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Assessing a combined theories approach to climate change communication

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ASSESSING A COMBINED THEORIES APPROACH TO CLIMATE CHANGE

COMMUNICATION

by

Ted Greenhalgh Jr.

A dissertation submitted in partial fulfillment

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ABSTRACT

This research examines the complexities of communicating climate change risk information and the underlying individual attitudes and message content that affect message reception. Using climate change messages incorporating fear appeals and normative information subject's reactions to the messages were evaluated using the Theory of Planned Behavior model. The study found that fear appeals did increase behavioral intention to adopt a lower carbon lifestyle among test group subjects. The Theory of Planned Behavior model showed that attitudes and self-efficacy were significant predictors of the behavioral intent to adopt a lower carbon lifestyle, while community norms were only marginally predictive. However, not all attitude measures were predictive, while the personal injunctive community norms measure was. The study also found that pre-existing attitudes towards the environment and conservatism were also good predictors of intent to change behavior. This study suggests that fear appeals can be an effective means of communicating climate change to motivate behavioral change. The study also suggests that the combined approach used in this study allows researchers to understand the interplay of worldviews, news information, and individual attitudes about changing behavior that play an integral part of how the public comes to terms with complex issues.

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CHAPTER 1

INTRODUCTION

Global climate change is arguably the greatest environmental challenge facing the world today (IPCC, 2007). It is challenging not only to science, which struggles to understand the physical dynamics of climate change, but also to society, which must make considerable changes from the grandest societal scales down to individual actions. As our power grids and manufacturing switch over to alternative power solutions, people will also have to adopt lower carbon lifestyles, whether through voluntary measures or governmental mandates. Individual actions can lower carbon emissions as well. Anthropogenic carbon dioxide emissions could be reduced by 30% using existing technologies and methods (IPCC, 2007), but getting people to adopt routines and innovations that will lower their carbon footprint have met with mixed results (Bord et al., 2008).

In the United States people have resisted calls for change for a number of reasons ranging from unfamiliarity with the emission reduction programs, lack of access to technologies, inability to afford new technologies, and apathy towards the need to act (Etkin & Ho, 2007; Moser & Dilling, 2004). This resistance continues despite attempts to communicate the problem with the public on many levels. High profile climate change advocates, like former Vice President Al Gore and T. Boone Pickens travel the world trying to educate the public on not only the threat posed by climate change, but also the economic and social opportunities

changing to a lower carbon lifestyle present. In popular culture a number of big-budget climate-driven disaster movies, regular references in television programs, and even in advertising campaigns continue to bring attention to the consequences of climate change, the problem continues unabated. While these activities have won acclaim from a number prestigious organizations, the majority of the American public display a limited willingness to sacrifice and change their carbon-emitting habits (Pew, 2009; Mason-Dixon, 2008, Bord et al., 2008). In the U.S. hybrid automobiles sales continue to show respectable numbers each year, but still lag far behind the top selling vehicles, the low gas mileage Ford F-150 and Cheverolet Silverado pickups. Even countries like the United Kingdom, where climate change issues are taken very seriously by a government with little political opposition, public engagement has increased understanding and concern about the issue, but still failed to create any significant behavioral changes (Lorenzi et al., 2007).

Ironically, the majority of poll respondents and study subjects state that they are aware of the problem and think something should be done, but still seem to lack the motivation to change to lower carbon alternatives (Pew, 2009; Mason-Dixon, 2008, Maibach et al., 2010). Unfortunately, simply trying to educate the public about a problem often is not enough. For social scientists, the debate about what really matters in promoting behavioral change often centers on two factors; human agency to change and the social structures involved (Blake, 1999). Undoubtedly, any changes to a lower carbon existence will require

using the high carbon infrastructure industrialized countries have embraced for over a century. Before lower carbon alternatives can replace current higher carbon choices, they need to be as efficient, effective, similar in price, availability, and capable of integrating with the current infrastructure (Black et al., 1985; Davies, et al., 1997; Eden, 1993; McKenzie-Mohr & Smith, 1999). Even ordinary individual actions can impact climate change mitigation, but are still ignored. Simple tasks like walking short trips instead of driving, turning off lights and electronics when not in use, adjusting thermostats to use less energy, and other similar carbon lowering activities continue to be minority behaviors (DEFRA, 2008). In the U.K. for example, despite attempts to promote these kinds of individual behaviors, the domestic energy use still increased by 5% and transportation energy use increased by 10% from 1990 to 2005, with only about one third of the population saying they tried to make better choices (DEFRA, 2008).

It seems switching to a lower carbon lifestyle depends on both improving human attitudes and social structures to support the change. Recent arguments put forward address both concerns by combining the processes into strategic communication campaigns that use government actions in a top down effort and public communications in a grassroots bottom-up fashion to foster behavioral change (Maibach et al., 2008;Ockwell et al., 2009). For the grassroots effort to succeed the messages have to resonate with the audience to motivate them to take action, but how people decide to adopt a new behavior or technology follows

a complex series of personal evaluations. Unfortunately, crafting messages that will resonate with the public appears to be much more complicated than earlier media campaigns had imagined and prompt a need to reevaluate how people come to adopt new behaviors (Bord et al., 2008; DEFRA, 2008; Lorenzi et al., 2007). Understanding how this process works and identifying what messages need to be effective is critical to promoting the wide variety of innovations necessary to mitigate or eliminate anthropogenic carbon dioxide production.

1.1 Purpose of the Study

This study evaluates the efficacy of various climate change media messages at promoting a behavioral intention among readers to adopt a lower carbon footprint. The study will also examined the underlying attitudes that might explain why some environmental messages resonate with some people while being ignored by other people. By understanding the dynamics of this unique environmental communication problem it is hoped that new light will be shed on the issues surrounding complicated risk information issues and allow risk communicators to better address their audiences and have a more complete understanding of why some people might be resistant to accepting their information.

Even as the information landscape continues to change due to 24 hour cable news outlets and the Internet, much of the public still depends on mass media television broadcasts and newspapers for news. Unfortunately, journalists

have a very limited amount of time and space to present these messages making it difficult to properly report on the complex nature of climate change. Add to this that journalists typically try to not take a stand on an issue, aiming for objective reporting over promoting behavioral change. The exception to this rule comes from health reporting, which often includes recommendations for detection, avoidance, and treatment options. This study used a similar approach, borrowing from communication persuasion theories to craft messages that promote behavioral changes to lessen individual contributions to carbon dioxide production. The study also borrows attitudinal theories from social psychology to evaluate those unique attributes that make one person accept a message and another person ignore it.

CHAPTER 2

STATE OF THE LITERATURE

This inter-disciplinary research draws on theories from three fields,

persuasion communication, behavioral psychology, and attitudinal psychology in

an attempt to answer unresolved questions related to climate change research.

2.1 Diffusion Theory Research

While studying the ways in which farmers came to adopt new

technologies, Everett Rogers made some keen conceptual insights into the

process (Rogers, 1962). Rogers first identified five groups that made up the

population of innovation adopters as shown in Figure 1.
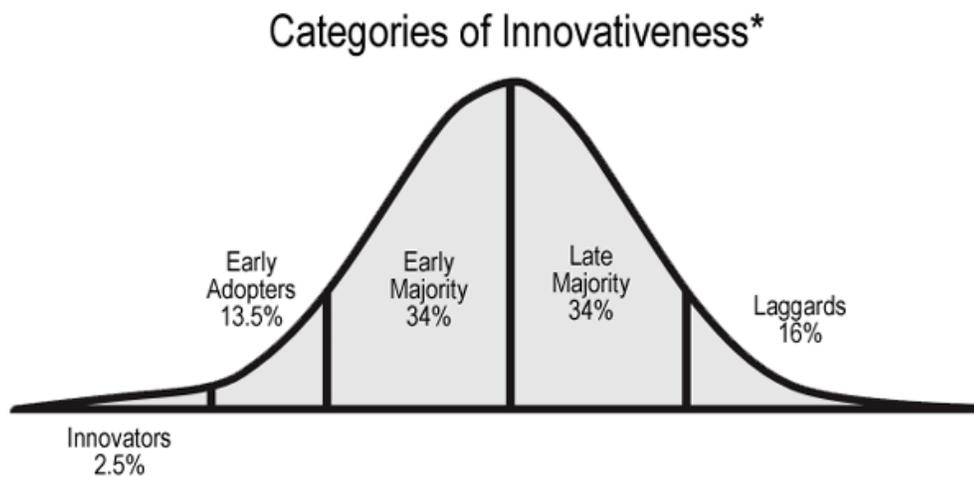
Figure 1. Adoption groups with the earliest adopters on the left.

The first group to adopt a new innovation, the innovator group, consists mainly of those people directly or peripherally responsible for the creation of the new innovation. This group has already invested heavily in the innovation creating a strong motivation for its adoption. The second group to adopt the innovation, the early adopters, contains members who like to be the first to own or use a new innovation and are willing to pay premium prices for the privilege. This group tends to have the more disposable income and sees acquisition of the new innovation as much as an expression of their self-image as a necessity of life. The third group, the early majority, is made up of mostly common people who have come to see the merit of using the new innovation, either through their own critical evaluation, or the recommendation of opinion leaders. Opinion leaders are respected individuals in a society, both formal and informal, whose choices promote similar behaviors in the broader society (Katz & Lazarsfeld,1955; Lazarsfeld, et al., 1944). The forth group, the late majority, are much like the third group, but slower to adopt due to lower income levels, lessened access to the innovation, or other physically limiting factors. The final group, the laggards, resists adoption of new innovations until they have no choice due mostly to the obsolescence of their previous preference.

Rogers modeled the process of how people decide to adopt a new innovation in figure 2. During the knowledge phase, the individual learns about and evaluates the value of the new innovation by weighing a number of personal and social variables like perceived needs and social norms. The more this new

information aligns with the person's perception that the innovation has the potential to improve their lives the more likely they are to take a closer look at the innovation.
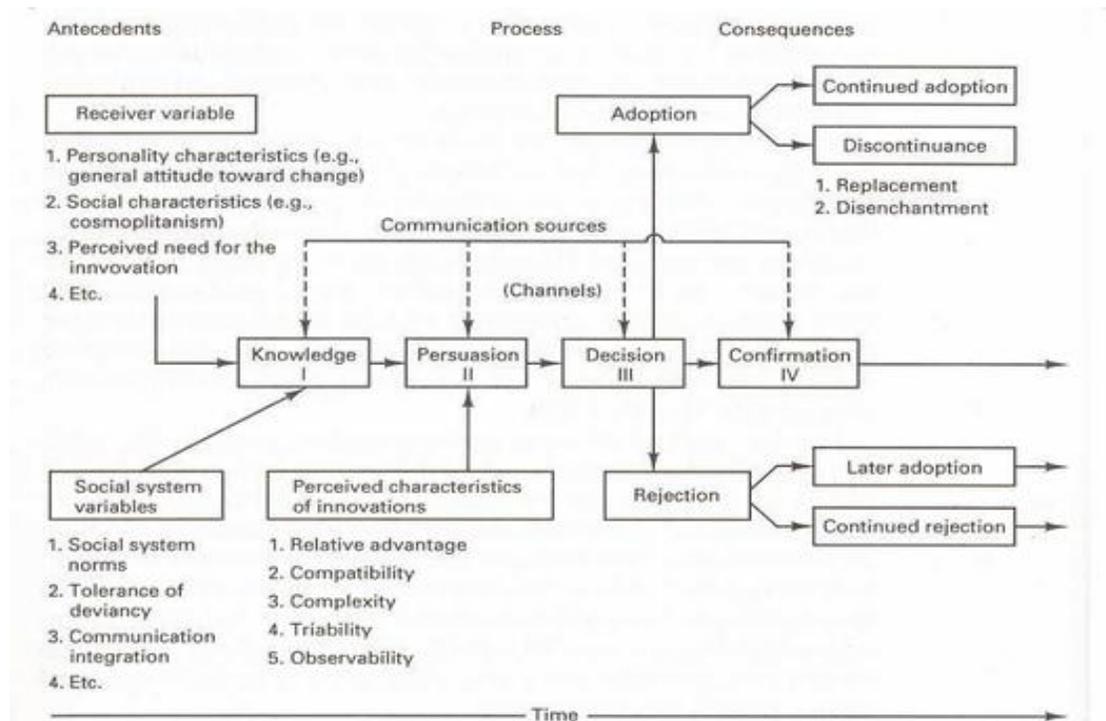
Figure 2. Innovation adoption process model (Rogers, 1995).

The persuasion phase refers to both internal pressures, like the personal gains/losses of adopting the innovation, and external ones, like the complexity of getting and using the innovation. During this phase the individual will seek to try out an innovation to better evaluate its qualities and how it fits into the person's lifestyle. The final two phases, decision and confirmation, are in action during the life of an innovation, as individuals repeatedly reassess the choice they made

previously about the innovation (whether they adopted or rejected the innovation at that time). This process might mean putting off adoption until a later time for a variety of reasons or discontinuing use of a previously adopted innovation.

Change comes slowly for innovations which do not seem salient to a population or provide an obvious benefit over what it currently uses (Rogers, 1962). It is not difficult to see how many green initiatives remain mired in the persuasion-decision loop Rogers described. As numerous psychological studies have shown (e.g. Blake, 1999; Kollmuss & Agyeman, 2002) there is often is a very real gap between what people think they should do and what they are willing to do.

For climate mitigation, studies and surveys regularly show that most of the people are aware of risks of climate change and know they should make better choices, but they just continue to pick what they always have (DEFRA, 2008; Attari et al., 2009). Although many arguments exists for why this gap continues for climate change behaviors, one recurring general perception is that green alternatives simply do not do anything better than what people already use or are too difficult to use (Etkin & Ho, 2007; Lorenzoni, et al.,2007; Moser & Dilling, 2004). Until green innovations become a "better value" than their high carbon equivalents, adoption levels will undoubtedly never reach the critical mass required in Roger's framework for universal acceptance to drive forward the behavioral changes needed along with the infrastructure support them. Keeping

Rogers' framework for adoption in mind, what light can recent climate change

perception research shed on the problem of creating effective messages?

2.2 Climate Change Research

Research on climate change messages indicates that the context and

language of how innovations are presented in messages can affect their ability to

promote behavior change. People were more likely to favor voluntary options

over mandatory ones, regardless of the way in which climate change was

framed. Also, the lack of monetary incentives or the personal freedom to choose

from various innovations to lower carbon use were negatively correlated with the

intent to change behavior to stop climate change (Attari et al., 2009; Maibach et

al., 2008). These findings illustrate the need people have to give innovations a

trial run or perceive a relative advantage over current choices as noted in

Roger's Diffusion theory. People also had difficulty understanding climate change

concepts that used probability, deep time (looking decades ahead), systems

thinking, or tried to explain scientific uncertainty (Etkin & Ho, 2007). Additionally,

Etkin and Ho found people had difficulty putting climate change information into

proper context due to the lack of cultural narratives in the presentations.

Similarly, Moser and Dilling (2004) found that people were less likely to

understand of climate change messages that were controversial in nature,

involved the concepts of deep time, or attempted to address scientific

uncertainty.

Studies about climate change knowledge and risk awareness had mixed effects on people's willingness to act. Some studies found that the perceived risks of climate change increased behavioral intent toward mitigating global warming (Lubell et al. 2007; O'Connor et al.,1999). This was quite different from two similar studies. Kellstedt et al. (2008) found that higher levels of perceived knowledge about climate change actually lead to lower feelings of worry, self-efficacy, and responsibility to do something about the issue. In another study, Whitmarsh (2008) found that perceived personal risk exposure to climate change effects was not predictive of the behavioral intent. As the Whitmarsh study goes on to elaborate, these contradictions might have been caused by a difference in methodology, as other studies have shown that knowledge or risk perceptions of climate change are not enough by themselves to promote positive behavioral changes (Norgaard, 2006;O'Neill & Nicholson-Cole, 2009; Whitmarsh, 2008)

Research on personal values showed significant influence on decisions to change behavior. People with pro-environmental attitudes were more likely to take steps to counter climate change (Attari et al., 2009; Whitmarsh, 2008). Similarly, climate change efforts that support personal values also predict the need to change behavior (Moser and Dilling, 2004, Nisbet, 2009a). Personal trust in climate science and scientists ironically leads to lower perceptions of worry, self-efficacy, and responsibility to do something about the issue (Kellstedt, 2008). Change messages that support community norms and shared values promote personal desires to change (Moser and Dilling, 2004; Nisbet, 2009b).

Additionally, those people who have a higher sense of community belonging are more likely to take action to protect those communities from climate change effects (Lubell et al. 2007). Researchers in another study also found that if people think their peers expect them to know more about climate change and mitigation strategies, they are more likely to seek out more information about it (Kahlor, 2007). All of these community perception studies support the notion that Roger's social system variables (innovations should align with social norms and integrate into the community) can affect adoption beliefs.

Studies looking into how self-efficacious people feel toward mitigating climate change found it largely depends on how seriously they perceive the risks. Messages that induce high perceptions of fear about climate change without increased self-efficacy make people feel climate change is remote and not personally salient (Lubell et al. 2007; O'Neill & Nicholson-Cole, 2009). These same studies found that messages with high perceptions of efficacy and low fear of climate change make people feel it is not an immediate threat. Norgaard (2006) found that high levels of fear and low levels of self-efficacy affected entire communities leading them to denial and apathy about climate change. Even though Norgaard's communities thought they were well informed about climate change, they still felt helpless to do anything about it. These studies support Roger's concept that innovations need to show an observable improvement over existing options.

Taken as a group, these studies and polling data show two major trends in climate change perception continue to weigh on the public. The first being that about 25-40% of the U.S. public (depending on the poll) deny that global warming is a problem and second, that many people, even those who consider climate change a serious problem, feel powerless to change such a global phenomenon. Looking back to Rogers' adoption process model, it appears part of the public (the denier group) is stuck at the knowledge phase and another part (the helpless) is still in the persuasion phase. While it could be argued that each audience should be studied to create messages tailored for each audience, that might be counter-productive with the level of polarization over climate change in the United States. Tailored messages might be taken out of context when played by the opponents of climate change efforts to other audiences, creating confusion and controversy, which lowers public interest in the combating the problem (Etkin & Ho, 2007; Moser & Dilling, 2004).

A better approach might be to identify a single effective message template based on theories that support the elements the literature shows are effective at overcoming the two negative trends found in previous studies. Since self-efficacy has been shown in the climate change literature to be particularly effective at promoting behavior change, the theories used to create and evaluate the messages should also include it. Fortunately, there are two solid candidate theories available to facilitate the evaluation of this new approach for creating effective climate change messages. This study combines two veteran behavioral

change approaches, the extended parallel processing model (Witte, 1992) and the theory of planned behavior (Ajzen, 1991) described in the following two sections.

2.3 Fear Appeals Research

A staple of modern behavioral change communication is *fear appeals*. This theory derives its power to persuade from two competing kinds of information, fear and self-efficacy. Fear appeals has been successful in predicting attitude and behavioral changes in a number of studies, ranging from drinking and driving (Nielsen & Shapiro, 2009), responses to terrorism (Lee & Lemyre, 2009), HIV prevention (Muthusamy et al., 2009), and many other topics (for an overview, see ; Godin & Kok, 1996; Ruiter, Abraham, & Kok, 2001). The idea of fear appeals has been around in various forms for decades and has been used in many behavior modification message campaigns, often with mixed success (Rigby et al, 1989; Godin & Kok, 1996; Ruiter, Abraham, & Kok, 2001). The crucial element that is often ignored or untested in failed messages is the special interplay of fear and self-efficacy used to promote behavioral change.

Witte's Extended Parallel Process Model (1992, 1994) provides the theoretical basis for creating motivating messages to reach climate change deniers as while sharing the same empowering self-efficacy component. EPPM (figure 3) belongs to the wider field of fear appeals. It retains the basic core concepts used in fear appeals, fear and self-efficacy, but uses more refined rules

to prevent maladaptive reactions to messages. The crucial element that is often

ignored or untested in failed messages is the special interplay of fear and self-

efficacy used to promote behavioral change. Witte's model accounts and controls

for this interplay during message processing phase by redefining perceived

efficacy and perceived threat as dual-dimension variables.
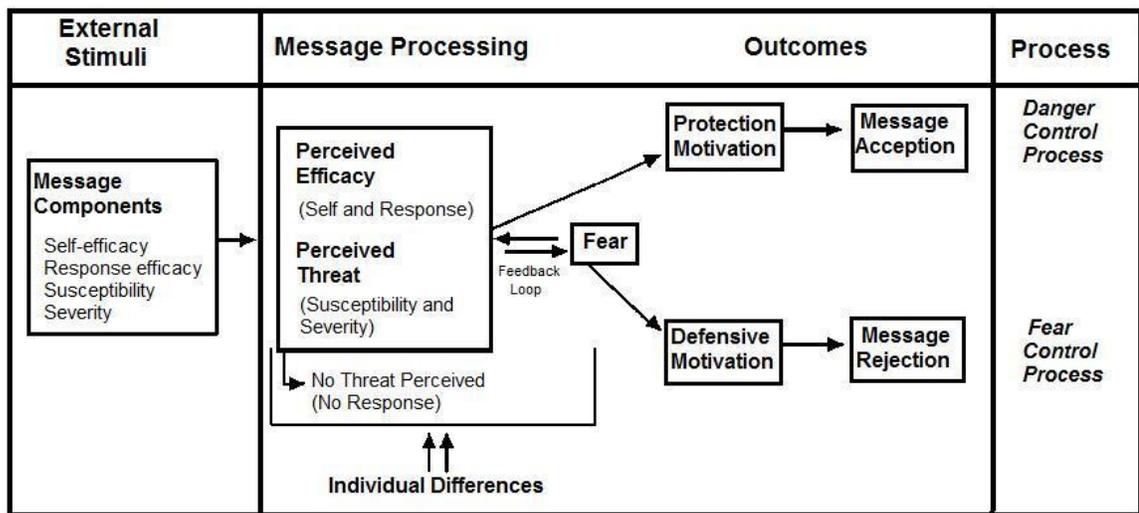
Figure 3. Extended Parallel Process Model (Witte, 1994).

Witte's work is the latest in a long series of fear appeals studies dating

back more than half a century. The first systematic analysis of the fear appeals

and persuasion resulted in the *drive reduction model* (Hovland et al., 1953). The

model and its extensions (Janis, 1967; McGuire, 1969) illustrate the interplay of

the drivers of change (attitudes, goal, needs, and arousal) on actions (Eagly &

Chaiken, 1993). The key elements of these messages leading to corrective

behavior was the *fear arousal state*, created through the message's fear element,

leading to a *mental rehearsal* of the protective precaution remedy offered from the message's self-efficacy element. It was believed that a very high fear arousal state would limit mental rehearsal, which in turn would limit corrective behavior while a low fear arousal state was thought to be insufficient to promote corrective action. These ideas proscribed a moderate fear level that should create the best response, but positive outcomes were rarely seen or very weak (Janis & Leventhal, 1968).

Leventhal reevaluated the previous research and in 1970 developed the *parallel response model* (Leventhal, 1970). This new model retained the core ideas of fear and self-efficacy, but also included cognitive antecedents and better defined coping mechanisms. Out of this research two coping mechanisms were identified, *fear control* which basically denies the threat exists through avoidance behavior and *danger control* which acts similar to the mental rehearsal by engaging cognition of the threat and remedy information to evaluate possible mitigation. According to the model, either coping mechanism can be in operation at various times depending on the context, level of fear, and level of remedy offered in the message. This means that fear arousal created by the message does not have to precede a coping response and that fear can undermine the desire to even consider any remedy actions (Leventhal, 1971).

In 1975 Rogers reworked the fear appeals models by including with the same *expectancy-value theory* (Edwards, 1954) used in the theories of reasoned action and planned behavior to develop the *protection motivation theory* (Rogers,

1975). This new theory used the same two core elements of the other models, but posited that fear appeals create two new mediating cognitive processes, *threat appraisal* and *coping appraisal.* Threat appraisal considers the source and strength of the threat along with its potential to harm the subject while coping appraisal considers the available remedies and the subject's ability to perform them. Taken together they are considered the danger control response and predict the protection motivation intentions of the individual's response to a message. Rogers later revised the theory to include the perceived costs of behavior changes and perceived benefits of continuing maladaptive behaviors stating that the new theory was now an attitude-based model similar to the theory of planned behavior (Rogers, 1983). However, a meta-analysis of the theory showed that the two new appraisal elements were poor predictors of behavioral change even though the old self-efficacy measures were very good predictors (Milne et al., 2000).

In response to the perceived shortcomings inherent in previous fear appeals theories, in 1992 Witte proposed putting the "fear" back in fear appeals and developing a better understanding of the fear control processes (Witte, 1992, 1994). Labeling the concept the extended parallel process model, she proposed that it was threat perception that initiates danger control processing, which in turn causes the coping appraisal evaluation to engage. The proposed remedy is then evaluated for effectiveness and the subject's ability to do it. If this evaluation leads to the action being perceived as ineffective or impossible to perform, fear

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control responses then trigger avoidance coping strategies, like denial or helplessness. While this solved the problem of integrating the two processes together, it does seem as if they operate serially and not in parallel, as the model name suggests.

What does all this mean for fear appeals? Messages with low perceived fear factors generate little interest in changing behavior, regardless of the level of self-efficacy or remedy (Rogers, 1975; Witte, 1992, 1994). People simply see the threat as too trivial or distant to be of major concern. Meanwhile, those messages with high fear factors, but with low self-efficacy to mitigate tend to prevent behavioral change, as people become overwhelmed with fear and will not act (Festinger & Carlsmith, 1959; Fishbein & Yzer, 2003; Leventhal, 1971; Rogers, 1975). Messages that create the perception of high fear factors and high self-efficacy to mitigate evoke a strong positive reaction to the threat (Fishbein & Yzer, 2003; Witte 1992, 1994). To promote a positive response to a threat, a significant and balanced level of both fear and self-efficacy must be communicated.

Although some form of self-efficacy was always a part of every fear appeals model, Bandura (1977) is generally credited with refining the concept as part of his social-cognitive theory. Perceived self-efficacy is the belief that people have about their ability to do an action that can affect their life. High levels of self-efficacy serve as a motivational force that allows people to tackle complex behaviors and remain focused on achieving positive outcomes in the face of

adversity. Even the most challenging of circumstances can be mitigated by self-efficacy as long as the person perceives that they have a fair chance of success. These beliefs determine how people feel about doing the act, their estimation of accomplish the act, as well as the perceived benefit of doing the act.

As described by Bandura, self-efficacy can be developed along four different axes; through an expectation of personal mastery (Bandura, 1977), through vicarious mastery (Bandura, 1982), through social persuasion (Bandura, 1977), and through improved emotional states (Bandura, 2000). *Personal mastery* experiences tend to be the strongest motivator of the four and refer to the actual past attempts by the person to attempt the behavior. Past successes increase confidence and self-efficacy, while failures lower expectations and lead to lower beliefs of self-efficacy (Bandura, 1977). Successes that were easily won before are just as easily discouraged by failure, especially if a sense of self-efficacy was not firmly established by earlier attempts. To build a resilient sense of self-efficacy, individuals must be made aware that setbacks can happen, but that they can be overcome (Bandura, 1977).

Vicarious mastery refers to observing other people thought to be similar to the observer successfully engaging in the new behavior (Bandura, 1982). This raises the observer's perception that they too can master the behavior in the same context. The closer the expected behavior situation matches the observed one, the higher the person's sense of self-efficacy (Bandura, 1982). Not only do the observations serve to establish the social standard expected to perform the

behavior, they can also serve to inspire the individual to perform a behavior better than the observed performer. The real weakness of vicarious mastery is the very limited resilience of self-efficacy in the face of failures. Since no real time was spent engaging in the behavior before, a failure instills in the person a feeling of inadequacy or that there was some 'trick' to executing the behavior that they missed (Bandura, 1982).

Social persuasion occurs when third parties confirm to an individual that they do indeed have the ability to master a task (Bandura, 1977). This outside encouragement leads to a higher sense of self-efficacy and a measure of resilience in the face of failures. When this prompting matches expectations while doing the behavior the perception of self-efficacy rapidly increases mitigating potential setbacks and motivating greater effort (Bandura, 1977). However, personal efficacy is decreased more by dissuasion than it is increased through persuasion. When dissuaded the person sees every failure as insurmountable, something they just cannot complete, causing the individual to give up trying (Bandura, 1977). This requires careful planning to insure that extolled proficiencies match individual abilities early in the attempted task and allow time for mastery to build.

Emotional states can greatly affect performance and perceptions of self-efficacy (Bandura, 2000). For many people reactions to the stresses of performing a new task seem like harbingers of failure causing them to underestimate their ability. Mental and physical fatigue while attempting a new

behavior represent inability, while vigor and optimism increase the sense of efficacy (Bandura, 2000). Reducing stress and calming negative reactions to engaging in the new behavior can greatly increase feelings of self-efficacy. To overcome the potential for negative emotional states to lower personal efficacy, behavior modification researchers need to become sensitive to when these states arise and how to interpret them (Bandura, 2000).

Self-efficacy plays an integral part in motivation through *reciprocal determinism* (Bandura, 1997) which ties together behavior, internal personal factors, and environmental influences. Self-efficacy sets expectations of success and affects behavior outcome, which then creates new environmental changes that in turn alter expectations of future attempts and the sense of personal efficacy. People motivate themselves through anticipatory forethought of their actions based on their beliefs of what they can accomplish in a given situation. Given this state of interplay, it would be reasonable to expect that those with high sense of self-efficacy for abating climate change would be more likely to engage in new lower-carbon behaviors.

Bandura's concept of self-efficacy shares concepts found in Rogers' Diffusion of Innovation theory (1962). Both theories suggest that people need to interact and master a new innovation in some way before they can adopt it in their lives. People weigh the idea of using an innovation through the adoption-rejection process where they analyze a myriad of attitudes and beliefs. For Rogers' Diffusion theory these self-efficacy measures include "triability," complexity,

compatibility, and observability. Triability and observability are similar to Bandura's concepts of personal mastery and vicarious mastery, respectively. Complexity and compatibility represent additional dimensions of personal efficacy.

Complexity refers to the perception of how difficult adopting or using an innovation appears (Rogers, 1995). This could refer to the person's perception of their ability to use the innovation, like with mastery, but it also relates to how different the innovation is from the one it replaces. An example of this would be replacing horses with automobiles as a primary source of transportation. By the time automobiles appeared animal husbandry had become second nature to those who depended on horses for travel. Horses were self-replacing, used a locally available food source, and could travel nearly anywhere a man could. This was in stark contrast to using an automobile, which was manufactured far away, required a special fuel not easily created, and was limited to developed roads for use. These issues were overcome by making fuel cheap and available, creating the "freedom of the open road" mythos, and developing inter-connected paved roadways, all of which increased the ease of using automobiles.

Compatibility relates to the perception of how the innovation would 'fit' in the person's life (Rogers, 1995). Innovations that fill an obvious void in an individual's life pique their interests and motivate them to further consider using it. Those innovations meant to replace existing ones or that have no clear fit for the person tend to lower desire for the item and the sense of personal efficacy to

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use them. Contrasting examples of compatibility would be microwave ovens and

cell phones. In the United States practically every household has a microwave,

but areas around the world with limited access to electricity have few

microwaves. However, these same areas quickly adopted cell phones despite

the lack of electricity because they could fill the void of phone service without the

need for extensive wiring or continuous power availability.

2.4 Theory of Planned Behavior Research

The theory of planned behavior (TPB) has successfully predicted attitude and

behavior changes in a wide variety of studies, from prevention of suicide

(Shemanski & Cerel 2009) to software piracy (Moores et al. 2009) and literally

dozens of other behaviors in between (for an overview see Armitage & Conner,

2000). The three main components of TPB, behavioral beliefs, normative belief,

and control beliefs (figure 4) are analogous to measures used in Rogers' theory

(receiver variables, social system variables, and perceived characteristics of the

innovation variables).
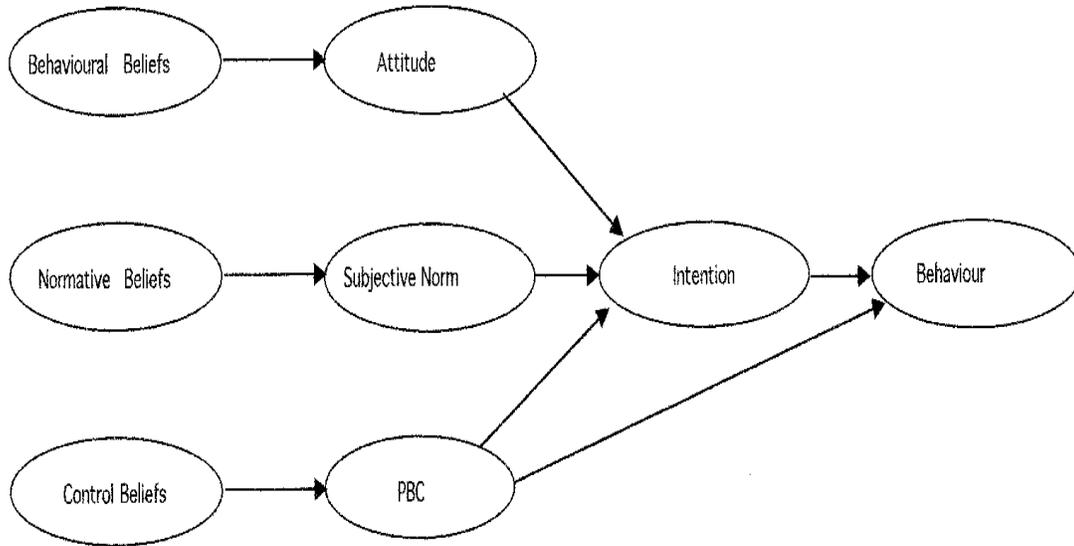
Figure 4. Theory of Planned Behavior Model (Ajzen, 1991).

TPB grew out of the Fishbein and Ajzen's earlier work on the theory of

reasoned action (1975) that looked at how behavioral beliefs and normative

beliefs influenced subject's decisions to engage in a new behavior. As

conceptualized by Fishbein and Ajzen, *behavioral beliefs* capture the individual's

perception of adopting a new behavior relative to a specific outcome (Fishbein &

Ajzen, 1975; Ajzen, 2001). Specific outcome attribute dimensions like personal

gain/loss, compatibility with existing needs, complexity of the innovation, and

others can be measured using the expectancy-value theory (Edwards, 1954;

Fishbein & Ajzen, 1975). The expectancy-value model measures both the power

of the feeling toward the act and the associated positive or negative affect. The

sum total of these behavioral belief calculations produces an individual's *attitude*

toward a behavior and, ultimately, their intention to perform the act. While this

appears to be a fairly linear relationship the attribute dimensions vary with the

context in which the behavior is presented (Cacioppo & Berntson, 1994; Barrett & Russell, 1998).

As defined by Fishbein and Ajzen, *Normative beliefs* refer to the individual's perception of how society will react to them doing a behavior (Fishbein & Ajzen, 1975). The more it is perceived that society approves of an action, the stronger it resonates as the subjective norm for the individual and increases behavioral intention to act. Like behavioral beliefs, these attributes can be measured using the expectancy-value theory for direction and power. The sum total of these measures calculates the *subjective norm* that predicts the individual's likelihood to engage in the behavior, however, it tends to be a poorer predictor than attitude (Godin & Kok, 1996). In fact, in some instances it has been dropped entirely from analysis by some researchers (Sparks, et al., 1995). However, in the meta-analysis by Armitage and Connor (2001), the authors argue that a more likely explanation for the subjective norm's poor performance lies in the limited measurements used in studies. They noticed that many studies used a single item to measure normative beliefs, which clearly could have difficulty capturing such a multi-dimensional object.

While the Theory of Reasoned Action is reasonably predictive of behaviors where there is no restriction on the subject's ability to easily engage in the behavior, it loses this predictive power for behaviors perceived to have self-efficacy barriers (Baron & Kenny, 1986). By integrating the *control beliefs* work of Bandura (1977) into the Theory of Reasoned Action, the power of the theory to

predict behavioral intent was greatly increased, especially for behaviors with perceived barriers (Ajzen, 1985). By including control beliefs, researchers could then examine the effects on control perception on potential to act. Control constraints can be physical, like access to an item to permit a behavior, psychological, like a phobia that causes automatic aversion of a behavior, or social, like lacking in station to engage in a behavior (Bandura, 1997). Control beliefs are also calculated using the expectancy-value theory and summed to create the *perceived behavioral control* (Ajzen, 1988). Ajzen's later work showed that measures of perceived behavioral control exerted both direct and interactive effects on behavioral intentions to act (Ajzen, 1991). In situations where the individual has complete control over a behavior, PBC typically exhibits limited interactive effects. As behavioral control decreases, the predictive strength of PBC increases to the point where it might become paramount.

Taken together the attitude, subjective norm, and perceived behavioral control determine the final behavioral intention as illustrated in Ajzen's equation:

Attitude + Subjective Norm + Perceived Behavioral Control => Behavioral Intention

The limitations of Theory of Planned Behavior involve its lack of motivating emotional variables, such as fear or dread (Gregory & Mendelsohn, 1993), which will certainly be part of the mental calculus people use when deciding what radical changes to their lifestyles they should adopt. As the literature

demonstrates, for climate change self-efficacy may not operate effectively without these fear appeals. Some researchers (Wang, 2009) have recently suggested that a fuller understanding of the behavioral attitude might be achieved by employing Katz's functional attitude theory (Katz, 1960) to explain why an attitude exists, as opposed to the Theory of Planned Behavior's single "attitude" measure the subject has about a behavior.

Behavioral interventions, like environmental awareness campaigns, aim to change theoretical mediating variables, such as knowledge, attitudes, self-efficacy, social norms, and perceived susceptibility, as a way to create new attitudes about and perceptions of a new behavior (Fishbein & Yzer, 2003; Slater, 1999; Yzer, Fishbein & Hennessy, 2008). It is thought that changes in attitudes are bought about though a process of *cognitive dissonance* that temporally precedes changes in beliefs (Festinger et al., 1956, 1957). Cognitive dissonance occurs when an individual contemplates doing something that creates a logical inconsistency with their current core beliefs. To relieve the cognitive dissonance, the individual finds ways to justify or rationalize the inconsistency. This rationalization may or may not be true, but it relieves the cognitive dissonance and makes the person feel better. This kind of rationalization may also lead to confirmation bias, where new information that disputes core beliefs is disbelieved regardless of truthfulness (Egan etal., 2007; Festinger & Carlsmith, 1959; Lee & Schwartz, 2010). It could be that cognitive dissonance caused by new climate change information creates confirmation bias

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in some people. This could certainly be the case for climate change, when people learn almost everything they do and have always done is causing great harm to the environment, this information might conflict with their existing worldview.

Theories like the Planned Behavior place significant emphasis on evaluating attitudes, but attitudes are mostly fixed judgments created by what is described by some cognitive researchers as the ABC model of affect, behavior, and cognition (Breckler & Wiggins, 1992; Secord & Backman,1964). Affect relates to the emotion creating the attitude, behavior is the intent to act on the attitude, and cognition is the ongoing evaluation of the attitude. When an individual encounters new information or situations, pre-existing attitudes might be challenged and changed. Attitudinal changes are based on evaluations of new information.

According to Secord and Backman, three broad groups of characteristics govern the way new information is processed: *Target characteristics* are the collection of factors that make up the individual receiving the new information. These include physical traits like race, sex, and intelligence, social traits like education, marital status, and income, and psychological traits like self-image and mood. *Source characteristics* are the collection of factors that make up the messenger delivering the new information. These include identifiable expertise, trustworthiness, and attractiveness. *Message characteristics* are the structure

and presentation quality of the new information and how these factors might improve/hinder understanding.

The emotional responses evoked by messages play a significant role in studies of media campaigns designed aimed at changing behavior and the theories underlying them. Source and message characteristics not only guide test message creation, understanding the range of target characteristics that combine to create perceptions of behavior attitudes is crucial to reaching the desired audiences.

Attitudes also provide a number of functions and are created, maintained, and changed depending on the individual's need to preserve these functions (Katz, 1960). Although not exhaustive, Katz identified four functions that attitudes provide: *Utilitarian* functions that help gain the things we want while also protecting us from things we wish to avoid. *Knowledge* functions that create manageable heuristics out of the vast amounts of complex information individuals are exposed to everyday. *Value-expressive* functions that maintain self-identity and its relationship to other people. *Ego-defensive* functions which protect the individual from the negative effects (both internal and external) caused by their actions.

All four functions could be in operation for those who deny that climate change is a problem. Adaptive functions would allow them to keep things as they are and avoid changing to lower carbon alternatives. Knowledge functions could convince them they already know the climate is pretty much the same as it

always has been. Value-expressive functions would allow them to continue with their already defined self-image. Ego-defensive functions could allow them to excuse continued high carbon consumption because the carbon dioxide is not causing a problem.

Research has shown that attitudes may be associated with one of more of these functions (Shavitt, 1990). Examples of this are transportation and clothing, which serve both a utilitarian function and a value-expressive function by identifying social status. These attitude functions can even be at odds with each other and behavior intentions. In a study of lifting the ban on gays serving in the military, the desire to lift the ban was positively correlated with the value-expressive attitudes of respondents while being negatively associated with ego defense attitudes (Wyman & Snyder, 1997). Value-expressive attitudes were also strongly associated with a desire to seek out testing for herpes (Hullet, 2004) and utilitarian and value-expressive attitudes were positively correlated with teacher's intentions to teach their students about HIV/AIDS awareness (Visser, 2004). Based on these findings, this study will incorporate utilitarian, ego defense, and value-expressive attitude measures into the Theory of Planned Behavior model design.

As noted earlier, another area in need better explanatory dimensions is the Theory of Planned Behavior's subjective norms variable. Rather than using the single measure to explain the subjective norm, other researchers have argued that using more measures of the three categories of norms provides a

better measure (Cialdina et al., 1991). The Theory of Planned Behavior subjective norm measure typically evaluates just the social injunctive norm; that is a norm that measures potential social rewards and punishments. However, other dimensions of norms can also be measured. Another type of norms, d*escriptive norms,* considers the subject's observations of the actions of others as motivation for new behavior. For example, if a person sees that everyone on their block recycles, they feel more motivated to recycle. A third variation, the *personal injunctive norm*, acts like a internal moral compass where the person views the intended behavior based on how they would think of themselves after engaging in it.

A meta-analysis of studies using descriptive norms variables showed that they accounted for an additional 5% of the variance in behavioral intentions (Rivis & Sheeran, 2003). Others have argued that both descriptive and injunctive norms are important sources of normative pressure on behavioral intention and should be modeled together (Fishbein & Yzer, 2003). Despite this appeal, little research has considered measuring the effects of all three norms (descriptive, social injunctive, and personal injunctive) and their ability to predict behavioral change. This study will explore the three different aspects of norms and how they individually and collectively influence decisions to change behavioral intent in place of the single measure for Theory of Planned Behavior's subjective norm.

2.5 A Combined Theories Approach

Combining the two theories with an expanded examination of attitudes

and norms (figure 5) offers the opportunity to raise awareness among climate

change doubters while empowering those who might feel overwhelmed by the

scale of climate change. While it might be argued that fear appeals or Theory of

Planned Behavior alone can handle this task, the two approaches complement

each other by sharing the necessary theoretical common ground of self-efficacy,

while adding needed attitudinal measures proposed in Rogers' adoption

framework.
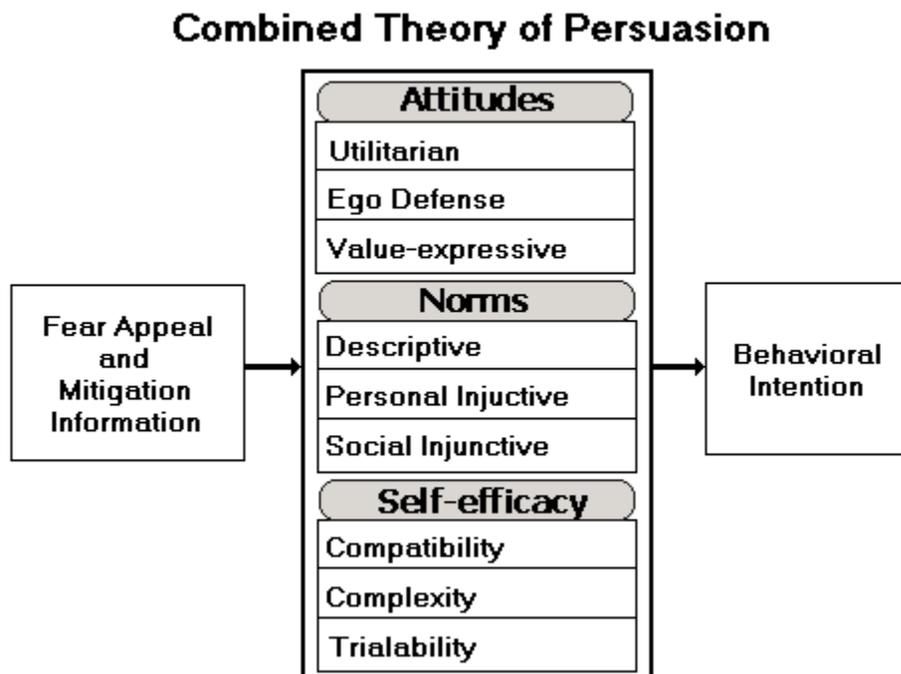
Figure 5. Proposed Combined Theory of Persuasion Model.

Fear appeals alone lack the normative variables found in Rogers'

framework which were shown to be a salient issue in the literature. The Theory of

Planned Behavior lacks the high motivation fear approaches needed to raise awareness and persuade climate change doubters to pay attention to the message. Both theories lack the wider range of attitudes encompassed by the innovation adoption theory. By combining these three sets of variables, all of the key points in Rogers' decision-adoption cycle can be modeled allowing this study to identify which messages resonate with the public and generate the highest intention to act.

The added emphasis on understanding the mediating variables that create attitudinal changes are necessary for other reasons. They potentially add additional layers of insight into the capabilities of the two theories to predict behavioral intent and the climate change persuasion problem is quite unlike the kinds of health message campaigns that have applied fear appeals and Theory of Planned Behavior in the past. Fear appeals for smoking, HIV, and drug use can use a bevy of very graphic images and descriptions of personal and community loss. Climate change lacks these salient images that the public can easily put into proper context. Add to this the real question of just how much self-efficacy can a climate change mitigation message deliver when the literature shows, many people understandably feel powerless to confront this global phenomenon. So, it remains unclear if these two theories can produce better results than the messages already tried. If for no other reason, by studying the additional mediating variables this study might identify why the two theories

succeeded or failed to increase the study subject's behavioral intent to do

something about climate change.

CHAPTER 3

RESEARCH QUESTIONS AND HYPOTHESES

3.1 Research Questions

This study presents climate change messages designed and evaluated

using inter-disciplinary methods to test reader reactions to the stories. Owing to

the novel nature of this approach (combining two models of persuasion theory,

fear appeals and the Theory of Planned Behavior, with expanded measures to

change and assess climate change perceptions), the following two general

research questions are proposed:

1.   How do pre-existing worldview attitudes towards the environment,

        science, government, religion, or conservatism affect willingness to adopt

        lower carbon innovations?

2.   What study variables (individual attitudes, community norms, self-efficacy,

        or fear) provided the best predictors of behavioral intent to adopt lower

        carbon innovations?

The literature also suggests that the conflicting views on the effects of community

norms (Armitage & Conner, 2000) and how they might affect adoption intentions

(Ajzen, 1988, 1991) prompts a slightly more specific research question:

3.   Can focusing on different aspects of community norms in messages affect

        people's intent to adopt an innovation?

Since it is not clear from the literature whether self-efficacy can even be instilled in people for an environmental problem as large as global climate change a forth research question was explored:

4.   How does exposure to increasing amounts of self-efficacy affect the

subject's behavioral intent to adopt lower carbon innovations?

3.2 Hypotheses

This study will present climate change messages designed using the combined models of Theory of Planned Behavior and fear appeals along with the source and message characteristics from the attitudinal studies to test reader reactions to the stories. Based on the literature and study design (see methods) more specific hypotheses can be tested. Fear appeals and Theory of Planned Behavior both have successfully been used to promote behavioral change (Godin & Kok, 1996; Ruiter, Abraham, & Kok, 2001). Since the control group messages will not use any fear appeals or community norms manipulations it can be suggested that:

1.   Lacking any motivational or mitigation information in their stories, the

control group will have lower overall behavioral intent to adopt the

innovations than any of the test groups.

As was earlier alluded to, it is likely that test subjects will experience some level of cognitive dissonance when learning that practically every activity of their

daily lives is slowly destroying the planet and that they need change how they live (Festinger et al., 1956, 1957). In some of these subjects the literature suggests come will relieve this dissonance through confirmation bias, ignoring messages that conflict with their worldview (Egan etal., 2007; Festinger & Carlsmith, 1959; Lee & Schwartz, 2010). Based on these studies it can also be suggested that:

2.   Those individuals in the experimental groups who self-identify as having low environmental concern in the pretest section will have lower levels of adoption than other subjects.

The literature also shows that target characteristics (age, race, lifestyle, etc.) of the test subjects influence attitude functions (Breckler & Wiggins, 1992; Secord & Backman,1964). These target characteristics might increase the subject's rationalizing their need to continue to have a large carbon footprint and resist the mitigation measures in the messages. Based on this argument it can also be suggested that:

3.   Those subjects with lower combined posttest attitude question scores will have lower levels of intent to adopt the innovations than other test subjects.

According to Bandura (1995) and Rogers (1962), each observation of someone using an innovation can improve the perception of self-efficacy. As an

observer sees more people using an innovation it, creates the belief that anyone, including the observer, could also use it. Since test messages will contain varying amounts of self-efficacy examples, it can also be suggested that:

4. Those individuals in the experimental groups who receive messages with repeated self-efficacy examples will have higher levels of adoption than other subjects.

CHAPTER 4

METHODOLOGY

The literature review shows that audiences have trouble relating to climate change messages that contain specialized or scientific jargon (Etkin & Ho, 2007) or present climate change science as controversial or uncertain (Moser & Dilling, 2004). For this experiment all messages, test or control, used common narratives and contexts while avoiding discussions involving controversy, deep time or systems thinking. The literature review also noted that climate change mitigation messages emphasizing the voluntary choice to adopt increased intentions among readers to change behaviors change (Attari et al., 2009; Maibach et al., 2008). Previous climate change studies also found that descriptions of self-efficacy (Kellstedt, 2008) and discussions of community norms made readers more likely to adopt lower carbon behaviors (Lubell, 2007; Moser and Dilling, 2004; Nisbet, 2009b). Based on these findings all test group messages will depict voluntary mitigation measures that highlight the self-efficacy experienced by those attempting the measures and how these actions are viewed positively within community norms.

For the initial experiment, a single control narrative was created based on real science news reports on climate change. This narrative contained no mention of scientific controversy, examples of potential threats, or possible actions one could take. Several test group messages were created as discussed below.

4.1 Treatment of Subjects

A convenience sample (n=226) of undergraduate student subjects was drawn from communication and introductory environmental studies courses at a medium-sized southwestern university. Volunteer students were offered a 3% bonus added to their final grade for participation in the study or could opt out of the study in lieu of another written assignment to gain the same extra credit. Students wishing to participate in the survey contacted the survey administrator by email.

Using the factorial design suggested by Mukerjee & Wu (2006), subjects were then randomly assigned to one of 19 groups; the control group (n=31), or one of the 18 experimental groups based on the following 2 x 3 x 3 model conditions:

Fear level: High or Moderate

X

Norms Measures: Social Injunctive Norms, Descriptive Norms, and Personal Injunctive Norms

X

Self-efficacy Measures: Compatibility, Complexity, and Triability

Each experimental group has two complementary groups evaluating identical measures for community norms and self-efficacy making the combined number of subjects for each comparison near that of the control group (n's ranged from 31 to 34). The survey administrator advised the subjects on how to access the survey online and presented them with a URL unique to their survey group. The survey itself was conducted online using the Survey Monkey software and website.

Each subject was administered a pre-test survey to evaluate their initial worldview attitudes about the environment, trust in information sources, conservatism, and religiosity. To measure environmental attitudes questions from the New Ecological Paradigm (Dunlap & Van Liere, 1978). The 14 questions of the New Ecological Paradigm have been used in numerous studies and found to be very predictive of environmental attitude. More recent studies have found that using three or four questions from the original 14 is just as predictive and more practical for surveys that are exploring more than just environmental attitude. For this study only the three New Ecological Paradigm questions with high beta values for predicting environmental attitude were chosen as measures.

The questions for measuring trust in information sources (mass media, science, weather, government, religion, and political leaders), conservatism (social, political, and economic), and religiosity are based on an earlier study by Priest (2008). An ad hoc question, suggested by an advisory committee, was

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included to evaluate the subjects' views on the state of climate change science.

Table 1 lists the pretest questions and what they were expected to measure.

Question	Measure	Source
When I hear information from weather services I tend to trust it.	Information Trust	Priest, 2008
Humans must live in harmony with nature.	Environmental Attitude	New Environmental Paradigm
I tend to be politically liberal.	Conservatism	Priest, 2008
When I get information from news outlets I tend to trust it.	Information Trust	Priest, 2008
People are abusing the environment.	Environmental Attitude	New Environmental Paradigm
I tend to consider my religious convictions when I make decisions.	Religiosity	Priest, 2008
When I get information from scientists I tend to trust it.	Information Trust	Priest, 2008
Our understanding of climate science is so uncertain we should wait to act.	View of Climate Change Science	Advisory Committee
When I get information from government reports I tend to trust it.	Information Trust	Priest, 2008
I tend to be conservative on social issues.	Conservatism	Priest, 2008
When I get information from religious leaders I tend to trust it.	Information Trust	Priest, 2008
The balance of nature is delicate.	Environmental Attitude	New Environmental Paradigm
I tend to be conservative on fiscal matters.	Conservatism	Priest, 2008
When I get information from environmentalists I tend to trust it.	Information Trust	Priest, 2008

Table 1. Survey pretest questions listing what they measure and the sources where they originated.

Subjects were asked to rate their level of agreement with each statement

using a five point scale. A response of one meant the subject completely

disagreed with the statement, two meant they disagreed somewhat with the

statement, three was a neutral feeling toward the statement, four meant the subject agreed somewhat with the statement, and five meant they completely agreed with the statement.

Subjects then read an article concerning climate change and personal carbon footprints. The control group message avoided any mention of the threat created by climate change, cultural norms, or carbon footprint mitigation strategies and reads as follows:

"Within the scientific community the question is no longer whether global warming will lead to climate change, but at what rate, with what effects, and what, if anything, we can do about it. The primary driver of this change is thought to be atmospheric carbon dioxide, with the major increases seen in the last century coming from the burning of fossil fuels and deforestation. Measurement of the earth's average temperature is based on daily readings taken as several thousand land-based meteorological stations around the world, as well as data taken from weather balloons, orbiting satellites, and sea-surface buoys.

"The last two decades have been the warmest recorded since stations began collecting temperature data in the 1850s, and the warming trend is continuing and some environmental changes have already been observed. Plants around the world are blooming in spring about one week earlier and fall leaf color changes are coming about one week later than they did just 50 years ago. Animals are also changing their habits by migrating earlier with longer stays at northern feeding areas. Even the physical world is changing. Glacier and polar

ice caps melting at the highest rates ever recorded, leading to higher sea levels

worldwide while weather patterns has changed with an increase in severe storm

activity around the globe.

"In response to growing scientific concern about climate change caused by global

warming, in 1988 the United Nations organized the Intergovernmental Panel on

Climate Change (IPCC) to review all the scientific data available and make

recommendations to the UN. The IPCC consists of hundreds of scientists who

provide data and review findings that allow the panel to craft the most definitive

statements available concerning climate change. Every five years the panel

reviews all scientific studies on the phenomenon and summarizes the current

state of our knowledge about climate change in a public report to the UN. In its

latest report (2007) the IPCC projected that without serious commitment on the

part of humans to reduce the levels of carbon dioxide in the atmosphere, the

average temperature of the planet will increase half a degree every decade. By

2100 the global temperature will be the warmest it has been in over 100 million

years.

"The amount of carbon dioxide each individual contributes to the atmosphere is

known as their *carbon footprint*. The carbon foot print is calculated based on the

energy it takes to produce the products a person consumes and their personal

energy use. This includes food, clothing, furniture, electronics, etc., and also the

packaging and transportation required to get these items to the person. It also

includes the individual's direct energy use in terms of electricity, heating, and

transportation. The average carbon footprint in the U.S. is over four times higher than the individual average for the rest of the world. The only country with a higher average is Canada, which is almost identical."

The test messages also contain varying levels of climate change threat (inserted after the third paragraph of the control message), community norms information (inserted after the last paragraph of the control message), and self-efficacy mitigation (inserted after the community norms information) strategies based on the test matrix. All other wording in the messages was kept identical. The moderate threat paragraph read:

"Scientific models predict this warming trend will redistribute rainfall, creating droughts across mid-latitude farmlands while increasing precipitation in the northern United States. These droughts will cause hundreds of U.S. farms to fail and food prices to rapidly rise. These models also predict the increases in temperature will lead to an increase in the severity and frequency of storm systems in the U.S. causing more tornadoes, hurricanes, and winter blizzards." The high threat message read:

"Scientific models predict this warming trend will redistribute rainfall, creating droughts across the world. These droughts will bring starvation to hundreds of millions of people around the globe and be particularly harmful to regions already hard pressed to feed their populations. Estimates are that more than 100 million additional deaths per year due to drought and starvation by 2100. Add to this that rising sea water levels will force the evacuation of low-lying coastal areas and

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many islands potentially affecting 1 billion people, creating a degree of human catastrophe the world has not seen since the black plague."

The descriptive norms message read:

"However, things are changing in the U.S. and around the world. A concerted effort by individuals, businesses, and government to lower carbon dioxide output has begun and continues to grow. People are driving less and buying gas-saving hybrid models while consciously using less electricity and water. Recycling centers exist in almost all U.S. cities, many with convenient curbside pick-up services. Many businesses now offer discounts for green conscious customers and provide low energy alternatives in their product lines. Governments in developed countries are not only promoting carbon reducing plans in their own countries, they are actively seeking ways to encourage low-carbon growth in developing countries through subsides and free technology transfers."

The personal injunctive norm message read:

"However, things are changing in the U.S. and around the world. People are beginning to see that taking steps to combat climate change isn't just good for the world, it benefits them, too. Where once owning an electric or hybrid vehicle was considered the realm of technophiles, today it's a status symbol. The all-electric Tesla supercar is not only the most fuel efficient car in class at 200 MPG, it's also the fastest, safest, has the same styling that defines these vehicles. Even hybrid sedans enjoy special status, with the top three responses university

students gave for selecting their hybrid cars being, 'It looks great and drives great', 'I care about the environment ', and 'It's the right thing to do.'"

The social injunctive norm message read:

"However, things are changing in the U.S. and around the world. People are beginning to see that taking steps to combat climate change isn't just good for the world, it benefits them, too. Where once recycling was something people did to earn a little pocket money, now it's expected. Depending on where you live, not recycling can get anything from a look of disgust to a fine of $100. Hybrid and electric cars also have seen a rise in popularity, not only for their better gas mileage, but also for what they say about the owner. As one university student recently stated, 'My friends all love my hybrid and people ask about it all the time, it's made me some kind of a celebrity.'"

The self-efficacy messages were done differently than threat and community norms to limit the study to 18 test groups as opposed to the 54 groups rotating the messages would create. This also would allow an evaluation of the idea from the literature review that more self-efficacy examples in a message would generate greater intent to adopt the new behavior (Bandura, 2000; E. Rogers,1995). Each test message received either one, two, or three paragraphs about different carbon mitigation strategies, each addressing one of the components of self-efficacy (compatibility, complexity, or triability) also based on Bandura (2000) and E. Rogers (1995) work. The first paragraph addressed

the "triability" or ease and accessibility of doing something to lower the subject's carbon footprint. This paragraph read:

"Many students are unaware of how easy it is to start to do something about climate change. It can be as simple as turning off lights and electronics when not in use. Even leaving electronics in sleep mode uses power, often accounting for most of the electricity used by them. As one student reported, 'At first I didn't think it would make much difference, but my roommates and I agreed to give it shot. We all looked after each other's electronics and turned off lights when nobody was using them. It was so simple, that we were sure it wouldn't change our power bill, but were we ever wrong! The first month alone cut our bill in half and we weren't even taking it all that seriously.'"

The second paragraph addressed compatibility or how the new behavior to lower the subject's carbon footprint was actually compatible and beneficial to their lifestyle. This paragraph read:

"Other students are unsure what things in their lives they could change to lower their carbon footprint, but it just takes a little planning to see how small changes in daily habits can lead to positive change. Things like walking instead of driving on short trips and recycling both greatly reduce carbon output as this sophomore found out, "Living in the dorms things tend to be about efficiency, whether throwing out the trash or going shopping. At a resident meeting we had a presentation about global warming and decided to try recycling our trash. I also decided to start walking the two blocks to the market instead of driving. Dropping

recyclables into the bins in the hall kept my room and the rest of the floor much cleaner and easier to maintain while my walking trips to the store helped me lose five pounds in the first month. It was a win for the earth and a win for me, I just wish I'd thought of it sooner!'"

The third paragraph addressed complexity or how with a little effort seemingly difficult behavior changes to lower the subject's carbon footprint would be rewarded. This paragraph read:

"When dealing with subsidies or rebates for lower carbon options students often shy away from prospect of red tape and having to find the relevant information to take advantage of the program. While the internet has plenty of information about these programs, it's actually the agencies and businesses that have stepped in to make the process simple and straight-forward as a recent graduate found out when trading in her used car in the Cash-for-Clunkers program, 'I had never been involved in a government program and was pretty sure I would hate having to talk with the car salesman. I was really surprised at the whole process. Not only did the manager explain how Cash-for-Clunkers worked, he checked to make sure my vehicle qualified for the program, filled out all the needed paperwork, and gave me my money on the spot. As if that wasn't enough, since I was buying a hybrid, I also qualified for both state and federal government rebate programs. The manager again did all the paperwork and took the rebates off the car price. Wonderful!'"

After reading the narrative, each subject answered a series of posttest questions designed to evaluate their attitudes, normative beliefs, and control beliefs about the message's low carbon footprint proposals and how likely they would be to attempt to lower their carbon footprint using the information in the message. Each question was designed to answer a specific measure of the study. Each question was based on a high beta (predictive) example from Ajzen's website (http://people.umass.edu/aizen/).Table 2 lists the questions and what research items they were expected to measure.

Question	Measure
Lowering my carbon footprint will save me money.	Utilitarian Attitude
People I care about would approve if I lived a lower carbon lifestyle.	Social Injunctive Norms
I think that lowering my carbon footprint fits my lifestyle.	Value Expressive Attitude
Being "green" is cool.	Personal Injunctive Norms
Lowering my carbon footprint is simply the right thing to do.	Ego Defense Attitude
I think that lowering my carbon footprint seems too complicated to try.	Self-efficacy Complexity
A lot of people I know have already started to decrease their carbon footprint.	Descriptive Norms
Lowering my carbon footprint would take too many sacrifices.	Self-efficacy Compatibility
I think it might be easy to try and lower my carbon footprint.	Self-efficacy Triability
I plan to take steps to lower my carbon footprint.	Behavioral Intent

Table 2. Survey posttest questions and the Theory of Planned Behavior component they measure.

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Subjects again used a five point scale to evaluate each statement with the same criterion (1=completely disagree through 5=completely agree). The posttest questions were based on the literature and specifically designed to measure the subject's attitudes, feelings of self-efficacy, and sense of community norms.

Following this, each subject also filled out a short demographics section to collect their age, gender and race. Because the subjects were all undergraduate students, age was grouped into four categories: 18-21, 22-25, 26-30, and over 30. Race options were African-American, Asian-American, Caucasian, Hispanic, or mixed-race. Subjects could also elect "Prefer not to state" for any of the demographic questions. Other traditional demographics such as education and income were not collected because undergraduate student populations are somewhat homogenous in those measures.

After this, subjects were thanked for their participation and debriefed about the fictional nature of the narratives, the purpose of the study, and its goals. If the subject's had any further questions or concerns they were provided the principle investigator's contact information.

4.2 Treatment of Data

All tests and analyses were performed using SPSS statistical software (version 18). For the first hypothesis, "Lacking any motivational or mitigation information in their stories, the control group will have lower overall behavioral

intent to adopt the innovations than any of the test groups" the following formal hypothesis test conditions were used:

Ho: There will be no statistically significant difference between the control group and test group responses to the survey posttest question, "I plan to take steps to lower my carbon footprint."

Ha: There will be a significant statistical difference between the control group and test group responses to the survey posttest question, "I plan to take steps to lower my carbon footprint."

This was initially tested using a one-tailed independent-samples t-test.

For the second hypothesis, "Due to confirmation bias, those individuals in the experimental groups who self-identify as having low environmental concern in the pretest section will have lower levels of adoption than other subjects." The following formal hypothesis test conditions were used:

Ho: There will be no significant statistical difference between those test subjects who self-reported higher levels of environmental concern in the pretest section of the survey and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

Ha: There will be a significant statistical difference between those test subjects who self-reported higher levels of environmental concern in the pretest section of the survey and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

For this test "environmental concern" represents a cumulative scoring of the following pretest questions based on similar New Ecological Paradigm (Dunlap & Van Liere, 1978) questions: "Humans must live in harmony with nature", "People are abusing the environment", and "The balance of nature is delicate." This was tested using one-way ANOVA.

For the third hypothesis, "Those subjects with lower combined posttest attitude question scores will have lower levels of intent to adopt the innovations than other test subjects." the following formal hypothesis test conditions were used:

Ho: There will be no significant statistical difference between those test subjects who self-reported lower post test attitudes concerning their ability to change and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

Ha: There will be a significant statistical difference between those test subjects who self-reported lower post test attitudes concerning their ability to change and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

For this test the first nine posttest questions "Lowering my carbon footprint will save me money" (reverse scored), "People I care about would approve if I lived a lower carbon lifestyle" (reverse scored), "I think that lowering my carbon footprint fits my lifestyle" (reverse scored), "Being 'green' is cool" (reverse scored), "Lowering my carbon footprint is simply the right thing to do" (reverse

scored), and "I think that lowering my carbon footprint seems too complicated to try," "A lot of people I know have already started to decrease their carbon footprint" (reverse scored), "Lowering my carbon footprint would take too many sacrifices," and "I think it might be easy to try and lower my carbon footprint" (reverse scored) were cumulative added to create a new variable called "rationalized." This was then tested using a one-tailed independent samples t-test using a dummy variable that was created based and responses to the posttest question "I plan to take steps to lower my carbon footprint" where the answers 1, 2 and 3 (disagree to neutral) were transformed into answer 0 and answers 4 and 5 (agree to strongly agree) became answer 1.

For the fourth hypothesis, "Those individuals in the experimental groups who receive messages with repeated self-efficacy examples will have higher levels of adoption than other subjects." the following formal hypothesis test conditions were used:

Ho: There will be no significant statistical difference between those test subjects who read more examples of ways to lower their carbon footprint and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

Ha: There will be a significant statistical difference between those test subjects who read more examples of ways to lower their carbon footprint and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint."

As an added check on this test, the groups of self-efficacy variation were also tested against the posttest question, "I think it would be easy to lower my carbon footprint." Both analyses were done using one-way ANOVA routines.

Exploring the overarching research questions involved more advanced statistical routines owing to the multiple variables involved to reveal a better picture of what the data was saying. In the cases where variables were combined into a single variable for exploration a Cronbach's alpha was performed to insure that the variable's changes were interrelated. Due to the exploratory nature of this study and the need to reduce the number of variables into grouped factors, a factor analysis was using the varimax protocol. Variable groupings created by this factor analysis were not checked using Cronbach's alpha as this was considered redundant.

For research question one, "How do pre-existing worldview attitudes towards the environment, science, government, religion, or conservatism affect willingness to adopt lower carbon innovations?" all pretest variables were tested using multiple linear regression against the behavioral intent posttest question, "I plan to take steps to lower my carbon footprint." Pretest variables found to be significantly related to the variation in the posttest question which seemed logically interrelated (i.e. the new environmental paradigm questions) were then checked using Cronbach's alpha to determine if they were, in fact, related. Since so many remaining variables were not significant in the linear regressions and their relationship to the behavioral intent question was unclear, an exploratory

factor analysis of the pretest variables using the varimax procedure was performed. The generated factor indices created were then used as dependent variables in multiple linear regressions with the behavioral intent posttest question to see if this clarified the relationships.

For the second research question, "What study variables (individual attitudes, community norms, self-efficacy, or fear) provided the best predictors of behavioral intent to adopt lower carbon innovations?" Test conditions and pretest questions were compared to the posttest question "I plan to take steps to lower my carbon footprint" using General Linear Mixed Model routines. Since this resulted in a similar number of non-significant findings, the General Linear Mixed Model routine was run a second time substituting the factor analysis indices created when exploring the first research question in place of the individual attitude questions to clarify the relationships.

The third research question "Can focusing on different aspects of norms in messages affect people's intent to adopt an innovation" was explored using an ANOVA with the posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable and the three community norms test conditions as the independent variable. Additional ANOVAs were also run using the three community norms posttest questions as the dependent variable and the community norms test conditions as the independent variable to see if the test conditions affected community norms perceptions.

The fourth research question "How does exposure to increasing amounts of self-efficacy affect the subject's behavioral intent to adopt lower carbon innovations" was explored using the test groups' responses to the posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable in an ANOVA with the number of paragraphs of self-efficacy information as the independent variable. A second analysis was then done again using the paragraph number as the independent variable in ANOVA with the three self-efficacy posttest questions as the dependent variable.

CHAPTER 5

FINDINGS OF THE STUDY

The demographics section showed the combined subject pool to be 62%

female (n=140) and 38% male (n=86), which is in line with the general university

population, but dissimilar with the state and national populations (about 51%

female and 49% male). The modal response to the age question was 18-21, with

55% of the subjects being Caucasian (n=124), 24% being mixed-race (n=54), 8%

being African-American (n=18), 8% being Hispanic (n=17), and 5% Asian-

American (n=11) with two subjects choosing not to state their race. This again

reflects the student population at the university.

5.1 Analysis of the Hypotheses

To insure that the control group would have enough members to generate

the statistical power needed for analysis one seventh of the subjects were

randomly placed in that group (n=31). The combined test groups totaled 195

other subjects. Eleven other subjects were removed from analysis due to

incomplete responses to either the pretest or posttest sections (more than 50%

of the question responses were missing).

In the test of the first hypothesis, "Lacking any motivational or mitigation

information in their stories, the control group will have lower overall behavioral

intent to adopt the innovations than any of the test groups," an one-tailed

independent-samples t-test of the control group and combined test groups

showed that their responses to the posttest question "I plan to take steps to lower my carbon footprint" were significantly different (df=224, F=1.012, p≤.019). Looking at the means of the two groups' responses to the posttest questions showed the test group intended to change their behavior more than the control group (control μ=3.38, test μ=3.91 where a higher score indicates more agreement with the statement). This finding suggests rejecting the null hypothesis "There will be no statistically significant difference between the control group and test group responses to the survey posttest question, 'I plan to take steps to lower my carbon footprint.'"

In analyzing the second hypothesis, "Those individuals in the experimental groups who self-identify as having low environmental concern in the pretest section will have lower levels of adoption than other subjects," the pretest questions that were drawn from the New Ecological Paradigm "Humans must live in harmony with nature," "People are abusing the environment," and "The balance of nature is delicate," were combined into a cumulative variable called "NEP." A one-way ANOVA was done using the NEP as the independent variable and the posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable for subjects in the test groups (Since the control group received no behavior changing information, it would not be possible to argue that their rejection of the article information was due to cognitive dissonance leading to confirmation bias). This was found to be statistically significant (df=12, F=64.931, p≤.000) and suggests rejecting the null hypothesis "There will be no

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significant statistical difference between those test subjects who self-reported higher levels of environmental concern in the pretest section of the survey and those who did not when responding to the survey posttest question, 'I plan to take steps to lower my carbon footprint.'"

To analyze the third hypothesis, "Those subjects with lower combined posttest attitude question scores will have lower levels of intent to adopt the innovations than other test subjects," a variable called "rationalized" was created the cumulative total of the first nine posttest questions "Lowering my carbon footprint will save me money" (reverse scored), "People I care about would approve if I lived a lower carbon lifestyle" (reverse scored), "I think that lowering my carbon footprint fits my lifestyle" (reverse scored), "Being 'green' is cool" (reverse scored), "Lowering my carbon footprint is simply the right thing to do" (reverse scored), and "I think that lowering my carbon footprint seems too complicated to try," "A lot of people I know have already started to decrease their carbon footprint" (reverse scored), "Lowering my carbon footprint would take too many sacrifices," and "I think it might be easy to try and lower my carbon footprint" (reverse scored). This was then tested using a one-tailed independent samples t-test using a dummy variable that was created based and responses to the posttest question "I plan to take steps to lower my carbon footprint" where the answers 1, 2 and 3 (disagree to neutral) were transformed into answer 0 and answers 4 and 5 (agree to strongly agree) became answer 1. The idea here being that achieving a high "rationalized" score would mean you disagreed with

the idea of lowering your carbon footprint, even after reading a story stating the many ways you could. The two groups were found to be statistically different (df=36, F=28.663, p≤.011) indicating the null hypothesis "There will be no significant statistical difference between those test subjects who self-reported lower post test attitudes concerning their ability to change and those who did not when responding to the survey posttest question, 'I plan to take steps to lower my carbon footprint'" should be rejected.

In analyzing the fourth hypothesis, "Those individuals in the experimental groups who receive messages with repeated self-efficacy examples will have higher levels of adoption than other subjects," the number of test group self-efficacy paragraphs were used as the independent variable and the response to the posttest question I plan to take steps to lower my carbon footprint" as the dependent variable in a one-way ANOVA and was not found to be significant (df=2, F=0.871, p≤.287). A second one-way ANOVA was performed using the same independent variable and the posttest question "I think it would be easy to lower my carbon footprint" as the dependent variable, which was also not significant (df=2, F=1.271, p≤.219).

5.2 Analysis of the Research Questions

In analyzing the first research question "How do pre-existing worldview attitudes towards the environment, science, government, religion, or conservatism affect willingness to adopt lower carbon innovations?" all survey

pretest variables were used as the independent variables in multiple linear

regression with the posttest question, "I plan to take steps to lower my carbon

footprint" as the dependent variable (see table 3).

Question	Beta	Significance
When I hear information from weather services I tend to trust it.	.113	p≤.282
Humans must live in harmony with nature.	.457	p≤.001***
I tend to be politically liberal.	.167	p≤.068
When I get information from news outlets I tend to trust it.	.179	p≤.266
People are abusing the environment.	.581	p≤.000***
I tend to consider my religious convictions when I make decisions.	.221	p≤.223
When I get information from scientists I tend to trust it.	.373	p≤.011*
Our understanding of climate science is so uncertain we should wait to act.	-.298	p≤.026*
When I get information from government reports I tend to trust it.	-.248	p≤.201
I tend to be conservative on social issues.	-.178	p≤.061
When I get information from religious leaders I tend to trust it.	-.198	p≤.211
The balance of nature is delicate.	.468	p≤.000***
I tend to be conservative on fiscal matters.	-.246	p≤.055
When I get information from environmentalists I tend to trust it.	.238	p≤.137

**Table 3. Results of a multiple linear regression using the above survey pretest
questions as independent variables and the behavioral intent posttest question, "I
plane to take steps to lower my carbon footprint," as the dependent variable.
* Denotes significance at p≤.050, ** denotes significance at p≤.010, and *** denotes
significance at p≤.001.**

Five of the fourteen pretest questions were found to be significant; "Humans must live in harmony with nature" (beta=.457, p≤.001), "People are abusing the environment" (beta=.581, p≤.000), "When I get information from scientists I tend to trust it" (beta=.373, p≤.011), "Our understanding of climate science is so uncertain we should wait to act" (beta=-.298, p≤.026), and "The balance of nature is delicate" (beta=.468, p≤.000). Three other pretest questions were also marginally significant; "I tend to be politically liberal" (beta=.167, p≤.068), "I tend to be conservative on social issues" (beta=-.178, p≤.061), and "I tend to be conservative on fiscal matters" (beta=-.246, p≤.055).

Using a Cronbach's alpha procedure the significant and marginally significant variables were tested to see if they were interrelated. The three New Environmental Paradigm questions "Humans must live in harmony with nature," "People are abusing the environment," and "The balance of nature is delicate" were found to be correlated with each other (α=.889), but not with the other significant variables. The three marginally significant questions were also found to be correlated when "I tend to be politically liberal" was reversed scored (α=.797). The other two significant variables were found to not be correlated to each other.

Because this study's approach to understanding the relationships between variables is exploratory in nature, some attempts at variable reduction were done to clarify the observations. The NEP variables had already been combined into a single variable from the earlier test of the first hypothesis and was used as the

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independent variable in a linear regression with the variable for the posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable and found to be significant and very predictive (adj r^2=.686, p≤.000). Another combined variable now named "conservatism" was created using the three marginally significant variables for the pretest questions "I tend to be politically liberal" (reverse scored), "I tend to be conservative on social issues", and "I tend to be conservative on fiscal matters". This new variable was then used as the independent variable in a linear regression with same posttest question variable and also found to be significant, but less predictive (adj r^2=.126, p≤.031).

This was intriguing so for the sake of exploring these relationships, additional variable reduction in the form of a factor analysis was performed on the pretest variables using the varimax procedure to see if any other groupings of variables proved to be good predictors of the behavioral intent posttest question (see table 4).

Question	Factor Analysis Component				Variable
	1	2	3	4	
When I hear information from weather services I tend to trust it.	.324	.030	.575	.069	Trust
Humans must live in harmony with nature.	.769	.202	-.253	-.031	NEP
I tend to be politically liberal.	-.400	-.675	-.205	-.071	Conserv Skeptic
When I get information from news outlets I tend to trust it.	.192	-.020	.604	.258	Trust
People are abusing the environment.	.634	-.180	-.358	.201	NEP

I tend to consider my religious convictions when I make decisions.	-.156	.027	.019	.616	Religion
When I get information from scientists I tend to trust it.	-.169	.028	.616	.177	Trust
Our understanding of climate science is so uncertain we should wait to act.	-.324	.510	.137	.351	Conserv Skeptic
When I get information from government reports I tend to trust it.	.145	.154	.511	-.017	Trust
I tend to be conservative on social issues.	-.345	.637	.207	.180	Conserv Skeptic
When I get information from religious leaders I tend to trust it.	.443	.460	.042	.604	Religion
The balance of nature is delicate.	.713	.221	-.047	.117	NEP
I tend to be conservative on fiscal matters.	.271	.536	-.085	.358	Conserv Skeptic
When I get information from environmentalists I tend to trust it.	.558	.030	-.271	.069	NEP

Table 4. Varimax factor analysis loadings for survey pretest questions. The highest loadings above .500 were combined into new variables as noted.

The factor analysis loaded the significant NEP variables in the same index with previously non-significant variable for the pretest question "When I get information from environmentalists, I tend to trust it." These were combined to make a new independent variable and used in a linear regression with the "I plan to take steps to lower my carbon footprint" variable as dependent and found to be less significant and predictive (adj r^2=.466, p≤.001) than the NEP variables alone and was dropped from further analysis.

A second index loaded the three "conservatism" variables as well as the independently significant "Our understanding of climate science is so uncertain

we should wait to act." A new variable was created called "conservative skepticism" and used as the independent variable in a linear regression with the same behavioral intent posttest question and found to be significant predictor (adj r^2=.168, p≤.015). Two other indices were created from the remaining questions by the factor analysis, but independent variables created based on those indices and used in regressions with the behavioral intent posttest question were found to be not significant predictors.

For analysis of the second research question, "What study variables (individual attitudes, community norms, self-efficacy, or fear) provided the best predictors of behavioral intent to adopt lower carbon innovations?" the test conditions of the messages (threat, self-efficacy paragraphs, and community norms), the significant predictor pretest questions (including the NEP and conservative skeptics variables) were evaluated as independent variables using General Linear Mixed Model routines with the behavioral intent posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable.

General Linear Mixed Models allow continuous and categorical variables to be controlled for in linear models with each other. These linear models generate typical Pearson's r^2 values for continuous variables and analogous partial eta values for categorical variables. The variable's significance to the model is measured using typical p-values for both categorical and continuous types. Table 5 shows the results of a General Linear Mixed Models regression of the significant worldview and test condition variables.

Measure	r^2 or eta[†] Value	Significance
New Ecological Paradigm	. 491	p≤.000***
Conservative Skepticism	.139	p≤.018*
When I get information from scientists I tend to trust it.	.131	p≤.044*
Message Threat Level	.033[†]	p≤.136
Message Norms	.083[†]	p≤.057
Message Self-efficacy Paragraphs	.067[†]	p≤.248

Table 5. Results of a general linear mixed model regression using the significant survey pretest question "When I get information from scientists I tend to trust it," the combined NEP, and conservative skepticism variables as independent variables, message threat, norms, and self-efficacy paragraphs as fixed factors, and the behavioral intent posttest question, "I plane to take steps to lower my carbon footprint," as the dependent variable.
* Denotes significance at p≤.050, ** denotes significance at p≤.010, and *** denotes significance at p≤.001.

Of the test conditions, the level of fear and used in the messages was not a significant predictor, nor was the amount of self-efficacy information. The different depictions of norms were marginally significant (df=2, F=2.282, p≤.057) and partial eta^2 value of .083. Since the third research question deals specifically with the norms information in the test messages, additional findings regarding this effect are reported there. The NEP and conservative skepticism variables both continued to be significant (adj r^2=.491, p≤.000 and adj r^2=.139, p≤.018 respectively) as well as the variable for the question "When I get information from scientists I tend to trust it" (adj r^2=.131, p≤.044).

The third research question "Can focusing on different aspects of norms in messages affect people's intent to adopt an innovation" was explored by ANOVA using the posttest question "I plan to take steps to lower my carbon footprint" as the dependent variable and the three community norms test conditions as the independent variable. Despite the marginal significance shown in the results for the second research question, there was a significant difference between norms information and its effect on the behavioral intent variable (df=2, F=4.551, p≤.034). Post hoc analysis using a Bonferroni test (see table 6) reveals that the personal injunctive norm condition used in the messages significantly increased responses to the behavioral intent question (+.401 to mean, p≤.031 compared to descriptive norms and +.383 to mean, p≤.042 compared to social injunctive norms).

Comparison of Norms		Mean Difference	Significance
Personal	Social	+.383*	p≤.042*
	Discriptive	+.401*	p≤.031*
Social	Discriptive	+.018	p≤.438
	Personal	-.383*	p≤.042*
Discriptive	Personal	-.401*	p≤.031*
	Social	-.018	p≤.438

Table 6. Bonferroni comparison of message norms content and the mean value of subject responses to the behavioral intent question "I plan to take steps to lower my carbon footprint." * Denotes significance at p≤.050.

The different community norms conditions of the messages were also used as the independent variable for ANOVAs using the rest of the posttest community norms questions as dependent variables. Only the personal injunctive norms measures "Being 'green' is cool" was found to be significant (df=2, F=3.251, p≤.048). None of the other variables were significant. Another post hoc analysis using Bonferroni confirmed that the personal injunctive norm condition significantly increased the means of both posttest questions (+.311 to mean, p≤.051 compared to descriptive norms and +.323 to mean, p≤.048 compared to social injunctive norms).

The analysis of the fourth research question, "How does exposure to varying degrees and models of self-efficacy affect the subject's behavioral intent to adopt lower carbon innovations?" An ANOVA was done using the increasing amount of self-efficacy information in the messages as the independent variable and the behavioral intent question as the dependent variable which showed no significant difference between the three treatments (df=2, F=1.181, p≤.238). Using the self-efficacy treatments again as the independent variable additional ANOVAs were conducted using the other nine posttest variables. None of these ANOVAs showed any significant relationships, either.

Analysis of the study's combined model approach used the posttest variables for attitudes, norms, and self-efficacy as independent variables in an ANOVA with the posttest variable for behavioral intent as the dependent variable (see table 7).

Question	F Value	Significance
Lowering my carbon footprint will save me money.	2.282	p≤.081
People I care about would approve if I lived a lower carbon lifestyle.	0.206	p≤.892
I think that lowering my carbon footprint fits my lifestyle.	2.668	p≤.069
Being "green" is cool.	3.781	p≤.048*
Lowering my carbon footprint is simply the right thing to do.	3.831	p≤.042*
I think that lowering my carbon footprint seems too complicated to try.	4.235	p≤.022*
A lot of people I know have already started to decrease their carbon footprint.	0.749	p≤.524
Lowering my carbon footprint would take too many sacrifices.	1.694	p≤.200
I think it might be easy to try and lower my carbon footprint.	4.972	p≤.009**

Table 7. ANOVA results using the posttest measures for the Theory of Planned Behavior as independent variables and the behavioral intent question "I plan to take steps to lower my carbon footprint" as the dependent variable. * Denotes significance at p≤.050, ** denotes significance at p≤.010.

Four of the posttest question were found to be significant "Being 'green' is cool"

(df=4, F=3.781, p≤.048), "Lowering my carbon footprint is simply the right thing to

do" (df=4, F=3.831, p≤.042), "I think that lowering my carbon footprint seems too

complicated to try" (df=4, F=4.235, p≤.022), and "I think it might be easy to try

and lower my carbon footprint" (df=4, F=4.972, p≤.009). Two other posttest

questions were marginally significant "Lowering my carbon footprint will save me

money" (df=4, F=2.282, p≤.081), and "I think that lowering my carbon footprint fits

my lifestyle" (df=4, F=2.668, p≤.069).

New variables called "attitudes", "norms", and "efficacy" were then created using the cumulative totals of the posttest variables designed to measure the various forms of attitudes, community norms perception, and self-efficacy perception. These new variables were then used as independent variables in multiple linear regressions with the posttest variable for behavioral intent as the dependent variable. Both "attitudes" and "efficacy" were significant (adj r^2=.548, p≤.001 and adj r^2=.348, p≤.014, respectively).and norms was marginally significant (adj r^2=.131, p≤.054). The results of this model appear in the discussion section.

CHAPTER 6

DISCUSSION

The demographics show that this convenience sample does not represent

the general population of the United States or even that of the city where they

live, so this discussion makes no claims that these findings represent anything

other than this group of university undergraduates. Despite this limitation, the

fear appeals approach does appear to have some value when discussing climate

change. The null hypothesis for the first hypothesis "There will be no significant

statistical difference between the control group and test group responses to the

survey posttest question, 'I plan to take steps to lower my carbon footprint'" is

rejected by the results of the one-tailed independent samples t-test (df=224,

F=1.012, p≤.019). The control and test groups are significantly different with the

test subjects showing a higher mean value in their intent to change their behavior

(control μ=3.38, test μ=3.91).

It is important to note that the control group already seems predisposed to

doing something already about climate change. Subjects choosing to change

behavior to lower their carbon footprint outnumbered those choosing not to by

50% (n=12 vs. n=8) in the control group. If this same predisposition existed in the

test groups, it makes their decision to take more action interesting, and supports

the idea that people want to do something about climate change, but are not sure

what will help. Looking at the two groups finds that 26% (n=8) of the control

group was hesitant about changing behavior compared to only 16% of the test

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groups (n=31). Those who were neutral about changing behavior in both groups was about equal, 35% of the control group (n=11) and 37% of the test groups (n=72). Finally, those opting to lower their carbon footprint was 39% of the control group (n=12) and 47% of the test group (n=92).

The New Environmental Paradigm (NEP) question set has been successfully predicting attitudes towards the environment for decades and continues to do so in this study. The ANOVA results of the NEP pretest questions and behavioral intent posttest question suggests a rejection of the second hypothesis' null hypothesis "There will be no significant statistical difference between those test subjects who self-reported higher levels of environmental concern in the pretest section of the survey and those who did not when responding to the survey posttest question, 'I plan to take steps to lower my carbon footprint'" (df=12, F=64.931, p≤.000). Figure 6 on the next page shows the graphical representation of this relationship.
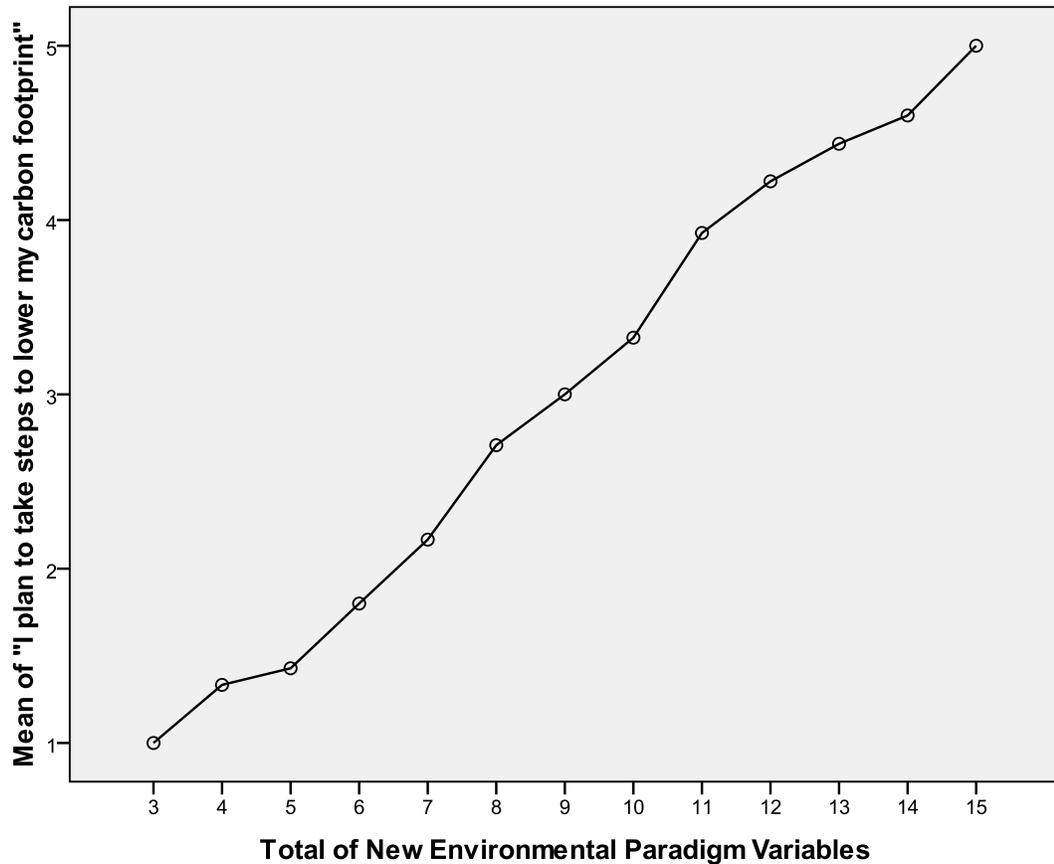
Figure 6. Plot of the relationship between the total of the three New Environmental Paradigm pretest questions and responses to the behavioral intent posttest question "I plan to take steps to lower my carbon footprint."

As the figure shows, there is an almost linear relationship between the cumulative NEP responses and behavioral intent. A check of the control group's responses shows a similar graph, so the messages alone were not responsible for creating the relationship. About 37% of the study's subjects self-identified with a combined NEP score of 9 or less suggesting that this group of college students might not be so different from the more general population. National and international polls typically find that 25-40% of respondents are not inclined to do

something about climate change. Based on the apparent relationship between NEP score and intent to help mitigate climate change effects it seems reasonable to assume that this 25-40% seen in polls would tend to have neutral or lower NEP scores.

The analysis of the third hypothesis rejected the null hypothesis "There will be no significant statistical difference between those test subjects who self-reported higher levels of rationalizing high carbon behavior in the posttest section of the survey and those who did not when responding to the survey posttest question, 'I plan to take steps to lower my carbon footprint'" (one-tailed independent t-test results were df=36, F=28.663, p≤.011). Looking at the differences in the mean values shows a much lower desire to engage in carbon lowering activities (the nine posttest attitude questions) among those who are neutral or disagree with the statement "I plan to take steps to lower my carbon footprint" (µ=25.778 compared with µ=37.181 for those who agree with the statement). This result is somewhat surprising considering that later analysis of the Theory of Planned Behavior portion of the combined model showed the only four of the nine posttest variables used to create "rationalized" variable were significantly related to changes in the behavioral intent question, "I plan to take steps to lower my carbon footprint."

It seems that despite the information contained in the test messages, some subjects were still resistant to the idea that mitigating climate change was something that they could or would want to attempt. To some extent this is

understandable considering this experiment is a single message that is completing with all the other climate change messages and attempts to change behavior these subjects have every experienced. What's more intriguing is that some parts of the message do resonate with significant numbers of these subject and suggests rejecting the null hypothesis.

This also points to a measurement problem for evaluating rationalization of bad behavior. For complex issues it is important to understand when rationalization occurs and what combination of attitudes and information aggravate or mitigate it. The measures used in this study identify some rationalization occurred, but also shows more research needs to be done to identify a collection of measures that can capture this phenomenon more clearly.

The analysis of the fourth hypothesis failed to reject the null hypothesis "There will be no significant statistical difference between those test subjects who read more examples of ways to lower their carbon footprint and those who did not when responding to the survey posttest question, "I plan to take steps to lower my carbon footprint," with an ANOVA significance of $p \le .287$. This is contrary to what the literature predicts, but it could be a result of the way the experiment was conducted or how self-efficacy messages might have different levels of resonance with readers.

Because all test messages carried the same initial self-efficacy paragraph, that first mitigation strategy might be the most accessible and influential with these subjects. Because rotating these paragraphs to test them individually

would have created too many test groups for the expected number of subjects, it is not possible to determine if this was the case in this study. It could also be a fatigue factor, as the self-efficacy messages were the last section of each story, and adding additional paragraphs to include the extra mitigation strategies made the stories somewhat lengthy. Attempts to use other posttest questions specifically designed to test self-efficacy effects as dependent variables also failed to show any significance, further suggesting that adding extra messages did not improve the subject's sense of efficacy.

The analysis of the more general research questions helped clarify how the interplay of many study variables was impacting the subject's intentions to change behavior. The analysis of the first research question "How do pre-existing worldview attitudes towards the environment, science, government, religion, or conservatism affect willingness to adopt lower carbon innovations" suggests that three pre-existing attitudes played a part in determining subject's willingness to change their behavior as shown in figure 7 on the next page.
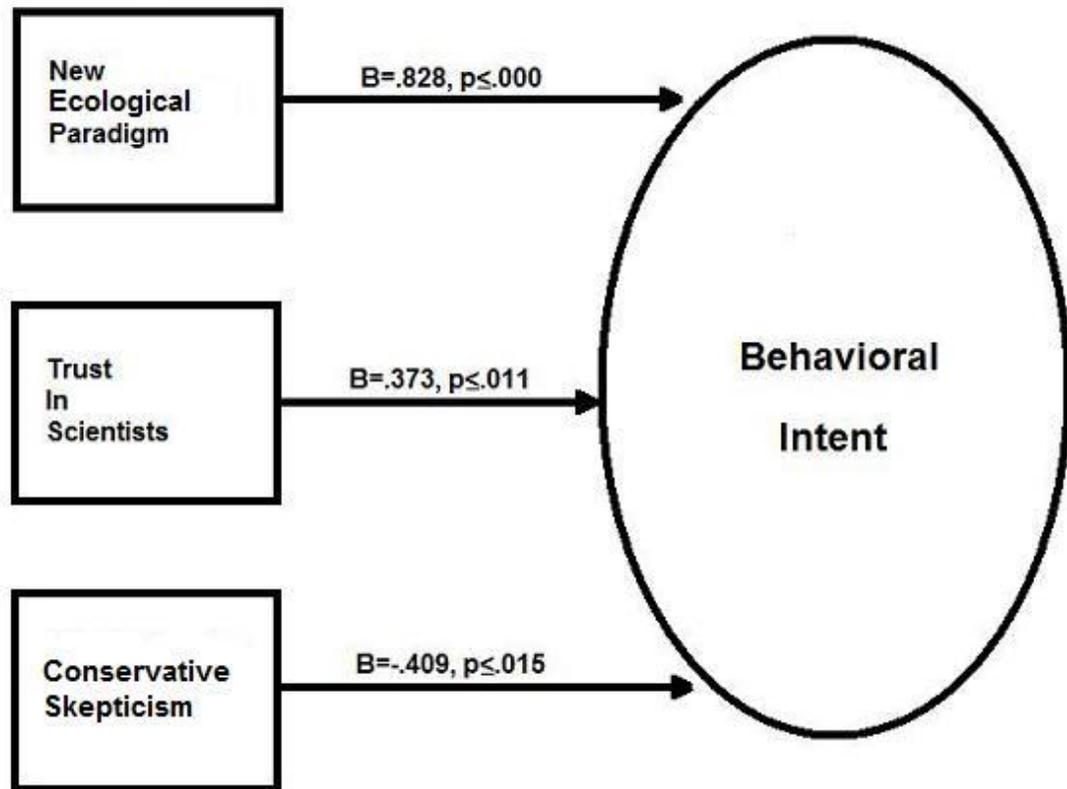
Figure 7. Linear regression model of pre-existing attitudes that significantly predict changes in behavioral intent showing beta values, direction, and significance.

As the literature suggested, responses to the New Environmental

Paradigm (NEP) questions were significantly related to the subject's willingness

to protect the environment by mitigating the effects of climate change. In fact, the

NEP questions were the most significant predictors of behavioral intent for the

entire study. Linear regression shows that NEP questions predict almost 69% of

the variation found in the posttest behavioral intent question "I plan to take steps

to lower my carbon footprint" (adj r^2=.686, p≤.000). While a nice confirmatory

finding, the 'discovery' that people predisposed toward protecting the

environment tend to react favorably toward pro-environmental messages is hardly surprising.

The other attitude findings are more interesting. Previous pilot studies conducted by this researcher on similar topics had found only weak support for "trust in scientists" as a predictor of behavioral intent, yet it was significant in this study even if it only predicts less than 13% of the variance (adj r^2=.128, p≤.011). While might seem reasonable that people who trust in science might be more inclined to believe the IPCC reports and climate science in general, another possibility might lay in the subject pool itself. For previous pilot studies all subjects had been drawn from communication and journalism class, but this subject pool also included several introductory environmental science classes. While this class in populated with students from a variety of majors (the class counts as a core science requirement for all majors), it might still contain those students more interested in science than the previous subject pools and account for this significance.

The conservative skepticism variable was another interesting finding. While individual variables measuring conservative attitudes were only marginally significant, as a group they become significantly predictive of behavioral intent (adj r^2=.386, p≤.013). As demonstrated by the Cronbach's alpha comparison, they act in a similar fashion (α=.797) and could reasonably be considered, both statistically and intuitively, to represent a collective worldview. The factor analysis loading of these measures with the independently significant predictor question

"Our understanding of climate science is so uncertain we should wait to act" was very intriguing. To better understand this group further demographic analysis was done.

Using the conservative skepticism variable as the dependent variable and race as the independent variable in ANOVA found they were significantly correlated (df=4, F=5.024, p≤.003). A post hoc Bonferroni analysis of the ANOVA revealed that those having a high conservative skepticism value were significantly more likely to be Caucasian than other races. An independent t-test using "sex" as the grouping variable and conservative skepticism as the dependent variable found that males had significantly higher conservative skepticism scores than females (df=224, F=2.342, p≤.020). A look at the top 30 conservative skepticism scores found that 16 were Caucasian males, 4 were Caucasian females, 4 were mixed race males, 2 were mixed race females,1 was an African-American male, 1 was an Asian-American male, 1 was an Asian-American female, and 1 was a Hispanic male (see table 8).

Race	Sex		Total
	Male	Female	
African-American	1		1
Asian-American	1	1	2
Caucasian	16	4	20
Hispanic	1		1
Mixed-Race	4	2	6
Total	23	7	30

Table 8. Race and sex of the top 30 conservative skepticism scores.

That the white males in the study seem to be inordinately pre-disposed against climate change mitigation (statistically the group should have had only 6 white males) compared to women or other races needs more research. Based on critical theory it seems plausible that resistance to climate change messages might in some way be linked to a sense that mitigating climate change leads to a loss of power and control for some people. White males enjoy elevated status in the U.S. and most industrialized countries, so events, like climate change, that threaten the status quo might differentially affect these males. It is also possible in a university population females outnumber males 2-to-1, the male subjects from the study might perceive a loss of power when on campus. Unfortunately, this study was not designed to measure for power and control attitudes, so any assessment is tentative at best, and requires further study.

The other two indices created by the factor analysis are interesting because they are 'not' significant predictors of behavioral intent. The third factor combined the two measures of religiosity from the study, both of which were not significant individually or as an index with the behavioral intent variable. This is interesting because some studies have linked religious beliefs with environmental issues (Bord et al., 2008) and science issues (Ho et al., 2007) while others have not (Priest and Greenhalgh, 2011). While this study suggests that religious convictions do not play a significant part in decisions about climate change mitigation it should be noted that the study used an attitude question "I tend to consider my religious convictions when I make decisions" to measure religiosity

when other studies typically use behavior questions like "How often do you attend a place of worship?" It could be that the two different questions actually measure two different things.

The last index created related to trust in sources of information which, with the exception of scientists, were all not significant. What is interesting is that the study subjects tend to trust most information sources at about the same level. It would make sense that news outlets and weather services would be similar due to most weather information being delivered during news broadcasts, but government and political sources are trusted no differently. This finding matches findings from an earlier pilot study (Priest and Greenhalgh, 2011) and makes the trust in scientists finding discussed above even more intriguing. Then again, this further argues in favor of the idea that the subjects in this study might be more science-minded and trusting in scientists.

The analysis of the second research question, "What study variables (individual attitudes, community norms, self-efficacy, or fear) provided the best predictors of behavioral intent to adopt lower carbon innovations" adding in the test conditions had mixed results. Contrary to the literature on fear appeals, moderate and high fear appeals showed no statistical difference in ANOVA with the behavioral intent adoption question. This could be a result of exposure to numerous previous messages about climate change or perhaps a belief among the test groups that hardship in the U.S. is equivalent to death and disaster for the world. Or it could be that the upper limit of threat the subjects would tolerate

was never reached. Regardless, for the climate change issue, depictions of severe consequences seem to have little effect on reader intentions.

Self-efficacy also went against expectations of the literature by showing no statistical difference in ANOVA with the behavioral intent adoption question. This finding might be a result of the lack of rotation of the messages, making it possible that the first paragraph (which appeared in all test messages) was the most salient to readers. If that were the case, the unique ability of the first paragraph to affect behavioral intention would have been lost in the analysis. It could also be that any mention of self-efficacy is enough to motivate the change in behavioral intent. This part of the study could benefit from additional testing and analysis.

Of the test conditions only community norms seemed to make a difference to the test groups, and only marginally at that, with a significance of p≤.057 and accounting for only 8% of the variance in responses to the behavioral intent question, "I plan to take steps to lower my carbon footprint." As the analysis for the third research question showed, only messages that promoted personal injunctive norms seemed to matter to test group subjects. This makes sense viewed from Maslow's Hierarchy of Needs (Maslow, 1954). Maslow argues that until people meet their most basic needs, they have great difficulty even considering more complex ethical and moral problems. Maslow expressed this hierarchy of needs as a pyramid with basic needs like food, water, and shelter at

the bottom and self-actualized concepts like fairness, lack of prejudice, and acceptance of facts at the top.

Environmental concerns occupy a high place in the hierarchy similar to that of the ability for the self-introspection required for personal injunctive norms assessments. While some debate the high placement of environmentalism in the hierarchy (i.e. clean water and a safe environment might be more pressing needs than 'thinking' about the whole of the environment) it makes sense that you would need a higher level of self-actualization to make appreciate personal injunctive norms about anything, including the environment.

This single effective measure of community norms lends some validation to the idea that the norms measures in other studies failed due to limited measurements and not due to norms having no effect (Armitage & Conner, 2000). This is particularly salient when looking at the personal injunctive norms in this study compared to other types of norms. The environment appears enormous to the individual to the point that even seeing descriptive norms acts might not seem to matter and the reflexive nature of social injunctive norms short of physical or financial punishment would seem insignificant. This leaves only individual motivation that can seem relevant to the problem of climate change mitigation. Reasonably it seems other studies using more norms measures would have found norms unique to respective topics. This seems intuitively satisfying.

The message's fear appeals and mitigation information significantly improved behavioral intention as predicted by the fear appeals literature, but

more importantly only certain aspects of the messages resonated with readers.

Using the Theory of Planned Behavior as framework some important distinction

could be made about what measures of attitude, norms, and self-efficacy

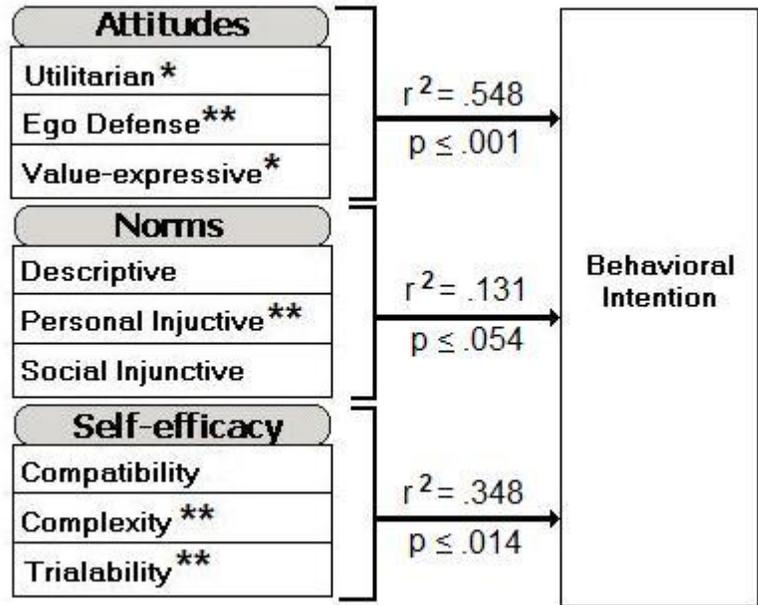seemed to matter to the experiment's subjects as shown in figure 8.

Figure 8. Multiple linear regression of the Theory of Planned Behavior Model showing the statistical significance and strength of attitudes, norms, and self-efficacy variables to predict changes in behavioral intent. The asterisks indicate the significance of individual posttest measures found in ANOVAs with behavioral intent as the dependent variable. * indicates marginal significance (p≤.081 and p≤.069). ** indicates statistical significance (p≤.050).

While the combined variable for attitudes was a statistically significant

predictor of behavioral intent (adj r^2=.548, p≤.001) not all individual attitude

measures were significant. ANOVAs for utilitarian and value expressive attitudes

were only marginally significant (df=4, F=2.282, p≤.081and df=4, F=2.668, p≤.069, respectively) to changes in the behavioral intent variable, while the ANOVA for ego defense attitude was statistically significant (df=4, F=3.831, p≤.042). Since utilitarian and value expressive attitudes were weakly predictive, environmental messages that appeal to gain/loss or lifestyle perspectives should have limited effects, while messages that focus on ego defense attitudes related to self-identification should resonate better with audiences and increase behavior change intentions.

The outlook for appeals to community norms has similar issues. Overall, the cumulative "norms" variable just misses being statistically predictive of behavioral intent to change (adj r^2=.131, p≤.054). Looking at the ANOVA of the individual norms measures shows that only the personal injunctive norms variable is statistically related to changes in behavioral intent variable (df=4, F=3.781, p≤.048) suggesting that messages targeting personal injunctive norms and self-image should resonate with readers more than those messages appealing to descriptive and social injunctive norms.

The cumulative variable of self-efficacy measures "efficacy" was a statistically significant predictor of changes in behavioral intent (adj r^2=.348, p≤.014). ANOVA for the individual variables found that both complexity and triability were both statistically related to changes in the behavioral intent variable ((df=4, F=4.235, p≤.022 and df=4, F=4.972, p≤.009, respectively) while compatibility was not. These findings suggest that test subjects were more

concerned with the barriers of accessibility and behavior complexity than they

were with fitting the new behavior into their lives. Messages that promote ease of

access to and use of new products or programs should resonate more than those

focused on lifestyle compatibility.

CHAPTER 7

CONCLUSION

These conclusions are tentative based on the convenience sample used. Despite the decent sample size, this group still represents a fairly homogenous sample of college students who are probably better at understanding the messages used, the consequences of climate change, and are predisposed to act in an environmentally friendly fashion. On another level, they still represent the responses and beliefs of young people who are members of a larger public, making some more general observations possible. Clearly there remains a great need for more research using random samples to verify the findings of this study, but that situation would exist even with an optimum random sample.

Fear appeals seem to have the ability to nudge people toward adopting new behaviors that can help lower carbon dioxide production and mitigate the effects of global climate change. It remains unclear whether information about the threat posed by climate change, mitigation strategies to limit this threat, or both were the primary drivers of this intent to change and calls for further study. The evaluation of the individual aspects of attitudes, community norms, and self-efficacy from the Theory of Planned Behavior was more illuminating. While the model as a whole predicted over 60% of the change of the behavioral intent variable (adj r^2=.635, p≤.000), the analysis of the components reveals a number of factors that resonate with readers and others that do not.

As this study demonstrates, a combined theories approach using both fear appeals and the Theory of Planned Behavior offers investigators more opportunities to explore ways to motivate changes in behavior and the underlying attitudes, values, and perceptions that informed the subjects' decisions to change. Understanding which of these features matters when people make a decision to adopt a new behavior becomes even more valuable when discussing controversial or politically polarized topics like climate change. Because promoters of positive changes sometimes have to compete in the marketplace of ideas with well-funded entities opposed to those positive changes, creating messages that better resonate with target audiences is necessary for success.

It is reasonable to assume that the variables affecting decisions to change for other topics and audiences will not match the same measures found in this study, particularly in light of the fact that this was a convenience sample of college undergraduates who were already environmentally minded. Using the combined theories approach could be applied to both health and social marketing campaigns to identify the combination of attitudes, values, and perceptions which could be incorporated into messages designed to promote better behaviors. Further research using the combined approach would not only give researchers a broader understanding the phenomena being studied than using just fear appeals or the Theory of Planned Behavior alone, it would also identify strengths and weaknesses in the combined approach, helping to refine the method.

The analysis of the pre-existing attitudes of subjects and how they affected the decision to adopt a lower carbon footprint are also somewhat provocative. While the finding that those subjects with high New Ecological Paradigm values were more likely to do something to protect the environment is not surprising, finding a tentative relationship between conservatism and climate change denial is. This makes sense on two levels. Conservatives, by nature and name, prefer things to remain the same. Add to this that through the political discourse on climate change in the U.S., the opposition to calls for mitigation measures is driven by conservative political ideology. It is understandable that many of these individuals trust opinion leaders that align with their political ideology.

The findings on information trust were also intriguing. Apparently among these students most information sources are viewed somewhat skeptically, with the exception of information from scientists. This is good news for the scientific community, who are still seen as trustworthy and reinforces the idea that public outreach approaches that use scientists will be seen as more credible. However, it again must be stated that some of these student subjects might be enrolled to become scientists themselves, adding to the possibility that they might be more trusting of science than the rest of the public.

Religiosity's apparent lack of affect is also noteworthy, but must be tempered by the subject pool being college undergraduates who tend to have lower religious conviction than the general population. That being said, there has

been a number of articles on climate change, as well as other science and technology topics, that show a negative relationship between trust in science and religiosity. It could be that the way religiosity is measured between studies is somewhat different. Most studies assume that attending church is equivalent to religious conviction, which is problematic.

Church attendance in many cases represents merely a social function, where community bonds are formed and maintained. People attend to demonstrate commitment to their community much more so than to assert their agreement with church doctrine. A better measurement of religious conviction might be gained by asking more direct questions about how these convictions influence behavior. In this study a direct question approach was taken and suggests that these previous religion vs. science findings in other studies might be more artifact than fact generated by poor question choices. Nevertheless, new research using random samples of the population to further explore these findings is needed.

The finding that males in general and white males in particular are more resistant to changing their environmental behaviors is very interesting. Understanding this phenomenon will require more research from social science scholars in a number of areas, including communication, critical studies, and social psychology. It has been observed in risk studies that small segment of white and Asian-American males have significantly lower risk perceptions of threats in general (see Finucane et al., 2000 for an overview), but the climate

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change ignoring group in this study represents over 40% of the white males. This makes it unlikely this is Finucane/Flynn's "white male" effect, but a larger systemic problem of political ideology and perceptions of power.

This finding also offers an opportunity to try and reach these conservative skeptics by appealing to both the conservative and critical approaches. If the issue is being caused by the group's predisposition to conservatism, communications that emphasize the relative minor changes in lifestyle that stave off major changes that uncontrolled climate change will bring might resonate better than previous attempts. Likewise, the idea that going with a lower carbon lifestyle somehow creates a loss of power perception among some readers could be countered by emphasizing that the proposed mitigations now allow people to control their destiny as opposed to a chaotic and uncertain future dominated by uncontrolled climate change.

The norms findings suggests that the meta-analyses of the Theory of Planed Behavior might be correct in recommending more measures of the subjective norms appraisal could bolster understanding of its effect on behavioral intention. For these subjects, descriptive norms and social injunctive norms have little resonance, but personal injunctive norms appeal to them. This is not too surprising for college students, who might be more interested in how they define their "greenness" than how society defines it. Again, this finding calls for more research using a random sample of the general public who are more likely influenced by external forms of community norms.

Overall, the study shows proof-of-concept on using the combined theories approach to changing behavior. The method highlights limitations of using either fear appeals or the Theory of Planned Behavior separately and exposes the potential underlying causes of past attempts to use these methods which met with mixed results. As this study shows, not every aspect of attitudes, community norms, or self-efficacy is affected the same way when contemplating a change in behaviors. Incomplete measures that do not take all these aspects into account run the risk of missing a valuable finding and reporting an erroneous non-finding. Combined theories also offers a wide variety of new research opportunities beyond climate change, whether by designing message campaigns to promote better behaviors or experiments in social psychology to understand decision making.

The combined theories framework could and should be used in the fields from where its core concepts were drawn, but also in areas like social marketing, public relations, and science outreach. Many times a great deal of capital has been expended on failed projects in these areas simply because the target audience was not understood well enough. This is especially true for groups, like non-governmental organizations, which operate on very limited funding even as the group attempts to promote colossal public goods similar to climate change mitigation. By using a combined theories approach to first understand their target audience and then craft messages shown by the process to resonate with that audience, these organizations can increase message understanding and calls to

action. In a world of messages rapidly increasing in both the number of voices

trying to be heard and overall volume of information, creating effective messages

requires effective analytical tools like the combined theories approach.

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EDUCATION

Ph.D. in Environmental Science, University of Nevada, Las Vegas (Anticipated 2011).
Dissertation: *Assessing a Combined-Theories Approach to Climate Change Communication*

Master of Science in Environmental Science, University of Nevada, Las Vegas, 2007.
Thesis: *Assessing the Homeland Security Advisory System*

Bachelor of Science in Biological Sciences, University of Nevada, Las Vegas, 1996.
Minor: Chemistry

ACADEMIC EXPERIENCE

Research Coordinator, Hank Greenspun School of Journalism and Media Studies, UNLV, 2008-present. Data collection and analysis, budget management, writing and coordinating grants from the National Science Foundation's National Nanotechnology Initiative.

Instructor, Department of Environmental Studies, UNLV, 2003-08. Taught in-class and online sections of ENV 100-Introduction to Environmental Science.

Instructor of Web Mastering, Division of Continuing Education, UNLV, 1998-2000. Designed and taught certification program courses in web site design.

Instructor of Sciences, Upward Bound Program, UNLV, 1994-1998. Taught physics, chemistry, and biology to college-bound high school students in federally funded program.

Student Tutor, Student Development Center, UNLV, 1992-1993. Specialization in biology, chemistry, mathematics, and English.

PUBLICATIONS

Priest, S., Lane, T., Greenhalgh, T., Hand, L., & Kramer, V. (under review). *Envisioning emerging nanotechnologies: A three-year panel study of South Carolina citizens*. Manuscript for *Risk Analysis*.

Priest, S., & Greenhalgh, T. (under review). *Attitudinal Communities and the Interpretation of Nanotechnology News: Frames, Schemas, and Attitudes as*

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Priest, S., & Greenhalgh, T. (2011). Nanotechnology as an experiment in democracy: How do citizens form opinions about technology and policy? *Journal of Nanoparticle Research*, *13*, 1521-1531.

Greenhalgh, T. (2010). Richard P. Feynman. In S. Priest (Ed.), *Encyclopedia of science and technology communication* (Vol. 1, pp. 298-300). Thousand Oaks, CA: Sage.

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CONFERENCE PRESENTATIONS AND PROCEEDINGS

Priest, S., & Greenhalgh, T. (2011). *Exploring the impact of media messages about climate change action*. Presented at the Conference on Communication and the Environment, University of Texas at El Paso.

Greenhalgh, T. & Priest, S. (2009, December). *Evaluating nanotechnology regulation Attitudes using a proportional odds regression model*. Presented at the Society for Risk Analysis annual meeting, Baltimore, MD (refereed).

Priest, S. & Greenhalgh, T. (2009, December). *Envisioning emerging nanotechnologies: Results of a three-year panel study*. Presented at the Society for Risk Analysis annual meeting, Baltimore, MD (refereed).

Priest, S., Yaros, R., and Greenhalgh, T. (2008, December). *Impact of information about risk and regulation on public perception of nanotechnology*. Presented at the Society for Risk Analysis annual meeting, Boston, MA (refereed).

Greenhalgh, T. (2007, June). *Assessing the Homeland Security Advisory System*. Paper presented at the International Symposium on Technology and Society of the Institute of Electronic and Electrical Engineers, Las Vegas, NV (conference proceedings).

RESEARCH GRANTS

Co-Principle Investigator, National Science Foundation, EPSCoR Climate Change Seed Grant Team, 2009 (with S. Priest & D. Tillery). Award amount: $25,000. Project title: *Understanding the impact of climate change media messages*.

AWARDS AND HONORS

Phi Kappa Phi International Honor Society, UNLV, 2007.
Golden Key International Honor Society, 1993.
Dean's List, College of Sciences, 1992, 1993.

PROFESSIONAL MEMBERSHIPS

American Association for the Advancement of Science
Association for Education in Journalism and Mass Communication
Society for Risk Analysis

PROFESSIONAL SERVICE

Secretary, Communicating Science, Health, Environment & Risk Division, Association for Education in Journalism and Mass Communication, 2010-present.

Panel Moderator, International Symposium on Technology and Society of the Institute of Electronic and Electrical Engineers, Las Vegas, NV, 2007.