Threat Perception as a Determinant of Pro-Environmental Behaviors: Public Involvement in Air Pollution Abatement in Cache Valley, Utah

Joshua D. Marquit
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THREAT PERCEPTION AS A DETERMINANT OF PRO-ENVIRONMENTAL BEHAVIORS: PUBLIC INVOLVEMENT IN AIR POLLUTION ABATEMENT IN CACHE VALLEY, UTAH

by

Joshua D. Marquit

A thesis submitted in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

in

Psychology

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2008
ABSTRACT

Threat Perception as a Determinant of Pro-Environmental Behaviors: Public Involvement in Air Pollution Abatement in Cache Valley, Utah

by

Joshua D. Marquit, Master of Science
Utah State University, 2008

Major Professor: Scott C. Bates, Ph.D.
Department: Psychology

Threat perception related to environmental issues such as air pollution may be a determinant of pro-environmental behaviors. Among the potential threats of air pollution, include the perceived impacts on the psychological, social, and economic wellbeing of a community. Because of rapid increases in population growth, urbanization, and the mountainous landscapes, the American West is extremely susceptible to the adverse impacts of air pollution.

A secondary data analysis was conducted using data from the Air Quality Perception Survey conducted in Cache County, Utah. The survey focused on the public perception of air pollution in Cache County and perceived impact on personal and community life. From a sample of 289 returned surveys, the data were examined to determine the possible link between threat perception and the decision to engage in
specific pro-environmental and avoidance behaviors. The analysis found that threat perception predicted some pro-environmental and avoidance behaviors.
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Joshua D. Marquit
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CHAPTER I
INTRODUCTION AND PROBLEM STATEMENT

Introduction

Since the 1970s, many social scientists have attempted to further our understanding of the determinants of pro-environmental behaviors (e.g., recycling, conserving water and electricity, and reducing personal vehicle use). Understanding why people act in an environmentally responsible manner is of great value to many people, including policymakers, scientists, and health professionals. The literature concerning the determinants of pro-environmental attitudes and behaviors is vast. Much of this literature has been dedicated to determinants such as sociodemographic variables (e.g., gender, age, socioeconomic status, and political orientation); psychological variables (e.g., values, attitudes, beliefs, and personal norms) have also been explored. Until recently, other social psychological variables, such as fear and threat perception, have received little attention as a determinant of pro-environmental behaviors from the scientific community. Despite receiving minimal attention, research concerning the link between social psychological variables and pro-environmental behaviors has been promising.

To explore the possible role threat perception plays as a determinant of pro-environmental behavior, a review of a study (Air Quality Perception Survey, see Appendix A) will be presented including a summary of the air pollution problem in Cache County, Utah, general review of potential health- and psychological-related threats associated with air pollution exposure from the literature, and summary of the local
health department’s social marketing campaign meant to encourage pro-environmental behaviors through education about potential threats associated with exposure to air pollution. This study collected data on air pollution perception, engagement in specific pro-environmental (driving fewer miles in your car) and avoidance behaviors (avoiding outdoor activity), possible causes of air pollution in Cache County, and evaluation of the local health department’s social marketing campaign to educate about the threats of air pollution and encourage pro-environmental and avoidance behaviors. This will be followed by a review of the literature on relevant determinants of pro-environmental attitudes and behavior some sociodemographic, psychological, environmental, and social determinants of pro-environmental attitudes and behaviors. Then, the literature on threat perception as a determinant of pro-environmental attitudes and behaviors will be examined.

Finally, a secondary data analysis using data from the Air Pollution Perception Survey explored threat perception related to air pollution, perceived susceptibility to the impacts of air pollution, perceived severity of air pollution, and the possible link between threat perception and the decision to engage in specific pro-environmental and avoidance behaviors in Cache County, Utah. Results suggest that threat perception influences the decision to engage in some pro-environmental and avoidance behaviors.
Problem Statement

Air Pollution

Air pollution is any substance or material that is added to the atmosphere by human activities or natural processes that may adversely impact or become toxic to humans, plants, animals, or the environment (Greenland, 1983; Plitnik, 1998). Air pollutants can be divided into two major categories: matter and vapor. Particulate matter in the air can range in size from $200 \mu$ (microns) to less than $0.1 \mu$ in diameter (Parker, 1977). The Environmental Protection Agency (EPA) currently recognizes 188 chemicals as hazardous air pollutants. The most hazardous of these air pollutants are carbon oxides, sulfur oxides, nitrogen oxides, and hydrocarbons (Plitnik).

According to the EPA (2006), air pollutants come from both natural and human-made sources. Natural sources of air pollutants include windblown dust, soot from wildfires, agriculture, and decomposition of organic materials. The most significant human-source contributors to air pollution are (in order of contribution) automobiles, electric power plants, industry, and homeowners (Collins & Chambers, 2005; Nickerson, 2003; Plitnik, 1998). Humans are emitting air pollutants into the atmosphere at an alarming rate—the United States alone produces over 120 million tons of air pollutants each year (Plitnik). As heavier particulates fall to the ground, air pollutants contaminate soil and water sources. Others become solutes in precipitation (Nickerson).

Another factor that contributes to the dangers of air pollution is that many of the most toxic pollutants are odorless, tasteless, and colorless (Plitnik, 1998). Because of the difficulty involved in identifying toxic air pollutants, many people remain unaware of its
potential dangers (Nickerson, 2003). The most significant contributor to air pollution in many urban areas is personal vehicle use. The gases released by vehicles (e.g., sulfur, nitrogen, oxides, lead and carbon monoxide) are often ignored until they accumulate and create a layer of smog or haze that reduces the quality of the air they breathe, impedes visibility, and is aesthetically unpleasing (Nickerson).

The physical health threats related to air pollution exposure are well documented (e.g., Holgate, Samet, Koren, & Maynard, 1999). The impact of air pollution on natural ecosystems and human health is severe and can be potentially lethal. Prolonged exposure to toxic particulates in the air has been linked to a variety of respiratory problems, premature deaths, destruction of delicate ecosystems, manmade structures, and environmental degradation (Holgate et al.). According to the EPA (2006), air particulates including nitrates and sulfates contribute to the formation of acid rain that adversely impacts natural ecosystems and built environments. In a review of the literature on the health effects of air pollution humans, Brunekreef and Holgate (2002) found that exposure to airborne pollutants and ozone has been associated with increases in mortality; respiratory and cardiovascular disease. These effects have been found in short- and long-term studies. Air pollution has also been found to be a threat to the health of children starting at conception (Moshammer et al., 2006). Moshammer and colleagues found that air pollution, particularly vehicular air pollution, increases the risk of low birth weight. A baby at low birthweight is at higher risk of suffering from a number of respiratory diseases and other air pollution episodes such as sudden infant death syndrome (SIDS). Moshammer and colleagues concluded that improving air quality would reduce death,
There may also be psychological impacts associated with air pollution that can become potential threats to human mental health. The human mental health reaction to air pollution may include both affective and cognitive components (Evans & Campbell, 1983; Evans, Colome, & Shearer, 1988). Zeidner and Shechter (1988) found that the perceived severity of air pollution was a strong predictor of affective response (high emotional arousal) and willingness to pay for air pollution abatement. They concluded that air pollution is considered by many respondents to be a chronic environmental stressor and a source of anxiety. These negative emotional responses are a direct result of decisions we make each day concerning which consumer products to purchase, natural resource usage, and transportation mode choices (Evans et al.). Similarly, Evans and colleagues found that there might be a relationship between exposure to air pollution and some psychological outcomes such as anxiety. To avoid both the physical and psychological stressors associated with air pollution, one must learn to utilize a variety of unorthodox coping and adaptive strategies that may become another source of threat (Zeidner & Shechter).

Another psychological construct associated with air pollution is perceived powerlessness to abate the problem (Gellar, 1995; Zeidner & Shechter, 1988). Because of the magnitude and severity of the air pollution problem, it is possible that individuals perceive that their behaviors will have little immediate or delayed impact on reducing air pollution. This perceived lack of control over environmental problems might discourage people from becoming part of the solution (Gellar). The actual and perceived impacts of
air pollution on personal, communal, and environmental health can be a source of threat for many people.

**Cache Valley Air Quality**

The Cache Valley provides an ideal setting to conduct an investigation of the impact of air pollution on the decision to engage in pro-environmental and avoidance behaviors. The valley is located in Northern Utah in Cache County and the southeastern corner of Idaho in Franklin County. This valley is surrounded by a number of mountain ranges that include the Clarkston, Wellsville, Davenport, and Bear River ranges each with an elevation of 2,500 meters or greater. Because of its topography (e.g., bowl-shaped valley), Cache Valley is susceptible to a climatic phenomenon known as inversion. An inversion occurs when low temperatures and snow cool the ground level air and the air above the valley and mountains remains warm. The difference in temperature between the ground level and mountain level air creates a pocket of cool stagnant air along the valley floor that promotes formation of ammonium nitrate-based particulate matter ($PM_{2.5}$). This pocket of air above the valley traps and suspends the particulate matter in the air creating haze. The high concentration of $PM_{2.5}$ is significantly influenced by the geographical, environmental, meteorological conditions of the valley. Particulate matter of this size is extremely dangerous to humans, animals, and environment. $PM_{2.5}$ has been linked to a number of negative health impacts including heart and lung disease, asthma, and prolonged exposure can lead to premature death (EPA, 2007; Holgate et al., 1999). Cache Valley is most susceptible to effects of the inversion during the winter months of November to March. In January of 2004, Cache Valley experienced the worst
episodes of air pollution in the United States (Malek, Davis, Martin, & Silva, 2006).

In an attempt to reduce the impacts of air pollution in the Cache Valley, the Bear River Health Department (BRHD; local health department) has implemented a number of air pollution abatement strategies and educational programs (e.g., social marketing campaigns). Their social marketing campaigns have primarily focused on the potential health threats related to the exposure to air pollution for humans and encouraging a number of specific pro-environmental (e.g., driving fewer miles, trip consolidation, and use of public transportation) and avoidance (e.g., avoiding outdoor activity and keeping children indoors) behaviors that can reduce their exposure to air pollution while reducing their personal contribution to the problem. One of these abatement strategies is the “Green, Yellow, and Red Air Day” Pollution Advisory. It is a color-coded alert that is designed to encourage people to become more cognizant of air quality in the valley, represents a specific range of pollution concentration, and provides a list of pro-environmental and avoidance behaviors. “Green Air Days” are clean air days. “Yellow Air Days” are days in which the concentration of $PM_{2.5}$ is climbing to an unhealthy level. “Red Air Days” are air days in which the concentration of particulate matter has reached an unhealthy level. Other air pollution strategies include smoking vehicle hotline, voluntary reduction of vehicle miles traveled program, wood burning program, air quality educational DVD, and encouraging the use of public transportation.

**Air Quality Perception Survey.** The Air Quality Perception Survey (Appendix A) was designed to assess the effectiveness of the BRHD’s social marketing campaign, air pollution perception, and gather data on how often people are engaging in pro-
environmental and avoidance behaviors on “Yellow” and “Red Air Days.” Surveys were randomly distributed to households throughout Cache County, UT. Results suggested that residents were concerned with air pollution, perceived the impact to be serious on personal, economical, communal, and natural conditions in Cache Valley, some of BRHD’s efforts were evaluated as effective in abating air pollution, and people reported engaging in pro-environmental and avoidance behaviors on “Yellow” and “Red Air Days.”
CHAPTER II

LITERATURE REVIEW

Determinants of Pro-Environmental Behaviors

For almost 40 years, researchers have conducted research on the potential determinants of predict pro-environmental behaviors in a variety of settings. The results for some determinants are promising. Among the determinants that will be reviewed are some demographic, psychological, environmental, and social variables.

Demographic Variables

Over the past 40 years, demographic variables such as sex, age, education, political orientation, religion, affluence, and economic status have been the primary focus of research concerning the determinants of pro-environmental behavior. There is little empirical evidence to support demographic variables as strong determinants of pro-environmental behaviors. Many researchers have concluded that sociodemographic variables are generally weakly correlated with environmental concern (e.g., Samdahl & Robertson, 1989; Van Liere & Dunlap, 1981). In contrast, Jones and Dunlap (1992), using longitudinal data obtained from National Opinion Research Center’s General Social Surveys (1973-1990), found that in the U.S., young adults, the well-educated, people who are affiliated with the Democratic political party and political liberals, and those raised and currently residing in urban areas were consistently more supportive of environmental protection.

Sex differences in pro-environmental behaviors have been the focus of a number
of empirical studies. Research on sex differences in environmental concern and pro-environmental behaviors have yielded modest results. Stern, Dietz, and Kalof (1993) and Stern, Dietz, Kalof, and Guagnano (1995) found that women expressed stronger intentions to engage in pro-environmental behaviors and stronger beliefs about the consequences of continued environmental degradation. These differences, however, were largely accounted for by differences in perceived values. Contrary to Stern and colleagues’ findings, Arcury and Christianson (1990) found that men were more environmentally concerned than women.

In 1991, Bord, O’Conner, and Epp (1992) conducted two independent national telephone surveys that asked respondents concerning either hazardous chemical waste sites or global warming. Respondents were surveyed concerning health- and ecological-risk perceptions, assessment of the seriousness of the environmental problem, and their intention to engage in voluntary migration of the problem. Reviewing the data from these surveys, Bord and O’Conner (1997) found that women were more concerned about the perceived health and ecological risks for each environmental problem than men. However, when health-risk perceptions were entered into equations accounting for environmental concern, this gender effect significantly weakened. They concluded that survey items that imply specific health-risks might produce significant gender differences.

Age has been found to be negatively correlated with environmental concern and engagement in pro-environmental behaviors (e.g., Arcury & Christianson, 1990; Van Liere & Dunlap, 1981). Generally, younger people have been found to be more
concerned about the environment than older people. For instance, Theodori and Luloff (2002) found that respondents who were young, highly educated, high SES, and liberal in their political orientation were more likely than their counterparts to maintain proactive stances on environmental issues.

Income level has been found to be positively correlated with pro-environmental attitudes and behaviors (e.g., Kemmelmeir, Krol, & Kim; 2002; Schultz, Oskamp, & Mainieri, 1995). Schultz and colleagues found that income level was positively related to recycling behaviors. However, the strength and nature of this relationship is not clear. Kemmelmeier and colleagues (2002), using survey data provided by the International Social Survey, examined the relationship between values, economic variables, and pro-environmental attitudes at both the individual and societal level. Their results suggested that postmaterialists values mediate the relationship between economic variables and pro-environmental attitudes and economic variables predicted pro-environmental behaviors at the individual but not at the societal level. They argued affluence or collective wealth of a nation at the societal level may not influence pro-environmental behaviors.

Conversely, some researchers have found evidence that public concern for environmental quality and engagement in pro-environmental behaviors is positively related to affluence. In 1992, this assumption was tested using an international survey conducted by the George H. Gallup International Institute, who collected data on environmental perceptions and opinions from 24 diverse (e.g., geography and economic status) nations. Using these data, Dunlap and Mertig (1995) concluded that public concern for environmental quality was negatively related to overall national affluence.
Diekmann and Franzen (1999) criticized the measurement of environmental concern in the survey used by Dunlap and Mertig (1995) and others, stating that researchers incorrectly assume environmental concern as a one-dimensional construct measuring willingness and ability to sacrifice something for the good of the environment. Rather, they suggested that researchers should measure environmental concern as a multi-dimensional construct that incorporates peoples’ awareness of environmental problems at the communal level and the perceived severity of the problem. Reanalyzing the data from the 1992 international survey and 1993 international social survey using this multi-dimensional construct, Diekman and Franzen concluded that environmental concern negatively correlated with gross national product (GNP) per capita and positively with willingness and ability to sacrifice something. According to Diekmann and Franzen, this difference may exist because in many poor countries, environmental problems are more perceptible at the local level than rich countries because of the severity of the problems. Additionally, poor countries may not have the same ability to address these environmental problems.

Psychological Determinants

Environmental concern. The construct of environmental concern emerged in the 1970s as environmental problems such as air and water pollution, fossil fuel consumption, and waste management became hot button political topics. Environmental concern has been among the most frequently studied potential determinants of pro-environmental behavior. Weigel and Weigel (1978) defined environmental concern as an attitude toward, or an evaluation of information, personal behavior, and others’ behaviors.
that have environmental consequences.

Over the past 30 years, research concerning environmental concern as a
determinant of pro-environmental has primarily been correlational in nature, which has
generally yielded weak to moderate correlations between concern and behavior. At least
one researcher has argued that environmental concern may be an important indirect
determinant of specific pro-environmental behaviors (Bamberg, 2003). In other words,
Bamberg suggest that environmental concern should be measured using specific
environmental concern measures as they related to the local context (Van Liere &
Dunlap, 1980). It may also be that general environmental concern is a prerequisite to
other more influential determinants of pro-environmental behaviors such as specific,
localized environmental concern. According to Bamberg, the weak correlation between
environmental concern and specific environmentally related behaviors is attributed to the
incorrect assumption that a general attitude such as environmental concern is a direct
determinant of a specific behavior. Rather, Bamberg suggested that environmental
concern may be an important indirect determinant of specific behavior, acting as a
prerequisite for more situation-specific cognitions. Bamberg argued that these situation-
specific cognitions may be stronger, direct determinants of specific pro-environmental
behaviors.

Bamberg (2003) tested his hypothesis by examining the indirect influence of
environmental concern on the formation and evaluation of situation-specific beliefs
concerning “green” electricity products and local providers. Bamberg tested this
assumption by collecting questionnaire data from 380 university students concerning
their decision to request an information brochure about green electricity. Students were asked to complete a questionnaire that included behavioral beliefs concerning the consequences of using the offered brochure concerning “green” electricity within the next few days, which “green” electricity products were of personal interest, how supportive those around would be, factors that may prevent them from using the brochure, and attitudes, subjective norms, perceived behavioral control, intentions concerning brochure usage. To measure actual brochure acquisition behavior, Bamberg included a bold-print paragraph on the first and last page of the questionnaire that informed participants the brochure could be requested by using a post-ready card attached to the questionnaire. Of the 380 participants, 199 separated the postcard from the questionnaire, with 41 actually sending the card back. Of those that scored high on the environmental concern scale, 58% removed the post-ready card and 16% actually sent it in. Of those who scored low on the scale, 48% removed the card and 8% sent it in. As he had hypothesized, Bamberg found that environmental concern did not directly affect intention but did effect the perception and evaluation of the green electricity brochure and personal behavioral consequences. Those students that were highly environmentally concerned also expressed greater interest in obtaining the brochure, felt the brochure would be useful, had stronger support for others, and reported higher behavioral control over the acquisition of the brochure.

Others have argued that environmental concern is a determinant of pro-environmental behavior only when combined with other determinants. For instance, Axelrod and Lehman (1993) argued that environmental concern can be divided into three domains: (a) attitudes as a determinant for behavior, (b) efficacy or personal control as a
determinant for behavior, and (c) desire to attain certain outcomes for one’s action. Axelrod and Lehman found that a multivariate approach to the study of pro-environmental behavior that included threat perception, issue importance, and efficacy variables accounted for a significant portion of the variance in self-reported pro-environmental behaviors from undergraduates and members of the local community. Similarly, Fransson and Garling (1999) conducted a review of literature on the influence of environmental concern on pro-environmental behaviors and found that knowledge concerning environmental problems, internal locus of control, personal responsibility, and perceived threat to one’s health all affect pro-environmental behavior. They suggested that further research was required to determine the extent to which these variables influenced pro-environmental behaviors and the influence of the interaction between these variables on pro-environmental behaviors.

According to Castro (2006), environmental concern research continues to suffer from three fundamental problems: (a) insufficient theoretical integration in environmental concern frameworks, (b) numerous contrasting definitions of environmental concern that has lead to flawed methodology and instrument design, and (c) overreliance on sociodemographics as determinants of environmental concern. To move beyond these limitations, Castro suggested researchers begin developing new research questions that incorporate empirically tested social psychological theories (e.g., fear appeals).

Behavioral intention. The theory of planned behavior (Azjen, 1985, 1991; Azjen & Madden, 1986; Fishbein & Azjen, 1975) has as its central tenet that the best predictor of future behavior is behavioral intention. The intentional strength is determined by a
person’s attitude toward the behavior (positive or negative), subjective norms to perform
the behavior (exclusion of personal norms), and perceived behavioral control. The theory
of planned behavior has been used in a variety of behavioral contexts.

Hines, Hungerford, and Tomera (1986) conducted a meta-analysis of research that
attempted to apply the theory of planned behavior framework to the prediction of
responsible environmental behavior (or pro-environmental behavior). Their goal was to
determine which variables (i.e., cognitive, psychosocial, and demographic) were most
strongly associated with engagement in pro-environmental behaviors and the relative
strength of these variables to each other. They found that variables such as (in order of
correlational strength) intention, locus of control, attitudes, personal responsibility, and
knowledge, were significantly correlated with pro-environmental behaviors. They further
suggested that pro-environmental behaviors were influenced by an individual’s specific
knowledge concerning the existence and severity of an environmental problem, the
possible countermeasures to reduce threat levels, the perceived efficacy of these
countermeasures, perceived ability to apply countermeasures, and a desire to act. The
desire to act was influenced by locus of control, attitudes, personal responsibility, and
situational factors.

A follow-up investigation by Hungerford and Volk (1990) found similar results
and concluded that there are three variables that contribute to the likelihood that a person
would engage in pro-environmental behavior that include general environmental
knowledge, attitudes, personal orientation variables such as ownership of the problem,
commitment, and resolve, and empowerment variables such as countermeasure
application skills, locus of control, and intention to act. Building upon this theoretical foundation of theory of planned behavior (Azjen, 1985, 1991; Azjen & Madden, 1986) and the meta-analysis findings from Hines and colleagues and Hungerford and Volk, the research team of Hammit, Freimund, Watson, Brod, and Monz (1995) created a theoretical model of responsible environmental behavior (see Figure 1). Based on the model, intention to act is influenced by beliefs, locus of control, personal responsibility, environmental knowledge, situational factors, concern for norm, and subjective norms.

In a recent application of the theory of planned behavior, De Groot and Steg (2007) investigated whether the theory could predict behavioral intentions to use a park-and-ride facility in Groningen, The Netherlands. Using a questionnaire, they collected data from 218 participants that regularly travel to Groningen for work, shopping, and leisure. The results revealed that positive attitudes, positive subjective norms, and high-perceived behavioral control toward the use of the park-and-ride were strongly related to behavioral intentions to use the park-and-ride.

![Figure 1. Theoretical model of responsible environmental behavior (Hammit et al., 1995).](image-url)
Value orientations. Stern and Dietz (1994) postulated that attitudes related to environmental concern are deeply rooted in an individual’s value system or orientation. They argued that an individual’s environmental attitudes are based on the perceived value placed on the individual, others, and nature. Stern and Dietz termed these three value-based environmental concerns egoistic (self-centered), social-altruistic (other-centered), and biospheric (nature-centered). Egoistic values are based on the perception the individual is of greater importance than other humans and living things. Under this value orientation, people are concerned with environmental issues when they are perceived threatening or costly to themselves. Social-altruistic values are concerned with the environment when it perceived threatening to other people or community. Biospheric values are rooted in the concern or perceived threat for all living things. Schultz (2001, 2004) conducted a number of studies on the structure of environmental attitudes and found evidence for the distinction between egoistic, altruistic, and biospheric environmental concern. This model is referred to as the value-belief-norm model (VBN).

According to Stern, Dietz, Abel, Guagnano, and Kalof (1999), the VBN contends that a person’s important values directly influence their beliefs, which in turn directly influence pro-environmental norms, which lead to pro-environmental behaviors. The theory postulates the effect of values on pro-environmental behavior is mediated by beliefs concerning perceived threats to important values and their perceived ability to take action to alleviate those threats through personal norms.

A number of studies have found support for the use of values in predicting pro-environmental behaviors (e.g., Grob, 1995; Karp, 1996; Nilsson, von Borgstede, & Biel,
Specifically, Karp and Schultz and colleagues found that values such as self-transcendence had a positive influence on pro-environmental behavior and self-enhancement values negatively influence pro-environmental behaviors. Grob found that values related to post-materialism and openness to new thinking were positively related to pro-environmental behavior. In more recent applications of the VBN model, Oreg and Katz-Gerro (2006) investigated postmaterialism values (country-level) as an antecedent to environmental concern. Results suggested that postmaterialism values were an antecedent to environmental concern, and environment concern, perceived threat, and perceived behavioral control affect willingness to sacrifice and pro-environmental behaviors. It appears that value orientations may directly influence pro-environmental behaviors.

Value orientations may also indirectly influence pro-environmental behaviors through personal norms. To test this assumption, Harland, Staats, and Wilke (1999) conducted a study to examine the effect of personal norms (as framed by the theory of planned behavior) on Dutch citizens who were part of a behavioral change intervention program on environmentally relevant behaviors. They found that personal norms helped to explain more of the variance in five behavioral intentions, and four self-reported measures of performed environmentally relevant behaviors beyond that explained by subjective norms, attitudes, and perceived behavioral control. In a related study, Nordlund and Garvill (2002) distributed a mail-back survey in Sweden with 1,400 respondents to specifically test a hierarchical model of the effects of general value orientations.
orientation (translated Schwartz’s Value Inventory Scale), ecocentric and anthropocentric (environmental) values, awareness of environmental problems, personal norms, and frequency in which they engaged in 25 different pro-environmental behaviors (e.g., recycling and saving hot water). Nordlund and Garvill found that general value orientation influenced environmental values, environmental problem awareness, and personal norms. Additionally, they found that environmental values and environmental problem awareness influenced personal norms and personal norms, directly influenced engagement in pro-environmental behaviors. The influence of environmental values was mediated by personal norms. Similarly, Nilsson and colleagues (2004) found among decision makers in the public sector that environmental values were a determinant of willingness to accept climate change policy measures but not in the private sector. The effects were mediated by personal norms, and VBN model did well to predict behavioral intention in the public forum but not private.

Other social scientists have found that general value orientations or attitudinal variables to be weak predictors of pro-environmental behaviors (e.g., Hines et al., 1986; Poortinga, Steg, & Vlek, 2004; Schultz et al., 1995; Scott & Willis, 1994; Tanner, 1999). Poortinga and colleagues investigated the influence of values (quality of life) and environmental concern (general and specific) on household energy use. The results suggested that values and environmental concern are modestly related to support for government regulation, market strategies aimed at managing environmental problems, and energy-saving home and transport measures. Additionally, the authors suggested that attitudinal variables may be insufficient in explaining pro-environmental behaviors and
support the inclusion of motivational and contextual variables (e.g., the individual opportunity and ability to address the problem).

*Self-efficacy.* Believing that one’s personal pro-environmental behaviors have a positive impact on negative environment conditions is considered by some to be an important determinant of pro-environmental behavior. Iwata (2004) investigated the correlation between six (efficacy of personal pro-environmental behaviors, behavioral independence, emotional sensitivity, social awareness, attitudes toward growth and technology, and sensitivity to noise) psychological variables and environmentally responsible behavior of undergraduate students in Japan. Results indicated that efficacy of personal pro-environmental behaviors, emotional sensitivity, and negative attitudes toward growth and technology were significantly related to environmentally responsible behavior.

*Awareness and knowledge.* Knowledge is an important precursor to other determinants of pro-environmental behaviors. Hines and colleagues (1986) suggested that pro-environmental behaviors are influenced by a person’s environmental knowledge as it relates to the existence and severity of the environmental problem, possible countermeasures environmental problem, and the potential effectiveness of these countermeasures. Similarly, O’Conner, Bord, Yarnal, and Wiefek (2002) found that those that could accurately identify the cause and expected consequences of climate change were more likely to support government antifossil fuel initiatives and voluntary actions. They also found that the belief that efforts to protect the environment would not threaten the respondent’s job, limit personal freedoms, and damage the economy was a strong
predictor of support for efforts by the government to reduce greenhouse gas emissions. They did not find a significant relationship between economic circumstances and anxieties and support for governmental efforts to reduce greenhouse gas emissions. O’Connor and colleagues concluded that a cognitive (or knowledge-based) explanation of support for reducing greenhouse gas emissions is a stronger predictor than economic or political explanations. Additionally, they concluded that those that perceive risks from climate change and potential job loss were the most likely to support reduced emission efforts.

Environmental Determinants

Localization. Localization of the environmental problem may also influence pro-environmental behaviors (e.g., Bickerstaff & Walker, 2001; Blake, 2001). When people perceive an environmental problem to be a threat to their immediate physical, cultural, social proximity, they may be more inclined to act in an environmentally responsible manner. The converse may also be true, when environmental problems are in another part of the world we are less inclined to take environmental action. The localization of the problem may play a significant role in predicting future pro-environmental behavior. To test this assumption, Blake proposed a more objective measure of environmental quality that included localization of the pollution or threats to personal health. Using data from a random survey sample from British Columbia, Blake examined contextual effects of environmental knowledge and political attitudes as determinants of behaviors to support environmental causes and collective efforts to stop or reverse environmental degradation. Blake found that determinants of individual political action differed from those of
collective political action. Blake found that geography of environmental problems had a significant effect on environmental perceptions and pro-environmental behavior. Individual political action was significantly influenced by environmental knowledge, perceived efficacy of the individual action, and postmaterialism values. Collective political action was significant and influenced personal values such as environmentalism. This difference was attributed to spatial variations between environmental issue and countermeasures. He suggested that people might be more likely to engage in individual political action if there is a singular traceable cause or offender. Also, people may be more likely to engage in collective political actions if there is an immediate threat to our economic and/or personal well-being. Contextual effects of environmental problems seem to play a significant role in both the perception of the environmental (e.g., severity and proximity) and the perceived countermeasures. McAllister (1994) and Rohrschneider (1988) argued for the localization of environmental concern by differentiating between the perceptions of local and national or international environmental problems.

*Personal versus situational.* A number of studies have examined the influence of the interaction between personal (e.g., values and beliefs) and situational variables (e.g., context of environmental problem and characteristics of physical environment) on pro-environmental behaviors (Collins & Chambers, 2005; Corraliza & Berenguer, 2000; Guagnano, Stern, & Dietz, 1995). According to Corraliza and Berenguer, the interaction between personal and situational variables is measured in terms of the extent to which they conflict or are consistent with each other. Personal variables are defined as the level of attitudinal disposition and situational variables are defined as inhibition to behavior or
level of facilitation. These variables can fluctuate between low and high that in turn creates conflict or consistency. For example, conflict can occur if a person has a high personal disposition to take action but situation variables prevent them from taking action. Consistency occurs when both personal disposition and situational variables are high or low.

To test the effect of the interaction between personal and situational variables, Corraliza and Berenguer (2000) collected data using a questionnaire from 125 randomly selected undergraduate students in Madrid, Spain. The questionnaire included measures of environmental beliefs, Schwartz’s (1973) measure of values, environmental inhibition levels, and environmental behaviors (e.g., recycling paper and batteries, buying environmentally friendly products, and restricting use of personal vehicles). Results suggested that pro-environmental behaviors depended strongly on the interaction among personal and situational variables. When high conflict levels were generated between the two variables the predictive power of attitudes was weak. Conversely, when the two variables were consistent (either low or high) predictive power was high. Additionally, it was found that for some pro-environmental behaviors situational variables explained more variance and for other behaviors personal variables explained more of the variance.

Others have found similar interactive effects (e.g., Collins & Chambers, 2005). Collins and Chambers conducted a study in Australia using 205 university students to examine the influence of the interaction between psychological (personal) and situational variables on a specific pro-environmental behavior (choice to use commuter transport). Results indicated again that the interactive of effect situational and psychological
variables strongly influence pro-environmental behavior. They concluded that encouraging students to use public transportation requires public policy strategies that focus on the psychological influences such as negative environmental effect of cars and personal control and situational influence of accessibility to public transportation at a reduced cost.

**Social Determinants**

*Social norms.* Another theory that has been explored in the context of environmental concern is the norm-activation theory (Schwartz, 1968, 1977). The norm-activation theory states that personal norms are expectations for self that are based on a commitment to internal values. These internal values influence behavior when activated by a number of factors, which include: (a) a person becomes aware of the consequences of their behavior toward others, and (b) a person ascribes responsibility for these consequences (accountability) or personal obligation. The relationship between values, personal norms, and behavior are mitigated by the perceived control over the behavior, whether the person perceives threats to that which they value, and believes they can behave in a specific manner to remove or minimize these perceived threats. An attitude is determined by the strength of the beliefs concerning the consequences of the behavior (positive or negative). The evaluation of these consequences is guided by internal values.

*Community cohesion.* According to Cutter (1981), a community’s attitude toward pollution is influenced by three factors: (a) psychological makeup of members of the community, (b) social characteristics of members of the community, and (c) actual level of the pollution in the community. Cutter conducted a study in Chicago to determine how
a community’s attitudes toward pollution vary across social group and with levels of pollution. She found that areas of Chicago that were predominately black and low SEC were most concerned with pollution. Additionally, economic status was negatively correlated with environmental concern, high levels of pollution were positively correlated with environmental concern among residents of the city, and there was little difference between pollution level indicators and social indicators in the prediction of community environmental concern. Cutter concluded that both social and environmental factors influence community environmental concern.

Others have found similar results (e.g., Clark, Kotchen, & Moore, 2003). Clark and colleagues conducted a study of internal and external determinants of pro-environmental behavior (participation in green electricity program) in southeastern Michigan. They asked residents why they participated in the green electricity program. The motives included personal health, environmental quality in southeastern Michigan, global warming, ecosystem health, and intrinsic satisfaction. Results indicated that residents were more concerned with local benefits to their community than global climate change. Based on the findings from these studies, it may be safe to assume that localized threats and benefits may play a more important role in encouraging people to act in an environmentally friendly manner than global threats and benefits. Future research should consider the use of community-specific measures of threat perception and environmental benefits as determinants of pro-environment, as they may be more salient and powerful than general or global measures.
Threat perception has emerged as a possible determinant of pro-environmental behaviors (e.g., Vining & Ebreo, 2002). The concept of threat perception emerged from 50 years of social psychological research on so-called fear appeals. In a meta-analysis of fear appeal literature, Witte and Allen (2000) found that fear appeals has three underlying independent variables that include fear, perceived threat, and perceived efficacy. Fear is a powerful, innate emotional response to a perceived threat or dangerous event. The use of fear appeals to change attitudes and behaviors are a common strategy employed by public health organizations, religious organizations, political campaigns, advertising and marketing, and terrorist groups. Research has found that fear arousal can lead to attitudinal and behavioral change under specific conditions (e.g., Witte & Allen).

Rogers first identified perceived threat and perceived efficacy as components of fear appeals in 1975. Rogers (1975) outlined the three components of a fear appeal in a protection motivation theory: (a) perceived severity of an event, (b) perceived likelihood that an event will occur, and (c) perceived efficacy of a protective response or countermeasure. According to Rogers, each of these three components activates a series of cognitive events that begin with an appraisal process that is preceded by an attitudinal change. Witte (1992, 1998) furthered Rogers’ work by adding perceive threat to the fear appeal theories suggesting that it is composed of two distinct dimensions including perceived susceptibility and severity of the threat. This suggests that perceived threat is a cognition rather than emotion such as fear. Others have argued that threat perception is
more than just cognition but an emotional component of fear arousal (e.g., Vining & Ebreo, 2002). The relationship between fear and perceived threat is positively correlated (Witte, 1992, 1998). In other words, as the level of perceived threat increases, fear arousal will also increase.

Additionally, Witte (1992, 1998) expanded other components of Rogers’s fear appeals theory by suggesting that perceived efficacy is composed of two distinct dimensions including perceived self-efficacy and response efficacy. Self-efficacy refers to an individual’s belief concerning their ability to perform a remedial response. Response efficacy refers to an individual’s belief concerning the effectiveness of remedial response for the threat. The predictive strength of fear arousal is dependent on perceived threat (e.g., susceptibility to and severity of the threat), perceived self- and response-efficacy, and clearly defined, specific knowledge concerning what can be done to avoid or abate the threat (Keller, 1999; Rogers, 1983). If people do not have specific knowledge concerning countermeasures, people can feel helpless, depressed, anxious, and/or engage in avoidance strategies (e.g., ignoring fear appeal message).

Other efforts were made to determine the role of threat perception in predicting behavior. In the 1950s, the Health Belief Model was developed by a group of social psychologists working in the U.S. Public Health Service to determine why people were not participating in health programs that would detect and prevent disease (Rosenstock, 1966). Becker (1974), Rosenstock (1966, 1990), and Rosenstock, Strecher, and Becker (1988, 1994) expanded the Health Belief Model to predict health behaviors. The Health Belief Model relies heavily on threat perception to predict health behaviors in a number
of contexts. The model proposes that a person will engage in health behaviors if they perceive: (a) that they are susceptible to the ill-health conditions (perceived susceptibility), (b) the ill-health conditions will lead to serious consequences (perceived severity), (c) a course of action will minimize the susceptibility or severity of the ill-health conditions (perceived benefits), and (d) the anticipated barriers or costs of this course of action do not outweigh perceived benefits (perceived costs). Much like Witte (1992, 1998), Rosenstock and colleagues (1994) argued that perceived threat is a combination of perceived susceptibility and severity. The role of threat in this model in predicting health behavior is essential. Some evidence has been found for the predictive validity of the model but it is not conclusive (e.g., Harrison, Mullen, & Green, 1992; Janz & Becker, 1984; Rosenstock et al., 1994). However, Rosenstock and colleagues suggested that additional components or a multivariate approach are needed to more completely predict health behavior including sociodemographic variables and social psychology constructs.

Some have argued that there may be an optimal level of perceived threat in fear appeals as it relates to motivating behavioral change (e.g., Jones & Owen, 2006). If an individual perceives the threat level to be too great, they may become overwhelmed and react in an adverse manner both physically and psychologically. Too little threat may have the opposite effect and encourage people to ignore the message. In an attempt at testing this assumption, Jones and Owen examined the impact of a social marketing campaign for mammography screening on Australian women to undergo mammographic screening. They experimentally manipulated threat messages (e.g., low to high)
concerning health risks and found that the level of threat had no impact on behavioral intentions to undergo mammographic screening. Their findings also suggested a relationship between high-threat messages and intense negative emotional affect. Finally, their findings revealed one unintended consequence of the marketing campaign. They found that young women who had not been a target group reported greater perceived susceptibility to health risks. The authors suggested restricting the use of high-threat messages in social marketing campaigns (e.g., public health campaigns).

Social scientists have applied threat perception frameworks to the prediction of behavioral change in a number of contexts. Goodwin, Wilson, and Gaines (2005) found terror threat perception to predict behavioral change. In another empirical study, Smith and Stutts (2003) presented 235 high school students with a number of antismoking advertisements on television, magazines, and Internet over a 5-month period of time to determine if the advertisements would influence smoking behaviors. Their results suggested that average-smoking behaviors declined for students exposed to antismoking advertisements for both males and females.

Threat perception has also been applied to the study of pro-environmental behaviors. Using threat perception frameworks, one could frame environmental problems such as air pollution as a threat to something of value to humans such as health, wellbeing, community, quality of life, environment, and/or other aspects of one’s life. Stern (1992) conceptualized threat perception to environmental problems as a component of anthropocentric value orientation. Under this assumption, people become concerned or care about environmental quality when they believe the environmental conditions pose a
threat to health or wellbeing.

Threat perception has also been found to significantly impact the likelihood in which an individual will engage in pro-environmental behaviors (e.g., Axelrod & Lehman, 1993; Baldassare & Katz, 1992; Fransson & Garling, 1999; Grob, 1995; Johnson & Scicchitano; 2000). Axelrod and Lehman reported that threat prevention beliefs have been found to be useful in predicting pro-environmental or counteractive behaviors. They argue that two factors associated with threat perception have been found to directly influence engagement in pro-environmental behaviors. The first of these factors is the probability the something threatening will occur. Second is the perceived severity of the threat. A third threat perception factor was proposed by Paterson and Neufeld (1987) but has received very little scientific attention. Paterson and Neufeld speculate that the proximal or immediate nature of the threat may also influence the likelihood in which an individual will engage in a pro-environmental behavior.

Baldassare and Katz (1992) conducted an investigation of health-related threat perception as a possible determinant of pro-environmental behaviors. According to their 1990 Orange County (California) Annual Survey, residents of the county who perceived environmental problems such as air or water pollution as a threat to their health and well-being were more likely to engage in environmental practices such as recycling, conservation of water, the purchase of environmentally safe products, and reduction of vehicle miles driven. Baldassare and Katz also concluded that perceived personal environmental threat is a better predictor of engagement in environmental practices than demographic or political variables. Perceived environmental threat was highest among
respondents that were young, women, Democrats, and liberal.

Others have found similar results. McDaniel, Axelrod, Cavanagh, and Slovic (1997) found that Canadians in their sample that valued threatened natural environments were more likely to support regulations to reduce threats to watersheds. Another study conducted by Seguin, Pelletier, and Hunsley (1998) found that Canadian respondent’s perception of environmental health risk strongly predicted environmental activism. Increased threat perception of global climate change may also be influence pro-environmental behavior. O’Connor, Bord, and Fisher (1999) found in a nationally conducted survey in the U.S. that people who expect increases in global temperatures and bad consequences are significantly more likely to report their willingness to reduce greenhouse gas emissions.

Norlund and Garvill (2003) found similar results in a study that examined the influence of values, general awareness of environmental problems as threats to humans and biosphere, specific awareness of negative environmental consequences and severity of the problem of car traffic, and personal norms concerning their willingness to reduce personal car use. They collected data from 2,500 Swedish car owners. Participants were asked to state their willingness to reduce personal car use thereby making a choice between the short-term personal gains (e.g., time savings, comfortable, flexible) of driving their personal cars and long-term environmental costs (e.g., air and noise pollution and high consumption of fossil fuel). The results indicated general awareness concerning the perceived threat of environmental problems to biosphere and humans influenced the level of specific problem awareness concerning the environmental
consequences of car traffic and perceived severity of these consequences. Specific problem awareness of environmental consequences of car traffic directly influenced personal norm that lead to a greater willingness to reduce personal car use. They concluded that peoples’ willingness to reduce personal car use was tied to their intention of sacrificing short-term personal gains for the long-term environmental collective gains.

Conversely, Tanner (1999) studied the constraints on environment behavior using a questionnaire distributed to Swiss adults and found little evidence that attitudinal variables such as threat perception determined pro-environmental behaviors.

Conclusion

Air pollution is a threat to the health of humans, animals, and plants. Air quality has been found to impact physical health, social, economic, and psychological well-being of communities. With the mounting threat of formation and exposure to toxic air pollution, encouraging people to engage in pro-environmental behaviors is of vital importance. The literature on demographic, psychological, environmental, social determinants of pro-environmental behaviors has been fruitful but remains insufficient. Threat perception may be another possible determinant of pro-environmental behavior but under specific conditions: (a) the source of the environmental threat is known, (b) the source of the environmental threat is local, (c) people perceive the environmental problem as a threat to themselves or something they value, (d) people perceive they are susceptible, (e) people perceive the environmental threat as severe, (f) people attribute the environmental problem as a byproduct of their personal or collective action, (g) people
know how (e.g., abatement strategies) to reduce the environmental threat, (h) people believe these abatement strategies can actually reduce the environmental threat, (i) people are physically and contextually capable of employing these abatement strategies, and (j) people feel they can make a difference.

The air pollution problem in Cache Valley and the local health department’s air pollution abatement marketing campaign provides an ideal context to investigate the threat perception related to air pollution, perceived susceptibility to the impacts of air pollution, perceived severity of air pollution, the possible link between threat perception and pro-environmental and avoidance behaviors. A secondary data analysis was conducted using data from the Air Quality Perception Survey conducted by this author and the Bear River Health Department. These data were used to determine the validity of a number of hypotheses. The hypotheses are as follows.

1. People are aware of the air pollution to problem in Cache Valley.

2. People perceive the impact of air pollution on the community to be serious (perceived severity).

3. People perceive that air pollution is a threat to something they value (perceived susceptibility).

4. Threat perception affects people’s decision to engage in specific pro-environmental and avoidance behaviors (i.e., reduce miles driven).

5. People are more likely to engage in pro-environmental and avoidance behaviors that require relatively low physical effort to complete (e.g., driving fewer miles and avoid idling) than high physical effort behaviors (e.g., riding a bicycle and walking).
6. As the perceived level of threat increases, people are more likely to engage in pro-environmental and avoidance behaviors on “Red Air Days” than “Yellow Air Days.”
CHAPTER III
METHOD

Participants

Sampling

The sample was generated in two stages. First, a cluster-sampling technique was used. By using the 2000 U.S. Government Census Data, a database containing every block in Cache County, Utah ($N = 2,698$) was constructed. The blocks containing no households were removed from the database ($n = 1153$) leaving an $N = 1,545$. Each of the blocks was assigned a random decimal number ranging from 0 to 1 (e.g., .45). This random number was continuous. Additionally, each block was assigned a probability of selection number. This number was calculated using an equation.

$$\frac{\text{Total number of households on the block}}{27,543 \text{ (Households in Cache County)}} \times \frac{27,543 \text{ (Households in Cache County)}}{1,500 \text{ (estimate for sampling size)}}$$

If the randomly selected number was less than the probability of being selected, then the block was selected to participate in the project. Thus, the more households present on a particular block, the more likely the block would be selected. This selection proportionate-to-size was conducted in an effort to compensate for the large number of census blocks with fewer households.

The final sample contained a total of 72 blocks with 3,673 households. To determine the number of households to be included in the sample, this household total (3,673) was then multiplied by .40. The resulting number of households sampled was
1,470. The 1,470 households were then multiplied by .30 (30% was the determined response rate for the survey drop-off approach), which equaled 441.

The second stage involved the selection of households on each block. A starting point (north, south, west, and east) on each block was assigned a number ranging from 1 to 4. From an Excel file, a number was randomly generated to determine which corner would be used to begin the distribution of the survey. From that starting point, 40% of the households on the block received a survey. For example, if the randomly selected block contained 10 households, the investigator would start from a randomly selected corner. The investigator would then determine the total number of households on the block (10) and multiply it by .4, which would equal 4. The investigator would then go to every other home. If the block had fewer than 4 households, one house was selected.

Response Rate

The overall response rate was 23%. In total, 1,247 surveys were distributed and 289 surveys were completed or partially completed and returned to doorknobs. Fifty blank surveys were never “picked-up” by participants and were retrieved after 2 days.

Demographic Information for the Sample

Table 1 includes the demographic information for the Air Quality Perception Survey. Age was measured as a continuous variable and was not included in the table. The mean age was 50. Age ranged from 18 to 90.

When compared to the 2000 U.S. Government Census Data, this sample may not be representative of the population in Cache County. According to the 2000 Cache
Table 1

*Demographic Information for Sample*

<table>
<thead>
<tr>
<th>Demographics</th>
<th>n</th>
<th>%</th>
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<tr>
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<tr>
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<td>85.1</td>
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<tr>
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<td>1.7</td>
</tr>
</tbody>
</table>

County Census, 42.9% of the population were female and 50.8% were male; of those 25 years and over: 90.4% were high school graduates and 31.9% earned bachelor’s degrees or higher; and 23.9 years old is the median age (U.S. Census Data, 2000). The sample was very different than this, 65.4% of the sample was female and 31.5% was male; 96.5% were high school graduates and 53.6% earned bachelor’s degrees or higher; and the median age of the sample was 50. As a consequence, these data should not be generalized to the Cache County population.
Materials

Materials included a scanable survey titled the Air Quality Perception Survey (Appendix A), cover letter (Appendix B), and plastic bag designed to be hung on a doorknob.

Scanable Survey

The scanable survey was designed using Scantron Telaform Version 7. Completed surveys were scanned using Scantron Telaform Version 7. The survey contains 56 items with both quantitative and qualitative questions. The survey included questions concerning local air quality perception, impacts on air pollution, an evaluation of air pollution abatement policy and educational campaigns, and frequency of pro-environmental behaviors (air pollution abatement activities).

Demographic Questions

Demographic information was collected and included: sex, age, formal education, and length of time as resident of Cache County. These questions were placed at the end of the survey.

Air Quality and Threat Perception Survey Items

Air quality perception information was collected using a Likert-type scale. Participants were asked the extent to which they agreed or disagreed with each of the following statements using a scale that ranged from 1 = strongly disagree to 1 = strongly agree. Among the two questions included in the analysis are “Air pollution is a problem
in Cache Valley” and “I consider air pollution in the winter as a threat to my health.”

*Impacts of Air Pollution Survey Items*

The impacts of air pollution were collected using a Likert-type scale. Participants were asked to indicate how serious they believed that each condition is affected by air pollution using a scale that ranged from 1 = Not Serious to 5 = Serious. Among the 13 conditions include in the analysis are “My current health,” “My future health,” “The health of someone they know,” Personal medical costs,” “Health of animals and plants,” “The general quality of life community life in Cache Valley,” “The visibility of landscape and roadways,” “Tourism and tourism dollars in Cache Valley,” “Property values in Cache Valley,” “Population growth (people moving here) in Cache Valley,” “Financial costs to business in Cache Valley,” “Attracting new business to open in Cache Valley,” and “Keeping business here in Cache Valley.”

*The Self-Reported Frequency of Engaging in Air Pollution Abatement Strategies on “Yellow” and “Red Air Days”*

Using a Likert-type scale (Never, Rarely, Sometimes, Often, Every Time, N/A), participants were asked to indicate how often they engage in a number of pro-environmental (or air pollution abatement behaviors) such as driving fewer miles, trip consolidation, carpooling, stop burning wood and coal, avoid idling, avoid “drive thru” windows, walking and riding a bicycle, using public transportations and activities to avoid such as outdoor activities and keeping children indoors on “Yellow” and “Red” air days.
**Cover Letter**

The cover letter explained that Utah State University and the BRHD were conducting air quality perception survey. Additionally, the cover letter briefly described the purpose of the survey, how the results would be used and disseminated, contact information, and direction concerning the return of the survey. In an attempt to establish legitimacy and creditability, both the cover letter and survey were printed on paper from the BRHD and included a BRHD wordmark.

**Newspaper Articles**

*The Herald Journal* and *The Utah Statesman* (Utah State University) both published articles about the Cache Valley Air Quality Perception Study. The articles outlined the purpose of the study, identified the supporting agencies (the Psychology Department at Utah State University and the Bear River Health Department), and encouraged residents of Cache County to participate in the study if they received a survey on the doorknob.

**Plastic Bag**

The plastic bags were purchased from an office supply store in Salt Lake City, Utah. The plastic bags were transparent and contained a large doorknob-sized hole on the top for hanging. They were used to hold and hang the survey and cover letter on selected households. Additionally, participants used the plastic bags to return completed surveys to their doorknobs.
Procedure

Data were collected using a scanable survey. The primary investigator traveled to each randomly selected block throughout the Cache Valley (Cache County, Utah) and distributed surveys by hand. A survey (Appendix A) and cover letter (Appendix B) was placed in bags and hung on doorknobs of 40% of the households on each of the randomly selected blocks. To ensure anonymity and confidentiality, names and information concerning participants were not required for participation or included on the returned surveys. Upon completion, participants were asked to return surveys to their doorknobs for pick-up. The primary investigator returned the following 2 days, checked doorknobs for completed surveys, and retrieved those that were completed. Returned surveys were scanned and inputted into a statistical program for analysis. The qualitative responses were typed and coded for use in the analysis. The study received Internal Review Board (IRB) approval at Utah State University.

Exclusion Criteria

Randomly selected blocks that were located on Utah State University lands were excluded because of laws against solicitation \((n = 2)\). Homes or apartments that were for rent or sale, vacant, and/or had an exclusionary gate were not sampled. In these circumstances, the primary investigator selected the next available home.

The primary investigator deemed portions of the blocks that were near major highways as a safety (i.e., speed of oncoming traffic) and parking (i.e., parking zones)
concern were excluded. Areas or roads on blocks that were undergoing major construction were also excluded due to access and safety concerns.
CHAPTER IV
RESULTS

The secondary data analysis included a report of descriptive statistics for perception survey items and “Yellow” and “Red Air Day” self-reported behavior survey items, exploratory factor analysis of threat perception and self-reported behavior survey items, and multiple regression analysis was conducted to predict “Yellow” and “Red Air Day” behavior factor scores.

Descriptive statistics were reported to determine air quality perception and the perceived seriousness (severity) and susceptibility of the impacts of air pollution on a number of personal, community, and economic conditions in Cache County, UT.

In order to create a composite threat perception score, an exploratory factor analysis with varimax rotation was conducted using maximum likelihood estimation to determine if there are unique underlying threat perception factors.

To determine how frequently people report engaging in specific pro-environmental and avoidance behaviors on “Yellow” and “Red Air days” to reduce air pollution in Cache County and their exposure to air pollution, responses were recoded and descriptive statistics were reported. To determine if respondents were more likely to engage in pro-environmental or avoidance behaviors as perceived levels of threat perception (i.e., “Yellow” to “Red Air Days”) increase, paired-sample t tests were used to compare mean scores of each behavior.

In order to create a composite behavior score, an exploratory factor analysis with varimax rotation was conducted using maximum likelihood estimation to determine if
there were unique underlying behavior factors for “Yellow Air Day” pro-environmental and avoidance behaviors. Another identical exploratory analysis was conducted for “Red Air Day” pro-environmental and avoidance behaviors.

To further analyze the data, the factor scores for each threat perception factor was saved. To determine if air pollution threat perception in Cache Valley affects the decision to engage in specific pro-environmental behavior, saved threat perception factor scores, sex, age, education level, and time spent in Cache Valley were predictor variables in a multiple regression model to predict “Yellow” and “Red Air Day” pro-environmental or avoidance behavior factor scores.

**Air Quality Perception**

Descriptive statistics for each Air Quality Perception survey item was determined. Respondents indicated the extent to which they agreed or disagreed with each statement. Respondents used a scale that ranged from 1 = Strongly Disagree and 6 = Strongly Agree to answer the questions. Respondents reported agreeing with both statements and perceived air pollution as a problem in the Cache Valley ($n = 284, M = 4.95, SD = 1.11$) and a threat to their health in the winter ($n = 282, M = 4.48, SD = 1.38$).

**Perceived Impact of Air Pollution**

Respondents indicated how seriously a number of personal and community conditions were impacted by local air pollution. Table 2 shows the descriptive statistics for the perceived Impact of Air Pollution survey items. Respondents used a scale that
Table 2

*Descriptive Statistics for Perceived Impacts of Air Pollution Questions*

<table>
<thead>
<tr>
<th>Condition</th>
<th>n</th>
<th>M</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>My current health</td>
<td>280</td>
<td>2.91</td>
<td>1.36</td>
</tr>
<tr>
<td>My future health</td>
<td>278</td>
<td>3.65</td>
<td>1.28</td>
</tr>
<tr>
<td>The health of someone I know</td>
<td>270</td>
<td>3.78</td>
<td>1.20</td>
</tr>
<tr>
<td>Personal medical costs</td>
<td>276</td>
<td>2.93</td>
<td>1.24</td>
</tr>
<tr>
<td>The health of plants and animals</td>
<td>272</td>
<td>3.04</td>
<td>1.17</td>
</tr>
<tr>
<td>The general quality of community life in Cache Valley</td>
<td>281</td>
<td>3.40</td>
<td>1.16</td>
</tr>
<tr>
<td>The visibility of landscape and roadways</td>
<td>282</td>
<td>3.40</td>
<td>1.18</td>
</tr>
<tr>
<td>Tourism and tourism dollars in Cache Valley</td>
<td>281</td>
<td>2.92</td>
<td>1.21</td>
</tr>
<tr>
<td>Property values in Cache Valley</td>
<td>275</td>
<td>2.80</td>
<td>1.13</td>
</tr>
<tr>
<td>Population growth (people moving here) in Cache Valley</td>
<td>280</td>
<td>2.79</td>
<td>1.33</td>
</tr>
<tr>
<td>Financial costs to business in Cache Valley</td>
<td>277</td>
<td>2.73</td>
<td>1.13</td>
</tr>
<tr>
<td>Attracting new businesses to open in Cache Valley</td>
<td>275</td>
<td>2.62</td>
<td>1.16</td>
</tr>
<tr>
<td>Keeping businesses here in Cache Valley</td>
<td>282</td>
<td>2.50</td>
<td>1.15</td>
</tr>
</tbody>
</table>

ranged from 1 = Not Serious to 5 = Serious. Respondents reported that the relative impact of air pollution on a number of personal and communal conditions to be somewhat serious. All items exceeded the mid-point. The two items that were identified as most serious were “My future health” \( (M = 3.65) \) and “The health of someone I know” \( (M = 3.78) \).

**Threat Perception**

An exploratory factor analysis with varimax rotation was conducted using maximum likelihood estimation on the Air Quality Perception and perceived Impacts of Air Pollution survey items. This was done in an effort to extract unique threat perception factor(s).
The survey items loaded on two factors and various indicators of factorability and residuals indicated that the solution was good. Two factors with eigenvalue of greater than 1.0 were found with factor 1 = 7.941 and factor 2 = 1.992. The screen plot also indicated two unique factors. The items that loaded on threat perception factor 1 appeared to relate to personal and community health, and threat perception factor 2 related to economic conditions in Cache Valley, Factor 1 accounted for 52.94% of the multivariate variance. Factor 2 accounted for 13.28% of the multivariate variance. The factors, variables that load on each factor, and rotated factor matrix values are shown in Table 3. From this analysis, two factor-scores were calculated and saved in the data set. For this factor analysis, the sample size was \( N = 242. \)

### Table 3

**Threat Perception Factors Found by Maximum Likelihood Factor Analysis and Rotated Variables**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>My future health</td>
<td>.823</td>
<td>.215</td>
</tr>
<tr>
<td>The health of animals and plants</td>
<td>.746</td>
<td>.176</td>
</tr>
<tr>
<td>The health of someone I know</td>
<td>.742</td>
<td>.198</td>
</tr>
<tr>
<td>The general quality of community life in Cache Valley</td>
<td>.738</td>
<td>.381</td>
</tr>
<tr>
<td>My current health</td>
<td>.718</td>
<td>.283</td>
</tr>
<tr>
<td>I consider air pollution in the winter as a threat to my health</td>
<td>.708</td>
<td>.211</td>
</tr>
<tr>
<td>Personal medical costs</td>
<td>.677</td>
<td>.311</td>
</tr>
<tr>
<td>Air pollution is a problem in Cache Valley</td>
<td>.596</td>
<td>.188</td>
</tr>
<tr>
<td>The visibility of landscape and roadways</td>
<td>.568</td>
<td>.325</td>
</tr>
<tr>
<td>Attracting new businesses in Cache Valley</td>
<td>.194</td>
<td>.936</td>
</tr>
<tr>
<td>Keeping businesses here in Cache Valley</td>
<td>.191</td>
<td>.890</td>
</tr>
<tr>
<td>Financial costs to business in Cache Valley</td>
<td>.291</td>
<td>.792</td>
</tr>
<tr>
<td>Population growth (people moving here) in Cache Valley</td>
<td>.264</td>
<td>.698</td>
</tr>
<tr>
<td>Property values in Cache Valley</td>
<td>.463</td>
<td>.596</td>
</tr>
<tr>
<td>Tourism and tourism dollars in Cache Valley</td>
<td>.458</td>
<td>.557</td>
</tr>
</tbody>
</table>

*Note. \( N = 242. \)*
Sociodemographic Variables

Pearson product-moment correlation (2-tailed) was conducted with age and the factor scores of each threat perception factor. Additionally, for threat perception factor scores, one-way ANOVAs were conducted to determine differences in factors by sex. If statistical significance was found, post-hoc comparisons with Bonferroni adjustments for family-wise error were conducted. An alpha level of .05 was used for all statistical tests.

Correlation coefficients were calculated for Age and threat perception factor scores. Age was statistically unrelated to factor 1 scores, \( r(233) = -.110, p = .095 \), and factor 2 scores, \( r(233) = .068, p = .305 \).

Analyses of variance were conducted in an effort to detect differences in the threat perception factor scores by sex. For factor 1 scores it was found that the effect of sex was statistically significant though the effect size was small, factor 1: \( F(1,234) = 12.678, p < .001, \) partial \( \eta^2 = .051 \). For factor 1, the female respondents’ mean perception (\( M = .120 \)) was significantly greater than the male respondents’ mean perception (\( M = -.235 \)). Thus, female respondents reported significantly greater levels of perceived threat on this factor. For factor 2 it was found that the effect of sex was not statistically significant, \( F(1,234) = .238, p = .626, \) partial \( \eta^2 = .001 \).

Self-Reported Pro-Environmental and Avoidance Behavior

Self-reported response rates concerning the frequency in which people engage in pro-environmental (e.g., “Drive fewer miles” and “Use public transportation”) and avoidance (e.g., “Keep children indoors” and “avoid outdoor activity”) behaviors on
“Yellow” and “Red Air Days” was recoded (1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Every time) such that higher values indicated more pro-environmental behaviors for both “Yellow Air Days” and “Red Air Days”; this was done for comparison purposes. Table 4 provides the descriptive statistics for the recoded self-reported behaviors.

A comparison of recoded self-reported pro-environmental and avoidance behaviors means from “Yellow Air Days” and “Red Air Days” was conducted using a paired-samples \( t \) test (2-tailed). This was done to determine if respondents were more

**Table 4**

*Descriptive Statistics and Results for Paired Samples \( t \) Tests for the Recoded Self-Reported Pro-Environmental and Avoidance Behaviors on “Yellow” and “Red Air Days”*

<table>
<thead>
<tr>
<th>Pro-environmental behavior</th>
<th>Yellow air days</th>
<th>Red air days</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>( n )</td>
<td>( M )</td>
</tr>
<tr>
<td>Drive fewer miles</td>
<td>246</td>
<td>3.20</td>
</tr>
<tr>
<td>Carpool</td>
<td>170</td>
<td>2.17</td>
</tr>
<tr>
<td>Use public transportation</td>
<td>211</td>
<td>1.86</td>
</tr>
<tr>
<td>Stop burning wood or coal</td>
<td>68</td>
<td>3.85</td>
</tr>
<tr>
<td>Keep children indoors</td>
<td>143</td>
<td>3.04</td>
</tr>
<tr>
<td>Trip consolidation</td>
<td>252</td>
<td>3.45</td>
</tr>
<tr>
<td>Avoid outdoor activity</td>
<td>256</td>
<td>3.22</td>
</tr>
<tr>
<td>Avoid idling your vehicle</td>
<td>246</td>
<td>3.61</td>
</tr>
<tr>
<td>Avoid using “drive thru” windows</td>
<td>215</td>
<td>2.94</td>
</tr>
<tr>
<td>Walk</td>
<td>234</td>
<td>2.57</td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>188</td>
<td>1.78</td>
</tr>
</tbody>
</table>
likely to engage in pro-environmental or avoidance behaviors as threat perception (i.e., “Yellow Air Days” to “Red Air Days”) increases. Table 3 includes the $t$ scores, $p$-values, and statistical significance for the paired samples $t$ tests.

For seven of the 11 self-reported pro-environmental and avoidance behaviors statistical significance was found; in every case, behavior was more likely to be reported during “Red Air Days.” Those behaviors included “Drive fewer miles”: $t(236) = -6.932$, $p < .001$, “Carpool”: $t(157) = -3.721$, $p < .001$, “Keep children indoors”: $t(139) = -8.556$, $p < .001$, “Trip consolidation (trip planning or making fewer trips)”: $t(241) = -7.016$, $p < .001$, “Avoid outdoor activity”: $t(245) = -7.258$, $p < .001$, “Avoid idling your vehicle”: $t(237) = -6.179$, $p < .001$, and “Avoid using “drive thru” windows”: $t(202) = -5.237$, $p < .001$. Thus, respondents were more likely to report engaging in all of these behaviors on “Red Air Days” than “Yellow Air Days.”

### Pro-Environmental and Avoidance Behaviors on “Yellow Air Days”

In an effort to leverage the overall number of pro-environmental behaviors across “Yellow Air Days,” an exploratory factor analysis was conducted using maximum likelihood estimation with varimax rotation on the recoded “Yellow Air Day” pro-environmental and avoidance self-reported behaviors items (0 = Not Applicable, 1 = Never, 2 = Rarely, 3 = Sometimes, 4 = Often, and 5 = Every time). This was done in an effort to extract unique “Yellow Air Day” behavior factor(s) that would represent a composite of “Yellow Air Day” pro-environmental and avoidance behavior. Pro-environmental and avoidance behavior survey items with a small sample sizes ($n < 170$)
were removed. These included three items: “Stop burning wood or coal,” “Keep children indoors,” and “Carpool.”

The survey items loaded on two factors and various indicators of factorability and residuals indicate that the solution was good. Two factors with eigenvalues of greater than 1.0 were found with factor 1 = 3.184 and factor 2 = 1.317. The scree plot also indicated two factors. The survey items that loaded on factor 1 appeared to relate pro-environmental and avoidance behaviors that require very little physical effort to complete, and factor 2 appeared to relate to behaviors that require greater physical effort, commitment, and behavioral change to complete than those in factor 1. Factor 1 accounted for 39.80% of multivariate variance. Factor 2 accounted for 16.47% of the multivariate variance. The factors, the variables that load on each component, and rotated factor matrix values are shown in Table 5. From this analysis two factor-scores were calculated and saved in the data set. For this factor analysis, the sample size was $N = 230$.

Table 5

*The “Yellow Air Day” Pro-Environmental and Avoidance Behavior Factors Found by the Maximum Likelihood Factor and Rotated Variables*

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trip consolidation</td>
<td>.754</td>
<td>.148</td>
</tr>
<tr>
<td>Drive fewer miles</td>
<td>.712</td>
<td>.218</td>
</tr>
<tr>
<td>Avoid idling</td>
<td>.695</td>
<td>.125</td>
</tr>
<tr>
<td>Avoid using “drive thru” windows</td>
<td>.622</td>
<td>.234</td>
</tr>
<tr>
<td>Avoid outdoor activities</td>
<td>.564</td>
<td>.101</td>
</tr>
<tr>
<td>Walk</td>
<td>.073</td>
<td>.727</td>
</tr>
<tr>
<td>Use public transportation</td>
<td>.190</td>
<td>.454</td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>.106</td>
<td>.410</td>
</tr>
</tbody>
</table>

*Note. N = 230.*
Pearson product-moment correlation (2-tailed) was conducted with age and the factor scores of each “Yellow Air Day” pro-environmental and avoidance behavior factor to determine differences. Additionally, for “Yellow Air Day” behavior factor scores, one-way ANOVAs were conducted to determine differences in the factors by sex. If statistical significance was found, post-hoc comparisons with Bonferroni adjustment were conducted. An alpha level of .05 was used for all statistical tests.

Correlation coefficients were calculated for age and each “Yellow Air Day” behavior factor scores. The relationship between age and all three of the “Yellow Air Day” behavior factor scores was statistically significant. Age had a moderate positive correlation with factor scores, factor 1: $r(223) = .201, p < .01$, and weak negative correlation with factor 2: $r(223) = -.125, p = .063$ that was not significant. Age was positively related to “Yellow Air Day” behaviors factor 1 scores.

Analyses of variance were conducted in an effort to detect differences in each of the factor scores by sex. The effect of sex was not statistically significant for the two factors, factor 1: $F(1,225) = 3.408, p = .066$, partial $\eta^2 = .015$, and factor 2: $F(1,225) = 1.027, p = .312$, partial $\eta^2 = .005$.

Pro-Environmental and Avoidance Behaviors on “Red Air Days”

In an effort to leverage the overall number of pro-environmental behaviors across “Red Air Days,” an exploratory factor analysis was conducted using maximum likelihood extraction with varimax rotation on the recoded “Red Air Day” pro-environmental and avoidance self-reported behaviors items (0 = Not Applicable, 1 = Never, 2 = Rarely, 3 =
Sometimes, 4 = Often, and 5 = Every time). This was done in an effort to extract unique “Red Air Day” behavior factor(s) that would represent a composite of “Red Air Day” pro-environmental and avoidance behavior. Pro-environmental and avoidance behavior survey items with small sample sizes were removed (n < 170). These included three items: “Stop burning wood or coal,” “Keep children indoors,” and “Carpool.”

The survey items loaded on two factors and various indicators of factorability and residuals indicated that the solution was good. Two factors with eigenvalues of greater than 1.0 were found with Factor 1 = 3.039 and Factor 2 = 1.326. The scree plot also indicated three factors. The survey items loaded on two factors. The “Red Air Day” behavior factors are identical to the “Yellow air Day” behavior factors. The survey items that loaded on factor 1 included the pro-environmental and avoidance behaviors that require low levels of physical effort to complete, and factor 2 included the behaviors that require high levels of physical effort to complete. Factor 1 accounted for 37.98% of multivariate variance. Factor 2 accounted for 16.57% of the multivariate variance. The factors, the variables that load on each component, and rotated factor matrix values are shown in Table 6. From this analysis two factor-scores were calculated and saved in the data set. For this factor analysis, the sample size was N = 228.

Pearson product-moment correlation (2-tailed) was conducted with age and the factor scores of each “Red Air Day” pro-environmental and avoidance behavior factor to determine differences. Additionally, for threat perception factor scores, one-way ANOVAs were conducted to determine in factors by sex. If statistical significance was found, post-hoc comparisons with Bonferroni adjustment were conducted. For age, a
Table 6

The Factors Found for “Red Air Day” Pro-Environmental and Avoidance Behaviors by the Maximum Likelihood Factor Analysis and Rotated Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Factor 1</th>
<th>Factor 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avoid idling</td>
<td>.715</td>
<td>.081</td>
</tr>
<tr>
<td>Drive fewer miles</td>
<td>.696</td>
<td>.217</td>
</tr>
<tr>
<td>Trip consolidation</td>
<td>.673</td>
<td>.120</td>
</tr>
<tr>
<td>Avoid outdoor activities</td>
<td>.597</td>
<td>.105</td>
</tr>
<tr>
<td>Avoid using “drive thru” windows</td>
<td>.588</td>
<td>.226</td>
</tr>
<tr>
<td>Walk</td>
<td>.044</td>
<td>.618</td>
</tr>
<tr>
<td>Ride a bicycle</td>
<td>.103</td>
<td>.458</td>
</tr>
<tr>
<td>Use public transportation</td>
<td>.204</td>
<td>.455</td>
</tr>
</tbody>
</table>

Note. N = 228

continuous variable, a correlation was conducted. An alpha level of .05 was used for all statistical tests.

Correlation coefficients were calculated for age and “Red Air Day” behavior factor scores. The relationship between age and the three “Red Air Day” behavior factor scores was statistically significant. Age had a moderate positive correlation with factor 1: \( r(220) = .137, p < .05 \), and a moderate negative correlation with factor 2: \( r(220) = -.114, p = .09 \) that was not significant. Age was positively related to factor 1 scores.

Analyses of variance were conducted in an effort to determine differences in factor scores by sex. The effect of sex was statistically significant for factor 1 though effect size was small, \( F(1,222) = 5.751, p < .05 \), partial \( \eta^2 = .025 \). Female mean factor 1: low effort pro-environmental or avoidance behaviors (\( M = .092 \)) was significantly greater than the male respondents’ mean perception (\( M = -.210 \)). Thus, female respondents
reported significantly greater frequency levels for the low effort pro-environmental or avoidance behaviors on “Red Air Days” than male respondents. The effect of sex was not statistically significant for factor 2: $F(1,222) = .442, p = .507$, partial $\eta^2 = .002$.

**Threat as a Determinant of “Yellow Air Day” Pro-Environmental and Avoidance Behaviors**

To determine if threat perception of air pollution in Cache Valley predicts engagement in pro-environmental behavior and avoidance behaviors, threat perception factor scores, sex, age, education level, and time spent in the Cache Valley will be predictor variables in a multiple linear regression model to predict “Yellow Air Day” pro-environmental or avoidance behavior factors’ scores.

**“Yellow Air Day” Behavior Factor 1**

Multiple linear regression was used to predict “Yellow Air Day” behavior factor 1 scores from a set of predictor variables. A statistically significant model emerged, $F(6,189) = 6.304, p < .001$. The model explains 14% of the variance (Adjusted $R^2 = .140$). Table 7 provides information for the predictor variables entered into the model. Age, threat perception factor 1 scores, and threat perception factor 2 scores were statistically significant, but the other predictor variables were not significant.

**“Yellow Air Day” Behavior Factor 2**

Multiple linear regression was used to predict “Yellow Air Day” behavior factor 2 scores from a set of predictor variables. A statistically significant model did not emerged,
Table 7

Multiple Regression Analysis of “Yellow Air Day” Behavior Factor 1 Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>$t$</th>
<th>$B$</th>
<th>SE $B$</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-.467</td>
<td>-.161</td>
<td>.344</td>
<td>.641</td>
<td></td>
</tr>
<tr>
<td>Threat perception factor 1</td>
<td>.285</td>
<td>4.142</td>
<td>.269</td>
<td>.065</td>
<td>.000</td>
</tr>
<tr>
<td>Threat perception factor 2</td>
<td>.143</td>
<td>2.063</td>
<td>.128</td>
<td>.062</td>
<td>.040</td>
</tr>
<tr>
<td>Age</td>
<td>.246</td>
<td>3.212</td>
<td>.012</td>
<td>.004</td>
<td>.002</td>
</tr>
<tr>
<td>Sex</td>
<td>-.101</td>
<td>-1.417</td>
<td>-.190</td>
<td>.134</td>
<td>.158</td>
</tr>
<tr>
<td>Education level</td>
<td>-.022</td>
<td>-.325</td>
<td>-.015</td>
<td>.046</td>
<td>.764</td>
</tr>
<tr>
<td>Time spent in Cache Valley</td>
<td>-.028</td>
<td>-.373</td>
<td>-.026</td>
<td>.069</td>
<td>.710</td>
</tr>
</tbody>
</table>

Note. Adjusted $R^2 = .140$; $N = 195$.

$F(6,189) = 1.778, p = .106$. The model explains 2.3% of the variance (Adjusted $R^2 = .023$). Table 8 provides information for the predictor variables entered into the model.

No predictor variables were statistically significant.

Threat as a Determinant of “Red Air Day” Pro-Environmental and Avoidance Behaviors

“Red Air Day” Behavior Factor 1

Multiple linear regression was used to predict “Red Air Day” behavior factor 1 scores from a set of predictor variables. A statistically significant model emerged, $F(6,187) = 8.887, p < .001$. The model explains 19.7% of the variance (Adjusted $R^2 = .197$). Table 9 provides information for the predictor variables entered into the model.

Age, sex, threat perception factor 1 scores, and threat perception factor 2 scores were statistically significant, but the other predictor variables were not significant.
Table 8

Multiple Regression Analysis of “Yellow Air Day” Behavior Factor 2 Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>$t$</th>
<th>B</th>
<th>SE B</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>.393</td>
<td>.125</td>
<td>.319</td>
<td>.695</td>
<td></td>
</tr>
<tr>
<td>Threat perception factor 1</td>
<td>.110</td>
<td>1.501</td>
<td>.090</td>
<td>.060</td>
<td>.135</td>
</tr>
<tr>
<td>Threat perception factor 2</td>
<td>-.019</td>
<td>-.257</td>
<td>-.015</td>
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<td>.797</td>
</tr>
<tr>
<td>Age</td>
<td>-.070</td>
<td>-.862</td>
<td>-.003</td>
<td>.003</td>
<td>.390</td>
</tr>
<tr>
<td>Sex</td>
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<td>-1.531</td>
<td>-.190</td>
<td>.124</td>
<td>.128</td>
</tr>
<tr>
<td>Education level</td>
<td>.117</td>
<td>1.623</td>
<td>.069</td>
<td>.042</td>
<td>.106</td>
</tr>
<tr>
<td>Time spent in Cache Valley</td>
<td>-.015</td>
<td>-.192</td>
<td>-.012</td>
<td>.064</td>
<td>.848</td>
</tr>
</tbody>
</table>

Note. Adjusted $R^2 = .023; N = 195.$

Table 9

Multiple Regression Analysis of “Red Air Day” Behavior Factor 1 Scores

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>$t$</th>
<th>B</th>
<th>SE B</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Threat perception factor 1</td>
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<td>.322</td>
<td>.065</td>
<td>.000</td>
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<tr>
<td>Threat perception factor 2</td>
<td>.168</td>
<td>2.518</td>
<td>.150</td>
<td>.060</td>
<td>.013</td>
</tr>
<tr>
<td>Age</td>
<td>.208</td>
<td>2.816</td>
<td>.010</td>
<td>.004</td>
<td>.005</td>
</tr>
<tr>
<td>Sex</td>
<td>-.160</td>
<td>-2.286</td>
<td>-.305</td>
<td>.133</td>
<td>.023</td>
</tr>
<tr>
<td>Education level</td>
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<td>.710</td>
<td>.031</td>
<td>.044</td>
<td>.479</td>
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<tr>
<td>Time spent in Cache Valley</td>
<td>.010</td>
<td>.133</td>
<td>.009</td>
<td>.066</td>
<td>.895</td>
</tr>
</tbody>
</table>

Note. Adjusted $R^2 = .197; N = 193.$

“Red Air Day” Behavior Factor 2

Multiple linear regression was used to predict “Red Air Day” behavior factor 2 scores from a set of predictor variables. A statistically significant model did not emerged, $F(6,187) = 1.168, p = .325.$ The model explains 0.5% of the variance (Adjusted $R^2 = \ldots$
Table 10 provides information for the predictor variables entered into the model. Age, time spent in Cache Valley, and threat perception factor 1 scores were statistically significant, but the other variables were not significant.

Table 10

*Multiple Regression Analysis of “Red Air Day” Behavior Factor 2 Scores*

<table>
<thead>
<tr>
<th>Variable</th>
<th>$\beta$</th>
<th>$t$</th>
<th>B</th>
<th>SE B</th>
<th>$p$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-.258</td>
<td>-.079</td>
<td>.305</td>
<td>.797</td>
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<tr>
<td>Threat perception factor 1</td>
<td>.099</td>
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<td>.078</td>
<td>.060</td>
<td>.195</td>
</tr>
<tr>
<td>Threat perception factor 2</td>
<td>.043</td>
<td>.576</td>
<td>.032</td>
<td>.055</td>
<td>.565</td>
</tr>
<tr>
<td>Age</td>
<td>-.102</td>
<td>-1.237</td>
<td>-.004</td>
<td>.003</td>
<td>.218</td>
</tr>
<tr>
<td>Sex</td>
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<td>-.674</td>
<td>-.082</td>
<td>.122</td>
<td>.501</td>
</tr>
<tr>
<td>Education level</td>
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<td>.050</td>
<td>.041</td>
<td>.222</td>
</tr>
<tr>
<td>Time Spent in Cache Valley</td>
<td>.064</td>
<td>.793</td>
<td>.048</td>
<td>.060</td>
<td>.429</td>
</tr>
</tbody>
</table>

*Note.* Adjusted $R^2 = .005$; $N = 193$. 

CHAPTER V
DISCUSSION

The purpose of this secondary data analysis was to determine if threat perception predicts pro-environmental and avoidance behaviors in the context of air pollution abatement in Cache County, UT. It was hypothesized that people are aware of the air pollution problem in Cache County, perceive the impact of air pollution on the community to be serious (perceived severity), and perceive air pollution is a threat to something they value (perceived susceptibility). Also, it was hypothesized that threat perception affects people’s decision to engage in specific pro-environmental and avoidance behaviors (i.e., reduce miles driven).

Specifically, people are more likely to engage in pro-environmental and avoidance behaviors that require relatively low physical effort to complete (e.g., driving fewer miles and avoid idling) than high physical effort behaviors (e.g., riding a bicycle and walking). Also, as the perceived level of threat increases, people are more likely to engage in pro-environmental and avoidance behaviors on “Red Air Days” than “Yellow Air Days.” The results of the secondary data analysis provide support for these hypotheses.

Air Quality Perception

The Air Quality Perception survey items appear to measure general awareness of local air pollution problems and the associated impacts on the community. Generally, respondents strongly agreed with the statements “Air pollution is a problem in Cache
Valley” and “I consider air pollution in the winter as a threat to my health.” Respondents appear to have a general awareness of the air pollution problem in Cache County. They also acknowledge that air pollution is a problem and a threat to their health in the winter months. Awareness of environmental problems has been found to be an important precursor to other determinants of pro-environmental behavior including environmental beliefs, attitudes, and threat perception (Bamberg & Moser, 2007; Hines et al., 1986).

Hines and colleagues (1986) found in their meta-analysis of the literature on the determinants of pro-environmental behaviors that awareness of the environmental problem to be an important precursor or building block for environmental perception. In a more recent meta-analysis of the literature on the determinants pro-environmental behavior, Bamberg and Moser (2007) found similar results.

These results also confirm some components of the theory of fear appeal in protective motivation theory introduced by Rogers (1975) and expanded by Witte (1992, 1998). One of the proposed components of fear appeals is the perceived likelihood that an environmental event will occur. The results of the analyses support the findings of Axelrod and Lehman (1993) who suggested that two factors: (a) the probability the something threatening will occur, and (b) perceived severity of the threat may directly influence engagement in pro-environmental behaviors. Similarly, the Health Belief Model (Rosenstock et al., 1994) and (Witte 1992, 1998) also argued that threat perception is the combination of perceived susceptibility (likelihood) and severity and helps to predict health behaviors. The results of the survey items suggest that respondents perceive air pollution as an immediate environmental problem, close in proximity or
localized, and occurring primarily in the winter months.

**Impact of Air Pollution Perception**

Furthermore, the perceived Impact of Air Pollution survey items appear to measure perceived threat to individual, community, economic, and nature values. The threat perception factor analysis found that survey items loaded on two separate factors. The survey items that loaded on each threat perception factor appeared to contain similarities. Specifically, factor 1 contained survey items that appeared to relate to personal and community health, and factor 2 contained items related to the economic well-being and conditions in Cache County.

The results of the analysis may also provide supportive evidence of Stern and Dietz (1994) theory that there are three value-based environmental concerns egoistic, social-altruistic, and biospheric. Their theory postulates that people will become concerned about environmental issues when there is a real or perceived impact (threat) on some condition or item of value to the person. Generally, the survey items appeared to capture components of these three value-based environmental concerns. Participants report that the perceived impact of air pollution on egoistic values such as their current and future health, social-altruistic values such as the health of someone they know, quality of community life, visibility of landscape and roadways, and tourism in Cache Valley, and biospheric values such as health of plants and animals to be relatively serious. Generally, perceived threat related to these values appears to be relatively high.

Additionally, the results confirm another component of fear appeals in a
protective motivation theory by Rogers (1975) and Witte (1992; 1998) concerning the perceived severity of an environmental event. These results also support Axelrod and Lehman’s (1993) theory, the Health Belief Model (Rosenstock et al., 1994), and the fear appeals theory (Witte 1992, 1998) concerning the perceived severity of the threat as the second component of threat perception. Additionally, the results are similar to Zeidner and Shechter (1988) findings that the perceived severity of air pollution was a strong predictor of affective response and willingness to pay for air pollution abatement. As measured by these survey items, the perceived severity of local air pollution appears to be relatively high.

Threat Perception

The exploratory factor analysis on these air quality perception and impacts of air pollution survey items found that they loaded on two threat perception factors. Factor-scores seem to suggest that there are two unique dimensions of threat perception that separate out into personal and community health-related survey items and economic-related survey items in Cache County. These factors can also be viewed as two aspects of the community that people consider valuable. Respondents’ mean scores on the survey items also suggest that they perceive air pollution as a threat to these two aspects of the community. Again, these results of the factor analysis seem to provide some supportive evidence for the value-based theory of Stern and Dietz (1994). Survey items appear to support a multi-dimensional threat factors that includes egoistic, social-altruistic, and biospheric qualities. Additionally, the results appear to support components of the fear
appeal theories of Rogers (1975) and Witte (1992, 1998), the theories of Axelrod and Lehman (1993), and Health Belief Model (Rosenstock et al., 1994). Specifically, threat perception may be a combination awareness of the threat, perceived susceptibility (likelihood) and perceived severity. Overall, reported threat perception of air pollution and its perceived impact on aspects of respondents’ personal and community life and economic well-being in Cache County appear to be relatively high.

Some sociodemographic differences were found for threat perception. It was found that female respondents reported a greater degree of perceived threat related to personal and community health in threat perception factor 1 scores than male respondents. Results confirm previous findings on sex differences that women report higher levels of environmental concern than men (i.e., Bord & O’Conner, 1997; Bord et al., 1992; Stern et al., 1993, 1995). However, no sex difference was found for threat perception factor 2 scores that included survey items related to economic well-being in the community.

Age was statistically unrelated to threat perception factor 1 scores and threat perception factor 2 scores. This conflicts the results of some previous research that suggests that young people are more concerned about environment than older people (i.e., Arcury & Christianson, 1990; Van Liere & Dunlap, 1981).

Self-Reported Pro-Environmental and Avoidance Behaviors

The frequency that respondents reported engaging in many pro-environmental and avoidance behaviors was relatively low. An analysis of the self-reported engagement in
pro-environmental and avoidance behaviors found that the respondents’ mean responses varied between “Never,” “Rarely,” and “Sometimes” for all of the survey behavior items. The behaviors that respondents reported most frequently engaging in on both “Yellow” and “Red Air Days” include “Drive fewer miles,” “Trip consolidation,” “Avoid outdoor activity,” “Avoid idling your vehicle,” and “Avoid using “drive thru” windows.” Three items were excluded from the factor analysis because total responses were low for each \((n < 170)\). These items include “Carpool,” “Keep children indoors,” and “Stop burning wood or coal.” The other behavior survey items were entered into an exploratory factor analysis and loaded on “Yellow” and “Red Air Day” behavior factor 1. Behavior factor 1 appears to include behaviors that require low levels of physical effort to complete. The opposite was found for behaviors that require a high level of physical effort to complete such as “Ride a Bicycle,” “Use public transportation,” and “Walk” with very low means for both “Yellow” and “Red Air Days.” Generally, respondents were less likely to report engaging in pro-environmental and avoidance behaviors that require a greater level of physical effort to complete than behaviors that require less physical effort though the reported frequency for both types of behaviors was relatively low.

Although the self-reported frequency means were generally low for most pro-environmental and avoidance behaviors, it was found that most behaviors increased in frequency from “Yellow” to “Red Air Days.” In other words, as both real and perceived threat increased, respondents were more likely to report engaging in a number of pro-environmental and avoidance behaviors on “Red Air Days” than on “Yellow Air Days.”
The results of this analysis confirm our hypothesis that increased levels of perceived threat influence respondents’ decision to engage in pro-environmental and avoidance behaviors. This also confirms the findings of other researchers that have found perceived threat as a determinant of pro-environmental behaviors in a variety of contexts and environmental issues (e.g., Axelrod & Lehman, 1993; Baldassare & Katz, 1992; Fransson & Garling, 1999; Grob, 1995; Johnson & Scicchitano, 2000).

Interestingly, the only behaviors that were found to increase in frequency from “Yellow” to “Red Air Days” were those that required low levels of physical effort to complete. The reason for this difference may be attributed to ease and convenience of these behaviors to complete. Unlike walking, riding a bicycle, and using public transportation, low effort behaviors do not require a large time commitment or major alteration in daily routine. Low effort behaviors from behavior factor 1 do not require one to severely alter their habitual, daily behaviors or routine. This has important implications for both future research and public policy development. Social marketing campaigns that focus on low effort, habitual behaviors that are part of our daily routines may be more effective in encouraging pro-environmental behavior. Clearly, pro-environmental behaviors that require high levels of physical energy or represent major behavioral change are more difficult to encourage.

Some sociodemographic differences were found for “Yellow” and “Red Air Day” behavior factor scores. Age was statistically related to respondents’ decision to engage in pro-environmental and avoidance. For “Yellow Air Day” and “Red Air Day” behavior factor 1 scores, age was positively correlated with the decision to engage in these
behaviors. Older respondents report higher frequency levels for pro-environmental behaviors on “Yellow Air Day” and “Red Air Day” than young respondents. Age differences may be due to a number of reasons. There may be age differences in how people perceive pro-environmental behaviors and their ability to engage in these behaviors. Older people may be more concerned with preventing environmental problems than younger people because they have more time to ruminate on the environmental issues, have fewer work- and family-related demands, and have more disposable income and time than young people. Because of different life demands, young people may not be as willing or able as older people to make behavioral modifications on “Yellow Air Days” when the air pollution levels in the valley are not at dangerous levels (low threat level). More research is needed to clarify the possible reasons for age differences.

Respondents’ sex appeared to have little impact on the decision to engage in pro-behaviors and avoidance behaviors from “Yellow Air Day” behavior factors 1 and 2 scores. Similarly, sex did not impact behaviors from “Red Air Day” behavior factors 2. However, sex did have a significant impact on behaviors from “Red Air Day” behavior factor 1 scores. Female respondents reported engaging in behaviors from “Red Air Day” behavior factor 1 more frequently than male respondents. Female respondents reported higher levels of perceived threat overall than male respondents and were more likely to report engaging in these behaviors on “Red Air Days.” This finding is noteworthy. These findings support the literature on sex differences. Additional research is needed to determine why men report lower levels of perceived threat and lower levels of engagement in pro-environmental and avoidance behaviors than females.
Threat as a Determinant of Pro-Environmental and Avoidance Behaviors

The multiple linear regression analysis on each “Yellow” and “Red Air Day” pro-environmental and avoidance behavior factor scores yielded a number of interesting results. Among the predictor variables used in the regression model are the two threat perception factor scores, age, sex, time spent in Cache Valley, and education level. The threat perception factor scores accounted for some of the variance on the “Yellow Air Day” and “Red Air Day” behavior factor 1 scores, but not on the behavior factor 2 scores.

Threat perception factor scores 1 accounted for the most variance in each of the statistically significant regression models. For threat perception factor 1 scores, it was found to be a significant predictor of behavior scores for “Yellow” and “Red Air Day” behavior factor 1 (i.e., driving fewer miles and avoid idling your vehicle) and behavior factor 2 (i.e., walking, bike riding, and using public transportation). Threat perception related to personal and community health-related survey items appears to predict pro-environmental and avoidance behaviors that require low levels of physical effort to complete and shared transportation activities but not high effort behaviors such as walking or riding a bicycle. Perceived threat related to personal or community health may discourage these behaviors because participating in these behaviors actually increases your exposure to air pollution.

Threat perception factor 2 that contained survey items relating economic well-being and conditions was a statistically significant predictor for behavior factor scores
“Yellow Air Day” and “Red Air Day” behavior factor 1, but not for behavior factor scores 2. Additional research is needed to clarify these findings.

Sociodemographic variables helped to predict pro-environmental and avoidance behaviors on “Yellow” and “Red Air Days.” Age was a statistically significant predictor variable for the behavior factor scores on all factors for both “Yellow” and “Red Air Days.” Sex was only significant in predicting “Red Air Day” behavior factor 1 scores. Time spent in Cache Valley and education level were not statistically significant predictor variables for any of the behavior factor 1 or 2 scores on either day. Education level was not a significant predictor variable for any of the behavior factors. Age and sex of the respondent should be included in future research regarding the prediction of pro-environmental and avoidance behaviors.

General Discussion

Threat perception played an important role in predicting some pro-environmental and avoidance in the context of air pollution abatement in Cache County, UT. Specifically, threat perception related to personal and community health in Cache County was found to be a significant predictor variable for most “Yellow” and “Red Air Day” behaviors except for walking, riding a bicycle, and using public transportation.

Each of the hypotheses was supported by the results of the secondary data analysis. Specifically, threat perception may be a combination awareness of the threat, perceived susceptibility (likelihood) and perceived severity. Also, the results confirm the findings of previous research on threat perception as a determinant of pro-environmental
behaviors (e.g., Axelrod & Lehman, 1993; Baldassare & Katz, 1992; Fransson & Garling, 1999; Grob, 1995; Johnson & Scicchitano, 2000). Based on the results of this secondary data analysis and the review of the threat perception literature, one could conclude that although threat perception accounted for some of the variance in the multivariate regression models, no single determinant predicts pro-environmental and avoidance behaviors. More likely, predicting pro-environmental behaviors requires one to take a multivariate approach and consider measures of other possible determinants such as emotions (e.g., fear and shame), attitudes, beliefs, cognitions, and sociodemographic variables.

Limitations

The results of this secondary data analysis suffer from a few limitations. First, the original survey instrument was not designed to test a specific threat perception theory or model. For this reason, one could argue that the survey items may have lacked construct and content validity and insufficiently measured threat perception. Future research on threat perception should include a more thorough inclusion of the findings from previous threat perception research.

Second, the results of the survey may not be generalizable to other communities. Survey items were designed specifically to capture local environmental perceptions and pro-environmental and avoidance behaviors concerning a specific local environmental problem. For example, Cache County, Utah, is part of the Mormon Culture Region (Meinig, 1965; Toney, Keller, & Hunter, 2003). It is estimated that 95% of the people...
that reside in the county are members of The Church of Jesus Christ of Latter-day Saints (LDS; The Association of Religion Data Archives, 2008). Their religious orientation may have an impact on environmental concern and pro-environmental behaviors. Brehm and Eisenhauer (2006) found LDS responses favored conservation efforts over preservation. When compared to non-LDS residents in their study, LDS were equally concerned with community health and/or identity, more concerned with conservation, more strongly opposed to public land restrictions, and lower importance on environmental issues not related to community health.

Similarly, Hunter and Toney (2005) found that LDS in Logan, UT (city in Cache County, UT) expressed greater levels of environmental concern but were less likely to engage in pro-environmental behaviors (e.g., paying higher prices and/or taxes to protect the environment or participation in environmental activism) than respondents from the national sample. The authors cautioned that the differences might be due to the large number of college students that participated in the study. College students may, because of both age and financial limitations, be unable to donate money toward environmental causes. Additional research is needed to determine the impact of religious orientation on the decision to engage in pro-environmental behaviors.

Another important sociodemographic variable not measured was information on at-risk residents. At-risk residents such as the elderly, young children, and those with health concerns that are exacerbated by air pollution may have higher levels of threat perception than other residents. Skov and colleagues (1991) found that specific populations such as those with lung disease may experience greater levels of threat and
anxiety and are more likely to protect themselves from exposure to air pollution by avoiding outdoor activity and car driving than healthy respondents. Because of these heightened levels of threat perception, “at-risk” people may be more likely to engage in pro-environmental or avoidance behaviors than someone of good health.

Third, a number of social psychological constructs that may act as mediating variables such as other negative emotions, positive emotions, locus control, and optimism were not included on the survey instrument. These constructs may act as mediating variables in the prediction of threat levels and pro-environmental behaviors. For example, Vining and Ebreo (2002), both positive and negative emotions may be strong predictors of pro-environmental behavior and mediators of other predictor variables. Emotions may play a significant role in whether or not people decide to engage in specific pro-environmental behaviors. Kals, Schumacher, and Montada (1999) also argued that both negative and positive emotions influence the decision to conserve resources.

Specifically, Carrus, Passafaro, and Bonnes (2008) found in two separate studies that negative anticipated emotions and past behavior were significantly correlated with desire that was positively correlated with behavioral intentions to use public transportation and recycle household waste. In a review of the pro-environmental literature, Bamberg and Moser (2007) suggested ‘moral’ emotions (i.e., guilt and shame) have been found to influence pro-environmental behavior. Research has also found that fear arousal (i.e., perceived threat) influences the decision to engage in pro-environmental behaviors (e.g., Axelrod & Lehman, 1993; Baldassare & Katz, 1992; Fransson & Garling, 1999; Grob, 1995; Johnson & Scicchitano, 2000). One positive emotional variable that
has received some recent attention from the scientific community is emotional affinity toward nature. Emotional affinity in this case refers to the fascination with the natural world that motivates contact with nature (Kals et al., 1999). Kals and colleagues conducted a questionnaire study in Germany that found that emotional affinity toward nature, indignation, and interest in nature were all powerful predictors of nature-protective behaviors.

Third, response rates for many of the surveyed blocks were relatively low. One reason for this low response rates may be that accommodations were not made for the Hispanic population that makes up an estimated 6.3% of the population in Cache County (U.S. Census Bureau, 2000), and a Spanish-language version of the survey instrument was not created. Hispanics levels of threat perception and pro-environmental behaviors might differ from that of the Caucasian residents of Cache Valley. Additional research is needed to determine differences. Other possible reasons for the low response rates may be due to the age restrictions (must be over 18 years of age) placed on participation in the study and educational level of potential participants.

Fourth, collection of the survey data suffered from a few problems. For example, the sample calculations were based on U.S. census data from 2000. Cache County population has grown significantly in the past 7 years. Many of the blocks that were sampled contain additional households. These additional households however, were excluded from the study. We did not modify our calculations to reflect the change in the total households on the block. Future studies in Cache County may choose to use estimated census data. Also, data collection occurred during an exceptionally mild winter
with very few “Red Air Days.” Because the air quality was relative clean during the winter of 2007, respondents’ perception of air pollution and its severity may not have been as high as it would have been during a poor air quality winter. This may have an affect on the perceived severity of air pollution conditions in Cache County, perceived threat, and how frequently people engaged in pro-environmental behaviors. Fifth, data collection occurred over a 4-week period of time from March to April in 2007.

Finally, the demographic information of the sample was not representative of the population description of Cache County, Utah provided by the 2000 U.S. Government Census Data. These limitations must be considered when interpreting the results and generalizing the findings to the Cache County population, similar, or different populations; and to other environmental problems and pro-environmental behaviors. Future research should specifically address these limitations.

Future Research

Future research on the determinants of pro-environmental and avoidance behaviors in the context of air pollution abatement should consider including measures of a wide variety of sociodemographic variables, social psychological constructs, and cognitions. Based on the results of this secondary data analysis, threat perception may be a determinant of pro-environmental and avoidance behaviors especially as it relates to health risks, but it is insufficient to predict behaviors. Other predictor variables are necessary to more completely explain and predict future participation in pro-environmental behaviors. Predicting pro-environmental behaviors most certainly requires
a multivariate research approach that more fully accounts for the many possible
determinants on pro-environmental behaviors. Some sociodemographic variables that
have showed some promise are age, sex, political orientation, and religion as potential
determinants. Other variables that researchers could focus future studies on are the
possible impact of both negative and positive anticipatory emotions on the decision to
engage in pro-environmental behaviors because of their recent emergence in other
literatures as determinant of self-reported behaviors (Izard, 2007; Mellers & McGraw,
2001) and actual behaviors (Lindsey, 2005). Additional research concerning anticipatory
emotions and their impact of pro-environmental behaviors is needed to determine more
clearly their role in predicting behavior.

As the human impact on the environment increases, research on the determinants
of pro-environmental and avoidance behavior becomes increasingly more important.
Results from research on the determinants of pro-environmental behaviors can led to
more informed public policy and educational efforts that may help to minimize or abate
the impact of humans on the environment. Specifically, social marketing campaigns
could focus their education efforts on impact of local environmental problems on human
values and provide a list of specific pro-environmental and avoidance behaviors that are
part of peoples’ daily routine and require minimal effort to complete. Creating an optimal
level of threat toward specific human values may be a key component of encouraging
long-term individual and collective behavioral change.
REFERENCES


Appendix A

Air Quality Perception Survey
Please answer the following questions. Do not write your name on this survey. You are free to discontinuе taking or not answer questions from the survey anytime for any reason without penalty. The survey should take between five and fifteen minutes to complete, but feel free to take as much time as you need to complete this survey.

Air Quality Perception
Below are some statements concerning air quality in Cache Valley. Using the scale provided, please indicate the extent to which you agree or disagree with each statement.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Disagree</th>
<th>Slightly Disagree</th>
<th>Slightly Agree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Air pollution is a problem in Cache Valley.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Air pollution is only a problem in Cache Valley.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. My individual actions have an impact on the air quality in Cache Valley.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. There are health risks related to exposure to air pollution.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. People in Cache Valley are doing their part to reduce air pollution.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. There should be more government efforts to control air pollution in Cache Valley.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. I consider air pollution in the winter as a threat to my health.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Possible causes of Air Pollution in Cache Valley during the winter
Below is a list of possible causes of air pollution in Cache Valley. In your view, what are the most significant contributors to air pollution in the valley? Please rank the possible causes of air pollution in Cache Valley by the extent to which you feel they contribute to air pollution in the winter. (1 = most significant contributor to 7 = least significant contributor)

<table>
<thead>
<tr>
<th>Cause and Source</th>
<th>First</th>
<th>Second</th>
<th>Third</th>
<th>Fourth</th>
<th>Fifth</th>
<th>Sixth</th>
<th>Seventh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars and Trucks (Non-diesel)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Climate and geography (valley)</td>
<td></td>
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<tr>
<td>Diesel-powered vehicles and motors</td>
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<td></td>
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<tr>
<td>Industrial (factory) sources</td>
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<tr>
<td>Agriculture and other agricultural resources</td>
<td></td>
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<tr>
<td>Wood and coal burning in homes</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Other possible sources</td>
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</tr>
</tbody>
</table>

Effects of Air Pollution
Below is a list of conditions that may be affected by air pollution in Cache Valley. Please indicate how serious you believe that each condition is affected by air pollution.

<table>
<thead>
<tr>
<th>Condition</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. My current health</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>2. My future health</td>
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<tr>
<td>3. The health of someone I know</td>
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<tr>
<td>4. Personal medical costs</td>
<td></td>
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<tr>
<td>5. The health of animals and plants</td>
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<tr>
<td>6. The general quality of community life in Cache Valley</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>7. The visibility of landmarks and scenery</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>8. Tourism and tourism dollars in Cache Valley</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>9. Property values in Cache Valley</td>
<td></td>
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<tr>
<td>10. Population growth (people moving here) in Cache Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. Financial costs to business in Cache Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. Attracting new businesses to open in Cache Valley</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. Keeping businesses here in Cache Valley</td>
<td></td>
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</tr>
</tbody>
</table>

86
"Green, Yellow, and Red Air Day" Pollution Advisory during the winter

The "Green, Yellow, and Red Air Day" Pollution Advisory is color-coded alert that tells the public how high the levels of pollution are in the air. Each color represents a specific concentration of pollution in the air and provides a list of activities that should be avoided to reduce the climbing levels of pollution. Please indicate how often (if ever) you find out about the current color alert of the "Green, Yellow, and Red Air Day" Pollution Advisory during the winter.

- Never
- Once a week
- Once a month
- 2-3 times a month
- Everyday

Please indicate which of the following sources you primarily use to find the current "Green, Yellow, and Red Air Day" alert. (Mark all that apply)

- [ ] Radio
- [ ] Internet
- [ ] Television
- [ ] Newspaper
- [ ] Other people
- [ ] Electronic road signs on Main Street

What can be done to improve the effectiveness of the "Green, Yellow, and Red Air Day" Pollution Advisory?

Your activities on "Yellow" and "Red" Air Days during the Winter Inversion

"Yellow" and "Red" air days are days with high levels of air pollution that can negatively impact your health. Please indicate how often you participate in the following activities on "yellow" and "red" air days.

**Yellow**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Every Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drive fewer miles</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>2. Carpool</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>3. Use public transportation</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>4. Stop burning wood or coal</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>5. Keep children indoors</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>6. Trip consolidation (trip planning or making fewer trips)</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>7. Avoid outdoor activity</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>8. Avoid idling your vehicle.</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>9. Avoid using &quot;drive thru&quot; windows</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>10. Walk</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>11. Ride a Bicycle</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
</tbody>
</table>

**Red**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Every Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Drive fewer miles</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>2. Carpool</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>3. Use public transportation</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>4. Stop burning wood or coal</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>5. Keep children indoors</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>6. Trip consolidation (trip planning or making fewer trips)</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>7. Avoid outdoor activity</td>
<td>☑</td>
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<tr>
<td>8. Avoid idling your vehicle.</td>
<td>☑</td>
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<td>☑</td>
<td>☑</td>
</tr>
<tr>
<td>9. Avoid using &quot;drive thru&quot; windows</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>10. Walk</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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<tr>
<td>11. Ride a Bicycle</td>
<td>☑</td>
<td>☑</td>
<td>☑</td>
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</tr>
</tbody>
</table>

What other activities are you doing to reduce air pollution on "yellow" and "red" air days?
What would you be willing to do in the future to minimize your contributions to air pollution during the winter inversions? (Check all that apply)

- [ ] Nothing
- [ ] Repair vehicles when it is giving off too much smoke
- [ ] Avoid idling vehicle
- [ ] Repair vehicles when "check engine" light comes on
- [ ] Avoid using the drive-thru windows
- [ ] Stop burning wood or coal
- [ ] Carpool
- [ ] Trip consolidation
- [ ] Drive fewer miles
- [ ] Yearly inspection of automobile emission system
- [ ] Public transportation (UTC and CVFD Bus)
- [ ] Other

Strategies of the Bear River Health Department to Reduce Air Pollution in Cache Valley

Listed below are some strategies that have been used by the Bear River Health Department to reduce air pollution in Cache Valley. Please indicate how effective you think these strategies have been in reducing air pollution in Cache Valley.

<table>
<thead>
<tr>
<th>Never heard of it</th>
<th>Indicative</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. &quot;Green Valley, and Bear Air Day&quot; Pollution Advisory</td>
<td>☐</td>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td>☑</td>
</tr>
<tr>
<td>2. Smoking Vehicle Hotline</td>
<td>☐</td>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td>☑</td>
</tr>
<tr>
<td>3. Voluntary Reduction of Kilometers (Miles Traveled Per Vehicle)</td>
<td>☐</td>
<td>☑</td>
<td></td>
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<td></td>
<td>☑</td>
</tr>
<tr>
<td>4. Wood Burning Program</td>
<td>☐</td>
<td>☑</td>
<td></td>
<td></td>
<td></td>
<td>☑</td>
</tr>
<tr>
<td>5. Air Quality Info (Videos)</td>
<td>☐</td>
<td>☑</td>
<td></td>
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<td>☑</td>
</tr>
<tr>
<td>6. Encouraging the use of public transportation</td>
<td>☐</td>
<td>☑</td>
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<td>☑</td>
</tr>
</tbody>
</table>

Please list any suggestions you may have about the strategies used by the Bear River Health Department to reduce air pollution during the winter inversions.

What other suggestions or comments do you have concerning air quality, policies, and education?

Indicate the answer that is most applicable to you:

1. Are you? ☐ Female ☐ Male
2. How old are you? [ ]
3. Are you currently enrolled as a part-time or full-time student at Utah State University? ☐ Yes ☐ No
4. Fill the circle next to the category which best describes your formal education:
   ☐ Some high school ☐ Vocational or Associate Degree
   ☐ Graduated from high school ☐ Four-year degree
   ☐ Some college ☐ Post-graduate work or degree
5. How long have you lived in Cache Valley?
   - Less than 1 year
   - 1 year to 5 years
   - 5 years to 10 years
   - More than 10 years

6. Have you viewed the Air Quality video produced by the Bear River Health Department?
   - Yes
   - No

7. What kind of wood burning device do you own?
   - None
   - Fireplace
   - Conventional woodstove (pre-1988)
   - EPA certified woodstove (post-1988)
   - Pellet stove

8. How often do you use your wood burning device during a typical winter season?
   - Less than 10 days
   - 11 - 30 days
   - More than 30 days
   - Not Applicable

9. What kind of wood do you burn?
   - Hardwood (e.g. maple, oak)
   - Softwood (e.g. pine, aspen)
   - Pellets
   - Scrap
   - Not Applicable

Thank you for your participation.
Appendix B

Cover Letter
Dear Community Member:

The Bear River Health Department and Utah State University are partners in conducting an Air Quality Survey in Cache Valley. The survey will collect information concerning the community’s opinions of air quality and the impact of educational efforts over the past year in Cache Valley. This information will be used by the Bear River Health Department to assist in developing strategies to improve air quality in Cache Valley.

Your opinions and ideas are of great value and we encourage your participation in this brief survey. Please take a few moments to complete this anonymous survey. After completing the survey, return the survey to the bag and hang it on your front doorknob for pick-up. A representative from the Bear River Health Department will return within 24 hours to pick-up your completed survey. Results from the survey will be posted on a page at the Bear River Health Department website: http://www.brhd.org/air_quality.html.

To ensure your anonymity and confidentiality, your name has not been included on any of these documents. Please do not write your name or put any identifying mark on the survey or any other document associated with the survey. Additionally, we prefer an adult (18 years old or older) to complete the survey.

If you have questions or comments concerning the survey please contact Joshua Marquit at 797-8101 or by email at jmarquit@cc.usu.edu. We look forward to receiving your ideas, opinions, and suggestions concerning air quality in Cache Valley.

Thank you,

Lloyd Borensten
Director
Bear River Health Department

Scott C. Bates
Assistant Professor, Department of Psychology
Utah State University

Joshua D. Marquit, Graduate Student, Experimental and Applied Psychological Science, Utah State University
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