of these attachment dimensions could further illuminate the perspectives and behaviors of this group.

Future work should also explore how message characteristics interact with attachment orientations to shape risk information engagement. For example, researchers could use experiments to study whether individuals with higher attachment anxiety are more responsive to interpersonally resonant messages (e.g., peer testimonials or relational appeals) and whether individuals with higher attachment avoidance more responsive to autonomy-focused messaging that emphasizes individual control. Doing so would help identify which types of messaging strategies are the most effective for each attachment orientation.

This study also highlights opportunities to revisit and refine core pathways within the RISP model. Qualitative insights suggested that informational subjective norms may influence how individuals cognitively (i.e., risk perception) and emotionally (i.e., affective response) interpret risk. Testing informational subjective norms as an antecedent of risk perception and affective response would clarify whether social expectations and peer cues shape how risks are understood and felt before individuals assess their own knowledge gaps. For example, if peers consistently downplay a hazard, an individual may come to perceive themselves as less susceptible, regardless of their exposure. Future work could test this pathway by asking the research question: Does perceived social downplaying of a hazard among peers lower an individual's risk perception and affective response, independent of their actual exposure? An experimental design would be well-suited to this test, by randomly assigning participants to read peer commentary that either downplays or validates a hazard, while their actual hazard exposure level is held constant or measured as a covariate.

Related to the role of social influence, future studies should investigate group-level uncertainty as a potential moderator of the relationship between informational subjective norms and information insufficiency. This study found that informational subjective norms predicted information insufficiency for extreme heat but not for air quality. Qualitative data suggested that workers experienced heat as a more familiar hazard, reinforced through workplace training and peer norms, whereas air quality conversations were frequently marked by shared confusion about causes and consequences. When a group collectively lacks clarity about a hazard, that shared uncertainty within an important referent group may become normalized, thereby dampening individuals' motivation to close their own knowledge gaps. Future studies could test this prediction by asking the research question: Does group-level uncertainty moderate the relationship between informational subjective norms and information insufficiency such that the motivational power of social norms weakens as perceived shared uncertainty within a referent group increases? Group-level uncertainty could be measured by adapting existing scales of perceived susceptibility and severity uncertainty (e.g., Y. Huang & Yang, 2020; Zhuang & Carey, 2025) to capture how individuals perceive uncertainty within important referent groups (e.g., family, friends, co-workers). An experimental design would be well-suited to answering this question. For example, to test whether perceived group consensus shifts perceived information insufficiency participants could be exposed to a simulated workplace discussion board (e.g., Slack or Microsoft Teams) where coworkers express varying levels of certainty about the perceived severity and susceptibility of a workplace hazard and how to mitigate their exposure.

Qualitative interviews or focus groups could also answer these questions by asking participants to reflect on real instances when family, friends, or co-workers expressed uncertainty or doubt about a hazard, and how those moments shaped their perceived information needs or decisions to seek more information. This would capture the contextual dynamics of how uncertainty spreads or resolves within groups, as well as other factors an experiment may not be able to capture such as trust or response efficacy. If collective uncertainty weakens the motivational power of social norms, campaigns may need to prioritize reducing shared ambiguity among co-workers or supervisors about a hazard before social expectations can effectively motivate information seeking.

Another important theoretical extension involves perceived task relevance as a driver of information engagement within the RISP model. In the focus groups, workers consistently described their engagement with hazard information through the lens of task planning (e.g., deciding which supplies to bring, scheduling high-exertion work, or timing crew rotations). These patterns suggest that risk information becomes more motivating when it is directly tied to immediate job functions. Future research could pose questions such as: Does perceived task relevance predict or moderate RISP pathways and do workers in different occupational roles respond differently to task-framed versus general health guidance? A multi-group experimental design could test both questions simultaneously. Specifically, workers recruited from multiple occupational sectors (e.g., agriculture, construction, transportation) could be randomly assigned task-framed health messaging (e.g., guidance tied to scheduling, supplies, or work rotations) or general health guidance, with occupational role and message framing serving as between-subjects factors. This design would allow researchers to assess both the direct influence of task relevance on RISP relationships and whether its effects vary across occupational contexts.

Beyond theoretical refinements, this study points to the importance of expanding risk communication research to compound hazard contexts, which are becoming increasingly common as environmental hazards intensify. To date, most RISP model applications have examined single hazards in isolation. Future research should examine how people shift information behaviors between hazards, how attention to one risk may redirect concern toward another, and how these processes influence both seeking and processing. This work could be extended to other compound hazards such as flooding and waterborne disease, where immediate physical dangers and less visible health risks unfold simultaneously. Eye-tracking studies or simulated digital environments (e.g., interactive mock weather applications displaying compound hazard information) could illuminate which hazard information users attend to first, how they prioritize decisions, and whether integrated displays improve or hinder comprehension. Participatory design workshops with workers or community members could complement these approaches by generating grounded insight into how users prefer to navigate compound hazard information and what communication formats best support their decision-making.

The findings of this study also raise questions about how researchers might effectively assess incidental information seeking, or risk information encountered without active searching. Future research could examine whether individuals retain air quality information encountered incidentally while seeking heat information during routine forecast checks. Controlled experiments that vary unsolicited risk information exposure, or analyses of behavioral data such as click-through and dwell time logs from weather websites or mobile applications, would be well-suited to testing this question. Addressing this question would help clarify how incidental information exposure complements passive and active information seeking within the RISP model.

Future research should also examine the effectiveness of visually representing heat and air quality information together. Drawing on literature-based recommendations for colormap selection in hazard graphics (Rosen, Bitterman, Krocak, et al., 2026), researchers could examine whether anchoring HeatRisk and the AQI to a shared, perceptually uniform, multi-hue sequential color palette improves comprehension of how the two hazards operate as compound risks and what protective behaviors are appropriate. This concordant approach could be compared to displays, which pair the traditional heat index (using a single-hue palette) with the AQI (using a multi-hue sequential palette).

An experimental design could test this directly by randomly assigning participants to view a simulated website displaying either HeatRisk paired with the AQI or the traditional heat index paired with the AQI, and then measuring participants' comprehension, accuracy, ease of understanding, and likelihood to take protective action by adapting existing scales (Rosen, Bitterman, Ripberger, et al., 2026). Qualitative think-aloud sessions could complement this approach by asking participants to identify where and why confusion arises. Together, these approaches would generate evidence-based recommendations for how these hazards should be visually represented.

Finally, methodological improvements should inform future work. Studies that recruit participants from the quantitative phase to participate in qualitative follow-up interviews would enable stronger data integration across phases and a richer understanding of how individual-level patterns relate across methods. Using more inclusive and accessible recruitment strategies, would also improve sample diversity and help capture perspectives from harder-to-reach segments of the outdoor workforce. These recruitment strategies could include conducting in-person recruitment at worksites, as well as partnering with trade unions, small businesses, or community organizations. Longitudinal designs, particularly those that track the same participants during both high-salience and low-salience hazard periods, would also provide valuable insight into how risk information engagement shifts with changing environmental conditions and seasonal risk contexts.

8.3. Closing Remarks

This dissertation bridges important gaps between individual, social, and contextual perspectives in environmental health risk communication. This work integrates attachment theory into the RISP model and examines risk information behavior in compound hazard contexts, offering theoretical and practical guidance for communication scholars, public health practitioners, and organizational decision-makers.

The study demonstrates that risk information engagement is shaped by what people know and how they feel about a hazard, as well as who surrounds them, and what their daily work demands of them. Personal dispositions such as attachment orientations, social environments that normalize or suppress concern, and the practical relevance of hazard information to job tasks all interact to produce the information behaviors workers exhibit in the field. Understanding these dynamics is essential to designing communication strategies that are scientifically grounded and operationally meaningful to the people they aim to reach.

As extreme heat and poor air quality events become more frequent and severe, the need for effective, worker-centered communication strategies grows more urgent. This dissertation contributes a timely step toward meeting that need, advancing theoretical understanding of what drives information engagement. It also offers clear, evidence-based recommendations for practitioners designing campaigns and organizational practices that are built to sustain engagement across a rapidly changing environmental landscape.

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APPENDIX

Appendix A: Review of Risk Information Seeking Models in Health and Environmental Communication Research

Model name	*Author(s)*	*Goal of model*	*Variables of interest*	*Strengths*	*Weaknesses*
Uses and gratifications	Katz, et al. (1973)	Focuses on an individual's media uses and gratifications sought from those uses.	Cognitive, affective, personal, social, and stress relieving needs.	Audience-based perspective that helps to explain the selection of certain media.	Assumes people always want more information. Concepts are hard to operationalize.
Health belief model (HBM)	Rosenstock (1974)	Predicts that individuals' beliefs explain health behaviors.	Demographics, psychological factors, perceived threat, evaluation of behavior, efficacy, cues to action.	Simplified health-related concepts that are easy to implement, apply, and test.	Does not account for emotions, social motivations, or habitual behaviors.
Social amplification of risk framework (SARF)	Kasperson et al. (1988)	Explains the transfer of risk information and response mechanisms of society.	Risk experience, information sources, and communication channels.	Recognizes the social, cultural, and institutional processes that influence risk perceptions.	Concepts are difficult to operationalize, not a causal theory.
Health information acquisition model (HIAM)	Freimuth et al. (1989)	Depicts key decisions in the health information seeking process.	Stimulus, information goals, cost-benefit analysis, search behavior, information evaluation, and decision.	Recognizes the iterative nature of information seeking.	Does not look at contextual or personal factors and does not address emotions.
Theory of planned behavior (TPB)	Ajzen (1991)	Explains the role of intention in performing an actual behavior.	Attitude toward behavior, subjective norm, perceived control, intention, and behavior.	Accounts for less voluntary actions and strong predictive power in studies.	Does not include emotion or account for individual characteristics.

Model name	*Author(s)*	*Goal of model*	*Variables of interest*	*Strengths*	*Weaknesses*
Extended parallel process model (EPPM)	Witte (1994)	Focuses on fear as a motivator for protective action.	Message, threat appraisal, efficacy and constructive or defensive response.	Seeks to understand the role of messages in risk perception and useful for audience segmentation.	Only recognizes fear as a motivator. Assumes audiences have no awareness of the threat prior to message exposure
Comprehensi ve model of information seeking (CMIS)	Johnson & Meiscke (1993)	Understand the use of health information sources.	Demographics, direct experience, salience, and beliefs.	Focuses on the selected information channel.	Support of the model differs based on context. Does not address emotion.
Heuristic systematic model (HSM)	Eagly & Chaiken (1993)	Explains how information is processed and received.	Processing: heuristic and systematic, sufficiency threshold, motivations: accuracy, defense, and impression.	Allows for cues to act as a heuristic, biasing factor, or partial trigger for more processing	Does not account for individual characteristics or emotion.
Risk information seeking and processing (RISP) Model	Griffin et al. (1999)	Explains variance in information seeking when risk is present.	Individual characteristics, risk perception, insufficiency, subjective norms, channel beliefs, gathering capacity	Considers how individual characteristics, emotion, and efficacy beliefs shape risk information seeking.	Information subjective norms provide limited explanation of broader social factors that shape risk information seeking.
Uncertainty management theory (UMT)	Brashers (2001)	Describes the role of information in managing uncertainty.	Uncertainty appraisal information seeking, adaptation, social support.	Considers multiple sources and ways of managing uncertainty.	Concepts are not easily operationalized.
Risk perception attitude (RPA) framework	Rimal & Real (2003)	Predicts the joint influence of perceived risk and efficacy beliefs in protective behaviors.	Severity, susceptibility, self-efficacy, response efficacy.	Useful for audience segmentation.	Does not account for knowledge, emotions, or social environment.

Model name	*Author(s)*	*Goal of model*	*Variables of interest*	*Strengths*	*Weaknesses*
Theory of motivated information management (TMIM)	Afifi & Weiner (2004)	Explains the decision-making process for reducing anxiety via information management.	Uncertainty discrepancy, anxiety, outcomes, efficacy, information management strategy.	Considers multiple information management strategies (e.g., avoiding, blunting, coping, seeking).	Theory is bound to interpersonal contexts and does not consider mediated channels.
Planned risk information seeking model (PRISM)	Kahlor (2010)	Explains health risk information seeking as a planned behavior.	Risk perception, knowledge, attitude toward seeking, perceived seeking control, subjective norms, and intent	Specific focus on risk information seeking. Has demonstrated strong predictive power.	No defined entry point into the model and overlooks the relevance of individual characteristics.

Note. Adapted from Ford (2019, pp. 93–95).

Appendix B: Air Aware Campaign Materials

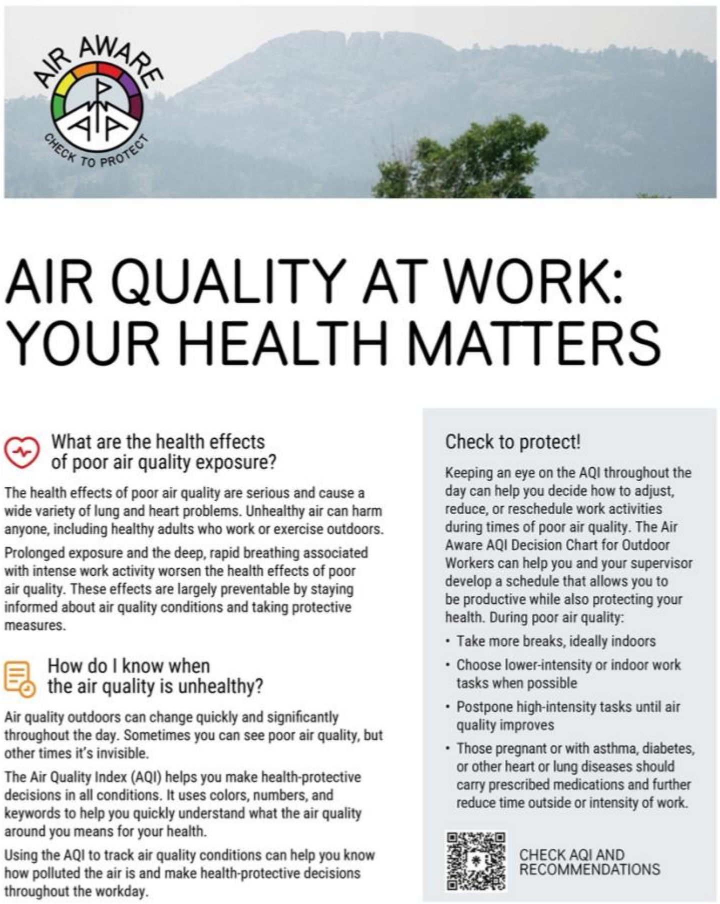


Figure B1. Sample of 8.5" x 11" flyers featuring Air Aware campaign messages and a QR code directing workers to the campaign's Linktree webpage (Figure B5)

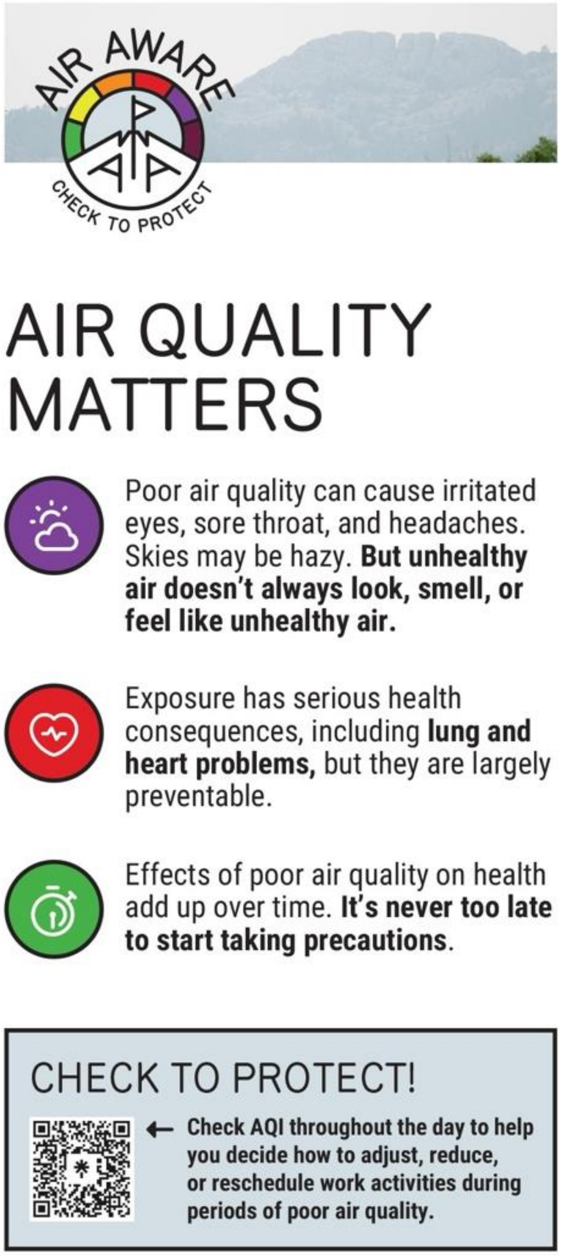


Figure B2. Sample of 3" x 8" handouts featuring concise Air Aware messages and a QR code directing workers to the campaign's Linktree webpage (Figure B5).

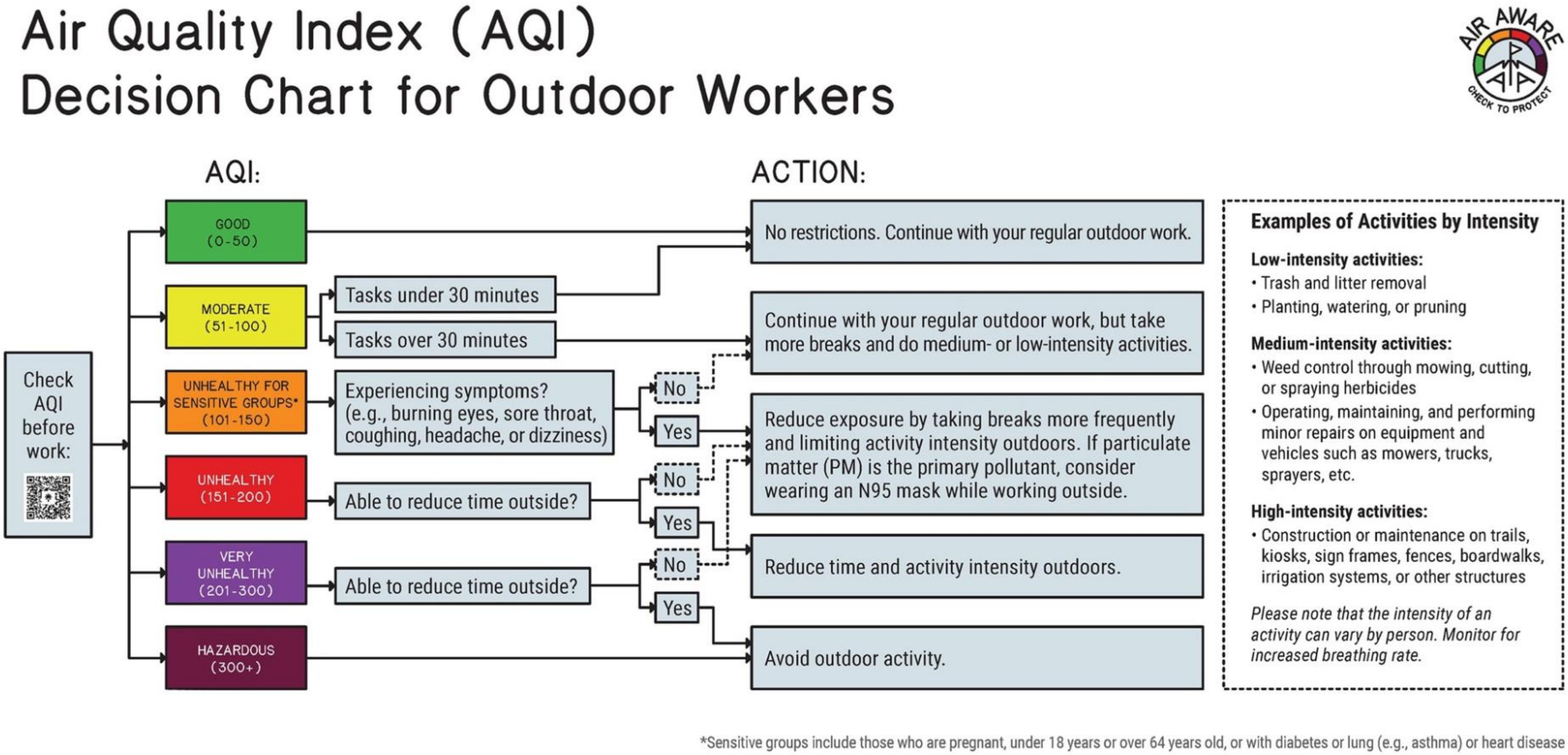


Figure B3. Sample of an Air Aware air quality decision chart for outdoor workers promoting health-protective actions at specific air quality levels.

Figure B4. Sample of Air Aware interactive air quality dial magnets that could be changed to reflect the daily AQI level (left) and campaign stickers (right).

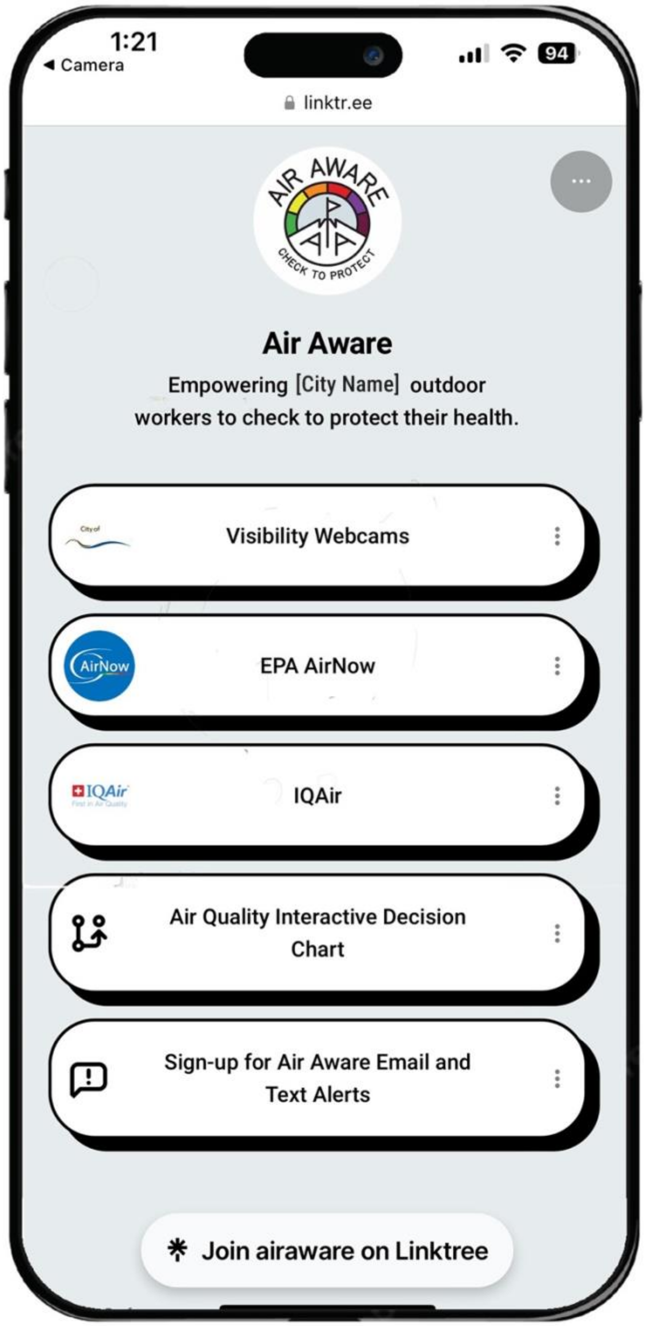


Figure B5. Air Aware Linktree webpage offering workers additional air quality information, or ability to enroll in email and/or text message alerts (Figure B6).

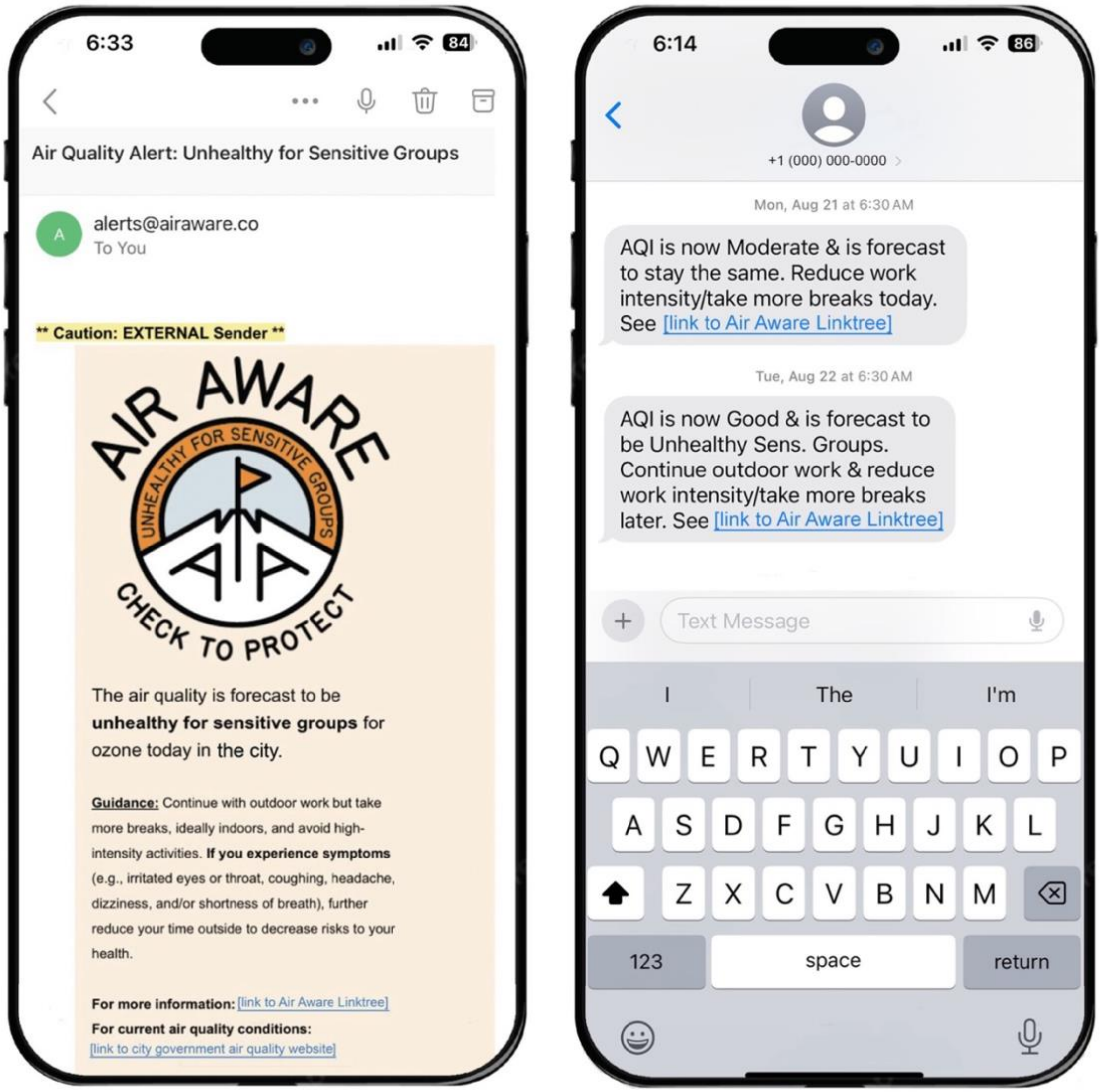


Figure B6. Sample Air Aware email alert (left) and text message alerts (right).

Appendix C: Complete Survey

Start of Block: Consent

Dear Participant,

My name is Channing Bice and I am a Ph.D. Candidate at Colorado State University in the Department of Journalism & Media Communication. We are conducting a research study to learn more about how outdoor workers think about air quality and extreme heat conditions while at work to inform effective occupational health and safety communication. We will ask you questions about your perceptions, attitudes, and knowledge about air quality and extreme heat conditions. We will also ask a few questions about your relationships, health, and some demographic questions.

The title of our project is Air Quality, Extreme Heat, and Outdoor Work. The Principal Investigator is Dr. Ashley Anderson in the Department of Journalism & Media Communication. This work is supported under assistance agreement no. 84036301-0 awarded by the U.S. Environmental Protection Agency.

We would like you to take an anonymous online survey that will take approximately 20-25 minutes. Your participation in this research is voluntary. If you decide to participate in this study, you may withdraw your consent and stop participation at any time without penalty. Should you decide to participate, you will be compensated $5 through your CloudResearch account. We will not collect your name or personal identifiers. When we report and share the data with others, we will combine the data from all participants. The results are only for academic research and may be used for future research studies or by another investigator for future research study without additional informed consent.

It is not possible to identify all potential risks in research procedures, but the researcher(s) have taken reasonable safeguards to minimize any known and potential (but unknown) risks. **To participate, you must be 18 years old or older and be employed in an occupation where you spend about 50% or more of your workday performing tasks outdoors.**

If you have any questions about the research, please contact Channing Bice at channing.bice@colostate.edu or Dr. Ashley Anderson at ashley.a.anderson@colostate.edu. If you have any questions about your rights as a volunteer in this research, contact the CSU IRB at: CSU_IRB@colostate.edu; (970) 491-1553.

Thank you,
Channing Bice, Ph.D. Candidate
Dr. Ashley Anderson, Associate Professor

To indicate your consent to participate in this research and continue to the survey, please select a response below.

○ I have read and understood the above, and I agree to participate.

○ I do not agree to participate.

Page Break

Display this question:

If Dear Participant, My name is Channing Bice and I am a Ph.D. Candidate at Colorado State Universit... = I do not agree to participate.

JS

Thank you for your interest in this survey! We appreciate your honest response to ensure the quality of our survey data. Please close this window now.

End of Block: Consent

Start of Block: Commitment Request (CR)

Before you begin...

We respect your time and do not want to waste it!

We **carefully inspect** each response to our survey and only approve work that meets the following criteria. **Your work will be approved when:**

- You can provide your valid Connect ID number
- You can confirm that you are 18 years of age or older
- You can confirm that you are currently employed in an occupation where you spend about 50% or more of a typical workday performing tasks outdoors
- You correctly follow detailed instructions
- You fully complete the survey (you will be asked to enter a completion code at the end of the survey to indicate that you have fully completed it)

We do not want to have to reject your work; if you do not believe you can meet the above criteria, please do not take this survey.

Given these requirements, would you like to continue?

○ No

○ Yes

Skip To: CR_no If Before you begin... We respect your time and do not want to waste it! We carefully inspect each r... = No

Page Break

Display this question:

If Before you begin... We respect your time and do not want to waste it! We carefully inspect each r... = No

Thank you for your interest in this survey! We appreciate your honest response to ensure the quality of our survey data. Please close this window now.

End of Block: Commitment Request (CR)

Start of Block: Eligibility Screening (ES)

Thank you for agreeing to participate in our survey! To get started, we will ask you a few questions about yourself and your job.

What is your Connect ID number?

____

What is your age?

____

On a typical workday in your current job, do you spend 50% or more of the day working outdoors exposed to all weather conditions?

○ Yes

○ No

Which of the following best describes your current employment status?

○ Employed full time

○ Employed part time

○ Self-employed full time

○ Self-employed part time

○ Not employed

○ Retired

○ Student

○ Other (please describe): ____

End of Block: Eligibility Screening (ES)

Start of Block: Job Characteristics

Using the drop-down menu below, please select which of the following best describes the industry that you work in.

- ○ Agriculture, Forestry, Fishing and Hunting
- ○ Arts, Entertainment, and Recreation
- ○ Construction
- ○ Couriers, Messengers, and Delivery Services
- ○ Educational Services
- ○ Food Services and Drinking Places
- ○ Forestry and Logging
- ○ Health Care and Social Assistance
- ○ Information
- ○ Leisure and Hospitality
- ○ Manufacturing
- ○ Mining, Quarrying, and Oil and Gas Extraction
- ○ Natural Resources and Mining
- ○ Professional and Business Services
- ○ Professional, Scientific, and Technical Services
- ○ Real Estate
- ○ Repair and Maintenance
- ○ Retail Trade
- ○ Telecommunications
- ○ Transportation and Warehousing
- ○ Utilities
- ○ None of these

Display this question:

If Using the drop-down menu below, please select which of the following best describes the industry... = None of these

You mentioned that the industry that you work in was not listed. Please describe the industry that you work in below.

____

Page Break

How long have you worked in your current job? Please enter the number of years and months in the boxes below.

If you have worked in your current job for less than 1 month, please enter 1 month.

○ Years ____

○ Months ____

Which of the following best describes the company or organization where you currently work?

○ For-profit

○ Not-for-profit

○ Local, state, or federal government

○ Other (please describe): ____

Does your job require you to work 14 months per year?

○ Yes

○ No

End of Block: Job Characteristics

Start of Block: Survey Introduction

Throughout this survey, we will ask you several questions about the **air quality** and **extreme heat** conditions you may encounter at work. Please take a moment to review some key definitions that will be used.

End of Block: Survey Introduction

Start of Block: Air Quality (AQ) Definitions

- **Air quality** describes how polluted the air that we breathe is and **only refers to outdoor air quality in this survey**. When air quality is poor, the air quality index value is at or above 100, meaning that there are high levels of pollutants in the air that can harm human health and the environment.

- The **Air Quality Index (AQI)** is used for reporting the outdoor air quality. The AQI tells you how polluted your air is, and what associated health effects might be a concern for you. The higher the AQI value, the more polluted the air is. Below is an image of the AQI:

Air Quality Index		
AQI Category and Color	**Index Value**	**Description of Air Quality**
Good Green	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Moderate Yellow	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups Orange	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Unhealthy Red	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy Purple	201 to 300	Health alert: The risk of health effects is increased for everyone.
Hazardous Maroon	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

End of Block: Air Quality (AQ) Definitions

Start of Block: Extreme Heat (EH) Definitions

- **Extreme heat** is defined as a period of high heat and humidity with temperatures above 90 degrees for at least two days.
- The **National Weather Service's (NWS) HeatRisk** is a color index that provides a forecast heat-related impacts to occur over a 24-hour period. That level of risk is illustrated by a color/number along with identifying groups of people that are most at risk

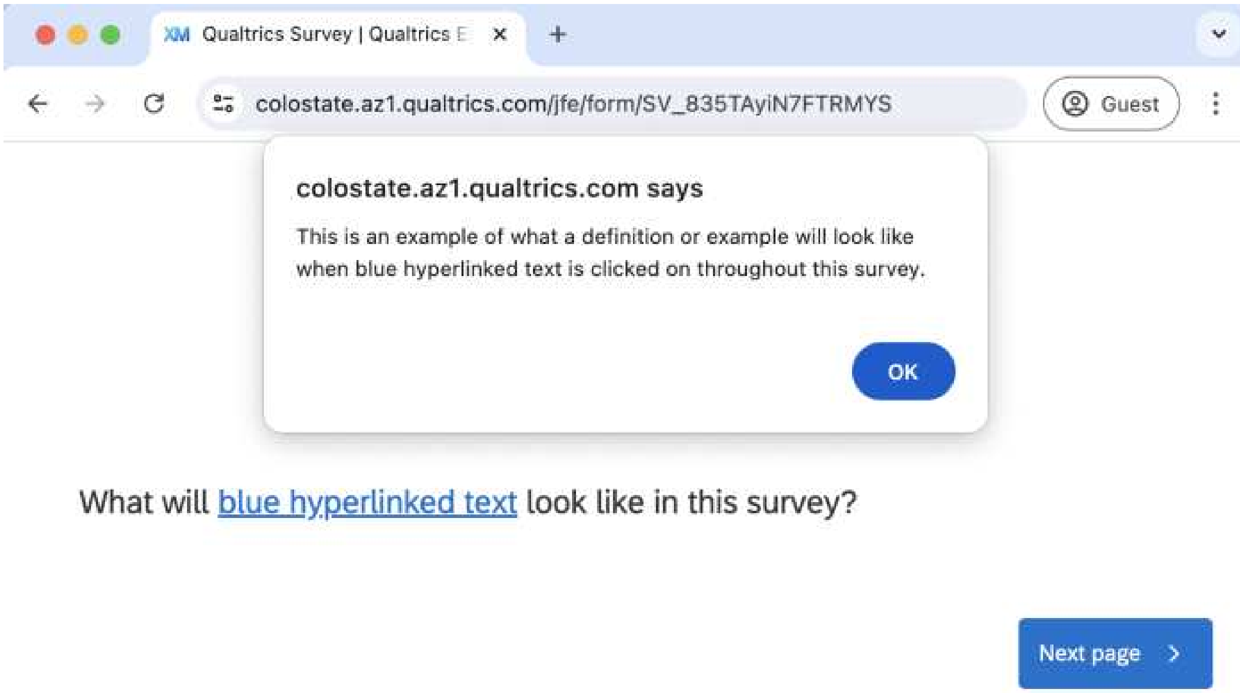
for each level and recommendations for heat protection at each level. Below is an image of the NWS HeatRisk Index:

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
Magenta 4	Extreme - This level of rare and/or long-duration extreme heat with little to no overnight relief affects anyone without effective cooling and/or adequate hydration. Impacts likely in most health systems, heat-sensitive industries and infrastructure.

End of Block: Extreme Heat (EH) Definitions

Start of Block: Hyperlink Instructions (HI)

The definitions you just reviewed, along with other relevant definitions and examples, will be available throughout the survey wherever you see blue hyperlinked text. You can click on this text anytime to refer back to these definitions or get clarifying information. Here is an example of what this might look like:



End of Block: Hyperlink Instructions (HI)

Start of Block: Local Recent Hazard Experience (LRHE)

This next set of questions will ask about your experiences with air quality and extreme heat during the past 3 months.

During the past 3 months, do you recall seeing or hearing about air quality alerts in your local area?

○ Yes

○ No

○ Not sure

Was there any time during the past 3 months that you thought that the air quality in your local area was bad?

- ○ Yes
- ○ No
- ○ Not sure

During the past 3 months, do you recall seeing or hearing warnings about heat in your local area?

- ○ Yes
- ○ No
- ○ Not sure

Was there any time during the past 3 months that you thought that the heat in your local area was bad?

- ○ Yes
- ○ No
- ○ Not sure

End of Block: Local Recent Hazard Experience (LRHE)

Start of Block: Workplace Policies (WP)

Now, we would like to know if your workplace has any administrative controls for employees that are working during extreme heat conditions or poor air quality conditions.

Are there any administrative controls in your workplace for working during extreme heat conditions?

- ○ Yes
- ○ No
- ○ Not sure

Are there any administrative controls in your workplace for working during poor air quality conditions?

- ○ Yes
- ○ No
- ○ Not sure

End of Block: Workplace Policies (WP)

Start of Block: Risk Perception (RP) - Air Quality (AQ)

This set of questions asks about your perceptions of the health risks posed by working outdoors during poor air quality.

How likely is it that you will be negatively impacted by the potential health risks of working outdoors during poor air quality?

- ○ Not at all likely
- ○ Unlikely
- ○ Neither likely nor unlikely
- ○ Likely
- ○ Extremely likely

If you were to develop a health problem from working outdoors during poor air quality, how serious would it be?

- ○ Not at all serious
- ○ Unserious
- ○ Neither unserious nor serious
- ○ Serious
- ○ Extremely serious

End of Block: Risk Perception (RP) - Air Quality (AQ)

Start of Block: Risk Perception (RP) - Extreme Heat (EH)

Please answer the following questions regarding your perceptions of the health risks posed by working outdoors during extreme heat.

How likely is it that you will be negatively impacted by the potential health risks of working outdoors during extreme heat?

- ○ Not at all likely
- ○ Unlikely
- ○ Neither likely nor unlikely
- ○ Likely
- ○ Extremely likely

If you were to develop a health problem from working outdoors during extreme heat, how serious would it be?

- ○ Not at all serious
- ○ Unserious
- ○ Neither unserious nor serious
- ○ Serious
- ○ Extremely serious

End of Block: Risk Perception (RP) - Extreme Heat (EH)

Start of Block: Affective Response - Air Quality

When I think about working outdoors during poor air quality conditions, I feel...

	1 (none of this feeling)	2	3	4	5 (a lot of this feeling)
Worried	○	○	○	○	○
Concerned	○	○	○	○	○
Overwhelmed	○	○	○	○	○
Scared	○	○	○	○	○

End of Block: Affective Response - Air Quality

Start of Block: Affective Response - Extreme Heat

When I think about working outdoors during extreme heat conditions, I feel...

	1 (none of this feeling)	2	3	4	5 (a lot of this feeling)
Worried	○	○	○	○	○
Concerned	○	○	○	○	○
Overwhelmed	○	○	○	○	○
Scared	○	○	○	○	○

End of Block: Affective Response - Extreme Heat

Start of Block: Information Insufficiency - Air Quality

The next set of questions asks about your knowledge regarding the health risks of working outdoors during poor air quality.

Using the scale of 0 to 10 below, please indicate how much you **currently know** about the health risks from working outdoors during poor air quality.

	0	1	2	3	4	5	6	7	8	9	10	
Nothing	○	○	○	○	○	○	○	○	○	○	○	All there is to know

This time, using that same scale, estimate how much **knowledge you need** about the health risks from working outdoors during poor air quality.

	0	1	2	3	4	5	6	7	8	9	10	
Nothing	○	○	○	○	○	○	○	○	○	○	○	All there is to know

End of Block: Information Insufficiency - Air Quality

Start of Block: Information Insufficiency - Extreme Heat

Now, we would like you to think about your knowledge regarding the health risks of working outdoors during extreme heat.

Using the scale of 0 to 10 below, please indicate how much you **currently know** about the health risks of working outdoors during extreme heat conditions.

	0	1	2	3	4	5	6	7	8	9	10	
Nothing	○	○	○	○	○	○	○	○	○	○	○	All there is to know

This time, using that same scale, estimate how much **knowledge you need** on the health risks of working outdoors during extreme heat conditions.

	0	1	2	3	4	5	6	7	8	9	10	
Nothing	○	○	○	○	○	○	○	○	○	○	○	All there is to know

End of Block: Information Insufficiency - Extreme Heat

Start of Block: Attachment

In these next few sections of questions, we would like to know more about how you generally experience relationships with other people, not just what is happening in one specific relationship. Please indicate how much you agree or disagree with each of the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I find that others don't want to be as close as I would like.	○	○	○	○	○	○	○
It does not help to turn to other people in times of need.	○	○	○	○	○	○	○
I want to be close to others, but I often find myself pulling back.	○	○	○	○	○	○	○

I need a lot of reassurance that I am appreciated by others.	○	○	○	○	○	○	○
This is an attention check, please select "Strongly disagree."	○	○	○	○	○	○	○
I prefer not to turn to other people for advice or help.	○	○	○	○	○	○	○
My desire to be very close sometimes scares people away.	○	○	○	○	○	○	○

Page Break

Please indicate how much you agree or disagree with each of the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I try to avoid getting too close to others.	○	○	○	○	○	○	○
I often worry about being	○	○	○	○	○	○	○

abandoned by others.							
I don't usually discuss my problems and concerns with other people.	○	○	○	○	○	○	○
I worry that other people won’t care about me as much as I care about them.	○	○	○	○	○	○	○
I get frustrated if others are not available when I need them.	○	○	○	○	○	○	○
I am nervous when others try to get too close to me	○	○	○	○	○	○	○

End of Block: Attachment

Start of Block: Informational Subjective Norms - Air Quality

Now, we would like to know about what specific people might think about air quality information. Please indicate the extent to which you agree or disagree with the following statements

Most people who are important to me think that I should seek information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My family expects me to seek information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

People that I work with expect me to seek information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

End of Block: Informational Subjective Norms - Air Quality

Start of Block: Informational Subjective Norms - Extreme Heat

We would like to know about what specific people might think about extreme heat information. Please indicate the extent to which you agree or disagree with the following statements.

Most people who are important to me think that I should seek information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

My family expects me to seek information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

People that I work with expect me to seek information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

End of Block: Informational Subjective Norms - Extreme Heat

Start of Block: Attitudes Toward Information Seeking - Air Quality

Now, using the following adjective scales, please indicate to what extent you feel that seeking information about air quality is...

	1	2	3	4	5	
Harmful	o	o	o	o	o	Beneficial
Unhelpful	o	o	o	o	o	Helpful
Foolish	o	o	o	o	o	Wise
Unproductive	o	o	o	o	o	Productive

End of Block: Attitudes Toward Information Seeking - Air Quality

Start of Block: Attitudes Toward Information Seeking - Extreme Heat

Using the following adjective scales, please indicate the extent to which you feel that seeking information about extreme heat is...

	1	2	3	4	5	
Harmful	o	o	o	o	o	Beneficial
Unhelpful	o	o	o	o	o	Helpful
Foolish	o	o	o	o	o	Wise
Unproductive	o	o	o	o	o	Productive

End of Block: Attitudes Toward Information Seeking - Extreme Heat

Start of Block: Perceived Information Seeking Control - Air Quality

Please indicate the extent to which you agree or disagree with similar statements about accessing information about air quality while you are working.

I know where to look for information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

When it comes to information about air quality, I know where to go.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

During work, I have open access to technology that I can use to look up information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

People vary in the amount that they pay attention to these kinds of surveys. Some take them seriously and read each question, whereas others go very quickly and barely read the questions at all. If you have carefully read this question, please write the word "purple" in the blank “Other” box below.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree
- ○ Other ____

End of Block: Perceived Information Seeking Control - Air Quality

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Start of Block: Perceived Information Seeking Control - Extreme Heat

Please indicate the extent to which you agree or disagree with the following statements about accessing information about extreme heat.

I know where to look for information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

When it comes to information about extreme heat, I know where to go.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

During work, I have open access to technology that I can use to look up information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

End of Block: Perceived Information Seeking Control - Extreme Heat

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Start of Block: Progress Message

You are more than halfway done! 🎉 We're grateful for your continued time and attention. Please click the next button to advance.

End of Block: Progress Message

Start of Block: Information Seeking Intention - Air Quality

Now, we would like to know if you intend to seek information about air quality in the next 3 months. Please indicate the extent to which you agree or disagree with the following statements.

I will try to seek information about air quality in the next 3 months.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I will look for information about air quality in the next 3 months.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

In the next 3 months, I am going to search for information about air quality.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

End of Block: Information Seeking Intention - Air Quality

Start of Block: Information Seeking Intention - Extreme Heat

We would like to know if you intend to seek information about extreme heat in the next 3 months. Please indicate the extent to which you agree or disagree with the following statements.

I will try to seek information about extreme heat in the next 3 months.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

I will look for information about extreme heat in the next 3 months.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

In the next 3 months, I am going to search for information about extreme heat.

- ○ Strongly disagree
- ○ Somewhat disagree
- ○ Neither agree nor disagree
- ○ Somewhat agree
- ○ Strongly agree

End of Block: Information Seeking Intention - Extreme Heat

Start of Block: Active Information Seeking - Air Quality

Would you like more information about how you can protect your health while you are working outdoors during **poor air quality conditions**?

- ○ Yes
- ○ No

Page Break

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

Timing
First Click
Last Click
Page Submit
Click Count

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

Click on the red button below to open a website about how you can protect your health while you are working outdoors during **poor air quality conditions**. Explore the website as much as you would like before moving on to the rest of the survey.

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

JS

Page Break

Display this question:

If Click on the red button below to open a website about how you can protect your health while you a... Displayed

What information did you find to be the most helpful?

____

____

____

____

____

Display this question:

If Click on the red button below to open a website about how you can protect your health while you a... Displayed

Do you have any suggestions about how the webpage you just viewed could be improved to be more helpful?

____

____

____

____

____

Page Break

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = No

You indicated that you were not interested in seeking information about how you can protect yourself from the health risks of poor air quality while you are working. Which of the following best describes why you were not interested?

- ○ I do not have enough time to seek more information right now.
- ○ I am already informed about this risk.
- ○ I am not concerned about this risk.
- ○ I do not feel like this risk is relevant to me.
- ○ I do not feel like the information would be relevant to me.
- ○ Seeking information about this risk is a waste of time.
- ○ Other (please describe): ____

End of Block: Active Information Seeking - Air Quality

Start of Block: Active Information Seeking - Extreme Heat

Would you like more information about how you can protect your health while you are working outdoors during **extreme heat conditions**?

- ○ Yes
- ○ No

Page Break

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

Timing
First Click
Last Click
Page Submit
Click Count

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

Click on the red button below to open a website about how you can protect your health while you are working outdoors during **extreme heat conditions**. Explore the website as much as you would like before moving on to the rest of the survey.

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = Yes

JS

Page Break

Display this question:

If Click on the red button below to open a website about how you can protect your health while you a... Displayed

What extreme heat information did you find to be the most helpful on this website?

____

____

____

____

____

Display this question:

If Click on the red button below to open a website about how you can protect your health while you a... Displayed

Do you have any suggestions about how the website that you just viewed could be improved to be more helpful?

____

____

____

____

____

Page Break

Timing
First Click
Last Click
Page Submit
Click Count

Display this question:

If Would you like more information about how you can protect your health while you are working outdo... = No

You indicated that you were not interested in seeking information about how you can protect yourself from the health risks of working outdoors in extreme heat conditions. Which of the following best describes why you were not interested?

- ○ I do not have enough time to seek more information right now.
- ○ I am already informed about this risk.
- ○ I am not concerned about this risk.
- ○ I do not feel like this risk is relevant to me.
- ○ I do not feel like the information would be relevant to me.
- ○ Seeking information about this risk is a waste of time.
- ○ Other (please describe): ____

End of Block: Active Information Seeking - Extreme Heat

Start of Block: Health

Now we are going to ask you a few questions about your health. In general, would you say that your physical health is...?

- ○ Poor
- ○ Fair
- ○ Good
- ○ Excellent

Have you ever been diagnosed with any of the following health conditions?

	No	Yes
Lung disease	○	○
Heart disease	○	○
Allergies	○	○
Mental health conditions	○	○
Overweight or obese	○	○
Diabetes-related condition	○	○

Have you ever experienced a heat illness at work?

○ Yes

○ No

Have you ever experienced symptoms at work that you thought could be due to poor air quality?

○ Yes

○ No

End of Block: Health

Start of Block: Demographics

In this last section, we will ask you a few questions about yourself.

In which state do you currently reside?

- ○ Alabama
- ○ Alaska
- ○ Arizona
- ○ Arkansas
- ○ California
- ○ Colorado
- ○ Connecticut
- ○ Delaware
- ○ District of Columbia
- ○ Florida
- ○ Georgia
- ○ Hawaii
- ○ Idaho
- ○ Illinois
- ○ Indiana
- ○ Iowa
- ○ Kansas
- ○ Kentucky
- ○ Louisiana
- ○ Maine
- ○ Maryland
- ○ Massachusetts
- ○ Michigan
- ○ Minnesota
- ○ Mississippi
- ○ Missouri
- ○ Montana
- ○ Nebraska
- ○ Nevada
- ○ New Hampshire
- ○ New Jersey
- ○ New Mexico

- ○ New York
- ○ North Carolina
- ○ North Dakota
- ○ Ohio
- ○ Oklahoma
- ○ Oregon
- ○ Pennsylvania
- ○ Puerto Rico
- ○ Rhode Island
- ○ South Carolina
- ○ South Dakota
- ○ Tennessee
- ○ Texas
- ○ Utah
- ○ Vermont
- ○ Virginia
- ○ Washington
- ○ West Virginia
- ○ Wisconsin
- ○ Wyoming
- ○ None of the above

What is your US Zip Code?

____

Page Break

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

What is the highest level of education you have completed?

- ○ Less than high school
- ○ Completed some high school
- ○ High school diploma or GED
- ○ Job-specific training program(s) after high school
- ○ Some college, but no degree
- ○ Associate's degree
- ○ Bachelor's degree (such as B.A., B.S.)
- ○ Some graduate school, but no degree
- ○ Graduate degree (such as MBA, MS, M.D., Ph.D.)

What is your annual household income before taxes?

- ○ Less than $15,000
- ○ $15,000 to $24,999
- ○ $25,000 to $34,999
- ○ $35,000 to $49,999
- ○ $50,000 to $74,999
- ○ $75,000 to $99,999
- ○ $100,000 to $124,999
- ○ $125,000 to $149,999
- ○ $150,000 to $199,999
- ○ $200,000 to $249,999
- ○ $250,000 or more
- ○ Prefer not to answer

What is your race or ethnicity? Please select all that apply.

- ☐ Native American or Alaska Native
- ☐ Asian or Asian American
- ☐ Black or African American
- ☐ Native Hawaiian or Pacific Islander
- ☐ White or Caucasian
- ☐ Hispanic or Latino
- ☐ Other (please describe): ____
- ☐ Prefer not to answer

End of Block: Demographics

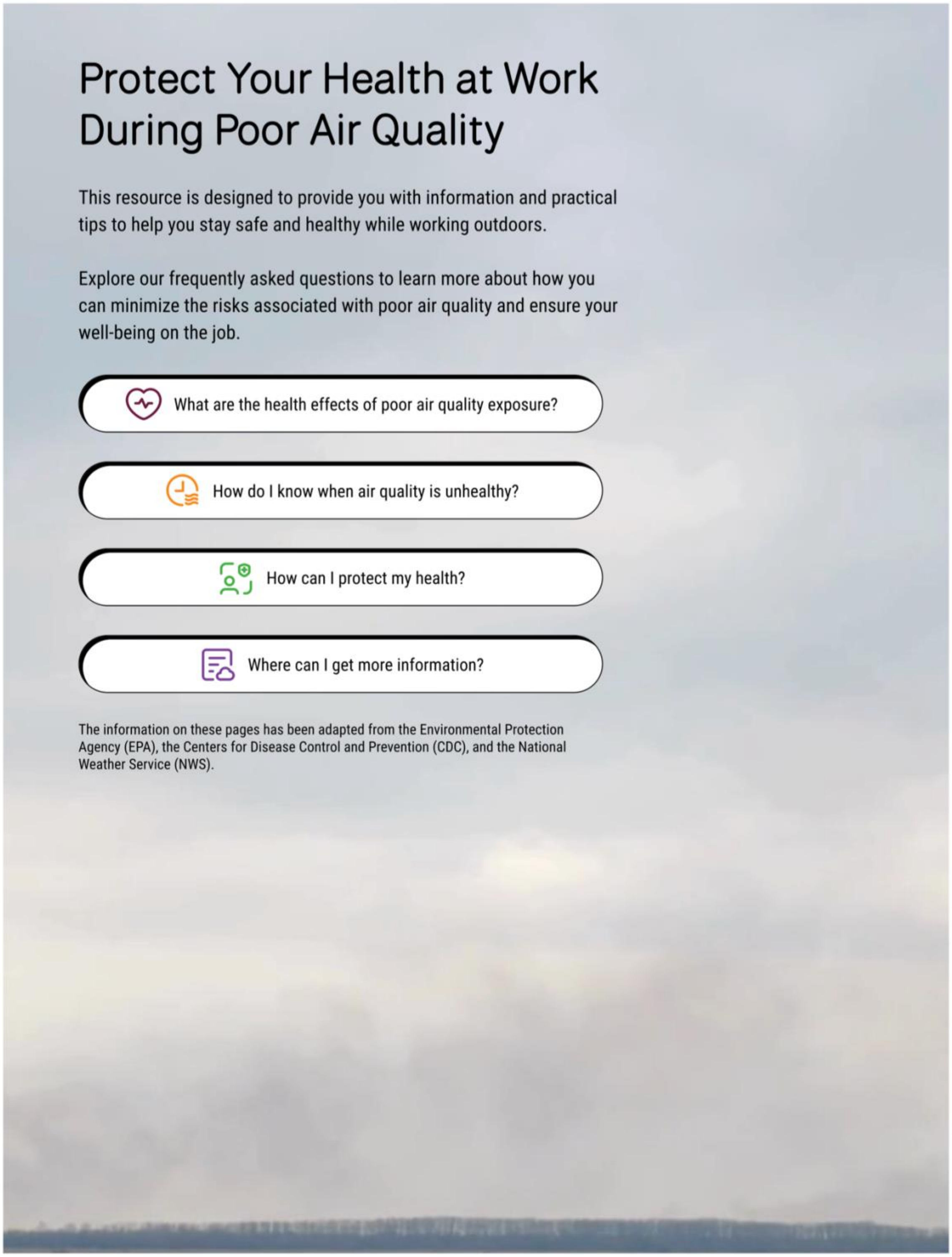
Appendix D: Survey Measure Descriptives

Concept	Measures	*M*	*SD*
Risk Perception (1-5 scales)	How likely is it that you will be negatively impacted by the potential health risks of working outdoors during poor air quality?	3.34	1.08
	If you were to develop a health problem from working outdoors during poor air quality, how serious would it be?	3.54	0.95
	Multiplied scale	12.34	5.98
	Cronbach's α	0.70	
	How likely is it that you will be negatively impacted by the potential health risks of working outdoors during extreme heat?	3.65	0.99
	If you were to develop a health problem from working outdoors during extreme heat, how serious would it be?	3.65	0.98
	Multiplied scale	13.90	6.02
	Cronbach's α	0.73	
Affective Response (1-5 scales)	*When I think about working outdoors during poor air quality conditions, I feel…*		
	Worried	3.14	1.27
	Concerned	3.36	1.23
	Overwhelmed	2.43	1.27
	Scared	2.48	1.30
	Averaged scale	2.85	1.13
	Cronbach's α	0.91	
	When I think about working outdoors during extreme heat conditions, I feel…		
	Worried	3.56	1.22
	Concerned	3.78	1.13
	Overwhelmed	3.04	1.31
	Scared	2.77	1.30
	Averaged scale	3.29	1.07
	Cronbach's α	0.88	
Information Insufficiency (1-10 scales)	Using the scale of 0 to 10 below, please indicate how much you currently know about the health risks from working outdoors during poor air quality.	5.35	2.34
	This time, using that same scale, estimate how much knowledge you need about the health risks from working outdoors during poor air quality.	6.76	2.32
	Information insufficiency (air quality)*	4.90	2.17
	Using the scale of 0 to 10 below, please indicate how much you currently know about the health risks of working outdoors during extreme heat conditions.	6.70	1.94

Concept	Measures	*M*	*SD*
	This time, using that same scale, estimate how much knowledge you need on the health risks of working outdoors during extreme heat conditions.	7.12	2.25
	Information insufficiency (extreme heat) *	4.69	2.14
Anxious Attachment (1-7 scale)	I find that others don't want to be as close as I would like.	3.05	1.72
	I need a lot of reassurance that I am appreciated by others.	3.45	1.73
	My desire to be very close sometimes scares people away.	2.72	1.70
	I often worry about being abandoned by others.	3.28	1.89
	I worry that other people won't care about me as much as I care about them.	3.43	1.79
	I get frustrated if others are not available when I need them.	3.81	1.72
	Summed scale	19.74	8.08
	Cronbach's α	0.86	
Avoidant Attachment (1-7 scale)	It does not help to turn to other people in times of need.	2.77	1.57
	I want to be close to others, but I often find myself pulling back.	3.53	1.89
	I prefer not to turn to other people for advice or help.	3.56	1.75
	I try to avoid getting too close to others.	3.44	1.82
	I don't usually discuss my problems and concerns with other people.	4.10	1.79
	I am nervous when others try to get too close to me.	3.27	1.80
	Summed scale	20.67	8.18
	Cronbach's α	0.86	
Informational Subjective Norms (1-5 scales)	Most people who are important to me think that I should seek information about air quality.	2.91	1.26
	My family expects me to seek information about air quality.	2.91	1.33
	People that I work with expect me to seek information about air quality.	2.87	1.31
	Averaged scale	2.90	1.19
	Cronbach's α	0.90	
	Most people who are important to me think that I should seek information about extreme heat.	3.27	1.24
	My family expects me to seek information about extreme heat.	3.34	1.28
	People that I work with expect me to seek information about extreme heat.	3.39	1.27
	Averaged scale	3.33	1.14
	Cronbach's α	0.88	
Attitudes Toward Information Seeking (1-5 scales)	*Please indicate to what extent you feel that seeking information about air quality is...*		
	Harmful…Beneficial	4.30	1.08
	Unhelpful…Helpful	4.26	1.10
	Foolish…Wise	4.28	1.08

Concept	Measures	*M*	*SD*
	Unproductive…Productive	4.10	1.08
	Averaged scale	4.24	1.01
	Cronbach's α	0.95	
	Please indicate the extent to which you feel that seeking information about extreme heat is…		
	Harmful…Beneficial	4.35	1.07
	Unhelpful…Helpful	4.25	1.18
	Foolish…Wise	4.37	1.10
	Unproductive…Productive	4.15	1.14
	Averaged scale	4.28	1.04
	Cronbach's α	0.95	
Perceived Information Seeking Control (1-5 scales)	I know where to look for information about air quality.	3.97	1.08
	When it comes to information about air quality, I know where to go.	3.91	1.10
	During work, I have open access to technology that I can use to look up information about air quality.	4.10	1.16
	Averaged scale	3.99	0.96
	Cronbach's α	0.83	
	I know where to look for information about extreme heat.	4.25	0.87
	When it comes to information about extreme heat, I know where to go.	4.27	0.88
	During work, I have open access to technology that I can use to look up information about extreme heat.	4.23	1.07
	Averaged scale	4.25	0.81
	Cronbach's α	0.82	
Information Seeking Intention (1-5 scales)	I will try to seek information about air quality in the next 3 months.	3.94	1.08
	I will look for information about air quality in the next 3 months.	3.91	1.11
	In the next 3 months, I am going to search for information about air quality.	3.89	1.08
	Averaged scale	3.91	1.05
	Cronbach's α	0.96	
	I will try to seek information about extreme heat in the next 3 months.	4.12	1.05
	I will look for information about extreme heat in the next 3 months.	4.09	1.09
	In the next 3 months, I am going to search for information about extreme heat.	4.04	1.10
	Averaged scale	4.08	1.03
	Cronbach's α	0.96	

Appendix E: Stimulus Materials for Active Information Seeking



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What are the health effects of poor air quality exposure?

The health effects of poor air quality are serious and cause a wide variety of lung and heart problems. Unhealthy air can harm anyone, including healthy adults who work or exercise outdoors.

Prolonged exposure and the deep, rapid breathing associated with intense work activity worsen the health effects of poor air quality. These effects are largely preventable by staying informed about air quality conditions and taking protective measures.

The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

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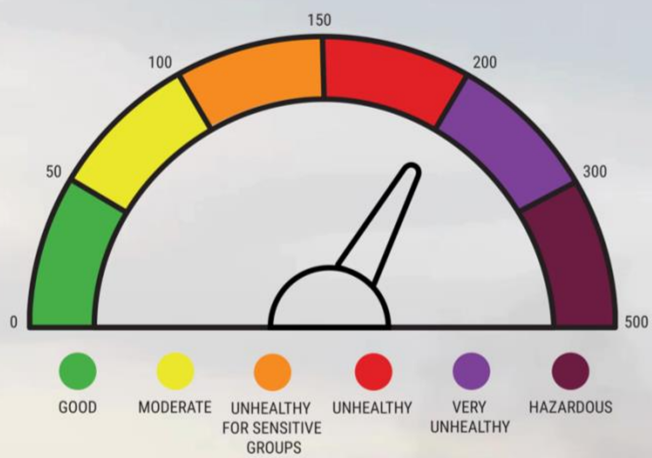
How do I know when air quality is unhealthy?

Air quality outdoors can change quickly and significantly throughout the day. Sometimes you can see poor air quality, but other times it's invisible.

The Air Quality Index (AQI) helps you make health-protective decisions in all conditions. It uses colors, numbers, and keywords to help you quickly understand what the air quality around you means for your health.

Using the AQI to track air quality conditions can help you know how polluted the air is and make health-protective decisions throughout the workday.



The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

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How can I protect my health?

Keeping track of the current air quality conditions in your area can help you take steps to protect yourself and others from poor air quality. Any of the following actions can help you protect your health while you are on the job:

- Taking more breaks, ideally indoors.
- Choosing lower-intensity or indoor work tasks when possible.
- Postponing high-intensity tasks until air quality improves.
- Those that are pregnant, or have asthma, diabetes, or other heart or lung conditions should carry prescribed medications and further reduce time outside or intensity of work.

For more guidance on when to take these actions, visit the chart below. ↓

Air Quality Decision Chart for Outdoor Workers

The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

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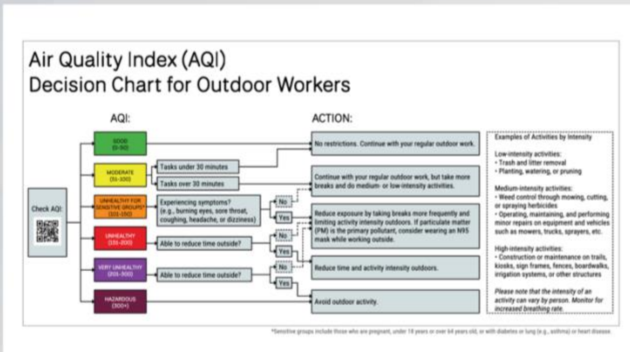
Air Quality Decision Chart for Outdoor Workers



The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

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Where can I get more information?

Information on the air quality conditions in your area can be found on the Environmental Protection Agency (EPA)'s AirNow website or mobile app.

You should also be able to find information about local air quality conditions wherever you get your weather forecast. Check your local radio, TV weather reports, newspaper, or the weather app on your phone.

Below is a list of information resources that you can save to help you keep track of air quality conditions while you are working. ↓

Air Quality Information Resource List

The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

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Air Quality Information Resource List

AIR QUALITY INFORMATION RESOURCES

Below are some information resources that can help you keep track of the current air quality conditions in your area while you are working outdoors.

EPA AirNow
- Website: www.airnow.gov
- Mobile app: www.airnow.gov/airnow-mobile-app
- Email notification sign-up: www.enviroflash.info

IQAir
- Website: www.iqair.com/us/
- Mobile app: www.iqair.com/us/air-quality-monitors-air-quality-app

You should also be able to find information about local air quality conditions wherever you get your weather forecast. Check your local radio, TV weather reports, newspaper or the weather app on your phone.

The information on these pages has been adapted from the Environmental Protection Agency (EPA), the Centers for Disease Control and Prevention (CDC), and the National Weather Service (NWS).

Protect Your Health at Work During Extreme Heat

This resource is designed to provide you with information and practical tips to help you stay safe and healthy while working outdoors.

Explore our frequently asked questions to learn more about how you can minimize the risks associated with extreme heat and ensure your well-being on the job.

What are the health effects of extreme heat?

How do I know when heat conditions are hazardous?

How can I protect my health?

Where can I get more information?

The information on these pages has been adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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What are the health effects of extreme heat?

Extreme heat can harm anyone, including healthy adults who work outdoors. Heat-related illnesses, like heat exhaustion or heat stroke, happen when the body is not able to properly cool itself.

While the body normally cools itself by sweating, during extreme heat, this might not be enough. In these cases, a person's body temperature rises faster than it can cool itself down, which can cause damage to the brain and other vital organs. These effects are largely preventable by staying informed about heat conditions and taking protective measures.

The information on these pages has adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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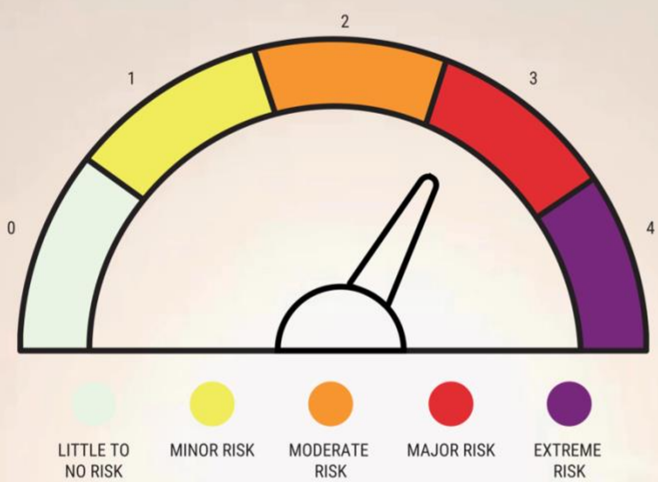
How do I know when heat conditions are hazardous?

Heat-related illness prevention starts by determining if a heat risk is present. Workers should be aware of any heat watches, advisories, or warnings from the National Weather Service (NWS).

The NWS HeatRisk is a color-based index that forecasts the potential heat-related impacts to occur over a 24-hour period. The level of risk is illustrated by a color/number along with recommendations for heat protection that can serve as a useful tool for planning for upcoming heat and its potential risk.



The information on these pages has adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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How can I protect my health?

Keeping track of any heat watches, advisories, or warnings in your area can help you protect yourself and others from heat-related illnesses. Any of the following actions can help you protect your health while you are on the job:

- Drinking a cup of cool water every 20 minutes, even if you aren't thirsty. For long, strenuous jobs, drink a beverage with electrolytes.
- Taking regular rest breaks in a shady or cool location. Skipping breaks during hot conditions is not safe.
- Dress for the heat by wearing a hat and light-colored, loose fitting, and breathable clothing if possible.
- If you are wearing a face covering, change it if it gets wet or soiled.
- Monitor yourself and others for signs of heat illness. Verbally check on others frequently.

For more guidance on heat illness symptoms and first aid, view the chart below. ↓

Heat Illness Symptoms & Actions Chart

The information on these pages has been adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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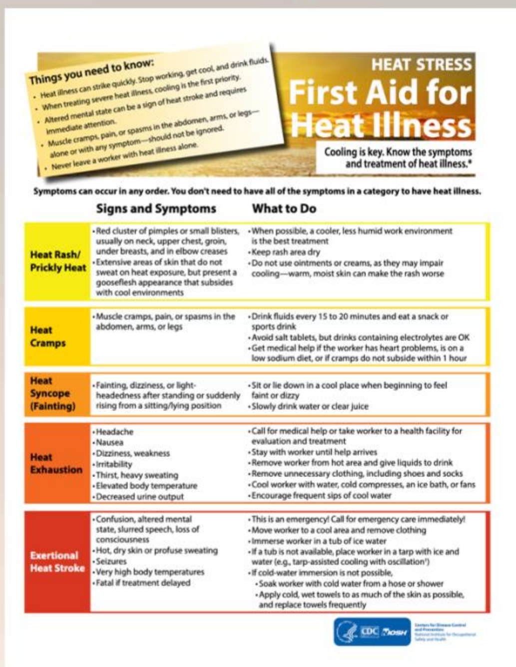
Heat Illness Symptoms & Actions Chart



Things you need to know:

- Heat illness can strike quickly. Stop working, get cool, and drink fluids.
- When treating severe heat illness, cooling is the first priority.
- Altered mental state can be a sign of heat stroke and requires immediate attention.
- Muscle cramps, pain, or spasms in the abdomen, arms, or legs—alone or with any symptom—should not be ignored.
- Never leave a worker with heat illness alone.

HEAT STRESS

First Aid for Heat Illness

Cooling is key. Know the symptoms and treatment of heat illness.*

Symptoms can occur in any order. You don't need to have all of the symptoms in a category to have heat illness.

	Signs and Symptoms	What to Do
Heat Rash/ Prickly Heat	• Red cluster of pimples or small blisters, usually on neck, upper chest, groin, under breasts, and in elbow creases • Extensive areas of skin that do not sweat on heat exposure, but present a gooseflesh appearance that subsides with cool environments	• When possible, a cooler, less humid work environment is the best treatment • Keep rash area dry • Do not use ointments or creams, as they may impair cooling—warm, moist skin can make the rash worse
Heat Cramps	• Muscle cramps, pain, or spasms in the abdomen, arms, or legs	• Drink fluids every 15 to 20 minutes and eat a snack or sports drink • Avoid salt tablets, but drinks containing electrolytes are OK • Get medical help if the worker has heart problems, is on a low sodium diet, or if cramps do not subside within 1 hour
Heat Syncope (Fainting)	• Fainting, dizziness, or light-headedness after standing or suddenly rising from a sitting/lying position	• Sit or lie down in a cool place when beginning to feel faint or dizzy • Slowly drink water or clear juice
Heat Exhaustion	• Headache • Nausea • Dizziness, weakness • Irritability • Thirst, heavy sweating • Elevated body temperature • Decreased urine output	• Call for medical help or take worker to a health facility for evaluation and treatment • Stay with worker until help arrives • Remove worker from hot area and give liquids to drink • Remove unnecessary clothing, including shoes and socks • Cool worker with water, cold compresses, an ice bath, or fans • Encourage frequent sips of cool water

Exertional Heat Stroke	• Confusion, altered mental state, slurred speech, loss of consciousness
	• Hot, dry skin or profuse sweating
	• Seizures
	• Very high body temperatures
	• Fatal if treatment delayed
		• This is an emergency! Call for emergency care immediately!
		• Move worker to a cool area and remove clothing
		• Immerse worker in a tub of ice water
		• If a tub is not available, place worker in a tarp with ice and water (e.g., tarp-assisted cooling with oscillation[†])
		• If cold-water immersion is not possible,
		  • Soak worker with cold water from a hose or shower
		  • Apply cold, wet towels to as much of the skin as possible, and replace towels frequently

The information on these pages has been adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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Where can I get more information?

Information on heat watches, advisories, or warnings issued for your area can be found on the National Weather Service (NWS)'s website.

You should also be able to find information about local heat conditions wherever you get your weather forecast. Check your local radio, TV weather reports, newspaper, or the weather app on your phone.

Below is a list of information resources that you can save to help you keep track of heat conditions while you are working. ↓

Heat Information Resource List

The information on these pages has adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

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Heat Information Resource List

HEAT INFORMATION RESOURCES

Below are some information resources that can help you keep track of the current heat conditions in your area while you are working outdoors.

National Weather Service (NWS)
www.weather.gov

NWS HeatRisk Forecast
www.wpc.ncep.noaa.gov/heatrisk/

OSHA-NIOSH Heat Safety Mobile App
www.cdc.gov/niosh/topics/heatstress/heatapp

You should also be able to find information about local heat conditions wherever you get your weather forecast. Check your local radio, TV weather reports, newspaper or the weather app on your phone.

The information on these pages has adapted from the National Weather Service (NWS), Centers for Disease Control and Prevention (CDC), and the Occupational Health & Safety Administration (OSHA).

Appendix F: Focus Group Participant Characteristics (*N* = 29)

	n	%
Gender		
Male	23	79
Female	6	21
Age		
18-24 years	3	10
25-34 years	12	41
35-44 years	6	21
45-54 years	4	14
55-64 years	2	7
65 years or older	2	7
Race/Ethnicity		
Asian or Asian American	1	3
Black or African American	0	0
Hispanic or Latino	3	10
Native American or Alaska Native	0	0
Native Hawaiian or Pacific Islander	0	0
White or Caucasian	25	86
Prefer not to answer	1	3
Residency		
Less than 1 year	2	7
1-5 years	4	14
6-12 years	4	14
13-20 years	5	17
More than 20 years	14	48
Education		
High school diploma or GED	4	14
Job-specific training program(s) after high school	5	17
Some college, but no degree	3	10
Associate's degree	3	10
Bachelor's degree (such as B.A., B.S.)	11	38
Some graduate school, but no degree	1	3
Graduate degree (such as MBA, MS, M.D., Ph.D.)	2	7
Income		
$15,000 to $24,999	1	3
$25,000 to $34,999	0	0
$35,000 to $49,999	5	17
$50,000 to $74,999	4	14
$75,000 to $99,999	3	10
$100,000 to $124,999	5	17
$125,000 to $149,999	1	3

	n	%
$150,000 to $199,999	7	24
$200,000 to $249,999	2	7
Prefer not to answer	1	3
Department		
Utilities	8	28
Natural Areas	11	38
Parks & Recreation	10	34
Job Role		
Apprentice Line Worker	2	6
Apprentice Lineman	1	3
Crew Chief	1	3
Equipment Operator	1	3
Hourly Crew Member	1	3
Journeyman Lineman	2	7
Line Worker	1	3
Lineman and Lead Safety Specialist	1	3
Maintenance Worker	2	7
Safety & Training Supervisor	1	3
Seasonal Worker	3	10
Senior Supervisor	1	3
Technician II	2	7
Tool Crib Attendant	3	10
Tool Crib Attendant, Equipment Operator	1	3
Worker I	6	21
Length of Employment in Current Job*		
Less than 1 year	7	24
1 to 5 years	12	41
6 to 10 years	6	21
11 to 15 years	0	0
16 to 25 years	3	10
26+ years	1	3
Seasonal or Year-Round Employment		
Seasonal	7	24
Year-round	22	76
Hourly Employee		
Yes	17	59
No	12	41
Have you ever been diagnosed with lung disease?		
Yes	0	0
No	29	100
Have you ever been diagnosed with heart disease?		
Yes	3	10
No	26	90
Have you ever been diagnosed with allergies?		

	n	%
Yes	12	41
No	17	59
Have you ever been diagnosed with mental health conditions?		
Yes	6	21
No	23	79
Have you ever been diagnosed as being overweight or obese?		
Yes	10	35
No	19	65
Have you ever been diagnosed with a diabetes-related condition?		
Yes	1	3
No	28	97

Note. Average job length was 5 years and 10 months. Minimum job length was 2 weeks and maximum job length was 26 years.

Appendix G: Focus Group Study Summary and Verbal Consent Form

JOURNALISM AND MEDIA COMMUNICATION
COLORADO STATE UNIVERSITY

ADULT PARTICIPANT INFORMED CONSENT

PARTICIPANT STUDY TITLE:
Air Quality, Extreme Heat, and Outdoor Work

FORMAL STUDY TITLE:
Air Quality, Extreme Heat, and Outdoor Work: The Influence of Attachment on Climate Change Health Risk Information Seeking

PRINCIPAL INVESTIGATOR: Ashley Anderson, PhD, Associate Professor, Department of Journalism and Media Communication

CO-INVESTIGATOR(S):
Marilee Long, Ph.D. Professor, Department of Journalism and Media Communication
Katie Abrams, PhD. Professor, Department of Journalism and Media Communication

STUDENT INVESTIGATOR(S):
Channing Bice, PhD Candidate, Department of Journalism and Media Communication
Lucy Chalgren, PhD Student, Department of Journalism and Media Communication

SPONSOR: 84036301-0

WHO CAN I CONTACT IF I HAVE QUESTIONS?
For questions or concerns about the study, you may contact **Channing Bice** at **channing.bice@colostate.edu**. You may also contact the Principal Investigator, **Ashley Anderson**, at **ashley.a.anderson@colostate.edu**.

For questions regarding the rights of research subjects, any complaints or comments regarding the manner in which the study is being conducted, contact the **CSU Institutional Review Board** at: **CSU_IRB@colostate.edu; (970) 491-1553**.

CONSISE STATEMENT OF STUDY
This research is aimed to understand how to better communicate about air quality and heat related to occupational health and safety. You may be interested because you are an employee of the City of Fort Collins that completes work-related tasks outdoors exposed to all weather conditions. There are minimal risks to participating in this study, like psychological impacts related to an increase in concern about air quality and

extreme heat. We hope that this research will benefit our understanding of how we communicate about air quality and extreme heat related to occupational health and safety.

WHAT IS THE PURPOSE OF THIS STUDY?
The purpose of this study is to understand how outdoor workers use air quality and heat information related to their job responsibilities outdoors. From this research, we hope to learn how to effectively communicate when and where the presence of poor air quality and extreme heat conditions pose a health risk for outdoor workers.

WHY AM I BEING INVITED TO TAKE PART IN THIS RESEARCH?
You are being asked to participate in the study because you fit these criteria: employee of the City of Fort Collins.

WHERE IS THE STUDY GOING TO TAKE PLACE AND HOW LONG WILL IT LAST?
You will be asked to participate in a one- to two-hour focus group held in-person.

WHAT WILL I BE ASKED TO DO?
If you volunteer to participate in this study, you will be asked to do the following: participate in a one- to two-hour focus group with other employees of the City of Fort Collins. Before the focus group, we also have an anonymous demographic information survey we would like you to complete.

WILL I RECEIVE ANY COMPENSATION FOR TAKING PART IN THIS STUDY?
You will receive a $25 gift card for participating in this research. All you'll have to do is fill out a form indicating that you received the compensation.

DO I HAVE TO TAKE PART IN THE STUDY?
Your participation in this study is voluntary. You may refuse to participate in this study or in any part of this study. You may withdraw at any time without prejudice to your relations with CSU. You are encouraged to ask questions about this study at the beginning or any time during the research study.

ARE THERE ANY BENEFITS FROM TAKING PART IN THIS STUDY?
There may be no direct benefit to you as a participant in this study. However, your awareness and understanding of air quality and extreme heat issues may be increased.

WHAT ARE THE POSSIBLE RISKS AND DISCOMFORTS?
While the level of risk is minimal, you may become uncomfortable with some questions related to the health outcomes of air quality and/or extreme heat exposure.

As with all research, there is a chance that confidentiality could be compromised; however, we are taking precautions to minimize this risk. We will take the following measures to ensure your confidentiality. First, we will transcribe the audio recordings as soon as possible after the focus groups and then destroy the recordings. Second, we are assigning you a unique identification code so that your name or the names of other people (e.g., colleagues) will not be transcribed; the transcription will be free of any identifying information. Third, when we report and share data from this study with others, we will not identify you by name. While we will ask all group members to keep the information that they hear in this group confidential, we cannot guarantee that everyone will do so.

WHO WILL SEE THE INFORMATION THAT I GIVE?
All information gathered in this study will be kept as confidential as possible. Your privacy is very important to us and the researchers will take every measure to protect it. Your information may be given out if required by law; however, the researchers will do their best to make sure that any information that is released will not identify you. No reference will be made in written or oral materials that could link you to this study. For this study, we will assign a code to your data so that the only place your name will appear in our records is in our data spreadsheet which links you to your code, on our calendar invites, and our compensation log. Only the research team will have access to the link between you, your code, and your data. All records will be stored in a restricted access folder at CSU for three years after completion of the study. After the storage time, the information gathered will be destroyed.

There are organizations that may inspect research records that may include yours. These organizations are required to make sure your information is kept private, unless required by law to provide information. Some of these organizations are:

- Environmental Protection Agency, the study sponsor.
- For funded studies, the CSU financial management team may request an audit of research expenditure, in which only your participation in the research may be shared, but not your research data.
- The Institutional Review Board (IRB) is a group of people who review the research with the goal of protecting the people who take part in the study.
- Department of Health and Human Services and similar ones if other countries are involved in the study.

Your identity/record of receiving compensation (NOT your data) may be made available to CSU officials for financial audits. Your identity/record of receiving compensation (NOT your data) may be made available to CSU officials for financial audits.
If you choose to take part in this study, identifiable private information will be removed from all focus group transcriptions, and, after such removal, could be used for future research studies or another investigator for future research study without additional informed consent.

PARTICIPANT CONSENT:
Your consent acknowledges that you have read the information stated and voluntarily wish to participate in this research, titled: Air Quality, Extreme Heat, and Outdoor Work

[IRB Protocol #5945]. Your consent also acknowledges that you have received, on this date, a copy of this document containing 3 pages.

Appendix H: Focus Group Intake Survey

Thank you for joining our focus group discussion today!

To get started, please enter the focus group ID code that will be highlighted in yellow on the handout that you just received.

____

Now, we would like to know more about you. Please answer the following questions.

What is your gender?

- ○ Male
- ○ Female
- ○ Non-binary / third gender
- ○ Prefer not to say

What is your age?

- ○ 18-24 years
- ○ 25-34 years
- ○ 35-44 years
- ○ 45-54 years
- ○ 55-64 years
- ○ 65 years or older

What is the highest level of education you have completed?

- ○ Less than high school
- ○ Completed some high school
- ○ High school diploma or GED
- ○ Job-specific training program(s) after high school
- ○ Some college, but no degree
- ○ Associate's degree
- ○ Bachelor's degree (such as B.A., B.S.)
- ○ Some graduate school, but no degree
- ○ Graduate degree (such as MBA, MS, M.D., Ph.D.)

What is your annual household income before taxes?

- ○ Less than $15,000
- ○ $15,000 to $24,999
- ○ $25,000 to $34,999
- ○ $35,000 to $49,999
- ○ $50,000 to $74,999
- ○ $75,000 to $99,999
- ○ $100,000 to $124,999
- ○ $125,000 to $149,999
- ○ $150,000 to $199,999
- ○ $200,000 to $249,999
- ○ $250,000 or more
- ○ Prefer not to answer

What is your race or ethnicity? Please select all that apply.

- ☐ Asian or Asian American
- ☐ Black or African American
- ☐ Native American or Alaska Native
- ☐ Native Hawaiian or Pacific Islander
- ☐ White or Caucasian
- ☐ Hispanic or Latino
- ☐ Other (please describe): ____
- ☐ Prefer not to answer

About how long have you lived in Colorado?

- ○ Less than 1 year
- ○ 1-5 years
- ○ 6-12 years
- ○ 13-20 years
- ○ More than 20 years

Have you ever been diagnosed with any of the following health conditions?

	No	Yes
Lung disease	○	○
Heart disease	○	○
Allergies	○	○
Mental health conditions	○	○
Overweight or obese	○	○
Diabetes-related condition	○	○

Now, we would like to know how you generally experience relationships with other people, not just what is happening in a specific relationship. Please indicate how much you agree or disagree with each of the following statements.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I find that others don't want to be as close as I would like.	○	○	○	○	○	○	○
It does not help to turn to other people in times of need.	○	○	○	○	○	○	○
I want to be close to others, but I often find myself pulling back.	○	○	○	○	○	○	○
I need a lot of reassurance that I am appreciated by others.	○	○	○	○	○	○	○
I prefer not to turn to other people for advice or help.	○	○	○	○	○	○	○
My desire to be very close sometimes scares people away.	○	○	○	○	○	○	○

Please indicate how much you agree or disagree with the following statements regarding how you generally experience relationships with others.

	Strongly disagree	Disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Agree	Strongly agree
I try to avoid getting too close to others.	○	○	○	○	○	○	○
I often worry about being abandoned by others.	○	○	○	○	○	○	○
I don't usually discuss my problems and concerns with other people.	○	○	○	○	○	○	○
I worry that other people won’t care about me as much as I care about them.	○	○	○	○	○	○	○
I get frustrated if others are not available when I need them.	○	○	○	○	○	○	○
I am nervous when others try to get too close to me	○	○	○	○	○	○	○

Now we would like to know more about your job.

Are you a seasonal or year-round employee in your current job position?

- ○ Yes
- ○ No

Are you an hourly employee in your current job position?

- ○ No
- ○ Yes

Within the last two years, do you remember participating in Colorado State University focus groups at work?

- ○ Yes
- ○ No
- ○ Not sure

Appendix I: Pre-Printed Cards With QR Code to Intake Survey and Unique ID Number

Air Quality, Extreme Heat, & Outdoor Work Focus Groups

Scan the QR code below or type https://col.st/3yLub into your browser to take the short survey.

Your focus group ID code is:
1NA

Air Quality, Extreme Heat, & Outdoor Work Focus Groups

Scan the QR code below or type https://col.st/3yLub into your browser to take the short survey.

Your focus group ID code is:
2NA

Air Quality, Extreme Heat, & Outdoor Work Focus Groups

Scan the QR code below or type https://col.st/3yLub into your browser to take the short survey.

Your focus group ID code is:
3NA

Air Quality, Extreme Heat, & Outdoor Work Focus Groups

Scan the QR code below or type https://col.st/3yLub into your browser to take the short survey.

Your focus group ID code is:
4NA

Appendix J. Focus Group Facilitation Guide and Notetaking Template

Air Quality, Extreme Heat, and Outdoor Work

Focus Group Facilitation Guide

This facilitation guide contains:

SCHEDULE 1
CATERING INFORMATION 1
SUPPLIES CHECKLIST 2
PRINT CHECKLIST 2
SET UP CHECKLIST 2
DISCUSSION GUIDE 3
Introduction & Welcome 3
Verbal Consent Statement 3
Anonymous Survey Details 4
Discussion Question Outline 7
Icebreaker Question 7
Content Questions 7
Closing 10
Possible Scenarios 11
Glossary of Terms 12
FOCUS GROUP NOTE TAKING DOCUMENT 13
Focus Group Overview 13
Picture of Room 13
Seating Chart 14
Note Taking Question Outline 15
Additional Notes or Observations 17

SCHEDULE

City of Fort Collins Utilities—Light & Power	City of Fort Collins Natural Areas	City of Fort Collins Parks & Recreation
Tuesday, September 24 7:30 am – 9:30 am Arrive @ 7:15 am USC Training Room Utilities Service Center, Bldg A	Wednesday, September 25 8:00 am – 9:30 am Arrive @ 7:45 am Nix Farm Natural Areas Facilities	Thursday, September 26 12:00 pm – 1:30 pm Arrive @ 11:45 am East Park Shop Large Conference Room

CATERING INFORMATION

Gib's Bagels
1112 Oakridge Drive, Fort Collins, CO 80525
(970) 223-5253

Tuesday, September 24 @ 6:45 am	Wednesday, September 25 @ 7:15 am	Thursday, September 26 @ 11:15 am
• 1 assorted bagel tray • 2 cream cheeses • 1 coffee carafe	• 1 assorted bagel tray • 2 cream cheeses • 1 coffee carafe	• Bagel sandwich tray with turkey, lettuce, tomato, and onion (10 sandwiches)

SUPPLIES CHECKLIST

- ☐ Computer
- ☐ iPad
- ☐ Recorders
- ☐ SD cards
- ☐ Flash drive with slides
- ☐ Forms (see print checklist below)
- ☐ Left over *Air Aware* materials
- ☐ Extra paper
- ☐ Extra pens

PRINT CHECKLIST

- ☐ Study summary and consent form
    - 30 copies, printed front and back
- ☐ Participant ID quarter sheets
    - 1 copy, printed one-sided
- ☐ Focus group compensation log
    - 3 copies, printed one-sided
- ☐ Focus group intake survey_print
    - 10 copies, printed front and back
- ☐ Focus group slide deck copies
    - 5 copies, printed front and back

SET UP CHECKLIST

- ☐ Try to arrive 10-15 minutes early.
- ☐ Before participants arrive, take a picture of the room and insert it in notes
    - ☐ If participants are already there or we don't have enough time, make sure to take a picture at the end.
- ☐ Set up breakfast/lunch.
- ☐ Decide on how to number seating chart and hand out participant ID code quarter sheets.
- ☐ Place recorders.
- ☐ Turn on computer and display focus group slides.
- ☐ Handout study summary and verbal consent form as participants walk in.

DISCUSSION GUIDE

Introduction & Welcome

Good [morning/afternoon]! It looks like everyone is here, so we'll go ahead and get started. If you haven't already, please feel free to help yourself to [breakfast/lunch].

We want to thank you for taking the time to attend today's focus group! My name is Channing and this is Lucy. We are PhD students at Colorado State University in the Department of Journalism and Media Communication working with the City of Fort Collins to improve occupational health and safety communication for outdoor workers. Today we're here to learn more about how you use air quality and extreme heat information related to your job responsibilities outdoors.

As you walked in, you should have received a consent form that summarizes today's study. I want to take a few minutes to go over some key pieces of this form get your verbal consent to participate in this study.

Verbal Consent Statement

The title of our project is Air Quality, Extreme Heat, and Outdoor Work and it is supported under assistance agreement no. 84036301-0 awarded by the U.S. Environmental Protection Agency. The Principal Investigator is Dr. Ashley Anderson in the Department of Journalism and Media Communication at Colorado State University.

As an employee of the City of Fort Collins, we would like you to participate in a focus group discussion about how you think about air quality and extreme heat information while you are working.

Today's discussion is expected to take approximately 90 minutes and your participation in this research is voluntary. If you choose to participate in this study, you will be compensated with a $25 gift card. You may refuse to participate in this study and may withdraw your consent and stop participation at any time without penalty. You are encouraged to ask questions about this study at any time during the research study.

There may be no direct benefit to you as a participant in this study; however, you may gain a greater awareness of air quality and extreme heat issues. While the level of risk is minimal, you may experience some discomfort with questions related to the health outcomes related to the health outcomes of air quality and/or extreme heat exposure.

Participation in a focus group involves some loss of privacy, because information is being shared in a group setting. We are taking the following measures to ensure your confidentiality. First, we will transcribe the audio recordings as soon as possible after the focus groups and then destroy the recordings. Second, we are assigning you a unique identification code so that your name or the names of other people (e.g., colleagues) will not be transcribed; the transcription will be free of any identifying information. Third, when we report and share data from this study with others, we will not identify you by name. We also ask that each of you keep what is shared in discussion today confidential.

We will be collecting your first name, basic demographic information, and the nature of your outdoor work. When we report and share the data with others, we will combine the data from participants in all focus groups. Any excerpts used from your focus group transcripts will not be identified as belonging to you. The results are only for academic research and may be used for future research or another investigator for future research study without additional informed consent.

There are no known risks to you from participating. The potential benefit of this research is in gaining greater awareness of air quality and extreme heat while you are working. In order to get the discussion started and begin recording, we will need to get your verbal consent.

Your consent acknowledges that you have read the information stated and voluntarily wish to participate in this research, titled: Air Quality, Extreme Heat, and Outdoor Work [IRB Protocol: 5945]. Your consent also acknowledges that you have received, on this date, a copy of this document containing 3 pages.

Would you like to participate?

> **If yes: Proceed**
> **If no: Thank you for your time.**

Anonymous Survey Details

> **Lucy passes around quarter sheets with the QR code to the survey and participant ID code that they will be prompted to enter into the survey to link their background information to perspectives shared in focus groups.**

Great! Now Lucy will be passing around these quarter sheets with a QR code and a number on them. When you scan the QR code, you will be asked to put in the number on your quarter sheet and then you will be advanced to a brief anonymous survey to give us background about you and your job, to better understand the perspectives that you share here today. We'll give you a few minutes to fill this out and then we'll jump into discussion.

Channing and Lucy pause for about five minutes until it looks like everyone is done and then turn on recorders.

Okay, it looks like everyone is done, so we can start moving into our discussion. Before we jump in, I want to mention a few housekeeping things to make the most of our time here today:

- My role is to help guide the conversation by asking questions and listening. If you need me to clarify or re-word the question, please feel free to ask. Lucy will primarily be listening and taking notes on our discussion today but may also ask questions if necessary. We will not be participating in the discussion by sharing our opinions, but we want you to feel free to talk with each other.
- Today's focus group will be about 10 questions. We want to respect your time by keeping the discussion to 90 minutes, so while I encourage you to elaborate on your answers to questions, there may be a few times where I choose to redirect the conversation so that we can cover as many questions as we can and equally represent everyone's ideas.
- It is important for us to hear everyone's ideas and opinions, both positive and negative. There are no right or wrong answers to questions – just ideas, experiences, and opinions, all of which are extremely valuable.
- In the middle of the table, you'll notice these recording devices. We are recording our discussion today, so that combined with Lucy's notes on the discussion today, we are able to capture your thoughts as accurately as possible. On that note, we kindly ask that you try to be mindful of having only one person talk at a time and refraining from having side conversations to ensure accurate recording and notetaking.
- Are there any questions I can answer at this point?

Q&A from participants, if need be.

Okay, now we would like to turn it over to you by first getting to know more about you. Could we take a moment to do a quick round of introductions and when you do, could you tell us your name, position, and how long you've worked here? We can start here.

Channing starts introductions where Lucy began handing out participant ID codes. Lucy fills in the seating chart with first names only based on the QR code number that they would have received. Participants go around and introduce themselves.

Great, it's nice to meet you all! So, we're going to start off by talking pretty broadly about your experiences with [heat/air quality][1] at work.

[1] Text highlighted in yellow denotes where the introduction of topics was changed for each focus group to mitigate potential order effects.

Discussion Question Outline

Icebreaker Question

1. Can you share an experience from this summer where heat or air quality affected you while you were working? Reflecting on that experience, how do you think it affected your health and safety?

- Examples: Alexander Mountain Fire and temperatures during the last week of July/first week of August
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Relevant hazard experience, risk perception

Content Questions

2. When you think about air quality and heat, which one represents the highest risk while you are working and why?

- Examples: Risk of illness or injury, short-term/long-term health effects
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Risk perception, affective response, comparative risk

3. What factors do you consider when deciding whether to use (i.e., search for, pay attention to) information about heat while you are working? What about air quality information?

- Examples: Some factors might include, workday responsibilities, social pressures, relevance of information, information accessibility, etc.
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Informational subjective norms, attitudes toward information seeking, perceived information seeking control, information seeking behavior

4. When you think about your job responsibilities outdoors, what types of air quality information are the most useful to you while you are working? What about heat information?

- Examples: How to plan for the day, what actions to take, symptoms to be aware of, etc.
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Attitudes toward information seeking

5. I want to pivot the discussion. I'd like to talk about how your family and friends influence how you use air quality or heat information on the job. What roles do they play in how you use air quality or heat information while you're working?

- Examples: Share air quality or heat information with you, check in on you during the workday
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Informational subjective norms

6. Now, thinking about the people you work with, what roles do your co-workers, supervisors, or the City of Fort Collins play in how you use heat or air quality information?

- Examples: Safety meetings, trainings, Air Aware campaign, etc.
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Informational subjective norms, perceived information seeking control

7. Thinking about other types of information that is available in your workplace on the topics we've been talking about today, do you recall seeing or hearing about this campaign in your workplace this summer?

> **Channing displays the Air Aware campaign logo on the screen (slide 2).**

If so, did you use it to stay informed about air quality at work?

- Examples: Signing up for texts or emails, reading the flyers, visiting the Linktree, etc.
- Probes:
  - If they recall the campaign and used it…
    - Ask how they used it to stay informed about air quality.
  - If they recall the campaign but didn't use it…
    - Ask if seeing the materials around their workplace made them pay more attention to air quality.
  - If they don't recall the campaign and didn't use it…
    - Display slides 3-7 or refer them to physical copies of materials that will be brought in to see if it jogs their memory. If not, ask them to take a look at some of these materials and start going into the next question.
- Related RISP concept(s): Information seeking behavior

8. We're interested in ways that we can improve this campaign, whether that be the types of channels (e.g., text messages, posters, magnetic dial, etc.), or the messages (e.g., health risks, actions to take at work, etc.) in the campaign. What parts of the ***Air Aware*** campaign did you find useful? What do you think could be improved?

- Examples (materials): Flyers, decision charts, stickers, window clings, magnet dials, text and email notifications, QR code to Linktree
- Examples (messages): Health risks, actions to take at work, etc.
- Follow-up (if need be): Was there information in the campaign that you found confusing, conflicting, or lacking in detail?
- Probes: Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Information seeking behavior

As we close, I am interested in how you feel or what you think about the *Air Aware* campaign including messaging about heat. For example, The National Weather Service has developed *HeatRisk,* a color-numeric based index that provides a forecast of the potential level of risk for heat-related impacts to occur over a 24-hour period. The level of risk is illustrated by a color and number along with identifying groups, such as outdoor workers, that are most at risk at that level. This is the *HeatRisk* index and what each category means. I'll give you a minute to read this over.

> **Channing displays slide 8 with *HeatRisk* definitions and categories from NWS on the screen and lets participants read over the definitions/categories for about a minute.**

Now that you've read this over, this is an example from the CDC of how *HeatRisk* is communicated.

> **After about a minute, Channing pulls up *HeatRisk* on CDC's website (if Internet is available) or displays slides 9-10 on the screen.**

For instance, today's *HeatRisk* for Larimer County is [Minor], and here are actions you can take to protect your health. As you scroll down, you also get the *HeatRisk* forecast and shortly thereafter, you see heat and air quality communicated together here.

9. With this in mind, what are your thoughts on a workplace campaign, similar to *Air Aware*, that includes both air quality and heat information? Just so you can envision what information about the two together might look like, here's the Air Quality Index and Heat Index for your reference.

> **Channing displays slide 11 on the screen.**

- Examples: For instance, text or email notifications that say the air quality is forecasted to be "Good" and today's HeatRisk is minor.

- Probes: Would it be helpful? Would it feel overwhelming? Tell me more. Please explain. Why is that? Can you expand on that?
- Related RISP concept(s): Information seeking behavior

Closing

The insights you've shared today are incredibly helpful and will contribute to improved air quality and heat communication for outdoor workers! Are there any final thoughts you would like to share with us before we wrap up?

> **Participants share any final thoughts or questions they may have.**

Again, we just want to reiterate that everything that was shared today will be de-identified and we will make every effort to ensure that information about you remains confidential and we ask that each of you keep what was shared in the discussion today, confidential. If you have any questions or additional thoughts you would like to share, please feel free to contact me at the information provided on the study summary sheet.

Before you leave, Lucy and I will pass around your gift cards to thank you for participating today. We will need a quick signature from you on our compensation log and then we will let you get on with the rest of your day.

> **Channing and Lucy turn off recorders and pass around gift cards. Participants sign compensation log and are then free to go.**

Possible Scenarios

No one is responding to a question

- Try asking the question in a different way.
- If it seems that they have no more to say, ask, "Is there anything else that you would like to share? [pause]. If not, we can move on to our next question."

Certain participant(s) dominate the conversation

- Respectfully acknowledge their contribution, and thank them, saying something like, "I really appreciate your comments." Then make direct eye contact with other people and ask something like, "I'm very interested in hearing how other people are feeling about this issue" or "It's very interesting to get a variety of perspectives, and I would like to hear from other people as well."
- Non-verbals such as exaggerating eye contact, turning body toward people to encourage them to talk more can help.

Women and men participating at different levels (e.g., men speak up more than women or vice versa)

- If men are dominating the conversation, respectfully thank a man who has just spoken, then suggest that it would be great to hear from some of the women present, as well. If women seem to be participating less, try to make a lot of eye contact with women, and even ask individual women direct questions.
- Non-verbals such as exaggerating eye contact, turning body toward people to encourage them to talk more can help.

Group begins to get off track

- Take advantage of a pause and say, "Thank you for that interesting idea. For the sake of time and the topics we have left to cover, perhaps we can revisit this idea toward the end of the discussion."

Glossary of Terms

Air quality: Describes how polluted the air that we breathe outdoors is. When air quality is poor, the air quality index value is at or above 100, meaning that there are high levels of pollutants in the air that can harm human health and the environment.

Air quality index (AQI): A color-numeric based index with six categories that is used to report the outdoor air quality. The AQI tells you how polluted your air is, and what associated health effects might be a concern for you. The higher the AQI value, the more polluted the air is.

Air quality information: Examples could include information about local air quality conditions, health risks, how to protect yourself, or any other air quality-related information.

Extreme heat: A period of high heat and humidity with temperatures above 90 degrees for at least two days.

Extreme heat information: Examples could include information about local heat conditions, health risks, how to protect yourself, or any other heat-related information.

FOCUS GROUP NOTE TAKING DOCUMENT

Focus Group Overview

Group Name: City of Fort Collins [Natural Areas, Parks, Utilities – Light & Power]
Date: 09/XX/2024
Start time:
End time:
Location:
How many attended:

Picture of Room

Delete me and insert picture of focus group room here ☺

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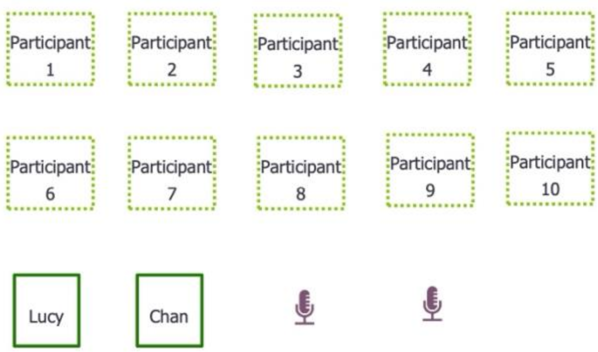
Seating Chart

As closely as you can, drag and drop everyone's position in the room and where recorders (purple microphone) were located. If there are less than 10 participants, feel free to delete participant boxes accordingly. ☺



Participant Name, Job Title, and Length of Job Tenure
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.

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Note Taking Question Outline

1. Can you share an experience from this summer where heat or air quality affected you while you were working? How did that experience affect your health and safety?

2. When you think about air quality and heat, which one represents the highest risk while you are working and why?

3. What factors do you consider when deciding whether to use (i.e., search for, pay attention to) information about heat while you are working? What about air quality information?

4. When you think about your job responsibilities outdoors, what types of air quality information are the most useful to you while you are working? What about heat information?

5. Are there types of heat or air quality information that you find conflicting, confusing, or are lacking in detail? Please explain.

6. I want to pivot the discussion. I'd like to talk about how your family and friends influence how you use air quality or heat information on the job. What roles do they play in how you use air quality or heat information while you're working?

7. Now, thinking about the people you work with, what roles do your co-workers, supervisors, or the City of Fort Collins play in how you use heat or air quality information?

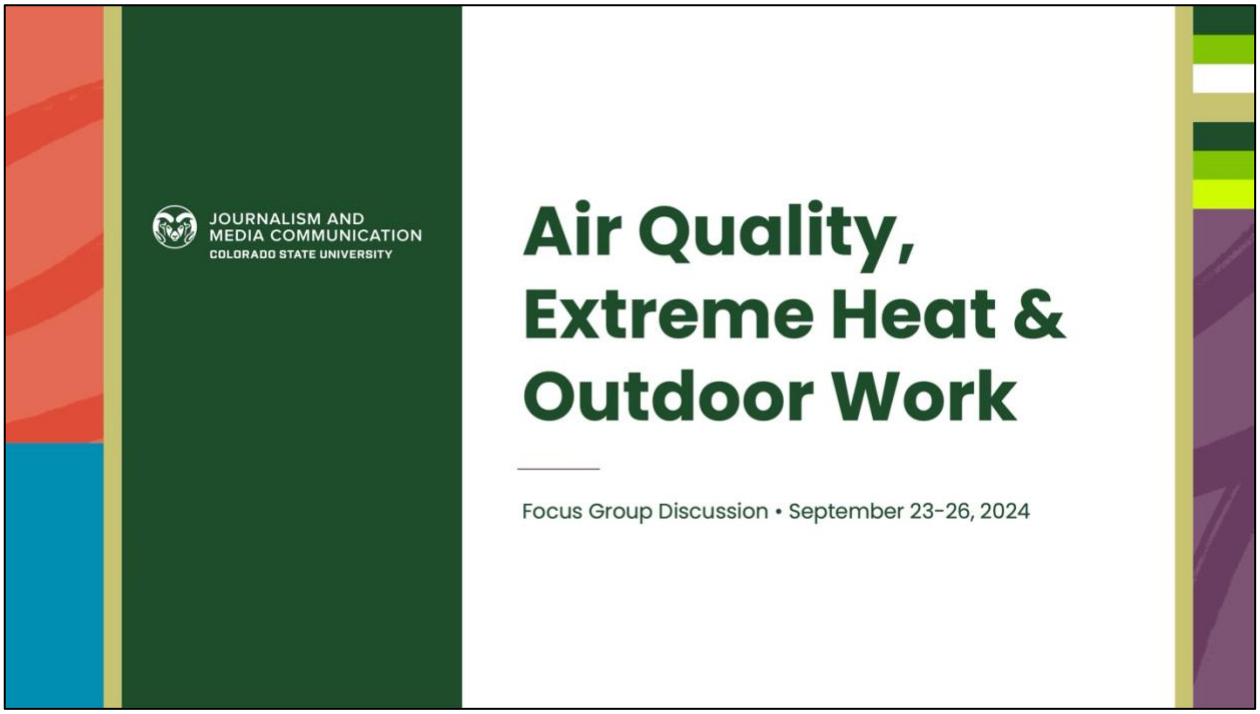
8. Thinking about other types of information that is available in your workplace on the topics we've been talking about today, do you recall seeing or hearing about this [Air Aware] campaign in your workplace this summer? If so, did you use it to stay informed about air quality at work?

9. What parts of the *Air Aware* campaign did you find useful? What do you think could be improved?

10. Channing pulls up *HeatRisk* definitions and categories from NWS on her screen, explains what they mean, and lets participants read over the definitions of categories. After about a minute, she pulls up *HeatRisk* on CDC's website and then asks: What are your thoughts on a workplace campaign, similar to *Air Aware*, that includes both air quality and heat information?

Additional Notes or Observations

Appendix K. Focus Group Slide Deck with Discussion Materials



AIR AWARE
CHECK TO PROTECT

AIR QUALITY AT WORK: YOUR HEALTH MATTERS

What are the health effects of poor air quality exposure?

The health effects of poor air quality are far-reaching but primarily affect the body's cardiovascular and respiratory systems. Poor air quality can be harmful to anyone, including healthy adults who work or exercise outdoors.

Prolonged exposure and the deep, rapid breathing associated with intense work activity exacerbate the health effects of poor air quality. These effects are largely preventable by staying informed about air quality conditions and taking protective measures.

How do I know when the air quality is poor?

Air quality can change quickly and significantly throughout the day. The Air Quality Index (AQI) provides local air quality information that you can use to protect your health from the harmful effects of poor air quality.

Using the AQI to track air quality conditions can help you know how polluted the air is and make health-protective decisions throughout the workday.

Check to protect!

Keeping an eye on the AQI throughout the day can help you decide how to adjust, reduce, or reschedule work activities during times of poor air quality. The Air Aware AQI Decision Chart for Outdoor Workers can help you and your supervisor develop a workday schedule that allows you to be productive while also protecting your health. During periods of poor air quality, consider the following actions:

- Taking frequent indoor breaks
- Wearing an N95 mask
- Choosing lower-intensity or indoor work tasks when possible
- Postponing high-intensity tasks until air quality improves

CHECK AQI HERE

EPA COLORADO STATE UNIVERSITY

AIR AWARE
CHECK TO PROTECT

AIR QUALITY MATTERS

Poor air quality can cause irritated eyes, sore throat, and headaches. Skies may be hazy. **But unhealthy air doesn't always look, smell, or feel like unhealthy air.**

Exposure has serious health consequences, including **lung and heart problems**, but they are largely preventable.

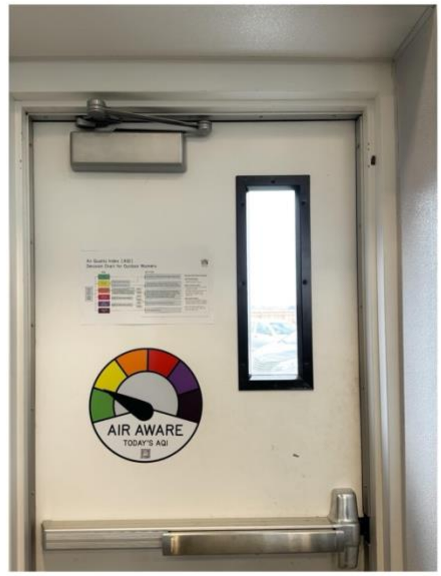
Effects of poor air quality on health add up over time. **It's never too late to start taking precautions.**

CHECK TO PROTECT!

Check AQI throughout the day to help you decide how to adjust, reduce, or reschedule work activities during periods of poor air quality.

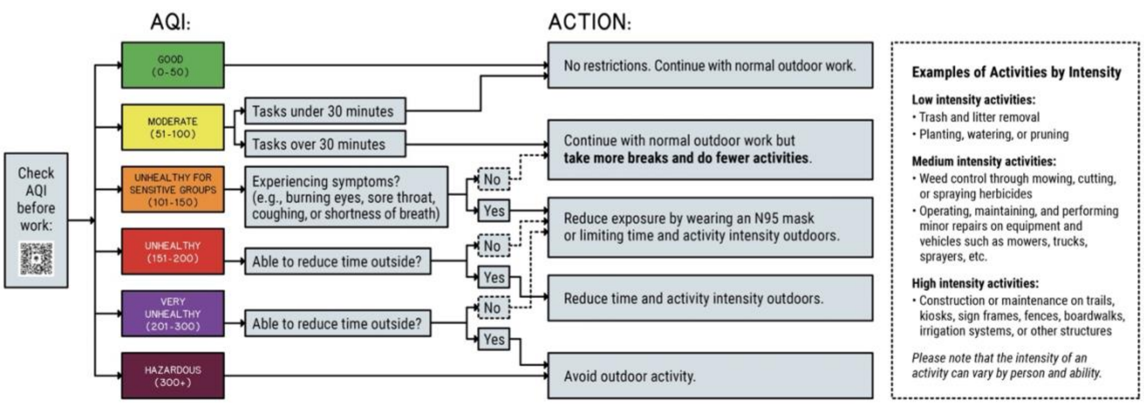
This publication was developed under Assistance Agreement awarded by the U.S. Environmental Protection Agency. ©2023

EPA COLORADO STATE UNIVERSITY

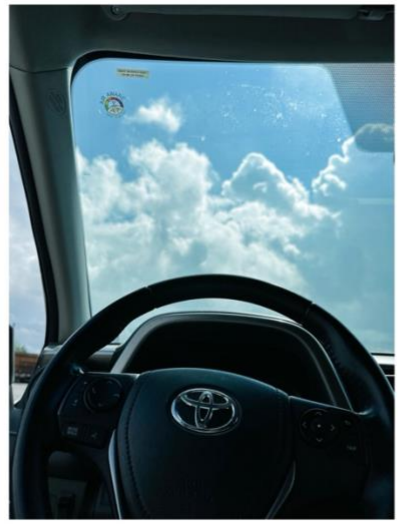


3

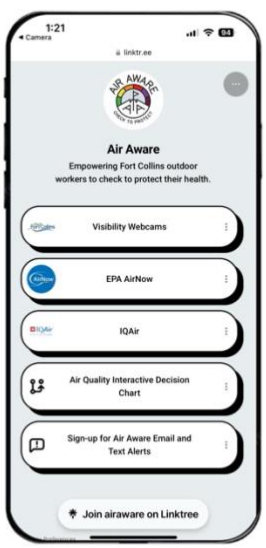
Air Quality Index (AQI) Decision Chart for Outdoor Workers

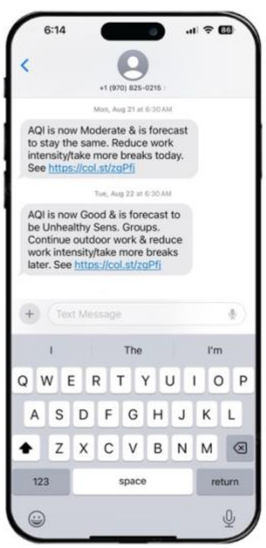



AIR AWARE
CHECK TO PROTECT



6


1:21
◂ Camera
linktr.ee
Air Aware
Empowering Fort Collins outdoor workers to check to protect their health.
Visibility Webcams
EPA AirNow
IQAir
Air Quality Interactive Decision Chart
Sign-up for Air Aware Email and Text Alerts
Join airaware on Linktree


6:14
+1 (970) 825-0215
Mon, Aug 21 at 6:30 AM
AQI is now Moderate & is forecast to stay the same. Reduce work intensity/take more breaks today. See https://col.st/zgPfj
Tue, Aug 22 at 6:30 AM
AQI is now Good & is forecast to be Unhealthy Sens. Groups. Continue outdoor work & reduce work intensity/take more breaks later. See https://col.st/zgPfj
Text Message
I
The
I'm
Q W E R T Y U I O P
A S D F G H J K L
Z X C V B N M
123
space
return


6:33
Fort Collins Air Quality Alert: Unhealthy for Sensitive Groups
alerts@airaware.co
To You
Jul 22
** Caution: EXTERNAL Sender **
AIR AWARE
UNHEALTHY FOR SENSITIVE GROUPS
CHECK TO PROTECT
The air quality is forecast to be unhealthy for sensitive groups for ozone today in Fort Collins.
Guidance: Continue with outdoor work but take more breaks, ideally indoors, and avoid high-intensity activities. If you experience symptoms (e.g., irritated eyes or throat, coughing, headache, dizziness, and/or shortness of breath), further reduce your time outside to decrease risks to your health.
For more information: https://bit.ly/FoCoAirAware
For current air quality conditions:
https://www.fcgov.com/airquality/aqdata

7

HeatRisk

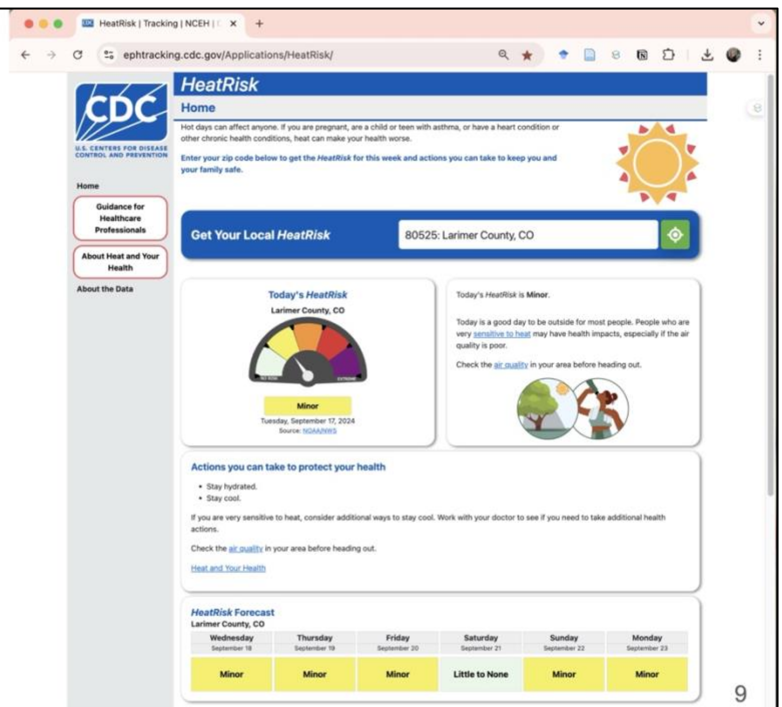
- Link to NWS website

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
Magenta 4	Extreme - This level of rare and/or long-duration extreme heat with little to no overnight relief affects anyone without effective cooling and/or adequate hydration. Impacts likely in most health systems, heat-sensitive industries and infrastructure.

8

HeatRisk

- Link to CDC website



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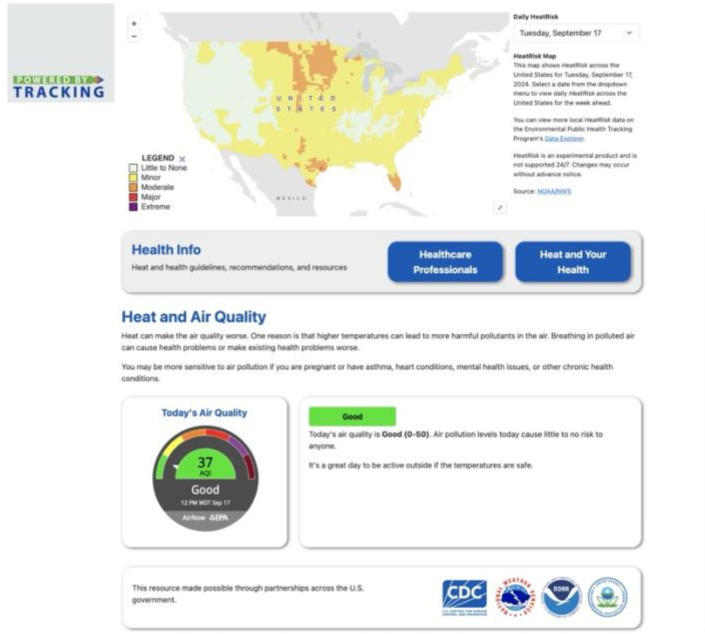
HeatRisk

- Link to CDC website



10

Air Quality Index

Air Quality Index		
AQI Category and Color	**Index Value**	**Description of Air Quality**
Good Green	0 to 50	Air quality is satisfactory, and air pollution poses little or no risk.
Moderate Yellow	51 to 100	Air quality is acceptable. However, there may be a risk for some people, particularly those who are unusually sensitive to air pollution.
Unhealthy for Sensitive Groups Orange	101 to 150	Members of sensitive groups may experience health effects. The general public is less likely to be affected.
Unhealthy Red	151 to 200	Some members of the general public may experience health effects; members of sensitive groups may experience more serious health effects.
Very Unhealthy Purple	201 to 300	Health alert: The risk of health effects is increased for everyone.
Hazardous Maroon	301 and higher	Health warning of emergency conditions: everyone is more likely to be affected.

HeatRisk Index

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
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11

HeatRisk Index

Category	Risk of Heat-Related Impacts
Green 0	Little to no risk from expected heat.
Yellow 1	Minor - This level of heat affects primarily those individuals extremely sensitive to heat, especially when outdoors without effective cooling and/or adequate hydration.
Orange 2	Moderate - This level of heat affects most individuals sensitive to heat, especially those without effective cooling and/or adequate hydration. Impacts possible in some health systems and in heat-sensitive industries.
Red 3	Major - This level of heat affects anyone without effective cooling and/or adequate hydration. Impacts likely in some health systems, heat-sensitive industries and infrastructure.
Magenta 4	Extreme - This level of rare and/or long-duration extreme heat with little to no overnight relief affects anyone without effective cooling and/or adequate hydration. Impacts likely in most health systems, heat-sensitive industries and infrastructure.

Heat Index

NWS Heat Index — Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution · Extreme Caution · Danger · Extreme Danger

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