SOCIAL MARKETING AND SOCIAL MEDIA: USING INTERNET-BASED SOCIAL NETWORK SYSTEMS TO ENCOURAGE GREEN BEHAVIOR

by

PAUL T. YORK

(Under the Direction of Marie-Claude Boudreau)

ABSTRACT

The consensus scientific opinion is that recent increases in average global temperature and changes to weather patterns have been caused by unprecedented increases in greenhouse gasses in the atmosphere, and that these changes are caused primarily by human industrial activities. When thinking about information systems’ role in reducing humanity’s environmental impact, most today consider primarily efforts at reducing the energy consumed by information technologies and data centers. Fewer consider the need for advanced information systems to help coordinate and optimize energy generation, distribution, and consumption. One type of information system in particular seems to have the potential to alter human attitudes and behaviors on a scale not before possible. Social media systems, such as Facebook and Twitter, touch millions of individuals every hour with not just facts or answers to questions but with value-laden messages. This dissertation examines the potential value of these social media systems as a means of encouraging green behavior through the application of social marketing techniques.

INDEX WORDS: Social Media Systems, Facebook, Social Marketing, Green Information Systems, Theory of Planned Behavior
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by

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DEDICATION

To my wife, Meredith—who has not known me without the weight of this seemingly eternal project bearing down on me—thank you for your love and patience throughout. To my beautiful daughter Kylie and my newborn son Keaton, thank you for keeping me grounded and inspired.

To those who began this journey with me but were not here to see it completed: my adoring and adored mother, Frissy, my father-in-law and best friend, John, and my beloved baby sister, hero, and saint, Katie. You all left way too soon, and I miss you more than I could hope to convey in words. Thank you for continuing to inhabit my heart and fill me with warmth and strength.
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Any project that spans eight years is bound to owe much to countless contributors along the way. This is no exception. The composition of my committee changed a number of times, as might be expected through years of stop/start/reset progress, but two members stayed with me from start to finish. My chair, Marie-Claude Boudreau, is one of the kindest and most compassionate (not to mention intelligent) people I have known. She never forgot about me and made sure I kept moving in a positive direction throughout. Rick Watson is undoubtedly the epitome of an academic role model—a bottomless well of fantastic ideas, deep knowledge, and insight. I was lucky to have found both of them early in my career at UGA and blessed to have had them support me through to the end.

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1 INTRODUCTION

The consensus scientific opinion is that recent increases in average global temperature and changes to weather patterns have been caused by unprecedented increases in greenhouse gases in the atmosphere, and that these changes are caused primarily by human industrial activities (IPCC, 2007). We are not simply facing warmer summers, but also the degradation of the world’s oceans (Grimond, 2008), biodiversity loss (Díaz, Fargione, Chapin, & Tilman, 2006), fresh water shortages (United Nations, 2006), and numerous other environmental and political problems as a consequence of climate change and our depletion of limited natural resources. In light of these revelations and as global population continues to grow, it is clear that we must modify our behavior in order to allow for the survival of our species and many others.

Physical scientists have long been investigating ways to address both the causes and effects of climate change, from sustainable energy sources to methods of actively removing excess greenhouse gasses from the atmosphere. Social scientists, too, are trying to better understand individual and group attitudes and behaviors with regard both to consuming and to conserving energy and natural resources. As information systems researchers, we have tended to ignore the potential of information systems themselves as directly contributing to solutions, yet over the past half-century, information systems have been the greatest force for productivity improvement and perhaps the largest catalyst for changes in human behavior. When thinking about information systems’ role in reducing humanity’s environmental impact, most today consider primarily efforts at reducing the energy consumed by information technologies and data centers (i.e., Green
Some may also consider the need for advanced information systems to help coordinate and optimize energy generation, distribution, and consumption (i.e., *Green IS*). Especially today given the ubiquity and pervasiveness of both information technologies and systems, we can also think of information systems’ potential to alter human behaviors in a green direction.

One type of information system in particular seems to have the potential to alter human attitudes and behaviors on a scale not before possible. Social media systems, such as Facebook and Twitter, touch millions of individuals every hour with not just facts or answers to questions but with value-laden messages. They are not just information systems, but ubiquitous platforms upon which a multitude of complementary information systems can be built and deployed. The marketing of products and the spread of ideas and social memes are most commonly viral in nature, and the speed at which the viral messages replicate can be staggering. With the immense size of their user base and the frequency and fervor with which a large subset of these users interact with their virtual social networks, it seems that there must be effective means of leveraging these systems to lessen the impact that humans are having on the environment. This study looks at the potential value of these social media systems as a means of encouraging green behavior through the application of social marketing techniques.

1.1 Motivation and Research Questions

This study is focused primarily on the use of a specific type of information system to encourage green behavior in specific ways. However, to gain a more holistic understanding of the problem domain, we first look broadly at theories addressing how individuals make decisions regarding green behaviors and at general strategies for
encouraging desirable behaviors using information systems. We are driven by the following three high-level questions:

- What motivations and cognitive processes are theorized to drive individuals towards green behaviors?
- In general, what methods can be used to encourage individuals to make more sustainable behavioral choices?
- More specifically, how can individuals and organizations leverage information systems as the tools to implement these methods of encouragement?

Armed with this broader understanding of green behavior and the potential efficacy of information systems as tools for encouraging green behavior, we delve more deeply into how social media systems might be leveraged to encourage green decision-making. We look at social marketing for guidance as to additional tools to use in altering behaviors using social media systems. We conduct an experiment in the hopes of finding answers to the following high-level research questions:

- In general, how might we leverage social network systems to encourage green behaviors?
- Can a social media system be used as a conduit for social marketing messages? Will it be an effective alternative to the face-to-face means by which most social marketing messages are spread?
- In particular, commitments are social marketing tools that have proven to work best when made public and when the targeted individuals are asked to report their compliance with their commitment. To what degree can
social media systems serve both as a means of obtaining commitments and as a forum for publicizing the commitments.

- Social marketing commitments are also believed to be more effective when made in groups rather than individually. To what degree will the real-world closeness of a group’s members impact the efficacy of a group commitment in a social media environment?

Finally, we are motivated simply to understand better social media systems as a rich and ubiquitous incarnation of computer-mediated human interaction. By their nature, such systems record a wealth of data both quantitative and qualitative. But also by their nature, such data are generally restricted and simulating such a system in a controlled manner is exceedingly difficult. We hope to achieve a reasonably accurate simulacrum of a social media environment, and thus see this study also as a means of cracking open a small microcosm of these data and hope that they, combined with a number of exploratory measures, may provide insight into theory and drive future research.

1.2 Green Behavior: Defined

A discourse on the alteration of a classification of behaviors must necessarily start with a basic understanding of the definition and inner workings of the behaviors in question. We are herein concerned with behaviors deemed to be “green.” To our knowledge there have been no attempts to assign a precise definition to the concept of green behavior for the purposes of academic study. Therefore, we offer a definition of green behavior as:
Courses of individual action that achieve a desired goal in a manner that will likely result in more environmentally sustainable outcomes than other likely means of achieving that goal.

There are several aspects of this definition that call for further discussion. First, the behaviors are actualized courses of action that result in tangible results. Though behavioral change may result from changes in attitude, such attitudinal change in itself does not constitute a change in behavior. An individual may have the best intentions to engage in a personal recycling program, but until she follows through with her intentions, she has not engaged in green behavior. Furthermore, an individual may believe that a particular behavior is green, but engaging in that behavior must result in a true net environmental benefit for it to be considered to be green behavior. For example, using a modern dishwasher to wash a full load of dishes can exact a significantly lower toll on the environment than washing that same load by hand. An individual armed with partial information may believe they are engaging in green behavior by running their one-third full load of dishes through their circa 1983 Kenmore every night, but this would not be green behavior. Note that determining the actual environmental impact of human activities is a field of research in itself, especially when one considers the full-lifecycle cost of products and resources used to enable green behavior (such as a new dishwasher, clean hot water, and electricity). It is highlighted here simply to point out that green behavior has tangible—not merely perceived—results.

Second, the definition implies that the behavior is goal oriented and that the behavior can take place over time via one or many individual actions. These distinctions allow for both quantification and comparison against alternatives. The sum of the
environmental impacts of each of the actions taken towards the achievement of a specific goal can be quantified and used to compare against alternative means of achieving the same goal. For example, if the goal is the disposal of used containers, alternative actions might include recycling and waste disposal. Similarly, if the goal is to attend a meeting in another city, the acceptable choices might include walking, biking, driving, flying, or telepresence. The goals are not themselves green; rather the choices of actions taken to achieve them are relatively more or less green. It is also important to acknowledge that the goal itself may place limitations the list of possible actions. Some meetings may, for example, require a physical presence and thus preclude the option of telepresence. Others may have logistical realities that preclude any option but flying. The available choices are often contextually sensitive, and thus relative greenness must be considered contextually as well.

Third, there is no absolute green. Being green is always relative to alternatives. One is not green in isolation, but only in relation to others living similar lives and achieving similar goals. The term might better be coined “greener,’ in fact. Similarly, the term “sustainable” has been adopted in the media and in the literature to denote green behavior. The term implies that there is a threshold below which an individual’s actions have no net impact on the environment (i.e., the negative impact of an individual’s actions are reversed by nature at a pace that exceeds the rate of negative impact). While this threshold likely exists, measuring it would be exceedingly difficult and may even be beyond current scientific means. Thus, we will specifically refrain from utilizing the term sustainable as an absolute term, instead only using it relatively (i.e., more or less sustainable).
We should make one final comment on our definition with regard to “offsetting” deleterious actions. There are today numerous organizations—e.g., TerraPass (http://www.terrapass.com), CarbonFund.org (http://www.carbonfund.org), etc.—that will for a variable fee perform a variety of actions that are intended to offset the negative environmental impact of an individual’s or organization’s activities. Though the actions vary in efficacy (Kollmuss, Zink, & Polycarp, 2008), most do effectively counteract a portion the negative effects of human activities on the environment. Some organizations that provide relatively high-impact goods and services, such as airlines, are starting to offer offsets as an optional addition to the cost of purchase (e.g., Gogoi, 2008), though to date few have inextricably included offsets in the cost of purchasing goods or services.

1.3 Overview of the Study

As discussed previously, we begin the study by enhancing our understanding of green behavior in general. We accomplish this first by elaborating on the theory of planned behavior (Ajzen, 1991) and then move on to examine a number of ways that later research has amended this theory. We examine a number of additional variables that add significant predictive value to the model and that we believe are particularly salient to green behavior. We also propose an additional relationship as well as two additional moderating forces that may account for variances in behavior that have as yet not been explained by the theory. We then aggregate our research into a model of an expanded theory of planned behavior, tailored specifically to aid our understanding of green behavior.

Guided by this expanded model, we then look more closely at how various information system tools might be leveraged to encourage green behavior. Here we
introduce a concept called *persuasive technology*, which guides us in the creation of a taxonomy for categorizing the information technologies that aid in the conduct of five specific behavioral intervention strategies.

Building on this understanding, we next move on to the conduct of a controlled experiment to test portions of the expanded model using specific information technology tools. We frame the experiment as a *social marketing* campaign, or more specifically a *community-based social marketing* campaign, conducted using a sophisticated simulation of a popular social media system. The experiment takes the form of a social game, played in small teams and designed to encourage participants to track their gasoline consumption, report on gasoline saving activities, and interact socially with other participants. We create three interventions, all guided by tenets of social marketing. The first is the team makeup, with half of the participants self-selecting their teams and the other half being pseudo-randomly assigned to teams (biased towards choosing teams that have little possibility of outside interaction). The other two interventions revolve around the implementation of the social marketing tool known as *commitments* and are designed to gauge the efficacy of social media as a tool for commitments and whether they operate in ways consistent with offline implementations. The details of the experiment will be covered in far greater detail in Chapter 3.

### 1.4 Importance of the Research

We believe there are three aspects of this study that make it a worthwhile endeavor. First, as discussed in the introduction to this chapter, the environmental challenges facing society are both numerous and onerous. Even ignoring pollution, the theorized contributions people are making to unusual global warming trends, and other
environmental concerns related to excessive use of fossil fuels, curtailing the wasteful use of limited energy resources is in the best interest of all humankind. To date, information systems have played only a supporting role in this effort. We hope that this study will spark an interest in future information systems research so that we may see realized their full potential to aid in the advancement of an environmental agenda.

Second, social marketing has only recently begun to garner attention in the business and information systems literature. We believe that there is great potential in social marketing—and in particular community-based social marketing—to further advance an environmental agenda. We hope that perhaps a broad publication of this study will draw the attention of experts from multiple disciplines to aid in advancing our understanding of its techniques and to increase the frequency and improve the efficacy of its implementation in practice.

Finally, we feel that social media systems are not only a remarkable short-term phenomenon, but also likely to be an enduring one. The tools may change with time and leaders in the space may ebb and flow with public sentiment, but the concept of public, virtual social interaction is becoming ingrained into the collective psyches of an entire generation. We argue in this study that we have hardly begun to grasp the changes that this is bringing to our understanding of social psychology, much less understand the full extent of the potential of social media in marketing, commerce, education, and nearly every other facet of the offline world. And though far from blind to the phenomenon, academics are simply unable to keep pace with the changes being wrought by the mass popular adoption of social media. Nor are they able to keep up with the changes introduced by the providers or with the many innovative ways in which practitioners are
trying to leverage social media. We believe a concerted, cross-discipline effort needs to be embarked upon to improve our understanding of social media so that academics are not forever playing catch-up and might be able to actually contribute valuable insights to practice. We hope that this study serves as one of the initial contributions to this effort.

1.5 Document Organization

The remainder of this document is organized as follows. Chapter 2 provides the literature review and theoretical development that will serve as the foundation for the remainder of the study. It is divided into five sections. The first two sections review the theory of planned behavior (Ajzen, 1991) and then develop an expanded version of the theory that includes constructs that we believe are salient to our understanding of green behavior. The third section presents and explains a number of strategies by which behavior can be altered, and for each examines the ways in which information systems might be used as instruments of behavioral change. The fourth section introduces social marketing as a popular means of achieving behavioral change. The fifth section introduces social media systems and discusses their potential as a platform upon which to implement a social marketing campaign.

Chapter 3 explores the research methodology employed in this study. We begin by examining the design of the experiment. We next present our research model from which we derive seven specific propositions. We conclude with a description of our experimental treatments as well as the measures and methods used to test each of our seven propositions.

Chapter 4 presents an analysis of the results of this study. We begin with a discussion of our experimental sample—the participants in our social media experiment.
Next, we perform a statistical validation of the items on our pre- and post-experiment surveys. Finally, we present the details of our data analysis, examining the results for each proposition individually.

Chapter 5 concludes the paper with a discussion our findings and a post-hoc analysis of some aspects of our experiment design. We also discuss the implications of the research to practice as well as some of the next steps we plan to take as we continue this stream of research.
2 LITERATURE REVIEW AND THEORETICAL DEVELOPMENT

In this chapter, we address the first of our research questions by developing a socio-cognitive model of green behavior and discuss multiple means by which technology might be leveraged to trigger changes in the model’s independent variables to enact positive changes. We then look more closely at the two primary research streams driving this study: social marketing and social media systems.

2.1 The Theory of Planned Behavior

*Rational* human behavior taken in pursuit of a goal requires that an individual make one or more decisions as to the courses of action to take towards achieving that goal. In order to encourage green behavior, we must first have a fundamental understanding of how these decisions are made and then how we might alter the decisions to achieve a less harmful environmental impact. Quite a number of competing and complementary theories attempt to explain human decision making, however perhaps the most well examined is the *theory of planned behavior* (Ajzen, 1991). An evolution of Fishbein’s and Ajzen’s *theory of reasoned action* (1980), the theory posits that behavior is predicated by an explicit intention to behave in a particular manner and moderated by one’s perceived ability to enact the intended behavior (*perceived behavioral control*). However, it is the cognitive processes that precede the development of these intentions that are most often examined in behavioral research. The theory of planned behavior asserts that a weighted sum of an individual’s salient beliefs about a particular behavior (*attitude*), a sum of the expectations of *important* others combined with the individual’s
motivation to comply with these expectations (*subjective norm*), and the individual’s *perceived behavioral control* together predict the individual’s behavioral intentions. Figure 1 depicts Ajzen’s model in its original form.

![Figure 1: The Theory of Planned Behavior](image)

According to the theory then, altering one or more of the three independent variables (*attitude, subjective norm, or perceived behavioral control*) should alter intentions, and given sufficient perceived (and *actual*) behavioral control, should result in alterations to behavior. This basic premise has formed the foundation for numerous experimental interventions since the theory’s initial introduction. Its power to predict both intention and behavior have been shown to be quite high. A meta-analyses of studies conducted in the health-related fields (Godin & Kok, 1996) found that these three predicates can account for as much as 41% of the variance in behavioral intentions and 34% of the variance in actual behavior. The level of predictive power found in health-related behaviors is exceptionally impressive, as such behaviors are often considered to be driven heavily by *affective* factors that are not directly accounted for by the theory (e.g., Dutta-Bergman, 2005, p. 112).
Its power and parsimonious elegance along with a wealth of supporting and complementary research would seem to make Ajzen’s theory a logical choice upon which to structure our understanding of green behavior. In its parsimony, however, the theory of planned behavior does omit several factors that are believed to have significant (though often context-sensitive) power to predict human behavior. Some of these omissions seem quite salient with regard to understanding how green behaviors might be encouraged. By design, the theory of planned behavior is open to amendment, and the potential predictive and explanatory power of numerous independent variables have been examined within the context of the model in the years following its introduction. The next few sections will take a deeper look at a few of these additional variables, presenting a summary of the findings and discussing why they might be important in this context.

2.2 Extending the Theory of Planned Behavior

In this section, we review a few of the extensions to the theory of planned behavior that have been hypothesized to increase the theory’s power to explain and predict human action. We focus specifically on those variables that we believe offer the greatest insights in our attempt to better understand Green Behavior. These variables include Past Behavior, Habit, Moral Norms, and Self-Identity, as well as two mediating variables that help us better understand why and how the theory’s power varies contextually.

2.2.1 Past Behavior and Habit

The colloquialism, “past behavior is the best predictor of future behavior,” implies that any model of behavior must certainly include a measure of past behavior. However, such a measure is notably absent from the theory of planned behavior. In
discussing and defending the completeness of his theory, Ajzen tentatively dismisses any need to account directly for past behavior as an independent variable:

_In sum, past behavior is best treated [...] as a reflection of all factors that determine the behavior of interest. The correlation between past and later behavior is an indication of the behavior’s stability or reliability, and it represents the ceiling for a theory’s predictive validity._ (Ajzen, 1991, p. 203:203)

Ajzen explains away findings to the contrary in studies examining the earlier theory of reasoned action as likely being accounted for in large part by the perceived behavioral control construct, a significant additional independent variable added to the revised theory. He reasons that repeating similar actions generally improves a person’s self-efficacy with regard to performing that action, and thus self-efficacy (a significant component of perceived behavioral control) likely stands as a mediator between past behaviors and current behavioral intentions.

Ajzen views _habit_ as a distinct construct from past behavior. He defines habit as behavior that occurs at least in part “without the mediation of attitudes, subjective norms, perceptions of control, or intentions” (1991:203). He believes that habit may well account for some of the unexplained variance in behavior, however he argues that habit as an independent construct adds little theoretical value unless it can be defined entirely independent of past behavior. For Ajzen, there are two distinct and largely independent modes of human action: conscious (reasoned) and subconscious. Habit works along with other stimulus-response mechanisms to determine action that is performed at a largely subconscious level. For conscious action, reason is the dominant force, and thus habit
should play little to no role beyond the direct effects that the habit may have on attitude and self-efficacy.

Despite objections as to the *theoretical* value of including past behavior and habit in the theory of planned behavior, Ajzen acknowledges the evidence that shows that past behavior provides some additional *predictive* value beyond the theory’s three core independent variables (Ajzen, 2002). By aggregating the results of a number of studies, Conner and Armitage (1998) present findings that show that incorporating past behavior as a distinct independent variable accounts for an average of an additional 7.2% of the variance in behavioral intentions and an additional 13% of the variance in actual behavior. This represents significant additional predictive power. Some assert that the *frequency* with which one has behaved in the past may *moderate* both the relationships between the independent variables and behavioral intention as well as the relationship between intention and behavior (e.g., Knussen, Yule, MacKenzie, & Wells, 2004; Verplanken, Aarts, Knippenberg, & Moonen, 1998). As Conner and Armitage note:

*Clearly, past behavior does not cause subsequent behavior. However, frequent performance of a behavior may bring subsequent behavior under the control of habitual processes, although the behavior does not become habitual just because it has been performed many times.* (Conner & Armitage, 1998, p. 1436:1436)

Thus, the line between rational analysis of past behavior and subconscious habitual action may well be conceptualized as a continuum based on frequency. Furthermore, behavioral habituation may well depend not only of frequency of *performing* a task but also on the frequency of *opportunity* that one has to perform the
task (Ajzen, 2002) and the temporal stability of both the task and the context in which the task is performed (Ajzen, 2002; Ouellette & Wood, 1998). In this later conceptualization, past behavior for a strongly habituated task (high frequency of opportunity and behavior) in a temporally stable environment will directly impact future behavior. For behaviors less habituated or in more volatile environments, more volition will be required to determine a course of action, and thus past behavior will impact future behavior only indirectly through the attitudinal and control structures. This notion that the level of habituation (habit strength) of a task determines the degree of cognition involved in decision-making is consistent Triandis’ (1980) model of attitude-behavior relations, as well.

The theoretical complexity of the relationship of habit and past behavior to future behavior obviously lessens the parsimony of the theory of planned behavior. However, understanding the nature of past behavior and how past behavior impacts future behavior is especially important if we are to attempt to modify patterns of behavior. Furthermore, many of the individual behaviors that we might wish to turn “green” are ones that have become habituated. Throwing out recyclables, leisurely showers, long moments spent staring into an open refrigerator, and circling a parking lot to find the closest available parking spot are all examples of common behaviors that are likely habituated and most certainly not green. Altering these habits could have a significant impact on individuals’ overall environmental footprint. For example, UPS is training its drivers to put on their seatbelt before starting a truck’s engine to reduce emissions (Watson, Boudreau, Li, & Levis, 2010). The habit of many was to start the engine before taking any other action.
2.2.2  *Moral Norms*

In his 1991 articulation of the theory, Ajzen noted a possible need to consider the notion of internal, personal, or moral norms (in practice, personal norms, moral norms, and perceived moral obligations are essentially synonymous) in addition to external, subjective norms. Citing three contemporary studies, he notes that the “addition of perceived moral obligation further increased the explained variance by 3 to 6%, making a significant contribution in the prediction of each intention.” (Ajzen, 1991, p. 200)

Further meta-analysis by Conner and Armitage (1998) found that including the construct increased the predictive potential of the theory of planned behavior by an average of 4%.

For environmentally relevant behaviors, researchers have found significant evidence to support the inclusion of moral norms in addition to the three core independent variables of the theory of planned behavior. In a study examining the effects of moral norms on behavioral intentions across a number of environmental behaviors (Harland, Staats, & Wilke, 1999), researchers found that, on average, moral norms in this context accounted for nearly 6% of the variance in behavioral intentions. This suggests that moral norms may play an even greater role in the context of green behaviors than elsewhere. However, the added predictive value of personal or moral norms on behavioral intentions varies widely (Conner & Armitage, 1998). Even within a seemingly homogenous group of environmentally significant behaviors, Harland, et al. (1999) found the increase in explained variance to range from 1% for using alternative transportation to 10% for reducing meat consumption. This unexplained variance implies either measurement error or the existence moderating influences.
There is no general agreement as to exactly how this construct affects the other theoretical constructs, with some finding direct effects on behavioral intent and others arguing that the construct operates through the behavioral, (subjective) normative, and control beliefs (Conner & Armitage, 1998). Harland, et al. (1999) conceptualize personal norms as a peer independent variable directly affecting behavioral intentions. This conceptualization is more appealing to us intuitively, as well. It seems logical since both moral norms and subjective norms are evaluations of normative beliefs that contribute to the formation of attitudinal beliefs but also often may directly conflict with these attitudinal beliefs. Thus, in our expanded theory of planned behavior, we see moral norms operating as an independent variable directly influencing behavioral intentions. Though, as is the case with subjective norm, we expect moral norms are likely to interact with the other independent variables, most especially attitude and subjective norm.

2.2.3 Self-Identity

Another component not directly accounted for by the core of the theory of planned behavior that would seem to provide significant insight into understanding green behavior is the notion of self-identity or self-concept. Self-identity is defined broadly by Conner and Armitage (1998) as “the salient part of an actor’s self that relates to a particular behavior.” Self-identity in this context derives from identity theory (Stryker, 1968), which is traditionally concerned with an individual’s identification with the multitude of socially-defined roles within society (e.g., male, mother, caregiver, conservative, activist, etc.). Such roles represent “the relatively enduring characteristics that people ascribe to themselves, which take the form of (or incorporate) socially given linguistic categorizations” (Sparks & Guthrie, 1998). Self-identity is notably distinct from
the concept of group-identity, whereby an individual identifies with and adopts the shared values of a social group. Though group-identity—or rather the strength of one’s identification with a group—has been thus far found only to moderate the relationship between subjective norm and behavioral intention (e.g., D. Terry & Hogg, 1996; D. J. Terry, Hogg, & White, 1999), self-identity has been found to have a direct impact on behavioral intention and on subsequent behavior (e.g., Conner & Armitage, 1998; Sparks & Guthrie, 1998; Sparks & Shepherd, 1992).

As with moral norms, the degree of impact that self-identity has on behavioral intentions seems to vary contextually. Conner and Armitage (1998) found that, on average, self-identity could account for an additional 1% of the variance in behavioral intention. However, the additional predictive power has been found to increase to 2% to 3% in certain situations (e.g., Sparks & Guthrie, 1998; Sparks & Shepherd, 1992; D. J. Terry, et al., 1999). Furthermore, including measures of both moral norms and self-identity in a test model provided support for assertion that both represent distinct concepts with each adding independently to the predictive power of the model (Sparks & Guthrie, 1998), Self-identity would seem to have significance in the understanding of green behavior, in particular. That people identifying themselves as recyclers (D. J. Terry, et al., 1999), environmental activists (Fielding, McDonald, & Louis, 2008), or green consumers (Sparks & Shepherd, 1992) would engage in green behaviors is not surprising; that these self-identities determine behavioral intentions independently beyond their formative impacts on attitudinal and normative beliefs is both surprising and significant.
2.2.4 Altruism’s Effect on Subjective Norm

In a meta-analysis of past work to model the determinants of green behavior (Bamberg & Möser, 2007), the authors find that the influence of subjective norms are effectively mediated by the internalization of those norms into one’s own moral normative structures. In other words, the link between subjective (social) norms and behavioral intention is removed from the model, and the covariance between subjective and moral norms is theorized as causal. Figure 2 is a shows the resulting model, with the path coefficients and explained variances achieved by processing a structural equation model with the amalgamated results of a number of prior studies that were informed by a model proposed by Hungerford, Tomera, and Hines (1986).

![Figure 2: Meta-Model of “Pro-Environmental Behavior” (Bamberg & Möser, 2007)](image_url)

Though they provide some corroborating data, Bamberg and Möser do not offer a solid theoretical argument as to why the direct relationship between subjective norm and behavioral intention should be removed in the realm of green behaviors. However, one logical explanation for this is that many environmentally significant behaviors could be
considered altruistic in nature. Altruistic behaviors are actions that are performed for the
good of others or society and from which the actor is expected to receive no extrinsic
reward. In a seminal work on the subject, Shalom Schwartz (Schwartz, 1977)
hyposesizes that, for altruistic behaviors, social norm only impacts behavior in as much
as it influences personal norms. Several studies of environmentally significant behaviors
have attempted to show that such behaviors are altruistic. For example, Hopper and
Nielsen (1991) found strong empirical support for the notion that recycling is altruistic in
finding that social norm had no direct impact on behavioral intention. Figure 3 shows a
conceptual model of altruistic behavior from this study. As can be seen, the model
predicts personal/moral norm as fully mediating the relationship between social norm and
recycling behavior.

![Figure 3: Model of Altruistic Behavior (Hopper & Nielsen, 1991)](image)

However, a more recent study of recycling behavior (Oom Do Valle, Rebelo,
Reis, & Menezes, 2005) specifically rejects the hypothesis that social norm’s influence
on recycling behavior is fully mediated by moral norms. We would expect that the degree
of direct social influence might vary between activities of differing types because the
degree to which any behavior would be considered altruistic will logically vary, as well.
However, the fact that the results are inconsistent between two studies of the same
behavior implies either significant measurement error or the existence of one or more moderating variables (or both).

One potential moderator might be the closeness of the individual to those conveying the normative messages. In the Hopper and Nielsen study, the researchers employed neighborhood “block leaders,” a concept also espoused by social marketing. The block leaders approached all of the members of the study individually and made personal appeals to comply with the recycling norm. According to the elaboration likelihood model, normative messages are absorbed more readily when conveyed by those that are known to and respected by the recipient. It seems logical that the social norm proffered by the neighbor is converted to moral norm far more readily than the much less personal efforts put forth by the Sociedade Ponto Verde, as described in the latter study. So we might expect that the relationship between subjective norm and moral norm would be moderated by the social closeness of the source(s) of the normative messages.

Another potential moderator is the observability of the behavior. Altruistic behaviors are those for which the actor can expect no extrinsic rewards. This includes the social rewards that might come from compliance with a norm (or avoidance of the social scorn that comes with non-compliance). Thus, almost by definition, altruistic behaviors are performed out of the view of others, or at least out of the view of those who “matter” to the actor—in fact, the observability of an action may well be a proxy determinant of whether that action is driven by altruism or not. This brings into question whether the Hopper and Neilsen study is actually finding support for Schwartz’s conceptualization of altruism, because the compliance with the request to recycle is visible both by neighbors
and by the block leaders and thus seems not to be purely altruistic in nature. Nonetheless, it seems logical to hypothesize that, for behaviors with significant subjective norm (positive or negative), the impact of subjective norm on behavioral intention would be moderated by the observability of the behavior in question.

Taking this concept one step further, subjective norm may also directly affect behavior depending on the observability of the behavior. This relationship is intuitively apparent. We can think of any number of cases where individuals may have no pre-conceived intentions to conform to socially desirable behavioral expectations, but do so only when the behavior is observed by others. For example, an individual may toss empty aluminum cans in the trash at home despite the ready availability of curbside recycling services and a full appreciation of the social norm for recycling. But that same individual may go out of their way to find a recycling container at the workplace where their (non-)compliance is easily observable. Such compliance could be pre-conceived, in which case the observability of socially desirable behavior likely influences behavioral intention, but does so contextually (i.e., the individual forms multiple rationally derived intentions based on location or other contextual cues). But it could also occur in situ, with the individual altering her behavior only after noticing that “someone is looking.” In this latter case, the individual’s knowledge of the subjective norm does not affect intentions. Rather it directly alters behavior, but only in the presence of an observer. Thus, we conceive of the observability of a behavior as moderating both the relationship between subjective norm and behavioral intention, as well as a direct, causal link between subjective norm and behavior.
2.2.5   Modeling an Expanded Theory of Planned Behavior

Our model of an expanded theory of planned behavior is depicted in Figure 4. We have added six independent variables to the model (darker and italicized). Arrows represent all of the theorized causal and moderating relationships discussed in this section. We have left out the non-causal co-variances that are often included in models of the theory of planned behavior (e.g., the correlations between perceived behavioral control, attitude and norms), though we do acknowledge the likelihood that many of the variables, especially those that directly predict behavioral intention, likely will co-vary in ways not yet accounted for by theory.

In the name of parsimony, we have also excluded many additional variables that have been found to play a role in determining green behavior in other studies. By and
large, the excluded variables are personality traits used to predict the formation of norms and attitudes, or are themselves formative components of moral norm. For example, specific dimensions a person’s *internal-external locus of control* have been found to play a role the formation of attitudes towards environmentally significant behavior (e.g., Cleveland, Kalamas, & Laroche, 2005; Larose & Ponton, 2000). Others include *feelings of guilt* (Bamberg & Möser, 2007), *internal attribution or ascription of responsibility* (e.g., Bamberg & Möser, 2007; Hopper & Nielsen, 1991) as well as a plethora of personal value-orientations, including most commonly *biospheric, altruistic, and egoistic* (e.g., Dietz, Fitzgerald, & Shwom, 2005; Lopez & Cuervo-Arango, 2008; Stern, 2000; Stern & Dietz, 1994). Such variables are numerous and difficult to manipulate directly, so we opted not to include them in some form of *grand model*. However, they should not be dismissed, as they provide clues as to some of the psychological processes through which the variables in this model can be manipulated. Future research should perhaps look at aggregating these predictive and formative factors into a more cohesive model that could be used to inform the creation of more effective interventions.

Also left out of the model are measures of *problem awareness* (e.g., Bamberg & Möser, 2007) or *awareness of consequences* (e.g., Bratt, 1999; Dietz, et al., 2005; Hansla, Gamble, Juliusson, & Gärling, 2008; Harland, Staats, & Wilke, 2007; Hopper & Nielsen, 1991), among a number of other cognitive factors. Such measures are readily targeted for manipulation, and as such could certainly have made the “cut” for inclusion in this model. However, they are often highly contextual and difficult to generalize across all forms of green behavior. And as with the personality traits discussed previously, they operate by contributing to the formation of both attitudes and norms. There are so many
widely varying cognitive forces that contribute to norms and attitudes that it simply did not seem “right” to pick only a few of these for inclusion in this model. However, again it is apparent that such formative factors are a significant component of the attitudes and norms that govern green behavior. Furthermore, these factors are often targeted directly for manipulation by both academics and practitioners. So as with the psychological variables discussed previously, a future synthesis should likely be conducted to try and “zoom in” on these formative cognitive factors, as well.

2.3 Encouraging Green Behavior Using Technology

Armed with the theoretical underpinnings of green behaviors in general, we may now move on to addressing our second and third overarching research questions. How we encourage individuals to engage in green behaviors, and more specifically how can we leverage information systems to help? In this section we examine five general means of encouraging behavioral change: enabling rational decisions, persuading, enhancing the analysis of past behavior, altering habits, and magnifying normative forces. For each, we will attempt to explain them vis-à-vis our expanded theory of planned behavior, provide specific examples of each, and look at how information systems might be leveraged to help encourage the behavioral changes.

It is important to note that we are deliberately limiting our scope only to methods of achieving behavioral change that would fit an intuitive definition of encouragement. In other words, we are excluding any form of coercive or deceptive means of behavioral alteration. Attempts at behavioral change have long been challenged by moral and ethical issues. To the extent possible, we wish to avoid introducing any new issues.
2.3.1 Enable Rational Decisions

As an outgrowth of expectancy-value theory, the theory of planned behavior asserts that attitudes are formed via a rational and pre-meditated cognitive process. Attitudes are, in essence, the sum of an individual’s expectations as to the outcomes of a particular action, weighted by the value that they place on each outcome (Ajzen & Fishbein, 1980). Each behavior that an individual can perform will have one or more outcome expectations. To aid in the analysis of attitude formation, researchers have classified these outcome expectations into three basic categories: utilitarian outcomes, hedonic outcomes, and social outcomes (Venkatesh & Brown, 2001). Although these categorizations were originally defined specifically with regard to personal computer usage, they are applicable to many conceptual domains. Utilitarian outcomes are those that are related to increased or reduced efficiency. Individuals will often feel pleasure or endure pain (physical or emotional) as a result of performing a behavior. Such feelings are classified as hedonic outcomes. Expected changes to an individual’s relative social standing, as a result of engaging in a behavior, are social outcomes.

One avenue of behavioral change is to appeal to an individual’s utilitarian outcome expectancies by making the desired green options cheaper, easier, or otherwise superior (or at least perceived to be so) than less green alternatives. In some cases, this may involve explicit, external incentives (i.e., rebates or tax credits) or penalties (i.e., fines or increased taxes) to shift the economic equation such that the environmentally desirable decision is also the most economically rational. However, often shifting the decision process may require simply educating consumers (or producers) as to more rational alternatives, as in the UPS example (Watson, et al., 2010).
Another example of the latter case is the green information technology phenomenon. Here, corporate consumers, armed with long term power cost projections for running traditional data centers, are able to make very easy decisions to invest in technologies that significantly reduce power consumption and result in quick returns on investment. An example that operates on a similar rational basis would the New Energy Tax Credit program implemented by the U.S. Congress for high-efficiency vehicles sold after 2006. Here, although it requires legislated incentives, the effects are the same: to make the purchase of a more efficient vehicle an economically rational decision. The same logic can be applied to non-purchase related behaviors, as well. For example, the rapid rise in gasoline prices from 2007 to 2008 is credited with U.S. drivers choosing to travel 4.3% fewer miles than in the prior year (Donovan, 2008). Logically, the same effect could be achieved by artificially raising fuel prices (e.g., Becker, 2002).

In each of these examples, the consumers’ rational decision process is not fundamentally altered; rather either the values of the decision-making criteria are changed to favor the greener alternative or the consumer is simply made aware of a more rational alternative. For the consumer, the fact that the behavior is greener than the alternatives is perhaps a nice side effect, but is not necessarily relevant. The interventions do not result in fundamental shifts in behavioral beliefs—mathematically speaking, the values of the variables might have changed but the equation remains unaltered.

Even when behavioral beliefs are held constant, information systems can play a significant role in encouraging green behavior. As energy costs are often a significant portion of the economic costs associated with particular behavior, simply enabling an individual to make the most rational economic decision possible can result in a positive
environmental impact. Further, to the extent that an individual’s existing beliefs align with green goals, the most rational decision—the one that most exactly aligns with the individual’s behavioral beliefs—should also favor greener alternatives. Thus, short of changing beliefs or altering other determinants of behavioral intention, the most effective means of encouraging green behavior may simply be to enable individuals to make the most rational decisions possible.

Information systems can support a rational decision making process simply by providing better information faster and more easily. The Internet, the World Wide Web, and information indexing and search technologies dramatically increased both the volume of and access to information consumers can use to make rational decisions regarding behavioral choices. For purchase decisions, consumers were once dependent almost on the limited information provided on product packaging (for a limited number of products available locally), the guidance of sales staff, and the opinions of friends and family to guide their decision-making processes. Today, consumers can access a wealth of factual information ranging from product sheets on a manufacturer’s web site to expert and consumer reviews of products to the results of independent or governmental testing and certification.

Of course, the availability of information does not mean that an individual will always make the most rational choice. The individual must consume the information, filter it, and process it in order for it to play a part in shaping that consumer’s attitudes. Even the most deliberative consumer can only process a certain amount of information, and here the Internet’s wealth of information may well be its most crippling handicap. Though there are many issues with regard to and possible methods of ameliorating this
information overload, we will examine three specific challenges with regard to enabling rational decisions via information systems. First, individuals must be educated as to the relevant decision criteria to support their existing behavioral beliefs. The actual costs, benefits, and repercussions of many behavioral decisions are quite complex. Simply knowing how to make an informed decision can often be challenging. In the case of consumer purchase decisions for individuals whose attitudes are driven chiefly by economic factors, these may include initial cost, incentives, energy usage, and long-term operating and maintenance costs. However, this list can become quite long and is likely different from product to product if a consumer has broader beliefs, such as a desire to purchase products that have a low full-lifecycle environmental impact. Second, the data to support these criteria must be aggregated in a format that is optimized for comparison. The time and effort required to access the data and compare products using relevant criteria should not significantly impede decisions. Third, the relevant information should be made available when and where needed to support a relevant decision.

Research Agents. For many decisions, especially consumer product purchase decisions, much of the information needed is already available on the Internet, and is often even aggregated in a useful fashion. For example, base price information and the ability to filter by or compare many relevant specifications for a large number of consumer products can often be found through research agents like PriceGrabber.com and MySimon.com. However, currently most of these research agents do not help educate users as to relevant decision criteria. Nor do they allow filtering and comparison based on all of the “green” criteria necessary to make a rational decision. For example, these sites often do not reflect rebates and incentives either from the manufacturer or from the
government that would be necessary to have an accurate estimate of up-front cost. Actual energy consumption data are also not provided beyond an indication as to whether the product complies with the U.S. Environmental Protection Agency’s (USEPA) EnergyStar guidelines. This is a good indicator, but there is significant variance in the actual energy used by EnergyStar compliant products, and not all consumer products have such guidelines. For all EnergyStar certifiable product categories, it is possible to visit the USEPA site to determine actual energy use, though the information there is not available in a format suitable for easy comparison. The USEPA also provides a compact description of alternative decision criteria, though it is somewhat dated for higher-tech products. In some cases, the availability of information is quite good. For automobile purchases, for example, sites such as edmunds.com, msn autos, and vehix.com offer information that quite extensive and amenable to rational comparison and also offer a significant amount of advice to aid the consumer in determining relevant decision criteria. In many other cases, very little information is available or it is exceedingly difficult to obtain. Thus, there remain significant opportunities to increase the breadth of information availability and to improve the ease and efficiency of access to information relevant to making rational choices.

Even when both comparative data and relevant decision criteria are available, the individual must still be willing and able to both access and leverage this information. Opportunities exist for information systems to make this process significantly easier. Most information today is still provided in such a way that the individual must take a very active role in educating herself as to the decision criteria and researching and analyzing possible options. Reducing or eliminating the individuals’ need for active
participation in this process should decrease the time required to research options and
thus increase the likelihood that an individual will make more informed decisions.
Especially in cases where individuals have a low degree of domain knowledge (Rathnam,
2005), automated, profile-based research agents that narrow possible choices down by
building a profile of general desires, needs, and traits of an individual rather than by
specific product characteristics may help enable rational decisions. There are quite a
number of factors that are theorized to impact the efficacy of such agents to aid in
decision making (e.g., Xiao & Benbasat, 2007), and certainly among these engendering
credibility in the source and trust in the results would seem paramount in a system that so
disassociates the individual from the decision. However, the potential of intelligent
search agents to enable consumers to make rational decisions seems quite high.

**Ubiquitous Computing.** Making this information available *when and where needed* was once a serious challenge, but in advanced economies, networks are
everywhere. We are moving to the point where all durable devices will be connected to a
network (Watson, Pitt, Berthon, & Zinkhan, 2002) and this should have a significant
additional impact on rational decision-making.

Humans have long sought ubiquitous access to information because of its
potential to improve decision-making. They have a “drive to have access to information
unconstrained by time and space” (Junglas & Watson, 2006). A combination of wireless
technologies (e.g., cellphone, Wi-Fi, etc.) can enable this drive to be fulfilled in today’s
world. Ubiquitous networks mean that information can be both delivered and retrieved
from just about any location in an advanced economy. As additional technologies such as
digital imagers, global positioning systems (GPS), and passive environmental sensors are
converged, connected to these ubiquitous networks, and able to coordinate their inputs, the opportunities to enable rational decisions is even further advanced. We will see that ubiquitous technologies can also play a vital role in encouraging green behavior in other ways, as well.

Ubiquitous networks and converging technologies open several opportunities for enabling rational decision-making. For example, with the latest mobile phone devices such as the Apple’s iPhone 3G or RIM’s Blackberry Storm, a consumer is now able to walk into a retail store, take a photo of a product of interest, and receive product reviews and price comparisons. It is easy to imaging extending this slightly to include additional decision criteria and to query the network for comparisons of other alternative product choices. The device could send its GPS coordinates and the system could check the reported inventory levels for the specific retailer and make a product recommendation based on the customer’s supplied decision criteria or a stored profile of general preferences. Using the GPS coordinates, the system might also be able to recommend even better alternatives at nearby retailers, notify the retailer of the user’s intent to purchase, and to have the item waiting upon arrival. Here, the ubiquitous system not only makes rational decision making easier, it also makes the entire consumer experience more efficient.

To the extent that an individual’s behavioral beliefs and utilitarian outcome expectancies will result in green behavioral choices, then simply enabling rational decision making may be a sufficient option to promote green behavior. However, in many cases, this will not be the case. Sometimes encouraging green behavior requires changing the equation. Our expanded theory of planned behavior gives us insight into
many of these variables in this equation. We will now examine how we might leverage information technology to manipulate other variables in order to encourage green behavior.

2.3.2 Persuade

With utilitarian appeals, existing attitudes are altered simply by changing the perception of the environment in which behavioral beliefs are translated into attitudes towards a behavior. It is possible that this may alter behavioral beliefs indirectly to the degree that the performance of the altered behaviors provides feedback into the formation of new beliefs. However, the direct alteration of behavioral beliefs—adding, modifying, or removing outcome expectations or the values placed on the outcomes—generally requires some degree of persuasion.

Currently the most widely studied model of persuasion is the elaboration likelihood model. The elaboration likelihood model describes two routes to persuasion: central and peripheral (Petty & Cacioppo, 1986). The persuasive messages that follow the central route are elaborated; that is, the arguments presented in the message are actively evaluated for merit, compared against existing attitudes, and incorporated based on the individual’s positive or negative evaluation of the message. In contrast, persuasive messages that follow the peripheral route are processed primarily based on environmental “cues”—i.e., the recipient’s affective reactions to the context of the message (e.g., perceptions of the credibility of the source, trust of the source, attractiveness of the source, pleasantness of background music, etc.). In the presence of these cues, the affective evaluation of the cues will serve as a proxy for cognitive evaluation of the merits of the message—the contents of the message will be positively or negatively
integrated into the recipients existing attitudes without cognitive scrutiny. In the absence of cues, the message will simply be discarded. Persuasive messages will follow one of the two routes depending on the recipient’s desire and ability to process the message. The central postulate of the model is that persuasive messages that are processed via the central route have a stronger and more enduring impact on attitudes than messages processed via the peripheral path. Ideally then, a persuader would like for the message to be processed via central route. Short of this, the message must be delivered with cues that will evoke a positive reaction in the recipient.

As a concept rooted in social psychological analysis, persuasion has traditionally focused on face-to-face or written forms modes of conveying persuasive messages. However, information systems can themselves be the source of a persuasive message or can be used to facilitate or enhance the delivery of a message from a human source. In the latter case, computer-mediated communication, the information system operates simply a type of media, little different conceptually than a telephone, a television, or a magazine. Because of this, we will focus on the information systems used as autonomous persuasive entities.

**Persuasive Technology.** Information systems that serve as the source of persuasion are sometimes referred to as persuasive technology. The term captology, derived from the phrase “computers as persuasive technologies,” has also been adopted to describe the study of persuasive technology (Fogg, 2003). Although there have to date been quite a number of studies conducted under the umbrella of captology, by and large these have been descriptive case studies and few have attempted to tie their propositions to theory. Where possible in describing persuasive technology and presenting existing
studies, we will attempt to enlighten their propositions and findings using our expanded theory of planned behavior.

One confounding point of theoretical conflict exists in the definition of persuasion as adopted by captology. Fogg (2003, p. 15:15) defines persuasion as “an attempt to change attitudes or behaviors or both (without using coercion or deception).” This broad definition conflicts with the narrower, more generally accepted conceptualization of persuasion as an attempt to change attitudes directly through persuasive messages. In fact, as we will see, most of the tools that are described as “persuasive” technologies will actually alter attitudes only indirectly through other constructs. Herein we have used the term encourage deliberately to avoid any such conceptual confusion. Nevertheless, as most of these tools can, however indirectly, change attitudes, we will stop short of challenging the use of the term and instead simply highlight the paths through which we believe attitude and/or behavioral change may occur.

Captology researchers have divided the technology tools that can be leveraged to change attitudes or alter behaviors into seven categories: reduction, tunneling, tailoring, suggestion, self-monitoring, surveillance, and conditioning. Reduction and tunneling are roughly equivalent to the types of research agents discussed in the previous section. Thus, as discussed previously, neither operates directly through the construct of persuasion we have adopted herein, but rather by enabling rational decision-making. Surveillance systems operate primarily by decreasing the perception of behavioral control and thus increase the likelihood of engaging in behaviors consistent with the observers’ desires.
Although a demonstrably effective means of altering behavior, this is more coercive in nature and thus falls out of scope of this paper.

With tailoring, information is provided to the user based on a customizable or adaptable set of parameters. Suggestion refers to providing relevant persuasive messages when and where appropriate. Tailoring and suggestion systems are quite similar in nature, differing mostly in the timing of the information delivery. As we will discuss, both tailoring and suggestion may be able to alter attitudes directly, or they may alter them indirectly by highlighting attitudinal beliefs that are inconsistent with one’s self-identity. Of these seven technology tools, suggestion and tailoring systems are the only ones we see as operating through the more traditional conceptualization of persuasion and are thus the only ones that we discuss in this section.

*Self-Monitoring* systems can allow for individuals to monitor their own behaviors. Feedback can be supplied either in real-time or for review at a future time. Such systems are useful for enhancing the reflective analysis of past behavior, and to the extent that feedback is supplied prior to or immediately following a monitored behavior, might also aid in altering habits. Like self-monitoring systems, *conditioning systems* monitor individuals and provide real-time or delayed feedback in response to behavior. However for conditioning systems, monitoring is usually not initiated by the monitored individual, and the feedback is intended not to allow for analytical reflection on the behavior, but rather to encourage or discourage future performance of the monitored behavior. We see the value of these systems primarily in their potential to aid in altering habits.

*Tailoring*. The concept of tailoring is actually a special form of the more commonly understood concept of *personalization*. Personalization allows a user of an
information system to customize their user experience in a number of ways. Tailoring focuses specifically on the customization of the information that is provided to the user. Tailoring can be active, requiring a user to configure a profile of interests and/or beliefs, or adaptive, profiling a user based on their use of the information system. Once profiled, users are only presented with information specific to their interests based on a set of pre-defined heuristics. A common example of this type of system are configurable news feeds that deliver only stories that are determined likely to be of interest to the user.

Because these systems are customized based on user’s interests or beliefs and their use is generally within the volitional control of the user, it would be at best ineffective to attempt to provide a user with information that is incompatible with their interests or beliefs as the user would simply be likely to ignore the information or discontinue use of the system. This notion is consistent with the elaboration likelihood model. If the information aligns with an individual’s interests or beliefs, then the individual is likely to be both more willing to view and more able to process the information and any persuasive messages contained therein.

Despite this limitation, it is certainly possible that the system could provide persuasive messages that are within their areas of interest that are not known to be explicitly inconsistent with their beliefs. For example, if a user has expressed interest in information about automobiles, the information delivered could be tailored to highlight high-mileage, low emission vehicles. Likewise, the system can be designed to highlight inconsistencies in interests. A user who shows interest in both anti-war information and high-performance sports cars might be presented with information about how energy dependence contributes to political instability and conflict. They might also be presented
with information regarding potentially compatible alternatives, such as all-electric sports cars. In both cases, the information provided to the user act as a form of persuasive communication and can be considered to be attempts to directly influence attitudes.

Similarly, if one or more potential components of a user’s self-identity can be identified, the system could also be configured to highlight desirable behaviors that are commonly compatible with that self-identity. For example, if the system determines that a user is a parent, the system could present information designed to play on a parent’s desires for their children to have opportunities to have a better life than their own by highlighting the impact that global warming may have on the next generation and pointing out aspects of their current interests or beliefs that are known to contribute to global warming. Such messages may serve to persuade the parent to change their attitude. However, even without changing attitudes, it may serve to change behavioral intentions by increasing the salience of self-identity.

**Suggestion.** Suggestion systems are defined “interactive computing product[s] that suggest a behavior at the most opportune moment.” (Fogg, 2003, p. 41:41) We will expand this definition to include not just suggesting behaviors, but also providing any form of persuasive message at the time when an individual is most likely to be receptive. This concept ties in directly with the elaboration likelihood model, whereby persuasive messages are most likely to be processed centrally and be cognitively elaborated—and thus will be more strongly incorporated into ones behavioral beliefs—when a person is both willing and able to process the message.

Suggestion technologies are similar to tailoring systems in that they must be able to ascertain information about a user in order to provide relevant suggestions. The critical
distinction is that the system must also have situational awareness in order to determine the most opportune moment to present the suggestion or persuasive message. This is relatively straightforward when a user is actively interacting with a system. For example, as soon as a user places an item in their shopping cart for purchase, Amazon.com encourages complementary buying behavior by presenting a list of items that other shoppers purchased when buying the same item. A similar example that encourages green behavior is provided by Continental Airlines, which at booking calculates the carbon dioxide generated by the customer’s itinerary and offers the option to purchase an equivalent amount of carbon offsets at that time.

*Sensing Technologies.* For suggestion systems to work when users are not actively interacting, the system must be granted other means of gaining situational awareness. We adopt the term *sensing technologies* to represent any of a number of types of technology that provide information systems with data regarding a user, his activities, or his current environment. Global positioning systems, electronic weather stations, power usage monitors, radio frequency identification (RFID) scanners, automobile engine data monitors, surveillance cameras, air-quality monitors, pressure and impact sensors, and vital sign monitors are all examples of sensing technologies. One or more of these technologies properly configured to supply their data to an information system can provide that system with varying degrees of awareness. As with ubiquitous technologies, we will see that sensing technologies can be leveraged to encourage green behaviors in a number of ways.

Sensing technologies can be active, constantly monitoring their charge, or they can be configured to supply their information on-demand. The example given in the prior
section where the system leveraged the GPS coordinates to determine which retail store
the consumer was in is an example of an on-demand use of sensing technologies. The
system is triggered by user interaction. To enable suggestion systems to operate when
users are not directly interacting with the system, the sensing technologies must be active.

Combining ubiquitous technologies with sensing technologies provides the
opportunity to mimic some of the functionality of online suggestion systems in offline
situations. For example, RFID chips are now beginning to be embedded in individually
packaged consumer products. A smart shopping cart with an embedded RFID scanner
could detect when a shopper places an item in the cart, suggest complementary items, and
direct the shopper to the proper location in the store to find any items of interest.

The opportunities for suggestion systems to leverage ubiquitous sensing
technologies to encourage green behavior seem nearly limitless. Already, organizations
and societies are developing dense networks of intelligent sensing technologies that can
monitor resource usage and the emission of pollutants. For example, energy utilities are
replacing their old analog and short-range wireless meters with wired meters that can be
read continuously via a dedicated communication network. A suggestion system might be
configured to monitor the power usage for a household, detect anomalies such as long
term power usage spikes, and send out a notification of the anomaly to the homeowner
along with suggestions of possible causes and fixes. As more and better sensory input is
available—for example, intelligent outlets that can identify themselves and report power
consumption for attached devices—both the quality and timeliness of the suggestions will
be able to be improved.
2.3.3 Enhance Analysis of Past Behavior

As discussed in our elucidation of green behavior, non-habituated past behavior can impact future behavior in two ways. First, the behavior can increase perceived behavioral control by improving self-efficacy. Second, cognitive analyses of behavioral outcomes serve to shape attitudes towards the subsequent performance of that behavior. For behaviors with outcomes that are predictable, immediate, and easy to ascertain, this cognitive analysis can be quite simple. However, for a large number of behaviors, especially those conducted frequently, in changing behavioral environments, or over an extended period of time, the outcomes can be quite difficult to determine. In these situations, individuals may analyze their behavior based on incomplete or inaccurate data or may be simply unable to analyze their own past behavior and will thus tend to stick with the status quo.

An individual’s efforts at reducing spending provide an apt example of this issue. A cash-consumer finds that she is exceeding her $200 weekly budget. Unable easily to determine the most optimal means of cutting back, she looks to cut the most extravagant and immediately visible expenditure: the cherished weekly pedicure, which had recently increased in price by $5. However, if supplied with a more complete view of their spending behavior, the consumer might have discovered that replacing one of her three daily iced frappuccinos with a cola would achieve the same savings and left her overall level of satisfaction largely unchanged. The relatively small, repeated expenditures tend get lost among a sea of other small expenditures, and thus the real outcome of engaging in the purchasing behavior is not evaluated.
**Self-monitoring.** For social psychologists, the term *self-monitoring* refers to a personality trait. It is defined as “*self-observation and self-control guided by situational cues to social appropriateness*” (Snyder, 1974, p. 526:526). Individuals with a high propensity towards self-monitoring will constantly monitor their environment and alter their behaviors to meet the expectations of the social group with whom they are currently interacting. Thus, they would seem to place relatively greater weight on social behavioral outcomes (Venkatesh & Brown, 2001) in determining behavioral intentions than would those not showing this trait. By contrast, self-monitoring *tools* are far broader in scope. Such tools enable individuals “to monitor themselves to modify their behaviors to achieve a predetermined goal or outcome” (Fogg, 2003, p. 44:44). For Fogg, self-monitoring tools are essentially a subset of the sensing technologies as discussed in the prior section. We embrace this notion, but expand upon it to include any type of system that passively tracks individual’s behavior and enables the individual to analyze his or her own behavior, either prior to or after its actualization, without requiring the individual to actively participate in tracking the behavior.

Depending on the implementation details, such self-monitoring systems could enable behavior modification in two ways. First, they have the potential to aid the alteration of habits, which we discuss in the following section. Second, they can provide additional, factual data to reinforce or discourage specific past behaviors through reflective analysis of the results of those behaviors. Here, the monitoring need not be real-time. An individual need only be able to associate specific behaviors with the feedback provided through monitoring.
In the prior example, if the consumer had switched from cash to a debit card and had signed up for an online financial tracking service such as Quicken.com or Mint.com, it would have been clear that her corner coffee shop might be the most logical place to begin trimming her budget. The combination of debit card and financial tracking service together represent a simple form of self-monitoring system that requires neither specialized sensing technologies nor real-time feedback.

Of course, many behaviors are not so readily monitored using our current information infrastructure. Tracking energy consumption is conceptually similar to financial tracking. However, the technology tools to enable this are simply not widely available. Most consumers looking to trim energy usage have only a monthly total to work from, roughly analogous to the $200 weekly budget in the prior example. Single outlet and whole-home energy monitors provide instant consumption figures that might be seen as analogous to price tags. However, completely missing is the ability to easily relate behaviors to consumption—especially over time—and the ability to readily compare alternative behaviors. For example, it would take careful scrutiny to determine that using a standard oven to heat cheese toast every morning may actually account for a significant portion of your daily energy consumption. If cost savings are the goal and multiple resources, such as electricity, natural gas, water, and sewer, are involved, this problem is further amplified. By and large, the sensing technologies required enable self-monitoring of consumption behavior are simply unavailable. There are significant opportunities here to prove the value of this self-monitoring and thus create a market for such devices.
2.3.4 Alter Habits

As we have discussed, habits bypass the cognitive evaluation of behaviors and outcomes. They are most often simply automatic responses to environmental stimuli. Thus, attempts to alter habits through improved information and persuasion reasoning ("downstream approaches") are not likely to be effective (e.g., Verplanken, Aarts, & Van Knippenberg, 1997; Verplanken & Wood, 2006). Instead, habits are most effectively altered when the environmental cues that trigger the habit are altered. Verplanken and Wood (2006) describe two basic strategies. The "downstream-plus-context-change" strategy suggests persuasion at a time when the environmental context changes naturally or through life event (e.g., after moving or changing jobs). The other strategy, referred to as "upstream-change," suggests that avoiding the performance environment altogether can remove the cues that invoke negative habits. Because habituated behaviors are often performed as a part of a more complex sequence of behaviors aimed at achieving a larger goal, providing other ways of achieving that larger goal might be sufficient to remove the impetus to engage in the habituated behavior. Furthermore, because habituated behaviors are often sanctioned by—or at least not discouraged by—social pressures, altering or enhancing social norms, a strategy elaborated in the following section, can also serve to change the performance environment.

Suggestion systems might be useful tools to support the downstream-plus-context-change strategy when trying to break non-green habits. To the extent that the systems can detect changes in context, they can be configured to provide appropriate persuasive messages that may convince an individual not to resume the habituated behavior in the new environment. For example, if the system detects that an individual has purchased a
new vehicle, the system might take that opportunity to highlight the fact that their new vehicle’s posted mileage figures are highly dependent on driving style and maintenance habits and to suggest means of reducing fuel consumption. The new vehicle may be a significant enough environmental change to allow the individual to process the suggestions and alter their habits.

Information systems may support a variety of upstream-change intervention strategies, as well. In a more traditional sense, information systems can be leveraged as enablers of certain types of environmental changes. For example, an organization wishing to encourage employees to telecommute may need to provide in-home high-speed networking and advanced collaboration tools as an alternative means of in achieving certain work-related goals. Suggestion systems may also be configured to detect opportunities for individuals to avoid habit-triggering environments. Real-time self-monitoring tools may simply alert the user when they have the potential to engage in an unwanted habituated behavior—or if the behavior is long-running, alert them of actual behavior—so as to bring that behavior more into the realm of volitional control.

**Conditioning.** Operant conditioning (Skinner, 1963) is a means of attempting to alter—*break, create, or replace*—habituated behaviors by providing positive or negative feedback immediately following the performance of the behavior. Skinner sees habituated behaviors not merely as actions performed frequently with some degree of atomicity, but also as providing predictable, conscious or subconscious hedonic outcomes for the individual. Responding to an environmental stimulus with the habituated behavior is comforting or pleasurable for the individual. By providing immediate negative stimuli following a habituated behavior, pleasure and comfort are replaced with more negative
feelings. Continually repeating this process—reinforcement—eventually drives the behavior back into the realm of volitional consideration. By repeatedly rewarding desirable behaviors, conditioning is likewise also considered to provide an effective means of encouraging behavior habituation (Skinner, 1963).

Conditioning tools are intended to automate the operant conditioning process, monitoring for a specific behavior and providing feedback as appropriate (Fogg, 2003). We certainly hope that the idea of humans receiving an electrical shock from their mobile phones every time they forget to recycle their drink can remains in the domain of science fiction. However, it is easy to envision a smart public recycling bin that could wirelessly determine a person’s identity from their mobile phone, detect the number of drink cans deposited, credit a nickel to their bank account for each can, and play a thank-you jingle. Such systems would seem to have significant potential to create or change habits by providing positive feedback. However, since the use of the devices providing the feedback are generally under the control of the user, the ability to supply negative feedback, at least repeatedly, seems quite limited. In our science fiction example, people may be just as likely to change mobile phones or develop a habit of turning it off prior to visiting a waste bin. Thus, less intrusive, generally user-initiated suggestion and self-monitoring systems are likely the best options for attempts to break habits.

2.3.5 Magnify Normative Forces

Based on our expanded theory of planned behavior, two normative forces are theorized to directly impact behavioral intentions. As discussed, moral norms are feelings of obligation to perform a particular behavior based on strong intrinsic beliefs. Subjective norms represent an individual’s evaluation of the attitudes of others in their social circle
and the individual’s perception of pressure to engage or not engage in a specific behavior based on these extrinsic beliefs (Ajzen, 1991). Although, on average, subjective norms have been shown to be the least powerful of the three independent variables in determining behavioral intentions (Armitage & Conner, 2001), the relatively low power may be attributed primarily to measurement error (Armitage & Conner, 2001).

Most any of the tools that we have thus far described could be used to amplify normative forces. For moral norms, information systems could highlight the existence of potential moral issues associated with a particular behavior. Combined with sensing technologies, such information could be provided in real-time. To the extent that the system is made aware of or able to detect or estimate an individual’s various moral beliefs, such a system could be quite effective at highlighting areas of moral conflict. Both technically and functionally, such systems would be little different than what we have previously discussed.

Likewise, information systems may be used to inform individuals of the existence or intensity of society’s normative beliefs regarding the conduct of a particular behavior. Online news sites and weblogs (blogs) already report on issues and consensus opinion, and research agents and tailoring systems can be used filter and summarize this information. Suggestion systems may also provide such information as part of the persuasive messages delivered at times when the individual might be most receptive. However, it is the potential for information systems to enable “mass interpersonal persuasion” (Fogg, 2008) that may be the most effective means of enhancing normative forces. As the techno-social environment at the heart of this study, we focus on social
network systems or—as they have been more recently reframed—social media systems in a subsequent section.

2.3.6 Summary of Technology-Based Means of Encouraging Green Behavior

In this section, we looked at five behavioral intervention strategies. For each, we drew attention to a few of the ways in which information technology tools could be applied in support of the intervention strategy. Table 1 provides a summary of each the strategies and tools discussed in this section. Note that in many cases, the tools are applicable across a number of intervention strategies. We attribute the tools to specific strategies for clarity and brevity.

<table>
<thead>
<tr>
<th>Behavioral Intervention Strategy</th>
<th>Enabling Information Technology Tool(s)</th>
</tr>
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<tbody>
<tr>
<td>Enable Rational Decisions</td>
<td>• Research Agents (i.e., Reduction and Tunneling) enhanced by Ubiquitous Computing</td>
</tr>
<tr>
<td>Persuade</td>
<td>• Tailoring</td>
</tr>
<tr>
<td></td>
<td>• Suggestion enhanced by Sensing Technologies &amp; Ubiquitous Computing</td>
</tr>
<tr>
<td>Enhance Analysis of Past Behavior</td>
<td>• Self-monitoring enhanced by Sensing Technologies &amp; Ubiquitous Computing</td>
</tr>
<tr>
<td>Alter Habits</td>
<td>• Conditioning</td>
</tr>
<tr>
<td></td>
<td>• Self-monitoring</td>
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<tr>
<td></td>
<td>• Suggestion enhanced by Sensing Technologies &amp; Ubiquitous Computing</td>
</tr>
<tr>
<td>Magnify Normative Forces</td>
<td>• Social Media Systems</td>
</tr>
</tbody>
</table>

Herein we have brought together multiple cross-discipline research streams in an attempt to create a taxonomy and a guide for future research on the use of technology to encourage green behavior specifically. However, the methods and tools are more generally applicable to a much broader range of socially desirable behavior change.
interventions. Furthermore, much of the past research using technology to encourage behavioral change has been largely atheoretical. By incorporating a theoretical basis for many of the intervention strategies, we have opened up this stream of research for greater synthesis with prior research and have provided one possible means of informing the results of future empirical research.

In the following sections we will delve more deeply into the literature surrounding the specific streams of research that we are examining in our study: social marketing and social media systems. Social marketing is a specific application of multiple behavioral intervention strategies. Social media systems are a specific application of an information technology tool—though as we will see, they are actually platforms from which to deploy multiple such tools.

2.4 Social Marketing

Social marketing began as an attempt by socially conscious researchers to apply marketing concepts to improve the efficacy of campaigns to encourage socially desirable behaviors. The concept was first published in the *Journal of Marketing* by Kotler and Zaltman (1971), but has since spawned multiple institutes and journals dedicated to its study and application. It is primarily a set of practical marketing tools applied to social campaigns, but has nonetheless received some degree of academic scrutiny beyond its seminal article.

Through the years its definition has evolved slightly, but the concepts evoked by the definitions have not been altered significantly. Herein we will adopt the definition proposed in Alan Andreasen’s highly cited book on the subject:
Social marketing is the application of commercial marketing technologies to the analysis, planning, execution, and evaluation of programs designed to influence the voluntary behavior of target audiences in order to improve their personal welfare and that of their society. (Andreasen, 1995, p. 7)

Andreasen further elaborates on seven “features” of a social marketing campaign that help to distinguish it from other means of achieving behavioral modification. These are listed in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Key Features of Social Marketing (Andreasen, 1995, p. 14)</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Consumer behavior is the bottom line</td>
</tr>
<tr>
<td>2</td>
<td>Programs must be cost effective</td>
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<tr>
<td>3</td>
<td>All strategies begin with the consumer</td>
</tr>
<tr>
<td>4</td>
<td>Interventions involve the four P’s: Product, Price, Place, and Promotion</td>
</tr>
<tr>
<td>5</td>
<td>Market research is essential to designing, pretesting, and evaluating intervention programs</td>
</tr>
<tr>
<td>6</td>
<td>Markets are carefully segmented</td>
</tr>
<tr>
<td>7</td>
<td>Competition is always recognized</td>
</tr>
</tbody>
</table>

All of these features accentuate the almost purely practical nature of social marketing. And it is notable that each could be considered equally valid when writing of standard, for-profit product or service marketing. This is certainly a nod to the fact that social marketing is not new, per se, but rather that it is an adaptation of existing concepts from one environment to another.

Of these features, numbers 1, 4, and 5 stand out as requiring a bit more discussion. First, the bottom line is behavior. This is a pretty significant point. The focus is not on attitudinal adjustment, per se, but rather on achieving the singular goal of
behavioral change. Social marketing is not about educating the consumer—it is not social advertising (e.g., the “Just Say No” campaign of the 1980’s, the NHTSA’s current “Click-it or Ticket” campaign, etc.). Kotler and Zaltman (1971) clarify the distinctions between advertising and marketing quite thoroughly in their seminal piece. Social marketing (and traditional marketing) is a set of targeted interventions intended to bring about a desired behavioral change. Increased knowledge or understanding, changes in attitudes, habits, or other antecedent variables may be targeted in the campaign, but such changes will never be the end goal.

Second, social marketing is about creating a research-driven, carefully planned, and well-coordinated campaign to target the socially desirable behavioral change. Just as the marketing campaign to sell Coca-Cola in China must be planned based on very careful market research, so must a campaign to reduce smoking in among teenagers in Bangladesh be carefully planned and adapted based on the nature of the target market. The massive social campaign that worked well to battle the spread of AIDS in the United States is highly unlikely to work as well in battling its spread in South Africa.

Third, social marketing focuses on controlling McCarthy’s four P’s of marketing (McCarthy & Perreault, 1987): product, promotion, place, and price. Though far from the only lens through which marketing academics and practitioners view their profession, it seems likely that Kotler and Zaltman chose this “marketing mix” for its parsimony and clarity of meaning—four basic control variables used as a means of conveying and organizing the many tools that can be used by social workers in their adoption of marketing principles. And seemingly this original inclination has weathered nearly 30 years of scrutiny, as it remains a guiding tenet of social marketing today (e.g., Andreasen,
2010; NSMC, 2010; Weinreich, 2010). We discuss each of the four P’s in much greater detail in the following section.

It is important to note that the term “social marketing” has been borrowed by firms providing marketing services that leverage social media systems (i.e., Facebook, Twitter, MySpace, etc.). The proper term for this practice is “social media marketing,” and it should neither be confused with the concept of social marketing discussed in this section nor with the broader topic of this study, which is social marketing with social media.

2.4.1 The Four P’s of (Social) Marketing

As mentioned previously, social marketing has adopted McCarthy’s “marketing mix”—more commonly referred to as the Four P’s. Table 3 provides a summary of each of the four “control variables” and how each is applied in a social marketing context. The following paragraphs discuss each in more detail, paying special attention to how they have been adapted to social marketing campaigns.

<table>
<thead>
<tr>
<th>Control Variable</th>
<th>As Applied to Social Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>Generally must translate overarching social goal into more tangible, individually sellable “products” to market to consumers.</td>
</tr>
<tr>
<td>Promotion</td>
<td>A campaign of persuasion. Can include advertising, personal selling, public relations, and sales promotion.</td>
</tr>
<tr>
<td>Place</td>
<td>“Arranging for accessible outlets which permit the translation of motivations into actions.” (Kotler &amp; Zaltman, 1971)</td>
</tr>
<tr>
<td>Price</td>
<td>The product should be at least economically neutral—i.e., the buyer should not be dissuaded by cost, be it monetary, temporal, physical, emotional or psychological.</td>
</tr>
</tbody>
</table>
The first of the P’s is product. Most social marketing campaigns deal with the adoption of behaviors, not physical products. However, this is not unique as behavior modification is often part of the scope of traditional marketing campaigns, as well. We might see this when marketers seek to increase the quantity of a product used—e.g., disposable diapers or cell phone minutes. It is also apparent when convincing a target market of the need to adopt a wholly new class of product—recent examples include Amazon.com with the Kindle or Apple with the iPad. However, for social marketers, the challenge is to take what often is a grand social goal—itself not easily marketed to consumers as a whole—and to divide it into tangible, “buyable” products or services such as petitions or physical exams or participation in a paper recycling drive. “Purchasing” these individual items advances the social goal. “Selling” them should be far easier than selling the social goal as a conceptual whole.

The second control variable in the marketing mix is promotion. The layman might equate promotion with advertising, but for marketers, this is only a portion of an often much broader promotional effort. In addition to standard, broadcast advertising via TV, radio, Web, email, newspaper, magazine, or other communication medium, promotion traditionally also includes personal selling, public relations, and sales promotions. Personal selling is most often face-to-face, but always involves a paid, individual sales person or sales team making a personal appeal to an individual or group to purchase a product or service. Paid celebrity endorsements or the sponsorship of a product or service by a (presumably) trusted company or expert might also be considered advertising or personal selling—the primary distinction between the two being the degree to which the endorsement is aimed at a mass audience (advertising) versus a smaller group or
individual (personal selling). Public relations (or simply publicity) refers to efforts to “sell” a product or service brand or the public image of the product’s company through (usually) unpaid and often ancillary means. Sales promotion is the use of special events, pricing discounts, or other short-term incentives to stimulate interest in a product or service. As we will see in section 2.4.2, the variety of activities that can fall under the umbrella of “promotion” has been extended significantly from the traditional conceptualization.

The third variable is place. It refers to the logistics surrounding the exchange of the good or service—the efficiency of the supply chain. If a person cannot physically receive a product or service, it makes marketing it otherwise irrelevant. Marketers must make the products not only available, but easily obtainable. For the social marketer, the supply chain for a social product is equally critical. Just as a marketer must ensure that bars of soap are available at every grocery and drug store in a target region, so must the social marketer insure that polling booths or recycling stations or electric vehicle charging stations are convenient to those within their target market to avoid defection to a less desirable behavioral path.

Price is the fourth of the control variables. Price represents not only the monetary costs associated with a product or service, but also the temporal, physical, emotional and psychological costs associated with the adoption of a product or service. Price also includes opportunity costs, or the loss endured by foregoing other products or activities in order to adopt the marketed product or service. Many—perhaps most—social marketing campaigns are designed to sell products that have no direct monetary cost. In fact, many will actually save the “customer” money, even in the short term. Thus, for social
marketers, controlling price is mostly about controlling the non-monetary costs associated with their products. For example, a campaign to increase condom usage might have a monetary price component (perhaps making available free or discounted condoms to the target consumers). However, likely the campaign would focus on other “costs” such as making it easy to obtain them (some crossover with “place”), attempting to reduce or reverse social (or religious) stigma regarding their use, highlighting many of the potential “costs” of not using them (disease, unplanned pregnancy, etc.), and perhaps working with manufacturers to make their use more stimulating or otherwise more enjoyable.

2.4.2 Marketing Green Behavior

Green behaviors are most certainly “social products.” The advancement of an environmental agenda was one of the earliest social marketing use cases, mentioned more than once in Kotler’s & Zaltman’s (1971) seminal piece. One of the most active torchbearers for the use of social marketing to advance an environmental agenda is Doug McKenzie-Mohr. Though written primarily for practitioners, his seminal book (McKenzie-Mohr & Smith, 1999) describing an adaptation of social marketing for sustainable behavior is rooted in theory (e.g., McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995; McKenzie-Mohr & Oskamp, 1995) and is cited in numerous academic studies. It is also available online in an updated and abridged version (McKenzie-Mohr, 2010b) and in formats more amenable to academic scrutiny (McKenzie-Mohr, 2000a, 2000b). His web site (McKenzie-Mohr, 2010a) aggregates nearly 1500 articles and 100 case studies (as of this writing) related to the encouragement of green behavior using social marketing techniques. We leverage McKenzie-Mohr’s social marketing
adaptation—termed *Community-Based Social Marketing*—in the creation of the social media based social marketing campaign for this study. Thus in this section we will discuss briefly the techniques espoused by McKenzie-Mohr and relate them back to social marketing and to our expanded model of green behavior.

*Community-Based Social Marketing* (CBSM), as its name implies, is based on the notion that marketing a social product often works best when started at a local level and grown using a number of primarily interpersonal tools. Many of these tools are based on the tenets of *social influence* (e.g., Cialdini & Goldstein, 2004). It is through social influence that we tie CBSM back to our expanded theory of green behavior—primarily through *subjective norm* and *self-identity*—so we will summarize briefly this theory prior to continuing.

*Social Influence*. The study of social influence comes from psychology. It looks at how individual attitudes and actions are influenced by others, including how norms (social and—to a lesser degree—moral) are formed. Social influence is not a single theory, but a body of research into the psychological processes that convert social messages into attitudes and actions. In fact, the aforementioned *elaboration likelihood model* is one of the theories often grouped into this body of research. In their 2004 meta-analysis of social influence, Cialdini and Goldstein divide the psychological responses to social messages into two categories: *compliance* and *conformity*. Compliance is a response to an actual or perceived *request* to behave in a particular fashion. Compliance can be achieved by openly coercive forces such as *power* and *obedience* (e.g., Raven, Schwarzwald, & Koslowsky, 1998). But compliance also includes a large breadth of forces that are much less overtly coercive in nature. Notable among these is the
possibility of controlling or enhancing the perception of social norms, a concept already discussed in great detail. Also notable are techniques that, according to Cialdini and Goldstein (2004), operate by evoking a sense of self-concept or, as we have termed it in our expanded model, self-identity. More specifically, they create a desire in the individual to be consistent with their self-identity. Predominant among the tools available to the practitioner to evoke this need for consistency with self-identity is the foot-in-the-door (FITD) technique (Freedman & Fraser, 1966), whereby an individual is asked to comply with a small/easy/inexpensive request, after which the individual is significantly more likely to comply with ever larger/more difficult/expensive requests from the same source or for the same cause.

FITD studies provide the primary theoretical basis for the commitment tool espoused by CBSM. As commitments form the basis for two of this study’s three treatments, it is important that we explore this concept in a bit more detail. As can be seen in Table 4, taken from a meta-analysis of FITD studies (Burger, 1999), FITD may actually be affected by multiple psychological processes. However, self-perception is the most commonly attributed process (Artz & Cooke, 2007; Burger, 1999; Cialdini & Goldstein, 2004). It also seems that perhaps some of these might be complementary, if not confounding. For example, the psychological need to act in a way that appears consistent with past behaviors is actually a major component of self-perception theory (that people wish to act in a way consistent with their self-identity—an identity also often formed from past behaviors). Labeling, a type of attribution (e.g., telling someone they are a “very generous and giving person” in response to a donation), is also considered to work by altering or enhancing an individual’s self-identity. Finally commitment (itself a
confounded term with *commitment* as a tool in CBSM) refers to a resistance to alter a course of action after one has committed to it, which at the very least is a component of consistency. In light of these theoretical concerns and in conformance with the preponderance of studies we choose to view FITD as operating primarily through the psychological process of self-perception, or self-identity.

Table 4: Psychological Processes Affecting Compliance in FITD (Burger, 1999)

<table>
<thead>
<tr>
<th>Psychological Process</th>
<th>Potential Effect on Foot-in-the-Door</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-Perception</td>
<td>Enhances Effect</td>
</tr>
<tr>
<td>Reciprocity Rules and Reactance</td>
<td>Reduces Effect</td>
</tr>
<tr>
<td>Conformity to Norm</td>
<td>Reduces or Enhances Effect</td>
</tr>
<tr>
<td>Consistency Needs</td>
<td>Enhances Effect</td>
</tr>
<tr>
<td>Attributions</td>
<td>Reduces or Enhances Effect</td>
</tr>
<tr>
<td>Commitment</td>
<td>Enhances Effect</td>
</tr>
</tbody>
</table>

Social influence also recognizes psychological responses that fall into the category of *conformity*, which refers to “changing one’s behavior to match the responses of others” (Cialdini & Goldstein, 2004). Here, it is not a direct request to comply, but a desire to conform to the perceived beliefs or behaviors of others—social norms. The primary psychological motivations driving conformity are a desire to understand and fit in to a socially constructed reality (e.g., Weick, 1995), the desire conform to obtain the approval of others, and, once again, the desire to maintain ones self-identity. There are obvious overlaps between the psychological processes involved in compliance and those of conformity, and likely both are often in play simultaneously when individuals respond to social influence (e.g., a direct request to recycle that also includes information about the positive recycling behavior of one’s neighbors or friends). However, we might think
of compliance as *extrinsic persuasion* and conformity as *intrinsic absorption of norms*. Due to its intrinsic nature, manipulating conformity is not as straightforward as the manipulation of compliance. Logically, however, enhancing the perception (or improving the reception) of normative messages and cues should improve the chances that an individual will receive and conform to the norms.

**Community-Based Social Marketing.** With a better understanding of social influence, we may now move on to a more thorough review of community-based social marketing. As discussed CBSM is a practical framework intended to guide individuals or groups in the application of a specific set of social marketing techniques—specifically those that are “grass roots” and interpersonal in nature. CBSM is framed as a technique to promote a specific social product: sustainable behavior. Though this social product is certainly congruent with this research, it seems that the tools and techniques of CBSM are applicable across a broad range of socially beneficial behaviors.

In line with Social Marketing, CBSM is concerned with altering behavior, not attitudes. According to McKensie-Mohr, “there is often little or no relationship between attitudes and/or knowledge, and behavior.” (2010b, p. 3) As such, CBSM eschews information and education campaigns—whether direct attempts to alter attitudes or attempts to alter attitudes by means of highlighting economic self-interest—as largely ineffective. At first glance, this might seem to contradict prior research using TPB. But this is actually consistent given the focus on behavior change, the wide variance in efficacy of attitudes on behavioral intentions and behavior, and the myriad forces *other than* broadcast information and education that form attitudes. Information campaigns (often broadcast advertising) are also generally expensive and do not take into account
the different ways in which cultural and socio-economic differences affect information processing.

CBSM holds that instead of broadcasting information in a likely wasteful manner, the limited resources available to most social marketing campaigns would be better focused at the local level, and allowing the social products to be marketed through natural diffusion processes. Normative messages (and other marketing tools) are proffered by people known by the recipients. As would be predicted by our expanded theory of planned behavior (and informed by the elaboration likelihood model), normative messages delivered by individuals socially close to a recipient are more readily converted into moral norm than broadcast messages. Thus, all other things being equal, theory tells us that such a “community-based” strategy of enacting social change may well be more effective than more traditional alternatives. McKenzie-Mohr’s book provides a recommended process by which practitioners might plan and conduct a CBSM campaign, and as with standard social marketing, this includes extensive market research, planning, and piloting. Of greater interest to this study, however, are the specific community-level tools that are highlighted as a means of marketing a social product, specifically sustainable behavior. Table 5 lists the tools that are available to the community-based social marketer.
Table 5: Community-Based Social Marketing Tools (McKenzie-Mohr, 2010b)

<table>
<thead>
<tr>
<th>Tool</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment</td>
<td>Directly asking an individual to commit to complying.</td>
</tr>
<tr>
<td>Prompts</td>
<td>Reminding an individual to comply at the right place and time</td>
</tr>
<tr>
<td>Norms</td>
<td>Encouraging compliance by enhancing the perception of social norms, either verbally or through modeling the desired behavior</td>
</tr>
<tr>
<td>Communication</td>
<td>Increasing the likelihood of compliance by carefully crafting messages</td>
</tr>
<tr>
<td>Incentives</td>
<td>Making it economically beneficial to comply</td>
</tr>
<tr>
<td>Conveniences</td>
<td>Making it easier to comply by removing barriers</td>
</tr>
</tbody>
</table>

Many of these tools have already been discussed, which is unsurprising as they are derived from the same theoretical streams that this paper has thus far explored. However, the specific means by which these tools can be adapted in this context are interesting, and in some cases unique. We will not cover ground already trod, but as mentioned previously, commitments form an integral part of this study, so we will look at them in more detail.

**Commitments.** Commitments are essentially the social marketing equivalent of the *foot-in-the-door* technique. The basic idea is to ask someone to commit to a course of action. The simple act of committing to that action is greatly increases the likelihood that the person will behave as requested. If the requested behavior is ongoing, obtaining a commitment increases the likelihood that the person will *continue* to behave as requested, as well. Furthermore, once committed to the initial action, commitments to larger requests (*commitment escalations*) have been shown to be much easier to obtain. As with FITD, commitments and escalations are assumed to operate by altering someone’s self-identity. Once a person thinks of themselves as a person who, for example, recycles aluminum cans, it is much easier to ask that person to increase their commitment to
recycling, perhaps by volunteering to help lead a neighborhood recycling effort. The person seeks to maintain consistency with their (perhaps altered) self-identity.

**Table 6: Notable Commitment Guidelines (McKenzie-Mohr, 2010b, pp. 21-23)**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emphasize Written over Verbal Commitments</td>
</tr>
<tr>
<td>Ask for Public Commitments</td>
</tr>
<tr>
<td>Seek Group Commitments</td>
</tr>
<tr>
<td>Actively Involve the Person</td>
</tr>
<tr>
<td>Help people to view themselves as environmentally concerned</td>
</tr>
</tbody>
</table>

There are several notable “guidelines” that are provided with regard to commitments. Some are derived from theory and most have been backed up by exemplar case studies. Five of the more notable guidelines are highlighted in Table 6. The first is to seek written commitment instead of merely receiving verbal assent. A number of cases are cited, but no theoretical reasoning is given for this. It makes sense, though, that we might see written commitment as form of binding contract and thus more official and difficult to simply shrug off.

Second, commitments are seen to be much more effective when the commitments are made public. This concept has deep theoretical roots in the commitment-consistency branch of social influence (e.g., Cialdini & Goldstein, 2004, p. 605), though it seems intuitively obvious that making a commitment public moves the psychological processes involved beyond those involved with self-identity. This is especially true if the compliance with the commitment is also made public. Given the relatively large increase in commitment efficacy in response to publication, it seems probable that the desire to comply with social norms and/or social acceptance may be more powerful than the
intrinsic need to maintain consistency with one’s self-identity. This is also consistent with our expanded model of planned behavior. Making a commitment is essentially compliance with subjective norm. As we have proposed in the model, subjective norm’s influence on both intentions and on behavior is significantly stronger when the compliance (or non-compliance) is observable, i.e., made public. As will be discussed in the next chapter, controlling the publicity of commitments and the subsequent reporting of individual compliance with the commitments is one of our experiment’s three interventions.

The third guideline, that commitments are more effective when made in groups, is quite similar to public commitments. It seems also to drive commitments out of self-identity and into the realm of compliance with social norms. The fourth and fifth guidelines, that commitments are most effective when the individual is actively involved and that commitments should be coupled with messages that help individuals see themselves as environmentally concerned, both are notable in the sense that they tie this practice back once again to self-perception. A commitment that requires active involvement in a green behavior helps to spark individuals into seeing themselves as environmentally conscious. Reinforcing this verbally or through follow-up written communications helps to cement this perception. These reinforcing messages form the basis for another of our experimental interventions, which again will be discussed in the following chapter.

2.5 **Social Network Systems / Social Media Systems**

Although the societal norms may influence attitudes, it is the individual’s perception of the opinion of those in his or her close social circle that are the primary
drivers of normative beliefs (Ajzen, 1991). The recent popularization of social networking web sites such as LinkedIn, Twitter, MySpace, and Facebook have opened up significant new ways in which information systems can amplify these opinions and potentially magnify the effects of subjective norm on behavioral intentions. While the initial wave of Web 2.0 technologies such as blogs created platforms for individuals to express opinions publicly, a relative few have created them and fewer still regularly update them. Information flow is primarily unidirectional, and they are by and large the domain of experts and opinion leaders. Furthermore, accessing the information posted to these sites requires interested parties to first find the sites and then either regularly check them or explicitly subscribe to automated feeds to receive new or updated postings—i.e., they implement a pull-based metaphor for information delivery.

If blogs provide a podium for opinion leaders, the latest wave social network sites provide a stage for the masses. Through these social network sites, thoughts and opinions flow bi-directionally from and to members of one’s social circle. Posts and updates from users are generally quite frequent and feedback to the posts can often be found within minutes. It is a single, integrated messaging system that allows for person-to-person, group-based, and broadcast messages. The messages can be simple or media-rich, and the sites allow for all types messages to be viewed in a single location. For a large number of active users, social networks are replacing email as their primary means of communicating among members of their social groups (e.g., O’Neal & McDaniel, 2008)—a “universal inbox” for viewing the thoughts and opinions of their social group. Once they have added someone to their list of friends, these messages flow to them automatically—push-based notification and reinforcement of normative beliefs. Mobile
versions of the systems allow information to flow to users wherever they are and thoughts and opinions to be posted whenever they occur.

As these sites continue to grow in popularity, our understanding of their impact on social-psychological processes will continue to be challenged. Already we are seeing these processes reframed—if not entirely changed—for social network system users (e.g., Acar, 2008; APA, 2009). Online social gratifications are becoming increasingly more salient for an increasingly large number of individuals (e.g., Park, Kee, & Valenzuela, 2009; Raacke & Bonds-Raacke, 2008), and more and more social network users are judged as much by their online profile and associations as by their offline appearance and acquaintances (e.g., Walther, Van Der Heide, Kim, Westerman, & Tong, 2008). They are changing marketing, as well. The nature and speed of “word of mouth” marketing are greatly impacted, and the efficacy of viral marketing techniques seem to be eclipsing that of traditional broadcast practices in the computer-based social networked world (e.g., Kozinets, de Valck, Wojnicki, & Wilner, 2010; Trusov, Bucklin, & Pauwels, 2009). Clearly, modern Web 2.0-based social network systems are increasingly affecting the nature of social interaction, and academics are just beginning to try and ascertain what this means both to theory and to practice.

In some ways, social network sites may be seen as merely an unusually successful form computer mediated communication system. But their power as a social platform provides potential well beyond that of basic message exchange—beyond mere social networking. A social platform—a social media system—allows for the integration of a far greater breadth of tools for influencing behavior than has to date been available. More and more, these platforms are becoming a network of socially-enhanced applications,
providing the capabilities of full-fledged information systems (as discussed previously) augmented with contextually relevant social feedback. Facebook in particular, which at the time of this writing is the most popular social media sites by a large margin, offers an open application programming interface that allows for the development of social applications that integrate into the system. More, Facebook allows for external sites to provide varying degrees of integration with its system, dramatically expanding the reach (and thus the potential influence) of the social network.

The capability to integrate information system tools with social interaction would seem to make a social media system an intriguing platform from which to conduct a social marketing campaign. The notion of using computer mediated communication as a social marketing tool is not entirely new. At least one study has examined the efficacy of e-mail communications in the context of an environmentally motivated social marketing campaign (Artz & Cooke, 2007). Though the authors acknowledged that the campaign had limitations imposed by the nature of email communications, the results were promising. Another study utilized social media marketing techniques to increase awareness of heart disease in women (Taubenheim et al., 2008). As discussed previously, social media marketing is unrelated to social marketing. In this case very few true social marketing techniques were employed. The campaign was largely a broadcast campaign modified to leverage social media “channels,” which would not have leveraged the unique capabilities of social media. But the successes discussed in this case study and backed up by practice (e.g., Hawn, 2009) demonstrate the reach—if not the full potential—of social media as a conduit for social marketing. A third study surveyed active social media users, 18-29 years old, to determine their receptivity to increased use
of social media for the delivery of health-related information (Uhrig, Bann, Williams, & Evans, 2010). In many ways, this study was far less ambitious than the Taubenheim, et al. study as it only presented hypothetical scenarios, and it only looked at one very limited means of spreading social messages (i.e., primarily adding an “expert” or “organization” as a friend). But it did uncover some interesting results. Perhaps most remarkable was that this age group on average spent six hours on the Internet each day, with nearly two and a half hours spent interacting on social media sites. Even acknowledging the selection bias, this finding alone says much about the potential reach of social media, at least among younger adults. The authors also found that, at least in the healthcare domain, 92% of these active social media users were receptive to receiving social marketing messages via social media.

We believe that these studies highlight only a small portion of the true potential for social media to empower social marketers. The present study seeks to conduct an experiment that embeds a social marketing campaign within the context of a social media system. We hope that the findings will advance our understanding of social media itself and its potential to alter the perception of subjective norm, the translation of subjective norm into moral norm, and positively impact the behavior of individuals in a green direction. This experiment is the subject of chapter 3, here to follow.
3 RESEARCH METHODOLOGY

This study employed a longitudinal field experiment in a simulated environment to test portions of the model presented in chapter 2, as well as a number of the assertions contained therein. This chapter describes in detail the design and nature of this experiment, the propositions tested, and the measures and methods used to test each of hypothesis.

3.1 Research Models and Propositions

In chapter 2, we synthesized a model of behavior based on analyzing empirical research conducted over many years and generally replicated many times. With only two exceptions, we have not proposed any new constructs or relationships. Thus, we will not be testing the model in its entirety. However, there are quite a few places where the intermediation of a social media environment may well produce results inconsistent with those observed in the past. Our research models and propositions look to find support for the proposed effects that two new independent variables have on planned green behavior and to determine the impact of social media on processes observed in traditional settings, specifically some of those psychological forces traditionally tapped in the conduct of a social marketing campaign. For convenience, Figure 5 presents again the model of expanded theory of planned behavior from section 2.2.5.
3.1.1 Closeness

Our first area of focus is on the closeness of individual relationships, both as a dependent variable and an independent variable. As defined and measured, closeness is really a composite measure of person A’s familiarity with person B and the degree to which person B’s beliefs and opinions are important to and respected by person A. It does not imply congruence between norms and attitudes, only the degree to which person A feels that person B is important to them socially. One might conceive of social media systems as changing the rules of closeness in that they can bridge physical distance and eliminate some of the barriers to social interaction typically brought on by distance. But the communication channels, despite significant increases in richness, remain quite distinct from physically close social interaction.
We make three distinct propositions regarding closeness in a social media setting. The first of these is depicted in Figure 6. Social media systems are often envisioned as an effective replacement for (or minimally a supplement to) physical, face-to-face social interaction. If this is true, then interaction over time between individuals on a social media system should increase their closeness in much the same way that face-to-face interaction does. Thus, our first proposition is:

\[ P1: \text{Over time, the level of social interaction between persons via a social media system should increase each person’s perceived closeness to the other.} \]

As discussed in chapter 2, the elaboration likelihood model predicts that messages from known or trusted individuals are more readily processed. Thus, normative messages (i.e., the transmission of actual social norms) should be more effectively received and
recognized as *subjective norm* when the normative messages are coming from those socially close to an individual. So, our second proposition is:

\[ P2: \text{Over time, the transfer of actual social norm into subjective norm will be moderated by the closeness of the source of the normative messages.} \]

![Figure 8: Impact of Closeness on the Translation of Subjective to Moral Norms](image)

3.1.2 Observability of Behavior

Our expanded theory also makes a few assertions that focus on subjective norm. In the first case, researchers have found that subjective norm plays little to no role in impacting behavioral intention or behavior beyond the effect they have on Moral Norm.
We posit instead that such a direct relationship does exist, but that it is moderated by the observability of the behavior such that for behaviors without significant intrinsic rewards (such as most green behaviors), subjective norm will only impact intention in the presence of observability.

To support this assertion, we must first determine whether moral norm fully mediates the relationship between subjective norm and behavioral intention. If so, then the remainder of our propositions focused on observability will need to be rethought. So, our first proposition related to observability has nothing actually to do with the observability construct:

*P4: The relationship between subjective norm and behavioral intention will not be fully mediated by moral norm.*

---

**Figure 9: Subjective Norm with Direct Effect on Behavioral Intention**

**Figure 10: Observability Moderates Subjective Norm ➔ Behavioral Intention**
If the relationship between subjective norm and behavioral intention is found not to be mediated fully by moral norm, we then move to find some explanation for the variance in effect size, and why the effect size might approach zero in prior analyses of green behavior. We assert that observability moderates this relationship—believing there to be a social norm, individuals will seek social rewards or to avoid social scorn, but only if others are there to witness the behavior. To the extent that the individual expects the behavior to be observable, this will alter the degree to which social norm impacts behavioral intention. Thus:

\[ P5: \text{The relationship between subjective norm and behavioral intention will be moderated by the degree to which the individual expects the behavior to be observable.} \]

![Figure 11: Observability Moderates Subjective Norm → Behavior](image)

We further argue that the perception of a social norm and the situational awareness of a behavior’s observability can alter (or reinforce) the tendency to behave in a way that is compliant with one’s cognitive intentions. People do something they wouldn’t normally do just because someone is or is not looking. Subjective norm can thus directly affect behavior, but generally only if the behavior is observed. Thus, we propose:
P6: The direct relationship between subjective norm and behavior will be moderated by the degree to which the behavior is perceived to be observed.

Note that P6 presumes that there is a direct relationship between subjective norm and behavior, and that this relationship is not fully mediated by intention. We have posited this based on logic and observation but have found no scientifically tested evidence to support the existence of the relationship. This experiment will not offer the opportunity to rule out complete mediation, either, because we will not be able to observe a situation in which an individual intends to behave contrary to the norm but behaves contrary due to the presence of an observer. Thus, even if we find support for P6, we don’t know for certain that the relationship is as modeled. P6 may actually indicate a dual moderation effect, whereby subjective norm and observability interact to moderate the relationship between behavioral intention and behavior.

3.1.3 Effectiveness of Follow-up

Our seventh and final proposition is atheoretical. Evidence shows that a face-to-face (or at least live, phone-based) follow-up to check on the status of a commitment increases the likelihood of compliance with the commitment. Theory tells us that this likely happens because it reinforces a self-perception, but here we are interested only in determining if a strategy shown to be highly effective when performed person-to-person will remain effective when the same techniques are initiated by and facilitated via a computer based system. Although an automated system in isolation may well be an ineffective tool for conducting follow-up calls to check on the status of a commitment (e.g., one can hardly imagine that an automated phone message would be effective here),
we believe the social media setting to be quite different. The individual is already primed
to view interactions with the system as social exchanges. We believe that this may carry
over even to automated messages.

P7: In a social media setting, automated follow-up messages will increase
the effectiveness of commitments at encouraging behavior.

3.1.4 Summary of Propositions

For easy reference, Table 7 lists each of the propositions presented in this section.
The following section elaborates on the treatments, measures, and analytical techniques
used to test each of these propositions.

Table 7: Summary of Propositions

<table>
<thead>
<tr>
<th>#</th>
<th>Proposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Over time, the level of social interaction between persons via a social media system should increase each person’s perceived closeness to the other.</td>
</tr>
<tr>
<td>P2</td>
<td>Over time, transfer of actual social norm into subjective norm will be moderated by the closeness of the source of the normative messages.</td>
</tr>
<tr>
<td>P3</td>
<td>Over time, the degree to which subjective norm is translated into moral norm will be moderated by the closeness of the sources of the normative messages that form the subjective norm.</td>
</tr>
<tr>
<td>P4</td>
<td>The relationship between subjective norm and behavioral intention will not be fully mediated by moral norm.</td>
</tr>
<tr>
<td>P5</td>
<td>The relationship between subjective norm and behavioral intention will be moderated by the degree to which the individual expects the behavior to be observable.</td>
</tr>
<tr>
<td>P6</td>
<td>The direct relationship between subjective norm and behavior will be moderated by the degree to which the behavior is perceived to be observed.</td>
</tr>
<tr>
<td>P7</td>
<td>In a social media setting, automated follow-up messages will increase the effectiveness of commitments at encouraging behavior.</td>
</tr>
</tbody>
</table>
3.2 Experimental Design

As discussed, this experiment placed participants in a social media environment—a social marketing campaign in the guise of a game designed to encourage participants to consume less gasoline. At its core, the study leveraged a standard pretest-posttest experiment design. The experiment was longitudinal, with uninterrupted participation by experiment subjects of two months between the pre- and post-experiment surveys. The custom social media system described in Appendix A was closely modeled after Facebook in its operational characteristics. And with active participation, it should accurately emulate many of the environmental conditions that exist within the leading social media systems like Facebook. But it was unable to emulate the social dynamics of a system with hundreds of millions of users, well-established networks of “friends,” and a huge variety of social activities to capture and maintain active interest. So despite extra steps taken to make up for these deficiencies (discussed in Appendix A), it was still a simulated environment, which means that this is not precisely a pure field experiment despite its extra-lab locale and sharing most of the attributes of a field experiment.

Participants were divided into 8 treatment groups of nearly equal size in a fully-filled, three-factor, 2 x 2 x 2 matrix design as shown in Figure 12. The individual treatments are discussed in detail in section 3.3. As implied by the “team assignment” treatment designation, participants were further subdivided into teams of between four and six. These teams were either self-assigned (presumably consisting of close peers) or pseudo-randomly assigned (with a bias towards attempting to maximize pre-experiment social distance—i.e., minimize closeness and thus maximize the variance in this independent variable). Teams were intended to simulate the friend-groups found in
traditional social media environments, but they were also designed to stimulate some
degree of inter-team competitiveness and intra-team camaraderie. There was no
competition involved, *per se*—there were no rewards given to teams based on
performance (only on active participation). This was to minimize the inflation of self-
reported performance solely to propel the team ahead of other teams. However, the
system was designed to allow for team-to-team comparisons, so it was expected that
some level of competition would arise.

<table>
<thead>
<tr>
<th>Commitment Design</th>
<th>Team Assignment</th>
<th>Self-Assigned</th>
<th>Random</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public With Follow-up</td>
<td>PuFS</td>
<td>PuFR</td>
<td></td>
</tr>
<tr>
<td>No Follow-up</td>
<td>PuNS</td>
<td>PuNR</td>
<td></td>
</tr>
<tr>
<td>Private With Follow-up</td>
<td>PrFS</td>
<td>PrFR</td>
<td></td>
</tr>
<tr>
<td>No Follow-up</td>
<td>PrNS</td>
<td>PrNR</td>
<td></td>
</tr>
</tbody>
</table>

**Figure 12: Experimental Treatment Groups**

The participants were encouraged to participate socially in the environment, but
were asked minimally to record information pertaining to their gasoline consumption as
well as any actions taken to conserve fuel and any long trips taken. The possible types of
interactions with the system are covered in detail in Appendix A. Most were designed
simply to engage the participants in the game and were not specifically targeted for
measurement or control. Of note, though, participants were asked to “commit” to one or
more actions that could potentially lead to decreased fuel consumption. The nature of
these commitments were the basis for the second and third of the experimental treatments, which will be covered in greater detail in section 3.3.

3.2.1 Experiment Procedures

Sample Selection. The experiment drew from a convenience sample of students from two Southeastern United States universities. Participants had to be responsible for the upkeep of their own automobile (ownership was not a requirement). Furthermore, we requested that participants be at least casual users of one or more social media systems (preferably Facebook). The design called for between 200 and 300 participants to be approved. Students self-selected into this experiment, which does raise the possibility of selection bias. In this case, it is possible that individuals that have a predisposition towards green behavior may have chosen to participate in greater numbers than those with more skeptical attitudes towards the environment, global warming, etc. Generally this could represent a threat to external validity, however in this case we do not expect this to be a significant issue for two reasons. First, reducing gasoline consumption is not purely an environmentally charged topic. It has significant and highly visible economic benefits for individuals. Furthermore, high gasoline consumption leads to dependence on foreign sources of oil, which is widely seen as a detriment to the country’s national security. Thus, it is likely that this study will have broad appeal beyond those predisposed to green behavior. Second, even if this undesirable selection bias were realized, it should have minimal effect on the results, really only reducing the pre-experiment variance in attitudes and norms. Furthermore, it is likely that such self-selection is simply an unavoidable reality of any similar social media-based social marketing campaign in the “real world.”
Team / Treatment Group Assignment. As discussed previously, approximately half of the teams were to be assigned either by the individual team members (self-assigned); the other half were to be assigned through a random selection process. Each team as a whole was assigned to a single treatment group to minimize the likelihood and impact of social interaction threats (e.g., imitation of treatment or compensatory rivalry) on the experiment. Note that other steps were also taken to minimize social interaction threats. For example, those assigned to the private commitment treatment groups did not see the notifications of commitment acceptance for those assigned to the public groups. Likewise, those assigned to the no follow-up groups did not see notifications of performance that were posted from those in the public/with follow-up groups (i.e., PuFS and PuFR). The assignment of teams to treatment groups was done randomly, though care was taken to insure that the treatment groups had nearly equivalent sample sizes.

Process. Table 8 shows each of the steps taken to administer the experiment. In addition to these steps, the system required some ongoing maintenance to keep the certain aspects of the system operating as designed. However, by and large, the system was designed to require very little intervention once the experiment began in earnest.
Table 8: Experiment Process

<table>
<thead>
<tr>
<th>#</th>
<th>Step / Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Present to classes (5-10 minute presentation; hand out consent forms; explain initial procedures)</td>
</tr>
<tr>
<td>2</td>
<td>Interested participants fill out and return consent form (possibly after class)</td>
</tr>
<tr>
<td>3</td>
<td>Interested participants fill out online registration form</td>
</tr>
<tr>
<td>4</td>
<td>Investigators match consent forms to registrations and preliminarily approve participants</td>
</tr>
<tr>
<td>5</td>
<td>Investigators send email to approved participants requesting that they identify between three and five desired team members (or indicate if they have no preference)</td>
</tr>
<tr>
<td>6</td>
<td>Participants respond</td>
</tr>
<tr>
<td>7</td>
<td>Investigators use the system to assign individuals to teams</td>
</tr>
<tr>
<td>8</td>
<td>Investigators use the system to assign treatment options to teams</td>
</tr>
<tr>
<td>9</td>
<td>Investigators officially approve all participants and send welcome email to all approved participants</td>
</tr>
<tr>
<td>10</td>
<td>Participants sign-in and must fill out pre-experiment survey before they can proceed</td>
</tr>
<tr>
<td>11</td>
<td>Participants take part in the experiment for two full months</td>
</tr>
<tr>
<td>12</td>
<td>Investigators send out email requesting that students sign-in to complete the post-experiment survey (required to receive compensation)</td>
</tr>
<tr>
<td>13</td>
<td>Participants sign-in and fill out survey</td>
</tr>
<tr>
<td>14</td>
<td>System is closed for further participation</td>
</tr>
<tr>
<td>15</td>
<td>Investigators distribute compensation and awards</td>
</tr>
</tbody>
</table>

Training. The system was designed to be very intuitive to use for the majority of the target population—i.e., regular users of Facebook. However, the participants were also presented with a short training video prior to the start of the experiment. The video covered the basics of system use, and it also focused on the activities that the participants needed to do outside of the system (primarily record their mileage and gallons pumped each time they visit the gas station).

Incentives. Though not particularly taxing on the participants, this was a long-term experiment requiring regular participation. As such, we offered multiple forms of incentive. First, we provided incentive for a minimal level of participation (using the
system as intended and completely filling out both pre- and post-participation surveys). For this minimal level of participation, we provided $5 gift cards to every participant. Furthermore, we wished to encourage active, social participation beyond the minimums. So at the conclusion of the experiment, we provided a number of larger prizes ($10, $20, and $50 gift cards) to a randomly selected group of participants drawn from the pool of participants who meet a specified level of participation above the minimums. Finally, to provide incentives for team members to encourage one another to participate, we further offered larger prizes for the most active teams—$50 gift cards given to each member of one team randomly selected from the pool of most active teams.

3.2.2 Data Collection

**Pre- and Post-Experiment Survey.** Two nearly identical electronic surveys were delivered as part of this study. As can be deduced from the procedures in Table 8, one was administered prior to the participants’ first utilizing the system. The second was administered at the conclusion of the experiment. The surveys were tied directly into the system both to provide a seamless experience for the participants and so that the system could block any other access until the surveys were completed. As discussed previously, filling out both was also required in order receive incentive payments, though the answers given on either of the surveys made no difference whatsoever in the distribution of incentives. We made this last point clear in the instructions for the survey in order to encourage honesty in answering the questions.

The survey instruments and notes regarding their development and validation are provided in Appendix B and Appendix C.
**Embedded Measures.** The social media system itself provided for numerous opportunities to collect data *in situ*. We leveraged this capability explicitly in two ways. First, we were able to measure the quantity of *posts* and *comments* (see appendix sections A.4 - Status Posts and A.5 - Likes and Comments) that a participant made in order to gauge their level of active participation. Additionally, we kept logs of all interactions with the system so we could gauge even passive participation. For example, if a user clicked to view the profile of another user, we knew the participant’s name, the date and time of the click, the page from which this click was made, and the profile of interest. Together, these data provided us with accurate measures of the level of interaction with the social media system.

Second, the *commitment* subsystem (see appendix section A.12 - Commitments) provided us with useful measures. We knew when the participant first saw a commitment request and when the participant accepted or rejected the commitment request. Further, for all members of the treatment groups that received follow-up notifications and questionnaires, the system collected self-reported behavior metrics. Note that we collected these same self-reported behavior metrics after the experiment for those not in the follow-up treatment group. This allowed these two metrics to be compared across treatment groups.

**Other Quantitative and Qualitative Participation Data.** Though were not looking to mine additional data from the system in the analysis of our proposed relationships (see section 3.1), by design the system does provide a wealth of additional quantitative and qualitative data which could provide exploratory opportunities for derivative studies. First, the system provides a user profile (see appendix sections A.10 - User Profiles and
that can be mined for specific demographic data. Such data, combined with additional demographic and attitudinal data points, can be used to segment individuals into demographic groups, which may provide insight into unexpected variances in norm transfers, attitude changes, or behaviors. In addition to this demographic data, the system offers numerous opportunities to gather insights or to explore data to inform future research. The system provides self-reported green behavior data (see appendix sections A.6 - Trips, A.7 - Actions, and A.8 - Mileage). It offers a wealth of potential qualitative data points embedded in the posts and comments. And the system offers the potential for exploratory social network analysis, as the interactions among team members and between teams can easily be mapped.

3.3 Treatments, Measures and Hypothesis Testing

As discussed in section 3.2 and shown in Figure 12, this experiment employed three dichotomous treatments in a fully-filled, 2 x 2 x 2 matrix creating 8 treatment groups of approximately equal size. Each of the treatments is discussed in this section, along with the measures and analytical method(s) used to test each of this study’s hypotheses. For all survey measures, see Appendix B and Appendix C to see the actual items used to gauge each factor.

3.3.1 Team Assignment (Closeness)

As we have discussed previously, the assignment of individuals to teams represents the first of our three treatments. Approximately half of the teams were to be allowed to form based on pre-existing social relationships and the other half to be assigned pseudo-randomly. The goal of this treatment was simply to provide maximum variance (pre-experiment) in the measure of closeness among the members of any given
team. The actual measure of closeness was taken in both the pre-experiment and post-experiment surveys. The measure is used to test the first three hypotheses (refer to section 3.1). Note that for both subjective norm and moral norm (analyzed for P2 and P3), we measured norms in two domains (gasoline consumption and concern for the environment). Herein we refer to only a single domain—gasoline consumption.

**Proposition 1.** Here we are measuring social media system interaction between pairs of individuals ($SMS_i$). This is an index calculated from the count of Participant A’s comments on posts from Participant B or posts that Participant B has also commented on. The index will also include the number of times Participant A views Participant B’s profile. Participant A’s perceived closeness to Participant B ($Cl$) was captured using a multi-item measure in both the pre- and post-experiment surveys. We excluded individuals with high levels of offline interaction, also measured both pre- and post-experiment. For each individual, we hypothesize a correlation between social media interaction and positive change between pre- and post-experiment perceptions of closeness. This hypothesis is tested using simple regression.

$$SMS_i \rightarrow \Delta Cl(+)$$

**Proposition 2.** This proposition is measured in terms of an individual as compared to the rest of the participants on his or her team. Actual social norm ($SN_{act}$) at the team level is realized as the average of the subjective norm measures for each of the other team members. We are interested in the difference between actual social norm and the measure of an individual’s perceived subjective norm ($SN_{act} - SN_{ind}$)—a subjective distance ($S_{dist}$) from the actual norm. As with P1, this proposition also measures change over time ($\Delta S_{dist}$). We hypothesize that $\Delta S_{dist}$ will covary with the aggregate of the
individual’s perceived *closeness* with their team members. This hypothesis is tested using simple regression, as well.

\[ \Delta S_{dist}(-) \rightarrow \sum C_l \]

**Proposition 3.** This is quite similar to P2 in the sense that we are looking for the difference between norms to decrease with exposure to meaningful normative messages. In this case, it is the difference between an individual’s perceived *subjective norm* and their reported *moral norm* \((SN_{ind} - MN)\)—a *normative distance* \((Nd_{ist})\). Again we measure this over time \((\Delta Nd_{ist})\). To the extent that the *subjective norm* is altered or enhanced by normative messages from peers, theory tells us that this distance should decrease, especially if the messages are from *close* peers (again measured as the aggregate of the individual’s perceived closeness with their team members). We hypothesize, then, that the change in the difference between and individual’s subjective and moral norms will covary with the perceived closeness of the individual’s team members. Once again, simple regression is the logical choice for rejecting the null hypothesis.

\[ \Delta N_{dist}(-) \rightarrow \sum C_l \]

Note that for the last two propositions, we would seem to make pretty significant assumptions—that the source of normative messages regarding gasoline consumption over the course of two months comes (a) primarily through this experiment and further (b) mostly from the members of a participant’s team. It is likely that normative messages from the system are, in fact, coming primarily from the team members simply because of the bias that such messages receive (e.g., email messages regarding posts from team members, ability to filter to view team member posts only, performance figures of team
members prominently displayed on the dashboard, etc.). Extra-experimental normative messages are more difficult to control for. However, neither of these assumptions should make a significant difference in the analysis since all participants were exposed to such external influences and should, in aggregate, affect all participants equally, and can thus be assumed to be a consistent error factor.

3.3.2 Public or Private Commitments (Observability)

The second treatment concerns whether a participant’s acceptance or rejection of a commitment (and their follow-up performance report, if applicable) automatically generates a public notification post. Whether the notification post will be generated is something that will be made very clear to the participant prior to accepting or rejecting commitment. The purpose of this intervention is to allow us to analyze the effect of observability on behavioral intentions and on behaviors. We measure this in the context of making and conforming to commitments. We make the following assumptions/assertions:

1) The commitment requests are all consistent with a specific subjective norm—in this case that curbing gasoline consumption is a desirable behavior

2) Acceptance of a commitment request is analogous to a behavioral intention

3) Reporting conformance with a commitment is analogous to behaving in accordance with the behavioral intention

4) Public notifications of a commitment acceptance/conformance is perceived by individuals to make the behaviors observable
The third and fourth assertions may not be completely accurate—it is really the self-reported conformance with the commitment that is observable, not the actual behavior. This would seem to challenge the ability to use commitments to test P5 and P6. However, we hold that even if self-reported behavior differs from actual behavior, the fact that the observability of the reporting of the behaviors may impact the reported conformance (or non-conformance) with the subjective norm is still an accurate test of the model. Altering reported behavior in the presence of norm and observability is not far removed from altering actual behavior.

Note that testing the moderation of observability on the relationship between subjective norm and behavioral intention does require that we first (re)establish the assertion that subjective norm does indeed have a direct relationship with behavioral intention. Thus, we discuss P4 here, although it does not actually have any direct bearing on this intervention.

Proposition 4. Here we are interested in finding support that there is a direct relationship between subjective norm and behavioral intention above and beyond that which is mediated by moral norm. We measure subjective and moral norm in both the pre- and post-experiment surveys. This provides us with four variables: \( SN_{time0}, SN_{time1}, MN_{time0}, \) and \( MN_{time1} \). As stated previously, we assert that accepting a commitment is analogous to a bi-modal measure of behavioral intention (BI), which gives us the three variables \( (SN, MN, BI) \) required to test P4. However, testing P4 would seem to require that we measure the normative factors at time \( N \), where \( N \) is the precise time between time0 and time1 at which a commitment is accepted. Measuring this was not really feasible, at least without adding an excessive burden to the participants and
lessening the chances that they would continue to accept commitments. However, if we assume some degree of linear progression, then we assert that an average of each of the two variables (i.e., $SNavg = \frac{SN_{time0} + SN_{time1}}{2}$ and $MNavg = \frac{MN_{time0} + MN_{time1}}{2}$) should suffice as an estimate for the measure of the actual normative factors at time $N$. We acknowledge that this it is a threat to construct validity and a limitation of this study in general, but we believe the impact on the validity of the results is most likely to be insignificant.

Though both the predictor variable and the mediator variable ($SNavg$ and $MNavg$) are continuously scaled, the outcome variable ($BI$) is dichotomous and we need to leverage logistical regression ($logit$) in our analysis of mediation effects. More specifically, we leverage the multiple regression technique proposed by Baron and Kenny (1986) and further elucidated by Frazier, Tix and Barron (2004) to test for mediation effects and to determine if the relationship is fully mediated. The technique involves four steps. First, determine whether the initial variable ($SNavg$ in this case) is correlated with the outcome variable ($BI$), noting the regression coefficient ($c$).

\[ SNavg \rightarrow c \rightarrow BI \]

Second, establish a correlation between the initial ($SNavg$) and mediating ($MNavg$) variables, recording the regression coefficient ($a$). Third, use regression to establish a correlation between the mediator ($MNavg$) and the dependent variable ($BI$), controlling for the initial variable ($SNavg$), and noting both regression coefficients ($b$ and $c'$).
Finally, test for the significance of $c'$ using a Sobel test or using a bootstrapping procedure. Note, however, that because this uses logistic regression rather than standard multiple regression, the coefficients must first be normalized. If the relationship between $SNavg$ and $BI$ is fully mediated, we should find that $c'$ is insignificant (statistically indistinguishable from 0).

**Proposition 5.** This proposition examines the moderating effect of observability on the relationship between subjective norm and behavioral intention. Again here we use our $SNavg$ measure to approximate the subjective norm at the time of the acceptance of a commitment ($BI$). Observability ($OB$) is a dichotomous variable denoting whether the participant was part of the public or private commitment group. Because $BI$ is dichotomous, we must leverage logistical regression. Testing for mediation effects in logistic regression is far more complicated than the techniques used to test mediation effects using standard multiple regression (also discussed by Baron and Kenny (1986)). Here we turn to Hayes and Matthes who provide an SPSS script and a paper (Hayes & Matthes, 2009) to help determine mediation effects using both OLS and logit techniques.

**Proposition 6.** Technically, this is nearly identical to P5, but we are testing the moderating effect of $OB$ on a direct relationship between $SNavg$ and *actual* behavior ($B$). As with P5, we use the Hayes and Matthes *MODPROBE* script to test for moderation effects. Note that because we are only able to measure whether an individual behaves as intended (that they complied with their commitment), we are only able to test the negative aspect of this moderating impact. In other words, we can find support for the assertion that an individual may decide **not** to behave as intended because the behavior is not perceived to be observable. But we cannot test for the opposite assertion that an
individual may decide to behave contrary to their intentions (and in line with subjective norm) if the behavior is observable.

3.3.3 Commitment Follow-up

The last of the interventions is a control over whether the participant receives follow-up reminders and questionnaires following the acceptance of a commitment. For those that were in the “no follow-up” group, the system asked for commitments and displayed a list of currently “active” commitments on the home screen, but that was it. Those that receive follow-ups were required take a much more active role. They were notified when the commitment period was about to expire and were asked to respond to a brief questionnaire regarding their performance. They also were asked to escalate their commitment where appropriate. Refer to Appendix A for more details on the commitment subsystem and to Appendix D for a list of all possible commitments.

Note that while a participant’s compliance with a commitment was measured immediately if they were members of the follow-up treatment group, the measure was not taken until after the completion of the experiment for the others. This could introduce some error simply due to time elapsed between the performance of a commitment and its reporting. Also, there may be error introduced from the public commitments group. The performance responses in the post-experiment survey was private, as was the responses from those in the in the private commitment treatment group. Those in public commitments group had their responses made public. This may have tempted some participants to be dishonest in their answers. Thus, we will exclude the public commitment group from the analysis of the results.
Proposition 7. Here we are interested in determining if follow-up communications are effective at improving the degree to which individuals comply with their commitments. These are both dichotomous variables, and since we are assuming some degree of causality, logistic regression is the logical choice for data analysis. The null hypothesis is that automated follow-up communications do not influence (reported) compliance.
4 DATA ANALYSIS AND FINDINGS

In this chapter, we analyze the data collected from the execution of the experiment described in the prior chapter. Section 4.1 details the experimental sample used to collect the data. In Section 4.2, we examine the validity of the pertinent measures of the instrument used to collect much of the data we will analyze. Finally, Section 4.3 presents a detailed, proposition-by-proposition statistical analysis of the data (the results of which are summarized in Table 9).

### Table 9: Summary of Results

<table>
<thead>
<tr>
<th>#</th>
<th>Proposition</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>Over time, the level of social interaction between persons via a social media system should increase each person’s perceived closeness to the other.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P2</td>
<td>Over time, transfer of actual social norm into subjective norm will be moderated by the closeness of the source of the normative messages.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P3</td>
<td>Over time, the degree to which subjective norm is translated into moral norm will be moderated by the closeness of the sources of the normative messages that form the subjective norm.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P4</td>
<td>The relationship between subjective norm and behavioral intention will not be fully mediated by moral norm.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P5</td>
<td>The relationship between subjective norm and behavioral intention will be moderated by the degree to which the individual expects the behavior to be observable.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P6</td>
<td>The direct relationship between subjective norm and behavior will be moderated by the degree to which the behavior is perceived to be observed.</td>
<td>Not Supported</td>
</tr>
<tr>
<td>P7</td>
<td>In a social media setting, automated follow-up messages will increase the effectiveness of commitments at encouraging behavior.</td>
<td>Supported</td>
</tr>
</tbody>
</table>
4.1 Experimental Sample

As described in section 3.2, the experiment was conducted using a sample of students from business schools at two different universities. The goal was to recruit between 200 and 300 students for the study, with the assumption that quite a number of these would not complete the entire experiment.

To incentivize active participation we offered $5 gift cards to every participant who met a minimal level of participation (the participants were told to expect “at least” $5 for this minimal level of participation). $50 gift cards were awarded to five randomly selected students picked from among those achieving the minimal level of participation. Additional $50 gift cards were awarded to each member of one of the top five most active teams. In order to maintain interest, at around the halfway point of the experiment we offered two additional award tiers: $20 for the 25 most active participants and $10 for the next 25 most active. The $5 level remained for the rest of the participants.

Recruitment took two forms. At one of the universities, participants were drawn from a single, large lecture course. For this course, participation in research studies was a mandatory part of their course responsibilities (though they could opt out of this responsibility by writing summaries of research papers). 124 students were recruited from this course. Of these, fifteen did not complete the registration process and an additional three did not complete the pre-experiment survey. Thus we started with 106 students from this group. During the course of the experiment, one student officially dropped out of the study. Six did not complete the post-experiment survey, and could thus not be included in the final data analysis. In all, though, 99 students from this course completed the experiment, a completion rate of 93.4%. This was well above our initial expectations.
Note that five additional students were recruited from this university by presenting the experiment remotely to two course sections. However none of the five completed the pre-experiment survey.

At the other university, students were recruited by presenting the experiment in front of classes and asking for volunteers. We presented to 16 different course sections representing approximately 300 potential participants. Despite distributing well over 200 information sheets and consent forms to interested students, only 70 students completed the registration process. Of these, only 57 ever logged in to complete the pre-experiment survey. From this group, only 40 participated to the end of the experiment and completed the post-experiment survey—a completion rate of approximately 70%, which fortunately was at the high end of our expectations.

The number of participants from the second university was well below our expectations. Thus our total starting sample size was only 163, significantly below our target of 200 to 300. Fortunately, the overall drop-out rate was well below our expectations, so the final usable sample size of 139 was within our target range.

Team assignment was made after all participants had registered to participate but before they completed the pre-experiment survey. In all, 37 teams were assembled from 184 total registrants. During the registration process, participants were asked to name up to four individuals that they would like to be teamed with—presumably people with whom they had offline relationships. The goal was to create an approximately equal number of teams with a low-degree of offline interaction as with a high-degree of offline interaction. However, far fewer participants indicated team member preferences than was expected. Thus, only eight teams were created with a presumed high-degree of offline
interaction ("A" teams). This was not a major issue as this assignment was primarily to insure variance in pre-experiment closeness, however it was unexpected. Eight additional teams were assembled using individuals from the same class, again presumed to have at least some degree of offline-interaction ("B" teams). The remaining 21 teams were assembled by randomly assigning at least two individuals from each of universities ("C" teams). All teams started with between four and six members.

One of the “A” teams was lost even before the experiment started because none of its members completed the pre-experiment survey. The remaining 36 teams remained at least partially intact until the end of the experiment. One of the “A” teams ended with only one team member. Three additional “A” teams ended with only two team members. The remainder of the teams all made it to the end of the experiment with three or more members (21 of these teams did not lose any of their members). It is not immediately clear why the “A” teams saw the highest level of defection (odds ratio = 5.38, p < .001). This is, in fact, quite counter to intuition.

As planned, the 37 teams were divided equally among the four commitment-design treatment groups: public/follow-up, public/no-follow-up, private/follow-up, and private/no-follow-up. The starting and ending participant counts are shown in Table 10. On the surface, it appears that the private/no-follow-up treatment group had a relatively higher degree of defection. However, this is less remarkable considering the loss of an entire five-person team prior to the beginning of the experiment. Excluding these, approximately ten participants were lost from each treatment group.
Table 10: Starting and Ending Treatment Group Breakdown

<table>
<thead>
<tr>
<th></th>
<th>Registered</th>
<th>Completed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Teams</td>
<td>Participants</td>
</tr>
<tr>
<td>Public/Follow-up</td>
<td>10</td>
<td>49</td>
</tr>
<tr>
<td>Public/No-Follow-up</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td>Private/Follow-up</td>
<td>9</td>
<td>43</td>
</tr>
<tr>
<td>Private/No-Follow-up</td>
<td>9</td>
<td>45</td>
</tr>
</tbody>
</table>

4.2 Scale Validation

The hypotheses tested in section 4.3 really only leverage three constructs from our pre- and post-surveys, *Closeness*, *Subjective Norm*, and *Moral Norm*. All other measures are unobtrusive, drawn from analyzing actual system usage data. The two normative constructs are measured using either two or three reflective scale items. As such, they can be assessed for convergent and discriminant validity using traditional methods. *Closeness*, however, is a composite, formative construct, itself composed of two distinct cognitive constructs. When added together, these constructs should represent the degree to which an individual feels “close” to another individual, at least in terms of our theory. These two individual constructs (loosely “familiarity” and “respect”) can be evaluated for validity. Note however that we cannot evaluate all four constructs simultaneously for convergent and discriminant validity as they are measured at different levels (individual for the normative constructs and interpersonal for the closeness constructs).

*Closeness*. Closeness consists of three scale items, listed below for convenience.

- *Closeness1*: I feel as though I know this person well
- *Closeness3*: I respect the opinions and beliefs of this person
- *Closeness4*: It is important to me that this person respects my opinions and beliefs
Closeness1 is a single item measure of “familiarity.” Closeness3 and Closeness4 should both reflect the concept of “respect.” We begin with a correlation matrix (Table 11) to determine whether the items group together along the lines of these two concepts.

<table>
<thead>
<tr>
<th></th>
<th>closeness1</th>
<th>closeness3</th>
<th>closeness4</th>
</tr>
</thead>
<tbody>
<tr>
<td>closeness1</td>
<td>1.00</td>
<td>0.31</td>
<td>0.24</td>
</tr>
<tr>
<td>closeness3</td>
<td>0.31</td>
<td>1.00</td>
<td>0.71</td>
</tr>
<tr>
<td>closeness4</td>
<td>0.24</td>
<td>0.71</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The matrix does seem to support the existence of at least two distinct constructs. Closeness1 is certainly distinct from the other two. Closeness3 and Closeness4 are correlated, though only moderately at 0.71 (p<0.001).

Examining the face validity of our “respect” construct may help explain the moderate correlation of the scale items. Closeness3 and Closeness4 both ask the respondent to rate the degree to which they respect or desire the respect of another individual. On the surface, it seems like these should be reflective of a single construct. If you respect someone, it seems logical that you should also care whether that someone respects you in return. However, in examining the responses, it appears that a significant minority of the respondents viewed these as measuring two distinct constructs. In fact, in looking at the summary statistics for the difference between these two items (i.e., Closeness3 – Closeness4), we see a range of negative six to six, indicating that to a few, these represented polar opposite constructs. And while the median was zero, the mean was approximately 0.37. This indicates that, on average, even if the respondent respects someone, in relative terms they cared less if that person respects them. In looking again at
the two items, this does make some sense, especially if the person considers himself or herself to be highly individualistic.

For the purposes of this analysis, the possibility of a third conceptual factor is not problematic. Whether the aggregate closeness is itself composed of two or three formative factors makes no difference in this analysis. However, if future research is to examine these factors individually, then a more extensive scale development process must take place to better understand these factors.

As discussed in the write-up of the testing of Proposition 1, closeness does appear to be highly susceptible to what one might term “cognitive rescaling” between measurements. This is to be expected for most constructs, but it is quite extreme here. It is especially troubling to see rather objective items such as *Closeness1* (“I feel as if I know this person well”) drop from four to one between pre- and post-experiment surveys. There is no reason to believe that the items themselves do not reflect the relative closeness of one individual to another. And within a single administration of the survey, a cursory examination of the data shows that the values provided are consistent with expectations for pairs of close and distant individuals. However, if we are to measure change in closeness over time, as we did in Proposition 1, then perhaps it will be prudent to reexamine these items in the future to allow us to better measure actual temporal variations and minimize error.

**Subjective Norm and Moral Norm.** The normative scale is composed of much more traditional, multi-item factors. The items themselves are adapted from well known and well vetted scales of these normative constructs (see appendix C for details on the source of these measures). As discussed previously, these factors were measured for two
distinct domains: concern over gasoline consumption and concern over environmental impact. In the case of subjective norm, the questions focused on the norm of the individuals playing the game, with an emphasis on an individual’s team members. The questions are listed here for convenience.

Subjective Norm (Gasoline Consumption):

- **SocialCons3**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that reducing gasoline consumption is important.

- **SocialCons4**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively take steps to reduce their gasoline consumption.

Moral Norm (Gasoline Consumption):

- **MoralCons1**: It bothers me when I find myself wasting gasoline.

- **MoralCons2**: I feel a personal obligation to conserve gasoline.

- **MoralCons3**: Conserving gasoline is a responsible thing to do.

Subjective Norm (Environment):

- **SocialEnv3**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that preserving the environment is important.

- **SocialEnv4**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively take steps to reduce their impact on the environment.

Moral Norm (Environment):
• **Moralenv1**: It bothers me when I do something that I know may negatively impact the environment.

• **Moralenv2**: I feel a personal obligation to minimize any negative impacts I may have on the environment.

• **MoralEnv3**: Minimizing the negative impact that someone has on the environment is a responsible thing to do.

We assess the validity of these measures grouped by domain, as it is expected that there could be correlation between norms related to gasoline consumption and those related to the environment. The two correlation matrices are shown in Table 12 and Table 13. All intra-construct correlations (i.e., those between items in the shaded boxes) have p-values less than 0.001.

### Table 12: Correlation Matrix for Norms (Gasoline Consumption)

<table>
<thead>
<tr>
<th></th>
<th>moralcons1</th>
<th>moralcons2</th>
<th>moralcons3</th>
<th>socialcons3</th>
<th>socialcons4</th>
</tr>
</thead>
<tbody>
<tr>
<td>moralcons1</td>
<td>1.00</td>
<td>0.55</td>
<td>0.47</td>
<td>0.22</td>
<td>0.18</td>
</tr>
<tr>
<td>moralcons2</td>
<td>0.55</td>
<td>1.00</td>
<td>0.58</td>
<td>0.35</td>
<td>0.34</td>
</tr>
<tr>
<td>moralcons3</td>
<td>0.47</td>
<td>0.58</td>
<td>1.00</td>
<td>0.30</td>
<td>0.27</td>
</tr>
<tr>
<td>socialcons3</td>
<td>0.22</td>
<td>0.35</td>
<td>0.30</td>
<td>1.00</td>
<td>0.88</td>
</tr>
<tr>
<td>socialcons4</td>
<td>0.18</td>
<td>0.34</td>
<td>0.27</td>
<td>0.88</td>
<td>1.00</td>
</tr>
</tbody>
</table>

### Table 13: Correlation Matrix for Norms (Environment)

<table>
<thead>
<tr>
<th></th>
<th>moralenv1</th>
<th>moralenv2</th>
<th>moralenv3</th>
<th>socialenv3</th>
<th>socialenv4</th>
</tr>
</thead>
<tbody>
<tr>
<td>moralenv1</td>
<td>1.00</td>
<td>0.88</td>
<td>0.66</td>
<td>0.43</td>
<td>0.38</td>
</tr>
<tr>
<td>moralenv2</td>
<td>0.88</td>
<td>1.00</td>
<td>0.69</td>
<td>0.46</td>
<td>0.43</td>
</tr>
<tr>
<td>moralenv3</td>
<td>0.66</td>
<td>0.69</td>
<td>1.00</td>
<td>0.35</td>
<td>0.26</td>
</tr>
<tr>
<td>socialenv3</td>
<td>0.43</td>
<td>0.46</td>
<td>0.35</td>
<td>1.00</td>
<td>0.84</td>
</tr>
<tr>
<td>socialenv4</td>
<td>0.38</td>
<td>0.43</td>
<td>0.26</td>
<td>0.84</td>
<td>1.00</td>
</tr>
</tbody>
</table>
In both cases, the two items measuring social norm correlate somewhat strongly, with correlations of 0.88 and 0.84 respectively. There is some correlation between the normative measures, though this is to be expected as they are theoretically related constructs. In both cases, the three items measuring moral norm are more correlated with themselves than with the other two items. However, the correlations are not terribly significant. In the case of moral norm regarding the environment, we have an average correlation for the construct of 0.74, which is on the low side in terms of construct reliability. With regard to gasoline consumption, however, we find an average inter-item correlation of only about 0.53. This is not a very reliable measure. And it is not immediately clear why. On the face the items seem quite correlated. And the scale itself is one that is well known.

Perhaps the lack of reliability is due to the rather “impure” nature of the morality being measured. Gasoline conservation can have mixed motives. People can feel obliged to save gas in order to save money or by more “pure” moral obligations such as preserving a limited natural resource or cutting their emission of pollutants. This is, in fact, one of the main reasons it was chosen, as it allows us to test our model with green behaviors that are not purely altruistic in nature. With this in mind and looking again at the questions, perhaps it is not a moral norm that we are measuring, but a mix of morality and a level of motivation to conserve fuel. Certainly future research will be needed to determine how best to measure these two distinct constructs.

Regardless, it does present somewhat of an issue in interpreting the results related to moral norm and helps explain why we found no support for our third proposition (see section 4.3.3). Had we found support, this low degree of construct reliability would have
forced us to question the validity of the results. As it is, it is simply a potential explanation for the lack of results and a noteworthy issue to be examined further in the future.

4.3 Data Analysis by Proposition

In this section, we summarize the results of the data analysis used to test each of the propositions using the strategies outlined in section 3.3. All testing was performed using R version 2.12.2. The data was extracted from the Microsoft SQL Server database that served as the data repository for the experiment. The data model as well as the SQL queries used to generate the summary tables required for analysis are quite large and complex, and are thus included in an appendix to this document.

4.3.1 Proposition 1

Data Collection. We are measuring social media system interaction between pairs of individuals ($SMS_i$). As operationalized, this index was calculated by counting instances of the following system actions:

- Participant A likes Participant B's post
- Participant B likes Participant A's post
- Participant A comments on Participant B's post
- Participant B comments on Participant A's post
- Participant A comments on a post that Participant B commented on
- Participant B comments on a post that Participant A commented on
- Participant A views Participant B's profile or wall

In each of these cases, Participant A is either directly or indirectly interacting with Participant B, or showing an interest in Participant B’s social interaction with the system.
A participant’s perceived closeness to another participant \((Cl)\) was captured using the following three questions on both the pre- and post-experiment surveys (the \(ClosenessX\) identifiers were not included as part of the survey instrument).

- \(Closeness1\): I feel as though I know this person well
- \(Closeness3\): I respect the opinions and beliefs of this person
- \(Closeness4\): It is important to me that this person respects my opinions and beliefs

Each was measured using a 7-level scale ranging from strongly disagree to strongly agree. Each measure was taken between the participant and that participant’s other team members (i.e., participant \(\rightarrow\) team member 1, participant \(\rightarrow\) team member 2, and so forth). The three were added together to form a single closeness scale ranging from 3 to 21. The change between pre- and post-surveys was then calculated \((\Delta Cl)\). We hypothesized that greater levels of social interaction would cause individuals to grow closer than would lower levels.

\(SMSi \rightarrow \Delta Cl(+)\)

\(Closeness2\) measured the degree to which a participant interacted with another participant “face-to-face”. It was used only as a filter.

**Statistical Analysis.** In total, there were 436 usable pairs of interacting users (fully crossed set of participant paired with participant’s team members). The summary statistics for the three measures are shown in Table 14.
Table 14: Proposition 1 Summary Statistics

<table>
<thead>
<tr>
<th>OfflineInteraction</th>
<th>DeltaCloseness</th>
<th>InteractionCount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. 1.00</td>
<td>Min. -9.00</td>
<td>Min. 0.00</td>
</tr>
<tr>
<td>1st Qu. 1.00</td>
<td>1st Qu. -2.00</td>
<td>1st Qu. 1.00</td>
</tr>
<tr>
<td>Median 1.00</td>
<td>Median 0.00</td>
<td>Median 3.00</td>
</tr>
<tr>
<td>Mean 1.71</td>
<td>Mean 0.49</td>
<td>Mean 6.72</td>
</tr>
<tr>
<td>3rd Qu. 1.00</td>
<td>3rd Qu. 2.00</td>
<td>3rd Qu. 8.00</td>
</tr>
<tr>
<td>Max. 7.00</td>
<td>Max. 11.00</td>
<td>Max. 80.00</td>
</tr>
</tbody>
</table>

The summary statistics show a wide variance in responses and system interaction, though in all cases both mean and median are at the low-end of the scale. The low level of offline interaction is positive in the sense that we are not likely to have our results confounded by the transfer of values other than that which occurs through the system. However, the relatively low mid-point for $\Delta C_l$ is less than desirable. And the preponderance of negative values for $\Delta C_l$ may be indicative of measurement error. Although the system may well not cause individuals to grow closer, as it seems unlikely that system use would cause individuals to grow less close, at least not in such large numbers. Likewise, the relatively low degree of interaction among the 436 measured pairs is also potentially worrisome.

Figure 13 shows the raw output of the simple linear regression run against all participants, regardless of their degree of offline (face-to-face) interaction.
lm(formula = DeltaCloseness ~ InteractionCount, data = H1)

Residuals:
Min 1Q Median 3Q Max
-9.4885 -2.4323 -0.4323 1.5677 10.5516

Coefficients:
           Estimate Std. Error t value Pr(>|t|)  
(Intercept) 0.432283   0.183338   2.358   0.0188 *  
InteractionCount 0.008034   0.014510   0.554   0.5801
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 3.243 on 434 degrees of freedom  
Multiple R-squared: 0.000706, Adjusted R-squared: -0.001597  
F-statistic: 0.3066 on 1 and 434 DF, p-value: 0.58

**Figure 13: Proposition 1 Regression Listing (All Users)**

As can be seen, with a p-value above 0.58, we find no support for Proposition 1 when we consider all participants without regard to offline interaction. But the strategy called for excluding those with high levels of offline interaction. Figure 14 shows the result of the same regression equation, only including those with a post-experiment *Closeness2* rating of either 2 or 1 (i.e., disagree strongly with the notion that they regularly interact with the person face-to-face).
lm(formula = DeltaCloseness ~ InteractionCount, data = H1, subset = OfflineInteraction < 3)

Residuals:

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Min</td>
<td>-9.3762</td>
<td>2.1795</td>
<td>0.1795</td>
<td>1.8205</td>
</tr>
</tbody>
</table>

Coefficients:

|                                | Estimate | Std. Error | t value | Pr(>|t|) |
|--------------------------------|----------|------------|---------|---------|
| (Intercept)                    | 0.17950  | 0.20636    | 0.870   | 0.385   |
| InteractionCount               | 0.02810  | 0.02177    | 1.291   | 0.198   |

Residual standard error: 3.222 on 368 degrees of freedom
Multiple R-squared: 0.004507, Adjusted R-squared: 0.001802
F-statistic: 1.666 on 1 and 368 DF, p-value: 0.1976

Figure 14: Proposition 1 Regression Listing (Low Offline Interaction)

Still we find no support. So we must conclude that the data do not support our first proposition.

4.3.2 Proposition 2

Data Collection. The survey measured norms related to two distinct moral values: preserving the environment and conserving fuel. The transfer of social norm to subjective norm was tested individually for each of these two values. For both values, there were two measures of subjective norm, which were summed to form a composite subjective norm value. In both cases, these two measures were focused on the perceived norms of the others playing the game, with an emphasis placed on the subject’s team members.

- **SocialCons3**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that reducing gasoline consumption is important.

- **SocialCons4**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively take steps to reduce their gasoline consumption.
• **SocialEnv3**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that preserving the environment is important.

• **SocialEnv4**: Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively take steps to reduce their impact on the environment.

An individual’s perceived subjective norm (SNind) was measured by averaging the two subjective norm value—e.g., \((SocialCons3 + SocialCons4) / 2\). Actual social norm (SNact) at the team level was approximated by averaging the SNind values for the remaining team members—i.e., \(SNact_{1} = (SNind_{2} + \ldots + SNind_{n}) / (n-1)\).

Closeness was calculated the same way is in Proposition 1, though the pre- and post-survey values were averaged to approximate the perceived closeness at any given time within the duration of the experiment. Each of the closeness scores was measuring individual closeness with a specific team member, so to approximate the closeness that the individual felt towards their entire team (Closeness\textsubscript{team}), the individual scores were again averaged. So the formula used to calculate team closeness looked like this:

\[
\frac{AVG(Closeness1\textsubscript{pre} + Closeness3\textsubscript{pre} + Closeness4\textsubscript{pre}) + AVG(Closeness1\textsubscript{post} + Closeness3\textsubscript{post} + Closeness4\textsubscript{post})}{2}
\]

As with individual closeness, team closeness had a potential range from 3 to 21.

As described in the strategy section, we are interested in the difference between actual social norm and the measure of an individual’s perceived subjective norm (\(SNact – SNind\))—a subjective distance (Sdist) from the actual norm. As with the hypothesis for Proposition 1, this hypothesis also measures change over time (\(\Delta Sdist\)). After examining the \(\Delta Sdist\) values, it was apparent that we needed to take the absolute value of Sdist prior
to calculating the change. This is logical as we don’t actually care whether a participant is above or below the actual norm, only how far she is from it. We expected that $\Delta S_{dist}$ would covary with $Closeness_{team}$.

**Statistical Analysis.** The hypothesis was tested using simple regression, once for conservation values and again for environmental values. There were 138 viable measurements rather than the full 139 as one of the teams had only one team member complete the post-experiment survey. The results of the regressions are show in Figure 15 and Figure 16.

```
lm(formula = DeltaSDist ~ Closeness, data = H2cons)

Residuals:
     Min      1Q  Median      3Q     Max
-7.1175 -1.1398  0.1322  1.0044  4.8825

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.46472    0.51738  -2.831  0.00534 **
Closeness    0.09703    0.04530   2.142  0.03398 *

---
Signif. codes:  0 ’***’ 0.001 ’**’ 0.01 ’*’ 0.05 ’.’ 0.1 ’ ’ 1

Residual standard error: 1.796 on 136 degrees of freedom
Multiple R-squared: 0.03263,  Adjusted R-squared: 0.02552
F-statistic: 4.588 on 1 and 136 DF,  p-value: 0.03398
```

Figure 15: Proposition 2 Regression Listing (Fuel Consumption)
lm(formula = DeltaSDist ~ Closeness, data = H2env)

Residuals:
  Min  1Q Median   3Q Max
-8.353 -1.127  0.133  1.079  5.216

Coefficients:
                      Estimate Std. Error t value  Pr(>|t|)
(Intercept)       -1.30118    0.57009  -2.282   0.0240 *
Closeness          0.10910    0.04992   2.186   0.0306 *
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.979 on 136 degrees of freedom
Multiple R-squared: 0.03393, Adjusted R-squared: 0.02683
F-statistic: 4.777 on 1 and 136 DF,  p-value: 0.03056

Figure 16: Proposition 2 Regression Listing (Environment)

We see an initial indication of support for Proposition 2. However, we should first perform some diagnostics on the data to insure that models meet the requirements for standard linear regression. The following figures show the basic diagnostics plots of both of the models provided by R.
Figure 17: Proposition 2 (Fuel Consumption) Diagnostics Plot
Neither of the diagnostics plots raises any red flags with regard to linearity. However, in both models, observation number 136 stands out as a potential outlier. An analysis of the results of running R’s outlierTest function reveals that in both cases, these observations are candidates for exclusion as their studentized residuals (Bonferonni p-values) fall well below 0.05 (0.005 and 0.001, respectively). Repeated tests show that this
is the only potential outlier. Thus, we should likely examine the results of the regression with this observation excluded. The results are shown in the following two figures.

Call:
lm(formula = DeltaSDist ~ Closeness, data = H2cons[-c(136), ])

Residuals:
   Min  1Q Median  3Q  Max
-4.1715 -1.1777  0.1066  1.0346  4.7181

Coefficients:  
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.16375    0.49276 -2.362   0.0196 *
Closeness    0.07428    0.04303   1.726   0.0866 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.693 on 135 degrees of freedom  
Multiple R-squared: 0.0216 , Adjusted R-squared: 0.01435
F-statistic: 2.98 on 1 and 135 DF,  p-value: 0.0866

Figure 19: Proposition 2 Regression Listing (Fuel Consumption – no outlier)

Call:
lm(formula = DeltaSDist ~ Closeness, data = H2env[-c(136), ])

Residuals:
   Min  1Q Median  3Q  Max
-4.9659 -1.1335  0.0378  0.9345  5.2101

Coefficients:  
             Estimate Std. Error t value Pr(>|t|)
(Intercept) -0.94796    0.53805 -1.762   0.0804 .
Closeness    0.08240    0.04699  1.754   0.0818 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.849 on 135 degrees of freedom  
Multiple R-squared: 0.02227 , Adjusted R-squared: 0.01503
F-statistic: 3.075 on 1 and 135 DF,  p-value: 0.08177

Figure 20: Proposition 2 Regression Listing (Environment – no outlier)
Neither of these models shows significant support for Proposition 2. So, if we assume that the excluded observation indeed represents an aberration (perhaps a result of measurement error) rather than a true measure of the two constructs being measured, then we must conclude that our data do not support Proposition 2.

Even if we do retain the observation and accept the lack of normality, the $R^2$ is quite low, indicating that closeness accounts only for a small portion of the change in subjective distance. This is quite evident when we examine the data graphically. The scatterplots depicting these two relationships and the regression lines are shown in Figure 21 and Figure 22.

![Figure 21: Proposition 2 (Fuel Consumption) Scatterplot](image)
We see that the intercept is far to the right, indicating that one would need to be quite close to one’s team in order for subjective distance to approach zero. This is good. However, the number of observations of $\Delta S_{dist}$ that are below zero would seem to imply that the system is, on average, causing individuals’ subjective norms to grow further apart from their team members. This actually causes the slope of the regression line to be opposite of what we might expect since we are starting from a negative instead of a positive distance. This is further highlighted if we look at the summary data for our variables of interest.
Table 15: Proposition 2 Summary Statistics

<table>
<thead>
<tr>
<th></th>
<th>Fuel Consumption</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DeltaSDist</td>
<td>Closeness</td>
</tr>
<tr>
<td>Min.</td>
<td>-8.00</td>
<td>3.00</td>
</tr>
<tr>
<td>1st Qu.</td>
<td>-1.63</td>
<td>8.82</td>
</tr>
<tr>
<td>Median</td>
<td>-0.29</td>
<td>11.00</td>
</tr>
<tr>
<td>Mean</td>
<td>-0.41</td>
<td>10.91</td>
</tr>
<tr>
<td>3rd Qu.</td>
<td>0.73</td>
<td>13.50</td>
</tr>
<tr>
<td>Max.</td>
<td>4.00</td>
<td>18.50</td>
</tr>
</tbody>
</table>

Here we see that both the mean and the median indicate either zero or negative change in the distance between actual and subjective norms. There is no theoretical basis for this, nor is there any immediately obvious rational reason for this to occur. So we are led to conclude that there is possibly a measurement error reflected in these figures.

Puzzled by this anomaly, we performed a deeper examination of the degree to which the use of the system, in general, affected subjective norms. In both cases, we find a highly significant, positive change in subjective norm. For concern over fuel consumption, the mean subjective norm increased by an average of 1.5 points (on a scale of 2 to 14) with a 95% confidence interval of 1.11 to 1.89 (p < .001). For concern over the environment, the mean increased by an average of 0.97 with a confidence interval of 0.60 to 1.34 (p < .001). This doesn’t directly impact our hypotheses, though it does demonstrate the efficacy of a social media system at altering subjective norm. This shows that the negative movement in \( \Delta S_{dist} \) is largely one of degree rather than direction. Usage of the system was probably transferring norms in the correct direction (positively), but each team member likely interpreted the degree of change differently, thus causing the subjective distance to grow rather than converge on zero.
Regardless, given the higher-than-acceptable p-values of the models that exclude the outlier, we simply cannot definitively reject the null hypothesis. Thus, we must conclude that the data do not support Proposition 2.

4.3.3 Proposition 3

Data Collection. As discussed in the testing strategy section, the testing of Proposition 3 is nearly identical to the testing for Proposition 2. In this case, it is the difference between an individual’s perceived subjective norm and their reported moral norm \((SNind - MN)\)—a normative distance \((Ndist)\). Again we take the absolute value and measure it over time \((\Delta Ndist)\). We expect that \(\Delta Ndist\) and the perceived closeness of a participant’s team members to covary.

Moral norm was measured on both the pre- and post-experiment using three separate measures, each scaled from 1 to 7 indicating the participants’ level of agreement with each. And as with subjective norm, moral norm was captured both with regard to fuel consumption behaviors and environmental concern. The six questions are as follows.

- MoralCons1: It bothers me when I find myself wasting gasoline.
- MoralCons2: I feel a personal obligation to conserve gasoline.
- MoralCons3: Conserving gasoline is a responsible thing to do.
- MoralEnv1: It bothers me when I do something that I know may negatively impact the environment.
- MoralEnv2: I feel a personal obligation to minimize any negative impacts I may have on the environment.
- MoralEnv3: Minimizing the negative impact that someone has on the environment is a responsible thing to do.
Closeness was measured in an identical fashion to Proposition 2, i.e., the average of an individual’s Closeness with each of his or her team members, again averaged between pre- and post-experiment.

Statistical Analysis. As with Proposition 2, Proposition 3 was tested using simple linear regression, positing that Closeness should determine ∆Ndist. The results of the two regressions are shown in Figure 23 and Figure 24.

lm(formula = DeltaNDist ~ Closeness, data = H3cons)

```
Residuals:
         Min       1Q   Median       3Q      Max
-3.34380 -0.64050  0.03280  0.58080  2.78500

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.67981    0.29938   2.271   0.0247 *
Closeness  -0.03718    0.02625  -1.417   0.1588
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 1.042 on 137 degrees of freedom
Multiple R-squared: 0.01444, Adjusted R-squared: 0.007244
F-statistic: 2.007 on 1 and 137 DF,  p-value: 0.1588
```

Figure 23: Proposition 3 Regression Listing (Fuel Consumption)

lm(formula = DeltaNDist ~ Closeness, data = H3env)

```
Residuals:
         Min       1Q   Median       3Q      Max
-2.40100 -0.58030 -0.11090  0.53130  3.58170

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept)  0.197374   0.282546   0.699  0.486
Closeness  -0.008649   0.024771  -0.349  0.728

Residual standard error: 0.9831 on 137 degrees of freedom
Multiple R-squared: 0.000889, Adjusted R-squared: -0.006404
F-statistic: 0.1219 on 1 and 137 DF,  p-value: 0.7275
```

Figure 24: Proposition 3 Regression Listing (Environment)
With p-values of 0.16 and 0.73, we cannot reject the null hypothesis and thus find no support for Proposition 3.

4.3.4 Proposition 4

Data Collection. Recall that we are interested in finding support that there is a direct relationship between subjective norm and behavioral intention above and beyond that which is mediated by moral norm. We measured subjective and moral norm in both the pre- and post-experiment surveys. In this case, because the behaviors in question related to gasoline consumption, only the normative measures related to gasoline consumption were considered (i.e., SocialCons3, SocialCons4, MoralCons1, MoralCons2, and MoralCons3). Because we did not measure the normative values at the time of the acceptance or rejection of a commitment, we take an average (SNavg and MNavg) of the values from the pre- and post-experiment surveys. Behavioral intention is a bimodal indication of whether or not an individual accepts a system-generated commitment request.

Statistical Analysis. Although a total of 1017 commitments were accepted during the course of the experiment, only 181 were accepted as a result of a system-generated “requests.” 213 were “recommits,” i.e., the participant chose to commit to the same action for another period. 94 were “escalations”—generally this meant that the participant committed to a higher number of actions (e.g., rides on public transit or carpools) than the one they had just successfully completed. The remaining 529 were actively sought by the participants by navigating to the “Commitments” section of the system’s web application. The fact that there were so many active commitment acceptances that were not in
response to a specific request is somewhat surprising. In terms of the effectiveness of the system as a tool for influencing behavior, this is likely a positive indicator. However, from an analysis perspective, this is somewhat detrimental. The system was designed only to request a commitment if the participant was not already committed to gas saving action. Further, there was no way to actively reject a commitment; rather, one could only a reject a commitment request. And the analysis requires that we consider only acceptances and rejections of commitment requests. As such, there were relatively few total observations. Only 76 commitment requests were rejected. 73 were ignored altogether—these, too, were not considered in our analysis. So we had only 257 total observations. Each observation was coded with an Accepted variable set to 1 if accepted and 0 if rejected.

Because the outcome variable is dichotomous, we leveraged logistical regression (logit) in our analysis of mediation effects. Per the analysis strategy, we intended to leverage Baron and Kenny (1986) method to test for mediation effects. The first step in this process is to determine whether $SNavg$ is correlated with the outcome variable (Accepted, i.e., behavioral intention). The result of this logit model is shown in Figure 25.
glm(formula = Accepted ~ SNavg, family = binomial(logit),
data = H4.5)

Deviance Residuals:
  Min       1Q   Median       3Q      Max
-1.5654 -1.5592   0.8368   0.8380   0.8412

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)  0.845327   0.805114   1.050    0.294
SNavg       0.004592   0.162393   0.028    0.977

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 312.1  on 256  degrees of freedom
Residual deviance: 312.1  on 255  degrees of freedom
AIC: 316.1

Number of Fisher Scoring iterations: 4

Figure 25: Proposition 4 Logit Model Listing (SNavg \rightarrow Accepted)

It appears as though there is no relationship between SNavg and Accepted evident in the data. This is not immediately remarkable as existing theory posits only an indirect relationship between subjective norm and behavioral intention. Rather, subjective norm’s influence on behavioral intention is instead fully mediated by moral norm (MNavg in our case). To test for this relationship, we again run a logit model, the results of which are provided in Figure 26.
glm(formula = Accepted ~ MNavg, family = binomial(logit),
data = H4.5)

Deviance Residuals:
  Min       1Q   Median       3Q      Max
-1.6235 -1.5393  0.8331  0.8437  0.8588

Coefficients:
  Estimate Std. Error z value Pr(>|z|)
(Intercept)   1.0603     0.6690   1.585    0.113
MNavg         -0.0361     0.1225  -0.295    0.768

(Dispersion parameter for binomial family taken to be 1)

 Null deviance: 312.10 on 256 degrees of freedom
Residual deviance: 312.01 on 255 degrees of freedom
AIC: 316.01

Number of Fisher Scoring iterations: 4

Figure 26: Proposition 4 Logit Model Listing (MNavg $\rightarrow$ Accepted)

Still we find no support. There is little need to continue the analysis of Proposition 4, however for the sake of completeness, we run a simple linear regression to test for a relationship between $SNavg$ and $MNavg$ (Figure 27) as well as a logit model testing the impact of $SNavg$, $MNavg$, and the interaction of the two on $Acceptance$ (Figure 28).
As predicted by theory, subjective norm does appear to have a significant and strong influence on moral norm, with an adjusted r-squared of 0.31. The more complete
logit model, however, does not provide any better value at predicting the acceptance of a commitment.

Assuming the measures are reliable (a somewhat questionable assumption for \( MNavg \), as discussed in the scale validation section) and assuming existing theory is correct in positing a relationship between norms and behavioral intention, then it appears that perhaps the acceptance of a commitment via a social media system is not a valid analog for behavioral intention. We will discuss this further in the concluding section of this document.

4.3.5 Proposition 5

**Data Collection.** This proposition examines the moderating effect of observability (in this case, whether or not the acceptance of a commitment is announced publicly via a status post on the system) on the relationship between subjective norm and behavioral intention. \( SNavg \) is measured in an identical fashion to Proposition 4. Behavioral intention is also again coded as a dichotomous variable \( Acceptance \), indicating whether or not the participant accepted or rejected a system-generated commitment request. Observability (\( Private \)) is also a dichotomous variable denoting whether the participant was part of the public or private commitment group.

**Statistical Analysis.** We can already state that we find no support for this proposition because we found no direct relationship between \( SNavg \) and \( Acceptance \) in our testing of Proposition 4 (Figure 28). However, to rule out the possibility that including the interaction of observability (\( Private \)) and \( SNavg \) will increase the predictive value of the model, we run a logit model including both \( SNavg \) and the interaction term. The results are shown in Figure 29.
The full model provides no additional predictive value. Proposition 5 is not supported.

4.3.6 Proposition 6

**Data Collection.** Here we are testing the moderating effect of observability on the relationship between $SNavg$ and behavior. Here, actual behavior is deemed to be compliance with an accepted commitment (i.e., they did what they committed to do). We coded a *Complied* variable with one if they reported that they successfully completed the commitment and zero if not. Because we do not care whether the commitment was actively accepted or whether it was accepted as part of a commitment request, we can expand our observation count significantly. However, we will not be able to include the
full 1017 acceptances because we were able to collect compliance data for only 709 of them.

**Statistical Analysis.** Because the dependent variable Complied is dichotomous, we will leverage logistic regression. We first test whether SNavg by itself can predict Complied. The result of this logit analysis is shown in Figure 30.

```
glm(formula = Complied ~ SNavg, family = binomial(logit), data = H6)
Deviance Residuals:
  Min       1Q   Median       3Q      Max
-2.1734   0.4516   0.4584   0.4687   0.4900
Coefficients:
  Estimate Std. Error z value Pr(>|z|)
(Intercept)  2.48215    0.72549   3.421 0.000623 ***
SNavg     -0.06264    0.14770  -0.424 0.671473
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
(Dispersion parameter for binomial family taken to be 1)
  Null deviance: 465.78  on 708  degrees of freedom
  Residual deviance: 465.60  on 707  degrees of freedom
  AIC: 469.6

Number of Fisher Scoring iterations: 4
```

**Figure 30: Proposition 6 Logit Model Listing (SNavg \(\rightarrow\) Complied)**

We find no support for the direct relationship between subjective norm and the compliance behavior. The same model run with moral norm is significant and does seem to show a slight negative correlation with compliance. As with Proposition 5, this is enough to rule out support for this proposition. However, again for the sake of completeness we run the full logit model with the interaction of SNavg and Public to
determine if a more complete model might better predict compliance. Figure 31 shows the results.

```
glm(formula = Complied ~ SNavg + SNavg:Private, family = binomial(logit),
data = H6)
```

Deviance Residuals:

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>1Q</th>
<th>Median</th>
<th>3Q</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-2.2159</td>
<td>0.4248</td>
<td>0.4695</td>
<td>0.4839</td>
<td>0.5063</td>
</tr>
</tbody>
</table>

Coefficients:

|                     | Estimate | Std. Error | z value | Pr(>|z|) |
|---------------------|----------|------------|---------|---------|
| (Intercept)         | 2.40654  | 0.73345    | 3.281   | 0.00103 ** |
| SNavg               | -0.06417 | 0.14837    | -0.432  | 0.66539 |
| SNavg:Private       | 0.05316  | 0.05613    | 0.947   | 0.34360 |

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 465.78 on 708 degrees of freedom
Residual deviance: 464.68 on 706 degrees of freedom
AIC: 470.68

Number of Fisher Scoring iterations: 5

**Figure 31: Proposition 6 Full Logit Model Listing**

Again, even the more complete model provides no significant predictive power.

So we can state again that this data set provides no support for Proposition 6.

Because the data were readily available, we also ran a model to determine whether publicly revealing the compliance with a commitment affects compliance. The results of this logistic regression are shown in Figure 32.
Here we have perhaps the most surprising finding of this analysis. Both existing theory and rational logic would tell us that having compliance with a commitment made public would make it more likely for the individual to report compliance. Even if the respondent is not being honest (i.e., reporting compliance when, in fact, they did not), this tenet would still seem to hold true. This is certainly deserving of further discussion in the concluding section of this document.

Note that some of these findings could be at least partly explained by a low number of observations. Despite having 709 total observations, 637 of these were reported compliances. Only 72 commitments—or just over 10%—were reported as having not been successfully completed. Also of note is the fact that those in the public group were far more likely to accept commitments in the first place. There were 456 public commitments but only 253 private ones (not including those without compliance.
data). Neither of these figures are altogether surprising, although both are again worthy of further discussion.

4.3.7 Proposition 7

Here we are interested in determining if follow-up communications are effective at improving the degree to which individuals comply with their commitments. The dichotomous Complied variable is determined in the same manner as Proposition 6. Whether or not the individual received follow-up communications (Followup) was determined at the outset of the experiment, and is also dichotomous with values of one and zero.

Because the follow-up communications themselves are used to collect compliance data, compliance for those that did not receive follow-up communications had to be assessed after the completion of the experiment. Due to a system error, this was not properly collected at the time of the post-experiment survey. Rather, it was collected in a follow-up survey sent only to this group of participants. Of the 66 participants in this group, 36 participants responded providing compliance data for 238 commitments. 471 responses were received from those in the follow-up group for a total of 709 (same subset as Proposition 6). However, per the testing strategy, we are only to consider the private commitments in order to minimize the possibility that the answers received during the course of the experiment would be affected by the desire to have positive answers made public (though as discussed previously, this seems unlikely). This reduces the number of observations to 253, with 180 in the follow-up group and 73 out.

Statistical Analysis. The results of the logistic regression are shown in Figure 33.
glm(formula = Complied ~ Followup, family = binomial(logit),
data = H7, subset = Public == 0 & Answered == 1)

Deviance Residuals:
Min 1Q Median 3Q Max
-2.2355 0.4142 0.4454 0.4454 0.4454

Coefficients:

| Estimate | Std. Error | z value | Pr(>|z|) |
|----------|------------|---------|----------|
| (Intercept) | 2.4129     | 0.4261  | 5.662 1.49e-08 *** |
| Followup | -0.1524 | 0.4965 | -0.307 0.759 |

---

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

Null deviance: 154.15 on 252 degrees of freedom
Residual deviance: 154.05 on 251 degrees of freedom
AIC: 158.05

Number of Fisher Scoring iterations: 5

Figure 33: Proposition 7 Logit Model Listing (Followup → Complied)

Given the constraint that we can only consider private commitments, we find no support for Proposition 7. However, given the low number of observations, this is close to meaningless. A look at the data in matrix form shows why.

<table>
<thead>
<tr>
<th>Followup</th>
<th>No Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complied</td>
<td>163</td>
</tr>
<tr>
<td>Did Not Comply</td>
<td>17</td>
</tr>
</tbody>
</table>

There is simply not enough non-compliance data to make any kind of meaningful analysis. Given the findings from Proposition 6 that reported compliance is not at all dependent on whether or not the commitment compliance is announced publicly, filtering out public commitments makes little sense. Thus, we will modify our strategy to remove this filter. The results of this logistic regression are shown in the following figure.
glm(formula = Complied ~ Followup, family = binomial(logit),
    data = H7, subset = Answered == 1)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-2.2801   0.3930   0.3930   0.5727   0.5727

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   1.7247     0.1809   9.534  < 2e-16 ***
Followup      0.7975     0.2522   3.163  0.00156 **
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 461.41  on 708  degrees of freedom
Residual deviance: 451.55  on 707  degrees of freedom
AIC: 455.55

Number of Fisher Scoring iterations: 5

Figure 34: Proposition 7 Logit Model Listing (Both Public and Private)

With a much higher number of observations, we now see a highly significant
result. Followup does indeed appear to influence Compliance. If we exponentiate the
coefficients of the model, we can calculate an odds ratio of 2.22. A look at the data in
matrix form should allow us to visualize this more clearly.

Table 17: Proposition 7 Data Matrix (Public and Private)

<table>
<thead>
<tr>
<th></th>
<th>Followup</th>
<th>No Followup</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complied</td>
<td>436 (92.6%)</td>
<td>202 (84.9%)</td>
</tr>
<tr>
<td>Did Not Comply</td>
<td>35 (7.4%)</td>
<td>36 (15.1%)</td>
</tr>
</tbody>
</table>

Despite there being nearly double the total number of observations from the
follow-up group, there are actually fewer non-compliances in this group than from those
who did not receive follow-up communications. Clearly we can reject the null hypothesis.
In this setting, the receipt of automated follow-up communications did positively affect the propensity of an individual to comply with their commitments. The data support Proposition 7.
5 DISCUSSION AND CONCLUSION

In this chapter, we discuss the findings and limitations of this study. Though we found support for only one of our theoretical propositions, we are still able to draw a significant amount of useful information from this study. We also are able to identify aspects of the study that could use significant attention should this study be replicated. We conclude with directions for future research.

5.1 We Observed Desirable Outcomes

We did not administer this experiment specifically to test the efficacy of social media as a means of encouraging green behavior. However, it was designed as a community-based social marketing (CBSM) campaign. Though we implemented a few controls, all participants were exposed to most of the tools created for this campaign—tools designed in alignment with those espoused by CBSM (e.g., McKenzie-Mohr, 2010b). In many cases, actual performance data were collected. Thus, it makes sense to perform at least some analysis of the empirical effectiveness of the social marketing campaign itself and the applicability of CBSM concepts to a virtual community.

Gasoline Consumption Decreased. As mentioned previously, the goal of any social marketing campaign is to produce measurable results. In this case, the primary goal of the campaign was to reduce gasoline consumption. And in this case, the data show that gasoline consumption was reduced significantly. Gross gallons consumed per day dropped from 3.44 (n=279) in the first month to 2.60 (n=288) in the second (p<0.001), and a month-to-month comparison of matched individual consumption figures
revealed a mean decrease in consumption of 0.435 gallons per day (n=75, p=0.047). Over this same period, gasoline consumption in the US rose by 1.8% (eia.doe.gov).

These numbers reflect self-reported data—we were not at the pump when the numbers were recorded, and thus we have no guarantee that the numbers reflect reality. However, there were no incentives to inflate the numbers, and the nature of the mileage data collected would have made it quite difficult for a participant to inflate these numbers repeatedly over an extended period. It also seems unlikely that they would have done so only in the second month of the experiment. Gasoline prices did rise slightly during the period of the experiment, though the increase in gasoline consumption in the US would seem to show that this had little, if any effect on consumption. We can think of no external reasons that would explain this decrease—in fact, spring break and the long “road trips” often accompanying it—almost precisely split the two months for one of the universities and came during the second month for the other. Thus, it seems likely that ongoing participation in the experiment itself played at least some role in the decreased consumption.

**Observability Affected Commitment Acceptance.** Though we found no relationship between commitment *compliance* and observability, we do find significant support for the notion that commitments are more likely to be accepted when the acceptance is made public. In terms of raw numbers, there were approximately 8.5 commitments accepted per participant in the public group versus approximately 5.9 per participant in the private group (see Table 18). Further supporting this observation, a log-linear model using the bimodal variable *AreCommitmentsPrivate* (0 = False / 1 = true) to
predict the count of accepted commitments is shown in Figure 35. Excluding a single outlier increases the coefficient to -0.33 (p<0.001).

Table 18: Commitments Accepted per Participant – Public vs. Private

<table>
<thead>
<tr>
<th></th>
<th>Participants</th>
<th>Accepted</th>
<th>Per Participant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public</td>
<td>77</td>
<td>652</td>
<td>8.47</td>
</tr>
<tr>
<td>Private</td>
<td>62</td>
<td>365</td>
<td>5.89</td>
</tr>
</tbody>
</table>

```r
glm(formula = Accepted ~ AreCommitmentsPrivate, family = poisson(log), data = PublicCommitmentAcceptance)
```

Deviance Residuals:

<table>
<thead>
<tr>
<th>Min</th>
<th>1Q</th>
<th>Median</th>
<th>3Q</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>-3.3259</td>
<td>-1.7823</td>
<td>-0.7098</td>
<td>0.8198</td>
<td>7.2227</td>
</tr>
</tbody>
</table>

Coefficients:

| Estimate | Std. Error | z value | Pr(>|z|) |
|----------|------------|---------|---------|
| (Intercept) | 2.16256 | 0.03916 | 55.219  < 2e-16 *** |
| AreCommitmentsPrivate | -0.25164 | 0.06537 | -3.849  0.000118 *** |

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for poisson family taken to be 1)

Null deviance: 623.65 on 128 degrees of freedom
Residual deviance: 608.51 on 127 degrees of freedom
AIC: 1075.6

Number of Fisher Scoring iterations: 5

Figure 35: Log-Linear Model of Commitment Acceptance Count per Participant – Public vs. Private

It is possible that these numbers reflect merely a lack of system-generated feedback posted to the participant’s news feed when accepting a private commitment, thus making it seem that nothing happened when they accepted the commitment.

However, it seems more likely that, once the participant realized that no one would know
that they accepted commitments, the impetus to accept them dropped significantly. This is congruent with observations for offline social marketing campaigns.

**Norms Did Change.** Propositions 2 and 3 both measured change in norms over time due to the transference of normative values via the social media system. We proposed that these changes would be more pronounced when the messages came from those perceived to be close. This concept was not supported. However, changes to norms did occur.

Subjective Norm towards gasoline consumption increased, on average, 1.5 points. A one-tailed t-test confirms this with a $p < 0.001$ and a 95% confidence interval from 1.17 to infinity. This is an average change of more than 21%. Subjective Norm towards environmental concern revealed similar results—a mean increase of 0.97 (14%) with a 95% confidence interval from 0.66 to infinity.

Perhaps more notable, the *subjective distance* (difference between subjective and actual norm) also decreased with system use. Here we found a mean decrease (*normative convergence*) of -0.41 ($p=0.005$) for norms related to gasoline consumption. There was no statistically significant convergence in norms towards the environment, though this is not surprising both because it would seem that these norms are likely to be more engrained in an individual and because the system was not designed specifically to convey messages related to these norms.

But this means that during the course of the experiment, norms regarding gasoline consumption changed in a desirable direction. Moreover, the norms of others were transferred and we saw a convergence of actual and subjective norm. We have no guarantee that this change was facilitated by the system, but it certainly seems likely.
We also experienced a positive change in moral norm. With regard to gasoline consumption, we saw a mean increase in our measure of moral norm of 0.34 ($p < 0.001$, confidence interval = 0.22 to infinity). This may have occurred, as theorized, from the increased subjective norm transferring onto the individual. It may also have occurred simply because the participant became more aware of his or her gasoline consumption and of the ways in which it could be reduced.

Surprisingly, moral norm with regard to the environment also increased—even more so than we saw with regard to gasoline consumption. Here we saw a mean increase of 0.39 ($p < 0.001$). The reason for this is not immediately apparent, especially given the insignificant increase in subjective norm regarding the environment. However, we might speculate that the participants may have, over the course of the experiment, increased their perceived level of association between their gasoline consumption and their impact on the environment. Thus, their concern for the environment was “dragged along” by their concern over their own gasoline consumption.

*They “Liked” It.* System usage well exceeded our expectations. Counting only the 139 participants who completed the post survey, over the two months of the experiment we recorded almost 25,000 minutes of system use, 40,000 individual “clicks,” 820 fuel tank fill-ups (567 with calculable fuel consumption figures), 1820 fuel conservation actions (with reported savings of over 40,232 miles), 505 trips covering 86,860 miles, and 1017 accepted commitments. And there were no major troughs in system usage with the exception of an expected lull during spring break. After the initial flurry of activity as participants created their user profiles, activity stayed fairly constant
at between 500 and 700 “clicks” per day throughout. Given the size of the audience and the somewhat limited content, this seems quite exceptional.

On the post-experiment survey, 87 of the 139 responders (63%) indicated that they would continue to play the game if it were integrated into Facebook. In response to an optional, open-ended question asking whether they were comfortable sharing this kind of personal information (energy consumption and conservation efforts), 125 provided responses; of those, 5 reported not using Facebook, 13 expressed some discomfort or just felt it wasn’t useful information to share, and 107 (86%) indicated varying degrees of positive support for the sharing this kind of personal activity with their Facebook friends.

So we have both quantitative and qualitative support for the notion that such a system could find and maintain an audience. Combined with the positive gasoline savings and attitudinal changes reported previously, this would seem to indicate that such a system has significant potential as a tool for practitioners to affect real-world change.

5.2 Flawed Design for Testing Degrees of Change

In hindsight, it seems that perhaps our tests for the first three propositions had significant design flaws. In all three cases, we desired to test the effect of one variable on the degree of change in another (change in closeness, subjective distance, and normative distance, respectively). There are two problems with our operationalization of this concept.

First, it seems very unlikely that individuals will maintain a consistent cognitive scale for these subjective constructs over a two-month period. In other words, what may have felt like a “5” in February might feel more like a “4” or a “3” in April. In fact, we saw strong evidence of this in our Closeness scale, as we discussed in the previous
chapter. This is quite problematic when the goal is to measure change over time. Actual change (i.e., the participant actually feels closer to the target) is effectively indistinguishable from this cognitive rescaling of the items. Alone, this issue would help to explain the almost random “noise” that we encountered when analyzing our data for the first three propositions.

There is, however, an even more fundamental issue with the measurement of these propositions. Our measurement strategy assumed each unit of change in closeness or one of the normative measures was equivalent. In other words, we assumed that a change in closeness from “1” to “2” represented the same degree of change as one from “6” to “7.” This is unlikely to be the case. Depending on how the respondent perceives the levels for a particular item, it may be quite easy to move from “1” (perhaps “don’t know them”) to “4” (“yeah, they sat next in front of me in class”), but quite difficult relatively to move up to “5” (“we hang out on Friday nights”). It is possible that for some respondents each unit is equivalent. But it is more likely that, for example, a three point move from “1” to “4” represents a completely different degree of change than one from “4” to “7”. But our measurement strategy treats both changes as being equivalent. This seems a very poor assumption, and might also help to explain the randomness of the data for the first three propositions.

5.3 **Closeness is Not a Single Construct**

None of the propositions related to our proposed *Closeness* construct were supported. This is likely at least partially explained by the design flaws described previously. But it also forces us to examine the construct a bit more closely to see if our
hypothesized relationships really do make sense when we consider closeness as a single, formative construct.

The original conceptualization of closeness derives from the elaboration likelihood model (Petty & Cacioppo, 1986), whereby normative messages that are not processed centrally are more likely to be absorbed if they originate from sources that are trusted and/or respected. Inspired primarily by a number of case studies that found that people responded more readily to norm-laden requests when they came in the form of personal appeals from known individuals, we expanded this notion of trust and respect to also include the concept interpersonal familiarity. We bound these together into a single conceptual measure. We then further postulated that this feeling of closeness should also include a desire for mutual respect, primarily because we felt that in a socially interactive environment, both are important, formative aspects of a close relationship.

In hindsight, it was quite a large jump to assume that a single measure formed from these distinct constructs would be meaningful in the context of existing theory. For Proposition 1, we assert that individuals will become closer via social media interaction and that the more they interact, the closer they will get. This is easily supported if we limit the definition of closeness to familiarity. However, it makes no sense (nor is there theoretical justification) to state that merely interacting with another individual will increase your respect for that person or your desire for mutual respect.

The elaboration likelihood model speaks to trust and respect. It matters not whether the message comes from someone you know well personally. Nor does it necessarily matter whether you desire the mutual respect of that individual. Propositions 2 and 3 both examine normative transfer—closeness here is the trust and respect derived
from the elaboration likelihood model. The other two components of closeness are superfluous.

If we retest our propositions including only the aspects of closeness that are relevant to that proposition (i.e., Closeness1 for Proposition 1 and Closeness3 for Propositions 2 and 3), we end up with much better models. In fact, if we limit the measurement error discussed in section 4.2 by examining only those with a preliminary Closeness1 of 1 (this represented a large majority of the observations), Proposition 1 is supported (p = 0.022, \( R^2 = 0.015 \)). Furthermore, Proposition 1 examined change in Closeness—Closeness1 accounted for all of this change (i.e., the averages for Closeness3 and Closeness4 showed no change between the pre- and post-experiment surveys).

The bottom line is that, although it may well be a logical conceptual construct, the notion of Closeness as a conglomeration of familiarity and mutual respect simply does not fit into our model. And given that familiarity is then not theoretically related to any of the constructs in our expanded model of planned behavior, Proposition 1—though now statistically supported—really adds very little to this study.

5.4 Were Private Commitments Really Private?

In a traditional community-based social marketing campaign, commitments are generally made face-to-face. A human being makes the request. The person accepting the commitment is often even asked to sign a statement of intention to comply with the commitment (i.e., McKenzie-Mohr, 2010b, p. 21)—a written contract between two individuals, albeit one that is likely quite informal.

By contrast, commitments in this experiment were made between an individual and a web page. For public commitments, the lack of an interpersonal “request” to
commit was tempered by the fact that the commitments were made public. However for private commitments, the commitment was truly only to one’s self. These differences were acknowledged from the start. We expected that we would be able to make some interesting observations based on what we originally though would be two very different types of commitment.

As we described earlier in this chapter, we did find that there was a significant difference between these two commitment groups in terms of how many commitments they accepted. However, we fully expected observability to affect commitment compliance, as well. It did not. Regardless of observability, a large majority of participants complied with their commitments. On the surface, this would seem to support the notion that simply actively committing one’s self to an action is sufficient to increase the likelihood of following through with that action. And certainly this could be the case. The actions were not onerous, and many were designed such that they could be easily incorporated into the participants’ normal routines without significant disruption.

It could also, however, be a statistical anomaly. There were far fewer commitments accepted from the private group. It was made quite clear that commitments would not be shared with others, but perhaps the participants in the private group initially expected that they would. Most were familiar with social games and understood that sharing this type of information is the norm. They also saw that their other interactions with the system were being shared. It makes sense that for their first commitments, at least, they may have assumed that their actions were observable. After they received no feedback from these actions, this misperception should have been corrected. However, likely because of this lack of feedback, many did not accept any additional commitments.
So it may well be that we simply did not have enough observations to detect the expected results.

5.5 Is a Commitment a Behavioral Intention?

We found no relationship between either of the normative constructs and the acceptance of a commitment. If we hold that the acceptance of a commitment is analogous to behavioral intention, then this is contrary to theory and quite puzzling. Why would someone commit to perform action, especially in public, that not only contradicted their moral values, but also their beliefs of what others expected of them? However, there are a number of reasons to believe that perhaps commitments are not a valid analog for behavioral intention and that these negative conclusions are fallacious.

First, commitments were embedded in the context of the game. Although there were no incentives specifically related to the acceptance of commitments, it may well be that participants accepted commitments simply because they felt that it was expected of them as part of the game. This explanation is somewhat dubious, however. This belief should have affected all participants equally, and thus we still should have seen those with higher normative pressures accept more commitments—unless commitment acceptance was not driven by norms at all.

Commitments were specific actions that were intended to reduce an individual’s the consumption of gasoline. As we have already noted, the reduction of gasoline consumption is not a purely altruistic behavior. There are multiple forces that would drive someone to reduce their consumption behaviors. These could include more altruistic concerns for the environment or even political concerns related to energy independence. However, for many, the primary impetus to reduce consumption is likely economic. In
this case, social norm would play almost no part in the rational decision making process. Moral norm would still seem to be in play, but we measured moral norm related to gasoline consumption—perhaps this is not exactly correlated with a moral norm against wasteful spending.

It may be also that these specific actions may not have been viewed by participants as directly related to their normative beliefs with regard to gasoline consumption. One might walk, carpool, bicycle, ride the bus, or even clean out their car for reasons other than saving gas. In fact, they may already be doing these things, in which case, making the commitment really didn’t represent any change in their behavior at all. Commitments could also have been perceived as one-time efforts, but did not really reflect any change in ongoing intentions to alter behavior

It is also important to note that commitment acceptance was bi-modal. There were no degrees of acceptance. Additionally, the means of the norms used in the testing of propositions 4 and 5 were above the midline and had relatively low standard deviations ($SN_{avg} \mu = 4.89, \sigma = 0.84$ and $MN_{avg} \mu = 5.33, \sigma = 1.13$). It may well be that the normative thresholds for accepting most of the commitments was low enough that even many in the lower quartile may have been likely to accept commitments—at least to the degree that the normative forces made them more or less likely to commit. The number of samples was already low at 257, so perhaps there simply was not enough data to detect any discernible normative effects on commitment acceptance.

Given all of this, it is apparent that the use of commitment acceptance as an embedded measure of behavioral intention was likely a poor choice. Likely a more standard measure of future behavioral intention added to the pre- and post-experiment
surveys (e.g., “in the future, I intend to actively take steps to reduce my gasoline consumption”) would have produced better and more meaningful results.

5.6 The Importance of Automation

In this experiment, commitment requests, commitment acceptances, and follow-up communications were entirely automated. In the past, commitments have been considered to be too labor intensive to be a financially viable tool (McKenzie-Mohr, 2010b, p. 22). Here, commitments were obtained at a cost that approached zero. The limitations discussed in the previous section do not detract from the potential efficacy of commitments. We have no way of directly correlating commitment acceptance (or compliance) with actual reduction in consumption behavior. However, past observations regarding the effectiveness of commitments in altering behavior, combined with the apparent positive behavior change reported in section 5.1, would seem to provide reason to believe that the commitments in this experiment might have played a role in influencing desirable behavior modifications.

We also find strong support for our seventh proposition. It does appear that following up with an individual after they have accepted a commitment is an effective means of increasing the likelihood of compliance. As discussed previously, this is in line the observations of the effectiveness of commitments in prior social marketing campaigns (see section 2.4.2 - Marketing Green Behavior). Thus, this is not in itself surprising. But again, the fact that the follow-up communications were fully automated is quite significant. It also lends credence to the assertion that these online commitments behave in a similar fashion to those obtained in a more traditional, face-to-face manner.
However, commitments were not the only automated portion of the system. Aside from some very minor human interventions (most notably the need to manually enter fuel tank sizes for participants’ vehicles), the system was entirely automated. The real cost of this campaign, even considering the significant initial effort required to develop the custom social media system, was minimal. And the system itself is almost infinitely scalable with very small incremental costs. Given that one of the primary barriers in social marketing is cost, the positive results and minimal costs of this simulated campaign should be quite exciting to practitioners.

5.7 Conclusion and Future Directions

We began this research effort with a concern for the environment and the intuition that social media systems represented a largely untapped resource for enabling social change. We posited a theoretical model to explain how attitudinal and behavioral change might occur through the social pressures facilitated by social media systems. We found no statistical support for the specific aspects of this model that we tested—perhaps due to the design shortcomings discussed previously. However, we observed results that were consistent both with our expectations and with theory. Thus, the lack of support for the majority of our propositions does not imply the need to go “back to the drawing board.” Still, there are aspects of the study that need to be reevaluated as well as new areas of research that our experiences with this study have uncovered.

It is quite possible that we will repeat the experiment in the near future. If so, significant changes should be made both to the constructs and to the data collection mechanisms to increase the “signal-to-noise ratio.” First, we should re-examine the concept of Closeness to insure that we are measuring only those components of this
construct that are theorized to affect the transfer of norms. We should also remove our first proposition from consideration for the reasons discussed in section 5.3. We would need to rethink our method of testing change over time. Minimally this would involve more carefully crafting the scale for subjective norm, though it is possible that more radical changes to the methodology may be desirable. A behavioral intention construct should also be added to both of the survey instruments to complement our embedded measure (i.e., commitment acceptance). This should help with the measurement errors affecting proposition 4. However, we must retain the embedded measure or completely rethink how we test propositions 5 and 6. Rather than completely reinvent the methodology for these two propositions, it may make more sense to tweak the commitment mechanism in the social media system itself. Our goals here would be twofold. First, we should make accepting a commitment feel like a true statement of intention rather than a simple click of a button in a game—perhaps have them type their name on a simulated pledge card. Second, we should make the observability of the commitment acceptance much more apparent at the outset.

All of this should make it more likely to detect significant results during a second iteration of the experiment. However, we also have a significant amount of data from our first iteration that we have yet to examine. As is apparent in Appendix B, a large number of the items on our pre- and post-experiment instruments were exploratory or were intended to test relationships not accounted for in the seven propositions tested herein. In many cases, the constructs measured are part of our larger model (e.g., attitude and perceived behavioral control), though in other cases, they are constructs drawn from other studies or are purely exploratory (e.g., world view and motivation to conserve). We
also have thousands of posts, comments, and other qualitative data sources that could be analyzed and coded. Our next step, certainly prior to a second iteration of the experiment, should be to analyze this data to determine if there are interesting trends that we could formally incorporate into our experiment without any major overhauls. Regardless, this data could run counter to expectations or otherwise provide additional interesting areas for future research.

We believe that this study has paved the way for a rewarding stream of research. We have observed normative and behavioral change; a future experiment to confirm these observations with more control over potential external influences is certainly worthwhile. Perhaps more importantly, we integrated a number of social marketing tools into our social media environment, but we have no idea which (if any) of these influenced the normative and behavioral changes. Understanding which aspects of the system were most effective will allow practitioners to tweak these components to maximize effect. Another outstanding question is whether a system like this could work for more purely altruistic social causes such as recycling. What changes might we see in terms of participation and effectiveness? Could this concept possibly work without meaningful personal rewards? These are only a few ideas for future research that remain well within the intersection of social marketing and social media. The opportunities to leverage our efforts outside of this narrow intersection seem ripe, as well.
REFERENCES


A. SOCIAL MEDIA ENVIRONMENT

This appendix provides some detail as to the workings of the social media system created to support the experiment. The goal in creating the system was to attempt to simulate to the greatest possible extent the market leading social media system—Facebook. In many cases (as was the case with the overall “look and feel” of the system), this was possible. The screenshots in the following section will bear a striking resemblance to Facebook (at the time of the experiment) in both visual style and in the methods of interaction.

What cannot be replicated is the actual social environment that Facebook has grown and fostered. As such, we have added a few extra pieces to add to the system’s “social glue” in an attempt to partially make up for the simple fact that this system is not Facebook. The notion of teams, for example, is an attempt to recreate in miniature the social networks formed by Facebook “friends.” Likewise, we have increased the frequency and nature of email notifications of network activity (discussed throughout this section and listed in Appendix G) to partially make up for the decrease in both the number and variety of social messages that are likely to be shared by the participants.
A.1 Participant Sign-Up / Sign-In

When a participant first visits the site she is presented with the page shown in Figure 36. Prior to being approved for the study, the potential participant fill out the fields in the “Sign Up” section. Upon clicking Register, the participant is forwarded to a page (not shown) that thanks them for their interest and informs them that they will be contacted regarding their approval for participation. Until approved, further attempts to log in to the system are also met with this information page.

![Sign-in / Sign-up Screen](image)

Figure 36: Sign-in / Sign-up Screen

A.2 Home Page

Once approved, the participants can return to this page and enter the credentials that they provided when they registered. The very first time they log in after approval, they are forwarded to the pre-participation survey instrument (see appendix B). After fully completing this survey they are thanked for their response and prompted to fill out
their user profile. Then—and on all future visits to the site prior to the completion of two-month study period—the user will be greeted with the “home” page shown in Figure 37.

![Figure 37: Home Page](image)

The central portion of the home page (and many of the other pages) is dominated by a list of “posts” created by participants. There are four main types of post: *status, trip, action, and mileage*. Each type of post is entered from a specialized page, and each will be discussed individually in much greater detail. However, on the home page, all types of post are aggregated into what is termed a “news feed.” By default, this contains a list of
all of the messages posted by every participant in the study. However, this can be filtered by clicking on the “Show Team” or “Show All” links as highlighted in Figure 38.

![News Feed](image)

**Figure 38: News Feed Filtering**

The left hand column of the home page provides four functions. First, it provides the identity of the logged-in participant: her name, profile picture, and an edit link to allow the participant to maintain her user profile. This is a core component of most social media systems, as identity and profile sharing are the foundations of the system genre. Clicking on the profile picture or the name of the participant allows her to view her profile as it is seen by others. Second, the left hand column contains the primary site navigation links, which are styled and arranged to mimic the navigation structure of Facebook. Third, it lists the *Achievements* that the participant has earned (discussed in appendix section A.13). Finally, it contains a pictorial list of all of the participant’s team members. Clicking on the profile picture or the name of any of these team members will display that person’s profile page. In fact, clicking on the name or photo of a user anywhere on any page in the system will display that user’s profile page. This is consistent with the functionality implemented by Facebook and should be familiar to most of the study participants.

The right hand column is divided into two sections. The first section lists the *Commitments* that the participant is currently committed to. As discussed elsewhere, commitments are a social marketing tool aimed at increasing the likelihood that a person will engage in one or more desirable social actions. The degree to which the system
“advertises” these commitments is one of the controls. However, all participants will be able to commit to actions, and each currently active commitment will be displayed in this section. The second section simply displays a randomly selected “tip” for reducing gasoline consumption. The list of tips is provided in Appendix E.

A.3 Notifications

The central column of the home page also plays host to a variety of notification messages (Figure 39). These messages are displayed until hidden, but once hidden, will remain so. Notifications are provided for a variety of reasons, including replies to posts, replies to replies, and post “likes”. Generally, notifications of this type are also accompanied by an email. It is also possible for one of the investigators to create manually a generic notification for one or more participants that will show up here.

![Figure 39: Notifications](image)

A.4 Status Posts

Each of the four main “post” pages (News Feed, Trips, Actions, and Mileage) has a form for posting a specific type of post. All of these pages have a text box at the top of the page that effectively “hides” the actual form. See Figure 40 for an example. Clicking
into this text box reveals the contents of the “real” post creation form. This keeps the interface somewhat cleaner, visually, but most importantly, it closely mimics the functionality of Facebook in this regard, so it should be familiar to our target population.

![Figure 40: Faux Post Form](image)

Generic “status” posts are entered from the News Feed page. The form itself, shown in Figure 41, is simply a single text box that can contain a message, short or long. Clicking the “Share” button will post the message to the aggregate news feed for the site.

![Figure 41: Status Post Form](image)

Messages in the news feed (and all other lists of posts) are sorted by date descending from most recent to oldest. As such, the new message entered in Figure 41 shows up at the top of the list of messages, as shown in Figure 42. All posts are similarly structured. The profile picture and name of the participant who posted the message is displayed first. This is followed by the text of the post, which will vary significantly depending on the type and nature of the post. This is followed by the date and time of the post, a link to add a comment to the post, and—depending on whether the currently
logged-in participant is the post author—either a link to “like” the post or a link to delete the post.

Any kind of post may be deleted. Physically, it is only hidden so that we don’t lose the ability to analyze this post later, but to the participant, the post, its associated data, and any replies are completely removed from the system and are no longer visible to any other participants. When a participant clicks the delete link, the message is removed immediately, but the user has the option to undo this action if so desired. As shown in Figure 43.
A.5 Likes and Comments

Any kind of post may also be “liked”. The notion of liking a post comes directly from Facebook, but the concept is common to most social media systems. It means only that the user agrees with or approves of a message from another user. In this system, as with Facebook, the fact that the user likes the post is displayed immediately below the post, as shown in Figure 44. If more than one user likes the post, only the most recent is displayed along with a count of the number of others that also like the post. Clicking on the count will bring up a list of all of the participants that like the post.

Figure 44: Like a Post

If someone wants to add their thoughts to a post (either additional thoughts to their own post or something to add to someone else’s post), the participant will “comment” on that post. Figure 45 depicts a comment form as it appears when a participant clicks on the “Comment” link below a post. In this case, it is a self-comment, but the look of the form is the same regardless. Like status posts, comments are simply a single block of text. Also like status posts, comments can be arbitrarily long. To post the comment, the participant clicks the “Comment” button. To cancel, the participant deletes the text and clicks away from the comment form.
Comments are displayed from oldest to newest to maintain the sense of a “thread” of conversation. This is in contrast to how the posts are displayed (newest first), but it is both logical and consistent with Facebook. As shown in Figure 46, comments consist of a smaller version of a participants profile picture, their name, the message, the date and time, and where appropriate a link to delete the comment. Deleting a comment works in a manner identical to deleting a post. Once recorded, the comment is displayed immediately below any other comments on that post. After a post receives its first comment, a “quick comment” box is enabled below the latest comment to allow for an “active” discussion thread to be joined more easily.
A.6 Trips

Trips are the second type of post supported by the social media system. Trips are defined as “any long journey that is significantly out of the ordinary from a daily driving perspective.” The idea is to capture the exceptional, one-off trips that will adversely affect a participant’s “miles driven per day” measure. It also serves as a means of eliciting social interaction, as often such trips are noteworthy. For example, a participant may travel to a concert and will share their experiences at the concert. Other participants may comment on their experiences, furthering the social experience offered by the system.
The trips page, shown in Figure 47, is very similar to the home page. The primary difference is that the “feed” of posts is filtered to show only trip posts. Also, the page provides a brief overview of the concept of a “trip,” as well as a completely different form for entering trip posts. The form, depicted in Figure 48, captures the information specific to a single trip. This includes the date of the trip, the destination, and the round-trip distance. Additionally, it captures whether or not the trip was perceived to be mandatory by the participant, and it allows for the participant to enter a brief description of the trip (perhaps sharing some details of their experience on that trip).
Trip

A trip is any long journey that is significantly out of the ordinary from a daily driving perspective. For example, a trip to see your family in another town would be considered a "trip"; a trip to the grocery store would not.

Such trips are given special treatment when determining how well you are pounding the pump. In other words, it is to your benefit to log them.

When was your trip? 08/27/2010
Where'd you go (city/event)? Atlanta, GA
About how far was the round trip? 300 miles
Was the trip absolutely necessary? Yes, it was mandatory
Tell us more about it (if you want to). Went to see the Braves lose...again.

Share Cancel

Figure 48: Trip Post Form

Clicking “Share” here will create a trip post that is displayed on all post feeds that don’t specifically filter it out. The text of the post, as exemplified in Figure 49, converts the raw information provided on the trip post form into prose. The participant’s comments on the trip will be highlighted, and as with all other post types, participants can comment on or “like” the trip. Likewise, the owner of the post can choose to delete it if so desired.

Paul York Took a trip on Friday, August 27 to Atlanta, GA. The round trip was approximately 300 miles.

Went to see the Braves lose...again.

Saturday, August 28, 2010 3:37 PM · Comment · Delete

Figure 49: New Trip Post
A.7 Actions

Actions are the third type of post supported by the Pound the Pump social media system. Actions are defined as “anything done consciously to drive less, and thus save gas.” Actions serve two purposes. The primary purpose is get participants to think about the things that they can do to avoid driving. Sharing such actions should also, in theory, provide them with social feedback that they are doing is (or possibly is not) conformant with the social norms of their team or of the microcosm of society participating in this study.

The actions page, depicted in Figure 50, is very similar in both look and operation to the trips page. The concept of a trip is defined and the middle-column post feed is filtered to show only other action posts.

![Figure 50: Actions Page](image-url)
As with the trips page, the actions page also contains a form for entering action posts that is designed to capture the specific information related to a gas-saving action. Figure 51 shows the action post form, which is displayed only when a participant clicks into the “Tell us about your action” text box. The form captures the date of the action, the type of action taken, an approximation of the miles saved by taking the action, an optional description of the action. Again, it is hoped that the description will be such that social feedback will be provided by other participants.

![Image of Action Post Form]

**Figure 51: Action Post Form**

Unlike trip posts, the system pre-defines a number of possible actions that a user can take. As shown in Figure 52, these can include carpooling, combining outings, cancelling discretionary outings, bike riding, walking, or taking public transportation. The primary reason for providing these pre-defined choices is to prompt participants as to
a number of common ways to avoid driving. However, participants are also encouraged
to think of other actions that can be taken to avoid driving and to post these, as well.
When one of the pre-defined actions is chosen, a brief description of the action is
displayed to help the participant understand the nature of the action. An example of the
description for cancelling an outing is provided in Figure 51. A listing of all action types
and their descriptions is provided in Appendix F.

Figure 52: Action Types

Similar to trip posts, when the participant clicks the “Share” button, the system
records the raw information provided, but also converts the individual form fields into
prose form for easier reading by other participants. An example of a posted action is
provided in Figure 53. The post contains the prose form of the action, a highlighted
comment (if provided), and the date of the post’s creation. And as with all posts, this one
can be commented on, liked, or deleted if the participant is viewing her own post.
The final type of post supported by the system is a mileage post. Mileage posts are simply records of trips to a gas station to fill up a vehicle with gasoline. This could perhaps be considered the most important type of post supported by the system, because the dashboard (discussed subsequently) relies on these posts to determine a participant’s absolute and relative “performance” in the game.
The mileage page, captured in Figure 54, is again quite similar to the other post pages. It is filtered to show only mileage posts and is the only page from which mileage posts may be entered. In addition to the filtered feed of mileage posts, this page also provides a quick list of the participant’s most recent fill-ups, ordered in descending order by date. This is primarily to allow the participant to reference quickly a past fill-up as they are entering a new one (primarily to see a prior odometer reading, which is a necessary component of a mileage post). It is not intended necessarily as a gauge of their performance. Gauging performance is the primary purpose of the participant’s dashboard.

![Mileage](image)

**Figure 55: Mileage Post Form**
A mileage post form (shown in Figure 55) is revealed when the participant clicks into the “Tell us about your latest trip to the pump” text box. The form captures a number of data points regarding a fill-up. These must include the date of the fill-up, the starting and ending odometer readings, the number of gallons pumped into the vehicle, and the participant’s perception of the type of driving engaged in since the prior fill-up. If the participant is entering their mileage sequentially, as is the case if she is using the system as prescribed, the starting odometer reading is pre-filled so that she need only enter the ending reading. The participant may also opt to provide the total cost of the fill-up. This information is recorded but not displayed or used in any of the performance calculations provided by the system.

Note here that the system supports participants with multiple vehicles. If the participant has added multiple vehicles to her profile, she will also need to select which of these vehicles was fueled.

![Figure 56: Driving Types](image)

Figure 56 depicts the four driving types that a participant may select from. These include city, mixed, mostly-highway, and all-highway. The driving type is used to calculate the gas mileage that the participant should have expected to have achieved according to EPA statistics.

Assuming this is not the first mileage post or a “skipped” one, clicking “Share” will create a post similar to the one shown in Figure 57. As with the other post types, the
post is displayed in prose form. However, this post type is special in that it also makes
and displays a number of relevant calculations based on this and all previous mileage
posts. In addition to the miles-per-gallon (MPG) efficiency calculation, these include the
total miles traveled, the number of days between fill-ups, the average miles driven per
day, and the average fuel consumed per day. The participant’s efficiency figure is also
compared with their current average efficiency and the efficiency that the EPA reports
should be expected for their specific vehicle give the participant’s reported driving type.

Figure 57: New Mileage Post

In addition to needing to record an initial mileage post, it is also expected that
participants will likely forget to record the gallons pumped or the current odometer
reading for one or more fill-ups during the duration of this study. An initial or skipped
mileage post is thus supported, which essentially allows the participant to leave the
starting odometer reading blank. As shown in Figure 58, clicking the “Oops, I forgot”
box on the mileage post form hides the starting odometer reading text box.
Because very little can be calculated for an initial or a forgotten fill-up, the post itself is quite a bit less detailed. As exemplified in Figure 59, an initial or forgotten mileage post shows only the raw details of the fill-up.

Regardless of the completeness of the mileage post, the list of recent fill-ups will be updated immediately upon posting. The recent fill-ups tool is highlighted in Figure 60.
A.9 Dashboard

The dashboard is the last of the “primary” system screens. It differs quite significantly from the post screens. Rather than displaying a feed of posts, it is designed to display a participant’s performance in the game in both graphical and tabular form. Although the system is not designed to be a competition, per se, it is expected that the participants will at least wish to compare their performance against others on their team and likely their team’s performance against all others. This is designed to build a sense of camaraderie among the member of a team, although this is not intended to be measured directly. It is simply another tool to try and make the system more engaging (or “sticky”), and thus to increase the use of the social tools provided by the system, increasing the likelihood of achieving measurable results for our actual measures.

Figure 61: Disabled Dashboard
During the first two or three weeks of participation, it is unlikely that a participant’s dashboard will be very informative. Because the system will be unable to gather any performance data from the participant’s mileage posts, there simply will be very little to display on the dashboard except for team and global statistics (discussed subsequently). Thus, the rather unhelpful screen shown in Figure 61 will greet the participant when they click on the dashboard.

Figure 61 also shows four content areas in the right column that are. These contain tabular statistics that can be used to compare a participant’s performance against that of their team and the entire population of the study (“global”). These statistics include average MPG (both in raw terms and as an average compared to the EPA—a percentage likely between 80% and 120%), average miles driven per day, and average gallons consumed per day.
Once at least two fill-ups have been recorded, the dashboard itself “lights up” to provide the participant with absolute and relative performance figures. As shown in Figure 62, the actual “dashboard” at the top of the page provides a “quick glance” overview of the participant’s performance. The mileage gauge (left) shows the average mileage (both in text form and as represented by the gauge’s needle), the total miles traveled (in text), the best mileage recorded to date (green marker), worst mileage recorded to date (red marker), and the EPA estimated mileage for a mix of city and highway (“combined”) mileage (blue marker). This same information is also provided in textual form on the right of the dashboard. We purposely provide the same information in multiple forms on multiple places on the page to attempt to appeal to the likely diverse
cognitive natures of our study’s population. Again note that this is just a “best practice” intended to increase the value of the information to the participants; it is not intended to form the basis for any scientific analysis within this study.

In addition to the graphical simulation of an automobile dashboard, the dashboard page also provides a bar/line chart below the dashboard. As it is shown in Figure 62, the bars on this chart compare a participant’s fuel efficiency over time against the EPA average combined mileage for their vehicle (represented by a thicker blue-gray line which is at "22" in the example). Not shown in the example is that bars will either extend above the EPA line in green or below it in red, depending on the participant’s relative fuel economy performance. The participant’s rolling average MPG is also depicted in line form overlaying the bars.

![Figure 63: Chart Types](image)

The example shown in Figure 62 is only one of a variety of charts that can be selected by the participant to depict their performance against the EPA, their team, or the global study population. Figure 63 provides a complete list of the chart types supported. All are very similar in nature, comparing point-in-time and rolling averages against either a fixed or rolling average over time. The “% of EPA” chart converts raw mileage figures
into percentages of EPA average mileage to make it easier to compare performance on an “apples-to-apples” basis between more and less fuel-efficient vehicles.

**Figure 64: “Roll-Over” Chart Details**

A feature of all of the charts is the ability to “roll” or “hover” over any item on the chart and receive a “pop-up” textual description of that specific data point. Figure 64 provides an example of this feature wherein the participant has moved her mouse over a specific bar on the chart to reveal the details of a particular fill-up. All data points on all charts are similarly interactive.

**A.10 User Profiles**

One of the core components of any social media system is the notion of a user profile. The profile is the public “persona” representing a member of the social network. As such, the social media system for our study has an extensive mechanism for viewing and maintaining user profiles. And as with most of the other components of the system, it is modeled closely after Facebook’s user profile system.
Every participant in the system has a profile page. The content and the amount of detail displayed on each page are controlled by the user, but it is not possible simply to “hide” one’s profile entirely or to make it completely private. Figure 65 shows an example of an individual profile page. Actually, it is one of three profile “tabs” (the Info tab). This is the first page shown whenever a participant’s profile is displayed. It provides a summary of all of the information about a participant, including their name, gender, birthday, school and/or work information, contact details, and a listing of the automobiles that a participant has registered with the system (usually only one, though this example shows the potential for two or more). Also displayed to the left is a list of that participant’s team members.

Profile pages can be accessed from most any page in the system. Clicking on a participant’s profile picture or their name will generally take one to the profile page of that participant. So clicking on a picture or user name from any post, comment, like, or
team member listing will bring up the profile for the referenced participant. This is consistent with Facebook and most other current social media systems.

Figure 66: User Profile Wall Tab

In addition to the basic information tab, a profile contains two other components. The first, shown in Figure 66, is referred to as a “wall.” For this system, this is simply a list of posts filtered to show only those from the profiled participant. It also shows an abbreviated, one-line post for each time the participant has commented on or liked another’s post (not shown in the example).

This concept of a wall is slightly different than that of Facebook. Facebook also offers the ability for users to write on one another’s walls, effectively creating public person-to-person messages (vs. broadcast—e.g., standard posts—and private person-to-person message—e.g., email or text messaging).
The final user profile tab is simply a view of that user’s dashboard. It is essentially identical to the dashboard view. Notable in the example provided in Figure 67 is that the dashboard also supports users with multiple vehicles. Also much clearer in this particular example is the green and red, better and worse (respectively) performance vs. EPA shown in the bar chart and the potential visual value of the rolling average to see trending over time (“am I getting better or worse?”).

A.11 Editing a Profile

Profiles must be created and maintained, as well. Although few changes are expected to be made to profile data over the relatively short course of this study, the
system is designed to support it. A participant can edit only her own profile. The editing process generally begins with viewing one’s own profile. As can be seen in Figure 68, a participant’s own profile is nearly the same as their public profile so that the participant can get a feel for how others will view them within the system. But it differs in that it has multiple links for editing the various components of the participant’s profile. Note that it is also possible to access the page for editing a profile from most any page simply by clicking on the “Edit My Profile” link in the upper left hand portion of most pages.

For the purposes of creation and maintenance, a participant’s profile is divided into five categories: Basic Information, Profile Picture, Work and School, Contact Information, and My Cars. Each of these categories has a dedicated “edit page.” Figure 69 depicts the page for editing Basic Information. This includes the participants username
and password and their personally identifying information, including their name, gender, and birthday. Here the user has the option of hiding their year of birth so as to keep their age private. However, they must still enter the full date of birth so that we can use it for control and categorization purposes if necessary.

![Edit Basic Information Screen](image)

**Figure 69: Edit Basic Information Screen**

They also here have the option of linking to their Facebook account. Although desirable, active usage of Facebook is not a requirement. This enables not only the ability to pull in a participants profile picture directly from Facebook, it also allows both for single sign-on (i.e., the participant can use her Facebook ID to log in to the system) and for the access to a subset of the system directly from Facebook itself.
In Figure 70 we see an example of how the system appears when a participant accesses it through Facebook. Only the News Feed and Dashboard are available directly. The participant can create status posts here and can comment on or like the posts of others. However, to interact with the system in any other way, the participant needs to click the link on the upper left to jump to the full system. Because of the single sign-on capabilities, however, this jump is essentially seamless.

The navigation links between the profile edit pages is in the left-hand column. Note that in every case, the system tries to prevent the participant from losing changes. On pages like the Edit Basic Information page, the system detects changes to the form values and will warn the participant prior to leaving the page if the changes have not been saved.
Another core component of most social media systems is the profile picture—also often referred to as an avatar. Facebook is actually somewhat unique in that users often use actual pictures of themselves as their avatar. On many other social sites, it is common for people to use symbols, caricatures, photos of celebrities, or other types of images in place of an actual image of themselves. We make no presumption or requirement as to the nature of the pictures utilized in this system. And acknowledging the secondary or tertiary position of this social media system for most of the participants, we make it as easy as possible for a profile picture to be utilized.

Figure 71 shows the Edit Profile Picture page. Changes made to the profile picture are saved immediately. This example happens to show the fourth profile picture type: a “gravatar.” A gravatar is actually just a profile picture that is uploaded to a single provider (www.gravatar.com), but can be shared with any number of sites based only on the email address associated with that avatar. It is popular with some users.
The other three methods of sharing a profile picture are shown in Figure 72. A participant may choose not to share a picture at all, in which case their profile picture will be a generic, obfuscated human profile. The participant may wish to upload an image of their own, which is stored by the system and associated with the participant. If the participant uploads their own image, it is automatically resized to display properly within the pages of this system. Finally, the participant may choose to use their Facebook profile
picture. This is a “dynamic” choice in that the system automatically pulls the most current image from Facebook each time their profile is shown. All changes on this page are automatically saved.

Figure 73 shows the screen for editing work and school information. This screen captures whether or not the participant is employed and/or in university (presumably so for this experiment). In both cases, it captures relevant information about their career(s). The page does demonstrate the level of control the participant has over their profile information, as they can keep their employment information private if so desired. However, for this study, it will be necessary to provide and make public the participants student details.

![Figure 73: Edit Work and School Information Screen](image)

Contact information is also collected by the system using the form shown in Figure 74. An email address and the participant’s current address are required. An email address is required for electronic communication and a current postal address is required to allow for the student’s participation incentives to be mailed, if they cannot be delivered.
face-to-face. However, all three forms of contact information (email, current address, and permanent address) can be kept private.

![Edit Contact Information Screen](image)

**Figure 74: Edit Contact Information Screen**

The edit contact profile information screen also offers an opportunity to show that these forms adjust to request only the information required based on answers to other profile questions. In Figure 75 we see that the permanent address fields are shown only if the “I Have A Different Permanent Address” box is checked. This concept is also applied to the work and school information form.
The final profile edit screen is perhaps the most pivotal in terms of the proper use of the system. The edit cars screen in Figure 76 is shown if the participant has yet to select a primary vehicle. The screen walks the participant through the selection of their automobile’s make, model, year, and variant. A variant is necessary if, for example, a vehicle has multiple engine options or multiple transmission options (both of which can significantly impact fuel economy).

Figure 75: Dynamically Displayed Form Fields

Figure 76: Initial Edit Cars Screen
Once the participant has identified their vehicle, the fuel economy data displayed as shown in Figure 77. These data are available for all car models available in the US from 1984 to 2011 as the data are provided by the EPA. The mileage “sticker” is the similar to what would be found on the side of a new vehicle. The mileage figures are all adjusted to reflect the 2008 change in how the EPA measures fuel economy. Thus, regardless of a vehicle’s age, it should be possible to gauge “apples-to-apples” relative performance between vehicles regardless of age.

![EPA Fuel Economy Estimates](image)

**Figure 77: Selected Car Fuel Economy**
It is possible that a participant may have a vehicle that is not in the EPA database. The participant can enter an unknown vehicle into the system, as shown in Figure 78. However, the system will provide much less useful feedback, as their performance cannot be gauged against the EPA or properly compared to others.

![Figure 78: Adding an Unlisted Vehicle](image)

Once the participant has added a primary vehicle, the edit car screen changes one that resembles the example shown in Figure 79. At this point, the participant can only add or change a vehicle. A secondary or tertiary vehicle may be removed if there has been no mileage data collected for that vehicle. But a primary vehicle cannot be removed. It can only be changed.

![Figure 79: Edit Cars Screen After Primary Car Selection](image)
The form for adding or changing a vehicle is similar to the initial edit cars screen, although it is presented as a “pop-over,” modal dialog as depicted in Figure 80. A user may add or change a vehicle at any time, though changing a vehicle that already has mileage data will not automatically update all of the existing mileage posts to reflect any change in mileage.

**Figure 80: Adding or Changing a Car**
A.12 Commitments

Although seemingly a small portion of the overall system, commitments actually represent two of the three interventions that the system is designed to accommodate. As discussed elsewhere, commitments are social marketing tools designed to encourage individuals to engage in a socially desirable action that they may not otherwise consider. Generally they are not difficult, but rather are designed to get the “committer” into an action-taking state of mind, perhaps changing their self-perception such that they think of themselves as being someone who engages the particular type of socially desirable action.

When a participant first signs in, she will not immediately be prompted to commit to any actions. Instead, the screen is designed to notify them of their lack of a commitment only passively. The text shown in Figure 81 is displayed to the participant unobtrusively in the upper right-hand portion of their screen. The participant may actively seek out a commitment, but she is not immediately “hounded” to accept one.

![Figure 81: No Commitments](image)

After a few days, however, the system will begin to actively solicit commitments from the participant by posting a commitment request as a notification at the top of the home screen. An example of such a notification is provided in Figure 82. This particular commitment is obviously in the beta system for testing purposes only, but the example
shows the basic concept. A complete listing of all commitments supported by the production system is provided in Appendix D. The participant is presented with the reasoning behind and benefits of taking a certain kind of action, and the participant must accept or reject the commitment.

![Will You Commit?]

**Figure 82: Active Commitment Request**

The algorithm used to select a commitment to present to a participant is actually quite complicated, but essentially it can be assumed that the user will see a random commitment request and that they will not be presented with one they have already seen and/or committed to unless there are no other available options.

Participants *can* take an active role in managing their commitment by clicking on the Commitments navigational link on the left of the home page. This takes the participant to the screen shown in Figure 83. From here, the participant can view current and past commitments, accept new commitments, and, if part of the “follow-up” treatment group, can report their success at following through with their commitments.
Figure 83: Manually Manage Commitments

Figure 83 also shows that there is a *state* associated with a commitment as well as start and end dates. Commitments are not generally expected to be ongoing, at least not indefinitely. They have a deadline at which time one can evaluate their success or failure to follow through with the commitment. In this system, commitments are either “open” or “completed.” Commitments are only considered completed when a designated duration has passed (the “end” date). The duration is set on a per-commitment basis, but will commonly be one week.

Regardless of how the commitments are accepted, once a commitment has been accepted, the upper right-hand portion of the participants home page change to show a list of active accepted commitments, as shown in Figure 84.
Figure 84: An Accepted Commitment on the Home Page

Figure 85 shows the list of “my commitments” on the commitments page after a commitment is accepted. It also shows that once all commitments have been accepted (in this example from the prototype there was only one), it is no longer possible to accept any more until the commitment duration has passed (i.e., the accepted commitment is completed).

Figure 85: An Accepted Commitment on the Commitments Page

It is also important to note that for members of the “public commitments” treatment group, a post will also be made to their news feed that indicates their acceptance of the commitment. No notification will be made of their rejection for the
same reasons a charity does not post the names of people who refuse to donate to a
cause—i.e., public scorn is an ineffective marketing tool.

At the “conclusion” of the commitment period (actually one day prior), users in
the “commitment follow-up” treatment group are notified of their need to provide
feedback on how well they followed through with their commitment. Members of the “no
follow-up” group will receive no notifications whatsoever—commitments will simply
transition from open to completed and will cease to be displayed in the list on their home
page.

The remaining screens in this section apply only to members of the “commitment
follow-up” treatment group. Figure 86, Figure 87, and Figure 88 show the methods by
which a participant is notified of the need to follow-up on their commitment.

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**Figure 86: Commitment Follow-up Notification**

You have committed to brushing your teeth
at least five times this week.

How’d you do?

**Figure 87: Follow-up Request in Commitment List on Home Page**

**Figure 88: Follow-up Request on Commitments Page**
All three methods of notification provide links to allow the user to answer a short set of questions—most will be only one simple yes or no question—to report as to how well the participant followed through with their commitment. All three links will take the participant to a screen similar to the one shown in Figure 89.

![Commitment Followup](image)

**Figure 89: Sample Follow-up Question**

Depending on the answer to the question(s), the participant may be asked either to escalate the level of their commitment or simply to recommit. Escalation is an integral part of the social marketing concept of commitment. According to the literature, once a person sees themselves as the type of person who engages in a particular type of socially desirable action (i.e., once they have successfully followed through with a lesser commitment), they are far more likely to commit to engage in a more intense version of the commitment.

Many (but not all) of the commitments in the system will have escalation paths. If available, an escalation request screen—see for example Figure 90—will be shown immediately after a participant responds positively to their follow-up question(s). Responding yes will commit the participant to the escalated commitment.
Figure 90: Commitment Escalation

If a participant responds no to an escalation request, responds negatively to the follow-up question(s), or if the commitment cannot be escalated, the participant will simply be asked to recommit using a screen similar to the one shown below in Figure 91.

Figure 91: Recommit

Note that, just as not all commitments can be escalated, likewise one cannot recommit to every commitment in the system. Some commitments will make sense to do only once (e.g., how many times can one commit to checking their tire pressure during a two month period?). The system is designed to handle this type of commitment, and will properly bypass the appropriate screens.
A.13 Achievements

Achievements are “badges” that can be earned by participants for reaching particular milestones in participation or performance. They have no particular bearing on the system itself and earning them gives the user no extra capabilities or monetary awards. Much like the badges earned while playing many modern computer games, they are simply a set of challenges and one of the ways we attempt to keep the participants interested in the game over an extended period of time.

![My Achievements](image)

**Figure 92: Achievements Panel**

The achievements panel is displayed on most of the pages in the system and serves as a constant reminder of how one is progressing. Each achievement is detailed in Appendix H; however, in brief there are eight possible achievements, each with three levels. A dim badge indicates that the participant has not yet earned the Achievement while level attainment is indicated by accumulating in green stars. Five of the Achievements relate to how active the participant is in the system. The remaining three represent how well the user is doing at “beating” the EPA’s mileage estimates for his or her vehicle.
The questions below were presented electronically immediately upon the participants’ initial login to the system as well as after 8 weeks of participation. Participants were required to provide answers to all of the pre-survey questions prior to continuing on to the system and completing their profiles and participating. The post-survey questions were announced by email and were required to be answered in their entirety prior to receiving consideration for any compensation. Both were “integrated” into the system, such that the participants needed only visit a single URL and remember a single set of credentials both to fill out the surveys and to participate in the social media system.

The questions below are prefixed with their internal question identifiers; however, they were presented using sequential numbers in the actual pre- and post-experiment surveys. The exceptions were the four closeness scale questions asked for each of the participants’ team members. These were grouped by team member and each group was presented in numerical sequence, but the items within each group were lettered A, B, C, and D rather than numerically.

Most of the items were presented on both the pre- and post-experiment surveys. However, a minority were presented only at the beginning of the pre-survey and at the end of the post-survey. These are noted below as appropriate. The surveys were divided into pages. The pre-experiment survey had five pages while the post-experiment survey had 6. Each page was also headed with a brief statement introducing the page and or
framing the items. In every case, this introductory text is provided at the top of each section.

B.1 Page 1 (Pre-Survey only)

We need to collect some basic information about you and your driving habits that we will use to help categorize our participants. As with all other information collected as part of this survey, it will be kept 100% confidential.

Please, please, please, PUHLEEEEEEZE take the time to answer this survey carefully. It should take no more than fifteen minutes, but random answers to these questions can completely ruin an experiment that I spent well over a thousand hours preparing. All I ask is a few minutes of your attention.

- **Demographic1** – I own or am responsible for paying for the vehicle(s) that I will be driving during the course of this experiment.
  
  Yes or No

- **Demographic2** – I am responsible for paying for the gas that I will put in my vehicle(s).
  
  Yes or No

- **Demographic3** – I am responsible for paying the rent or mortgage on my current residence (house, apartment, condo, or dorm room).
  
  Yes or No

- **Demographic4** – I live in campus housing (dormitory or school-sponsored apartment)?
  
  Yes or No
• **Demographic5** – If you drive to school, approximately how many miles is it from your current residence?

  Number required

• **Demographic6** – If you drive to work, approximately how many miles is it from your current residence? Note that if your primary job is located at your school (e.g., you’re a student assistant or other school worker), leave this blank so you don't double-count your commute distance.

  Number required

• **Demographic7** – Each month, I have around $_______ to spend on things I would consider to be "discretionary" (i.e., money not spent on essential expenses required to live, eat, work, and go to school).

  Number required

**B.2  Page 2**

Now we'd like to know more about your attitudes. When considering the concept of "environmental impact," focus primarily on the depletion of limited natural resources and on the pollution of our atmosphere. Please read each scenario below and respond by choosing the bubble that most closely represents your feelings towards each.

• **AttitudeCons1** – Minimizing the amount of gas that I personally consume would be:

  Very Bad 0 ... 7 Very Good

• **AttitudeCons2** – I am concerned about the amount of gas that I consume.

  Strongly Disagree 1 … 7 Strongly Agree
- **AttitudeCons3** – I consider reducing my gas consumption to be priority for me personally.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeCons4** – I am concerned about the amount of gas consumed by our society.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeCons5** – I believe that gas savings should be a priority for our society.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeEnv1** – For me, minimizing my impact on the environment would be:

  Very Bad 0 … 7 Very Good

- **AttitudeEnv2** – I am concerned about how my actions impact the environment.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeEnv3** – I consider reducing my impact on the environment to be a priority for me personally.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeEnv4** – I am concerned about the negative impact that our society has on the environment.

  Strongly Disagree 1 … 7 Strongly Agree

- **AttitudeEnv5** – I believe that minimizing negative environmental impact should be a priority for our society.

  Strongly Disagree 1 … 7 Strongly Agree
B.3 Page 3

Now we'd like to know more about how you believe others feel about gasoline consumption and environmental preservation. We also wish to know to what degree others generally affect your beliefs. Again, when considering the concept of "environmental preservation," focus primarily on the depletion of limited natural resources and on the pollution of our atmosphere.

- **SocialCons1** – Most people who are important to me believe that reducing gasoline consumption is important.

  Strongly Disagree 1 … 7 Strongly Agree

- **SocialCons2** – Most people who are important to me actively take steps to reduce their gasoline consumption.

  Strongly Disagree 1 … 7 Strongly Agree

- **SocialCons3** – Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that reducing gasoline consumption is important.

  Strongly Disagree 1 … 7 Strongly Agree

- **SocialCons4** – Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively takes steps to reduce their gasoline consumption.

  Strongly Disagree 1 … 7 Strongly Agree

- **SocialEnv1** – Most people who are important to me believe that preserving the environment is important.

  Strongly Disagree 1 … 7 Strongly Agree
SocialEnv2 – Most people who are important to me actively take steps to reduce their impact on the environment.

Strongly Disagree 1 … 7 Strongly Agree

SocialEnv3 – Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—believe that preserving the environment is important.

Strongly Disagree 1 … 7 Strongly Agree

SocialEnv4 – Most people playing this game—especially my team members ([team member 1], [team member 2], [team member 3], …)—actively take steps to reduce their impact on the environment.

Strongly Disagree 1 … 7 Strongly Agree

SocialOthers1 – In general, if people who are important to me think I should do something, I am likely to do it.

Strongly Disagree 1 … 7 Strongly Agree

SocialOthers2 – My opinions and beliefs are often shaped by the opinions and beliefs of the people who are important to me.

Strongly Disagree 1 … 7 Strongly Agree

SocialOthers3 – I care that the people who are important to me will respect my opinions and beliefs.

Strongly Disagree 1 … 7 Strongly Agree

SocialOthers4 – If someone important to me disagrees with one of my opinions or beliefs, I am likely to be upset.

Strongly Disagree 1 … 7 Strongly Agree
Almost there! Now we'd like to know more about how much control you believe you have over your behavior and a little about your morals regarding gasoline consumption and environmental preservation. Please read and respond to the following carefully.

- **ControlCons1** – I have full control over how much gasoline I consume.

  Strongly Disagree 1 … 7 Strongly Agree

- **ControlCons2** – I am confident that I can take steps to minimize the amount of gasoline that I consume.

  Strongly Disagree 1 … 7 Strongly Agree

- **ControlCons3** – Minimizing my gasoline consumption would be:

  Very Easy 1 … 7 Very Hard

- **ControlEnv1** – I have full control over any negative impact I have on the environment.

  Strongly Disagree 1 … 7 Strongly Agree

- **ControlEnv2** – I am confident that I can take steps to minimize any negative impact I have on the environment.

  Strongly Disagree 1 … 7 Strongly Agree

- **ControlEnv3** – Minimizing the negative impact that I have on the environment would be:

  Very Easy 1 … 7 Very Hard

- **MoralCons1** – It bothers me when I find myself wasting gasoline.

  Strongly Disagree 1 … 7 Strongly Agree
• **MoralCons2** – I feel a personal obligation to conserve gasoline.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **MoralCons3** – Conserving gasoline is a responsible thing to do.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **MoralEnv1** – It bothers me when I do something that I know may negatively impact the environment.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **MoralEnv2** – I feel a personal obligation to minimize any negative impacts I may have on the environment.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **MoralEnv3** – Minimizing the negative impact that someone has on the environment is a responsible thing to do.
  
  Strongly Disagree 1 … 7 Strongly Agree

**B.5 Page 5 (four questions repeated for each team member)**

Finally, we'd like you to think about the members of your team and to answer a few questions about each.

Regarding [Team Member 1]:

• **Closeness1** – I feel as though I know this person well.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **Closeness2** – I often speak with this person face-to-face.
  
  Strongly Disagree 1 … 7 Strongly Agree

• **Closeness3** – I respect the opinions and beliefs of this person.
  
  Strongly Disagree 1 … 7 Strongly Agree
• **Closeness4** – It is important to me that this person respects my opinions and beliefs.

  Strongly Disagree 1 … 7 Strongly Agree

**B.6 Page 6 (Post-Experiment Survey Only)**

Okay, the rest of the questions are "exploratory" in nature, which means we are trying to pave the way for future research. As with all of the questions on this survey, your answers will have no bearing on your compensation, and all of your personally identifying information will be scrubbed from the data prior to analysis. So, please answer truthfully with how YOU feel; NOT how you think others would want you to feel.

• **Motivation1** – When considering reducing gas consumption, how important is saving money to you personally?

  Not Important At All 1 … 7 Very Important

• **Motivation2** – When considering reducing gas consumption, how important is preserving the environment to you personally?

  Not Important At All 1 … 7 Very Important

• **Motivation3** – When considering reducing gas consumption, how important is reducing our country's reliance on foreign oil to you personally?

  Not Important At All 1 … 7 Very Important

• **Belief1** – I believe that the burning of fossil fuels such as gasoline has a direct and negative impact on the natural environment.

  Strongly Disagree 1 … 7 Strongly Agree
• **Belief2** – I believe that human industrial activity, such as the burning of fossil fuels, is the primary cause of the current climatic changes that are commonly referred to as global warming.

  Strongly Disagree 1 … 7 Strongly Agree

• **WorldView1** – I believe that my individual efforts at reducing gasoline consumption can play a part in slowing the consumption of oil in our society.

  Strongly Disagree 1 … 7 Strongly Agree

• **WorldView2** – When it comes to gasoline consumption, whatever I do is insignificant because there are billions of other people.

  Strongly Disagree 1 … 7 Strongly Agree

• **Effectiveness1** – Considering your usage of this game over the past two months, how effective do you think the game was at helping you reduce your gasoline consumption?

  Not Helpful At All 1 … 7 Very Helpful

• **Effectiveness2** – Considering your usage of this game over the past two months, how effective do you think the game was at increasing your awareness of your gasoline consumption?

  Not Helpful At All 1 … 7 Very Helpful

• **Effectiveness3** – Considering your usage of this game over the past two months, how effective do you think the game was at making you aware of the attitudes of others towards gasoline consumption?

  Not Helpful At All 1 … 7 Very Helpful
Whew! Last page! This page contains open-ended questions that will allow you to provide additional feedback on this experiment that we did not cover in our structured questions. Just because you aren't providing a numeric answer doesn't mean it isn't exceedingly useful information. These questions are all optional, but answers to them will help shape future research into social media systems and how they might be leveraged to help improve our society. PLEASE provide any and all feedback you have regarding your experience over the prior two months.

- **Likes** – What aspect(s) of the game (e.g., Dashboard, Commitments, Mileage Reports, etc.) did you find most useful in helping you reduce gasoline consumption? Why?

  Open-Ended Text – Optional

- **Dislikes** – What aspect(s) of the game did you find least helpful? Why?

  Open-Ended Text – Optional

- **Would Play** – If a game similar to this one were fully integrated into Facebook, would you be likely to participate?

  Yes or No

- **Share** – In general, are you comfortable with the idea of sharing information regarding your resource consumption activities (e.g., actions, mileage, commitments, etc.) publicly with your friends on Facebook? Why or why not?

  Open-Ended Text – Optional
• *OtherText* – Please feel free to relate any other comments or feedback that you have regarding the game.

Open-Ended Text – Optional

Oh yeah, and assuming you participated at the minimal level, you should expect compensation. Please select your preferred compensation method below. I prefer either Amazon or PayPal simply for convenience, but I will certainly get a gas card(s) to you if that is your preference. For both PayPal and Amazon, I will need to send them to an e-mail address. If you would like it sent to an email address other than the one you associated with the game, please change it below.

• *OtherText* – Which method of compensation would you prefer?

Amazon.com Gift Card / PayPal / Gas Card

• *OtherText* – What email address would you like the compensation sent to (if applicable)?

Text field
C. INSTRUMENT DEVELOPMENT

This appendix addresses the process used to formulate the instrument described in Appendix B. As discussed in section 4.2, only three factors in the instrument were relevant to this study: Subjective Norm, Moral Norm, and Closeness.

C.1 Subjective Norm

Subjective Norm is one of the original factors in Ajzen’s Theory of Planned Behavior (1991). As such, it has been measured countless times. On his website, Ajzen has assembled a guide (2011a) with recommendations on how to construct an instrument to assess the various factors of the theory. He has also provided a sample questionnaire (2011b). Another similar guide (Francis et al., 2004) written for health services researchers also references the aforementioned guides, but provides additional guidance. All three of these resources were consulted in the crafting of the items for the Subjective Norm scales.

As indicated previously, the normative values measured in this study were divided into two separate domains: norms related to gasoline consumption and norms related to environmental preservation. The scales are further broken down to measure the individuals’ perceived norms for two separate populations: individuals important to the participant and those participating in the experiment (with emphasis on the participant’s team members). Thus, there were four separate measures of subjective norm.

There is no absolute standard for the number of items required to insure internal consistency for a measure. Ajzen’s instrument development process implies that there
should be five to six (2011a, p. 2), however his sample questionnaire contains only four
(2011b, pp. 5-6). And of these, only three are specific to a given population (i.e., “people
important to me”). The other addresses general feelings of pressure to conform to the
norm in question. The second guide recommends three questions (Francis, et al., 2004, p.
17). Here we see that only one of the suggested three questions refers to a specific
population where the remaining two reference generic pressures to conform.

Because we were interested in assessing subjective norms for specific
populations—most importantly the population of all participants—we opted to exclude
the items related to a general pressure to conform and instead included two questions per
item that were specifically intended to measure the perceived norms of the specific
population. These questions were worded in a manner very similar to the relevant
dexamples (Ajzen, 2011a, p. 3; 2011b, pp. 5-6; Francis, et al., 2004, pp. 17,38). Thus we
had two items for each of four measures of subjective norm for a total of 8 items.

C.2 Moral Norm

Unlike Subjective (Perceived) Norm, we know of no “definitive” source for the
development of a scale to measure Moral (Personal) Norms. In the domain of green
behavior however, numerous studies have measured this construct. By-and-large, it is
seems to be included as a test and/or validation of Schwarz’s model of altruistic behavior
(Schwartz, 1977). The earliest work we found to include the items of a scale for Moral
Norm in this domain is the recycling behavior study from Hopper and Nielsen (1991).
They developed a single measure of a personal norm towards recycling that consisted of
9 items (p. 205) measuring both personal obligations and feelings of guilt (“how much
does it bother you”) towards recycling a variety of different materials. The author
reported a high level of internal consistency for the measure. The following year, Vining and Ebreo (1992) included five items to measure Personal Norm (p. 1591). In general, these measured feelings of personal obligation and guilt, as well as the willingness to “go out of the way” and two measures of economic motivation. Since, other studies have adopted similar scales (e.g., Hansla, et al., 2008; Oom Do Valle, et al., 2005) which have focused primarily on the feelings of obligation and guilt. Both of these later studies report adequate reliability figures for these scales.

It appears, then, that a scale that measures personal obligation and feelings of guilt towards a specific problem domain is the commonly accepted practice for measuring Moral Norms, at least in the domain of green behavior. In this vein, we crafted three items each for both of our two normative domains (gasoline consumption and environment). Two of the items related to personal obligation one related to feelings of guilt. One of the personal obligation measures addresses the issue at a more general level (“is a responsible thing to do”), which may be interpreted in more of a subjective manner. However, this item can be excluded if necessary.

C.3 Closeness

As discussed in the main body of this dissertation, Closeness is a new theoretical construct. As such, there were no pre-existing instruments from which to derive items. The goal was to create a relative measure of closeness. In other words, we cared only that we were able to ascertain that an individual viewed herself to be closer to one team member than to another.

Two aspects of closeness were deemed important to measure: familiarity and respect for one another’s opinions and beliefs. Familiarity is believed to be a relatively
concrete concept, measuring simply how well a person feels they know another. A single, 7-level item was used to gauge closeness. The concept of respect required at least two measures: one to determine an individual’s respect for another and one to measure the importance that the individual places on the other’s respect for herself.

These three measures were vetted by presenting them to a number of fellow researchers both during a presentation and one-on-one. Given the definition of the concept as well as the context in which the items would be presented, none of the researchers expressed concern that these items would provide an acceptable measure of relative closeness.
D. LIST OF COMMITMENTS USED IN EXPERIMENT

The following is a list of the eleven commitments offered to the participants during the experiment. Most were available to any participant at any time, though a few, as indicated, were escalations of prior commitments and were only available if the participant reported compliance with the requisite commitment.

Table 19: List of Commitments

<table>
<thead>
<tr>
<th></th>
<th>Short Description</th>
<th>Long Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>You have committed to checking your tire pressure within the next three days.</td>
<td>You should always strive to keep your tire air pressure at the level recommended by your vehicle manufacturer. This is usually found on a sticker on the driver or passenger door frame. A single tire under-inflated by as little as 2 PSI significantly increases the rolling resistance of your tires and will increase fuel consumption by at least 1%. The bigger and wider the tire, the more profound the effect on your fuel economy. Checking the pressure in your tires and filling them with air as necessary is very easy to do yourself. But if you are uncomfortable, you can ask a friend or take your car by a service center--most will perform this service free of charge. Will you commit to checking your tire pressure within the next three days?</td>
</tr>
</tbody>
</table>

Duration 3 days

Follow-up It’s been three days. Time for you to tell us how you well you did.

Did you check your tire pressure?
Yes or No

If you found it to be low, did you add air?
Yes, No, or N/A
2. **Short Description**

You have committed to bicycling to a destination at least twice this week.

**Long Description**

Statistics show that a large portion of your driving is likely to be within a 2 mile radius of your home. And yeah, when it's frigid or baking hot or raining, it makes sense to hop in a car to make these short treks. However, most of the time it would be just as quick and often more convenient to ride a bicycle to your destination. It saves gas (you know, like it consumes NONE) and it helps work off that Baconator you ate for lunch. And who doesn't look hot in tight bicycle shorts??

So, will you commit to bicycling to a destination at least twice this week? If not for your wallet, then for your thighs?

**Duration**

7 days

**Follow-up**

So, it's time to tell us whether you spun those pedals this week. Are you a biker or a bum?

Did you bike to a destination at least twice this past week? Yes or No

3. **Short Description**

You have committed to bicycling to a destination at least five times this week.

**Long Description**

Alright, you've proven you can pump some pedals instead of pumping gas. But how committed are you? Are you willing to prove your pedaling prowess by making it a regular part of your routine? Truly, it is hard to imagine that you could ever bike too much and drive too little. So why not bump it up a notch?

Will you commit to bicycling to a destination at least five times this week?

**Duration**

7 days

**Follow-up**

Okay aspiring bicycle messenger, it is time to come clean. Is you is or is you ain't truly committed to this bicycling thing? Will your next stop be the velodrome or the gas station?

Did you bike to a destination at least five times this past week? Yes or No

**Escalation Of**

2
<table>
<thead>
<tr>
<th></th>
<th>Short Description</th>
<th>Long Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>You have committed to carpooling to school, work, or nighttime fun at least twice this week.</td>
<td>Sure, if you're the driver, it doesn't save YOU gas. But carpooling saves somebody gas, reduces traffic on the roads, eases congestion in parking lots, and in general is a good idea. If you share the cost of gas, it saves everyone. Oh, and if you carpool to your nighttime destinations, only one person needs to stay, err, in driving condition. The cost? Only the slight inconvenience of needing to come and go at the same time. So with all those positives, what's stopping you? Will you commit to carpooling at least twice this week to your work, your school, and/or evening playtime?</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td>Okay, your week is up! Time for you to tell us how well you did with your carpooling commitment. Did you carpool AT LEAST twice in the last seven days? Yes or No</td>
</tr>
<tr>
<td>5</td>
<td>You have committed to carpooling at least four times this week.</td>
<td>Carpooling really is easy. The more you do it, the easier it is to adapt to the slight inconveniences. And on your days NOT driving, it is so much more relaxing to let someone else do the work that you'd be doing otherwise--unless of course your carpool mate is a driving menace, in which case you may want to do the world a favor and do all the driving yourself. So, more being better, would you commit to doubling up and carpooling four times this week? So much to gain. So little to lose.</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td>Alright carpool commander, how did you do? Did you carpool AT LEAST four times in the last seven days? Yes or No</td>
</tr>
<tr>
<td></td>
<td>Escalation Of</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Short Description</td>
<td>Long Description</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>6.</td>
<td>You have committed to emptying out the heavy &quot;junk&quot; from your car sometime in the next three days.</td>
<td>Spring is here. Time for some cleaning. Did you know that your fuel economy can be reduced by two percent for every 100 pounds of extra weight you are carrying around? Some of us keep our back seats and our trunks clean, but others (you know who you are) carry around enough extra junk in the trunk to anchor the USS Nimitz. Old textbooks, empty kegs, dead bodies...everything adds up and subtracts from your mileage. So what do you think? Will you commit to cleaning out your car and trunk (or truck bed) some time in the next three days?</td>
</tr>
<tr>
<td>7.</td>
<td>You have committed to driving with a &quot;light foot&quot; for a week.</td>
<td>There's no doubt that quick acceleration and hard braking is the best way to win a race at the track. But it is terrible on your gas mileage. This alone can knock 5% or more off of your gas mileage just driving around town. And most of the time it won't save any driving time at all. It is also amazing how much less stressful it is to &quot;take it easy&quot; on the gas pedal, and less stress makes for a happier psyche. So how about it? Will you control your drag-racing tendencies and commit to accelerating and braking in a &quot;reasonable&quot; manner this week?</td>
</tr>
<tr>
<td></td>
<td>Short Description</td>
<td>Long Description</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>8.</td>
<td>You have committed to taking public transportation at least twice this week.</td>
<td>Being &quot;too cool for the bus&quot; is so high-school. Assuming there's a bus stop near where you are and where you're going, there are very few excuses for not taking it. Raining? Grab an umbrella. In a hurry? Well, you still might save time by not having to park. Lazy? Well, at least you're honest. That bus is running whether you're riding it or not, so YOU are using zero gas and the bus is using no more gas because of your ridership. Going to hop in the car to go from one side of campus to the other? Seriously?? Come on. Public transportation is paid for by tax dollars and activity fees. Might as well use it. Will you commit to riding public transportation at least twice in the next seven days?</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td>Yo! Bus bandit! Time for a follow-up. Did you take public transportation AT LEAST twice in the past week? Yes or No</td>
</tr>
<tr>
<td>9.</td>
<td>You have committed to taking public transportation at least four times this week.</td>
<td>Okay, so the bus really isn't all that bad. You've proven it. Now ask yourself if this you can take it to the next level. Every round trip on a bus or train saves you real money. More is mo better. Two is great, but four? Four would be fantastic! So, will you commit to riding the bus or taking a train for at least four round trips this week?</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td>Time to tell it like it is. Were you able to hop on the bus or were your posh buns too fine to sit on a public bench? Did you take public transportation at least four times this past week? Yes or No</td>
</tr>
<tr>
<td></td>
<td>Escalation Of</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Short Description</td>
<td>Long Description</td>
</tr>
<tr>
<td>---</td>
<td>------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>10.</td>
<td>You have committed to driving within 5 MPH of the speed limit for a week.</td>
<td>Yeah, okay, safety and tickets aside, you know what else is bad about speeding? You guessed it. Fuel consumption. Fast, aggressive driving, especially on the highway, can dink you up to 33%. Yep...33%!! According to the EPA, &quot;you can assume that each 5 mph you drive over 60 mph is like paying an additional $0.24 per gallon for gas.&quot; And it's actually worse than that because the mileage drops more quickly the faster you are going (and that's based on old gas prices AND if you're driving that fast, you also probably punched the accelerator to get there). You MIGHT get someplace a little faster, but especially in traffic, you're likely to knock off only a minute or two at the cost of, well, a few bucks. Oh yeah, and it's also safer...</td>
</tr>
<tr>
<td></td>
<td>Duration</td>
<td>7 days</td>
</tr>
<tr>
<td></td>
<td>Follow-up</td>
<td>Okay, time to let us know if you were able to ditch the radar detector and drive at a relatively reasonable pace this week. Did you keep your speed within 5 MPH of the posted limit this past week? Yes or No</td>
</tr>
<tr>
<td></td>
<td>Short Description</td>
<td>Long Description</td>
</tr>
<tr>
<td>---</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>11.</td>
<td>You have committed to walking to a destination at least <strong>three</strong> times this week.</td>
<td>We walk all the time. But sometimes we forget that our own two legs can carry us pretty long distances. It may be a bit slower than driving and you're out of luck if you need a trunk or a truck bed, but when it's a reasonable choice to make, it is almost 100% better for your health, your wallet, and your state of mind. And unlike biking, you don't even need to worry about locking anything up when you get where you're going. So, will you commit to walking to a destination that you might normally drive to at least three times this week?</td>
</tr>
<tr>
<td><strong>Duration</strong></td>
<td>7 days</td>
<td></td>
</tr>
<tr>
<td><strong>Follow-up</strong></td>
<td>Time to check whether you wore down your soles or sold your soul. Did you choose to walk instead of driving at least three times this past week? <strong>Yes or No</strong></td>
<td></td>
</tr>
</tbody>
</table>
E. LIST OF TIPS USED IN EXPERIMENT

A “tip of the day”—somewhat of a misnomer because a random one was chosen each time the page was displayed—was displayed to participants on the social media system’s home page. All of the possible tips are displayed below.

Table 20: List of Tips

<table>
<thead>
<tr>
<th></th>
<th>Keep Your Wheels Aligned. Properly aligned wheels create far less rolling resistance. Keep them aligned for better mileage and a much longer tire life, too.</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Keep Your Car Light. Remove any unnecessary weight from your interior and trunk. Extra weight means extra load on the engine which means worse mileage.</td>
</tr>
<tr>
<td>3</td>
<td>Use Cruise Control. Maintaining a constant speed over long distances often saves gas.</td>
</tr>
<tr>
<td>4</td>
<td>Keep Your Brakes Adjusted. Poorly adjusted brakes will increase resistance, which results in lower mileage.</td>
</tr>
<tr>
<td>5</td>
<td>Keep Your Eyes Moving And Your Feet Still. Drive evenly with a steady foot. Avoid jiggling the accelerator.</td>
</tr>
<tr>
<td>6</td>
<td>Double Check! Don't forget to release the emergency brake before pulling away.</td>
</tr>
<tr>
<td>7</td>
<td>Idling Sucks (gas)! Idling gets 0 MPG. When starting your car, don't idle it for more than 30 seconds, even in cold weather. Today's cars are designed to be driven almost immediately. If you must stop for more than 30 seconds, don't idle your car. The engine is more fuel efficient if you turn it off and restart it.</td>
</tr>
<tr>
<td>8</td>
<td>Service Vehicle Regularly. Proper maintenance avoids poor fuel economy related to dirty air filters, old spark plugs or low fluid levels.</td>
</tr>
<tr>
<td>9</td>
<td>Avoid traffic. If possible, avoid driving during rush-hour and other peak traffic periods. Keep tuned to radio traffic reports to avoid traffic jams, other delays.</td>
</tr>
<tr>
<td>10</td>
<td>Don't Slow Down. Pay attention if you are approaching a slower vehicle. If the way is clear, pass as soon as you see you are overtaking them. Don't slow down and then &quot;punch it&quot; to pass.</td>
</tr>
<tr>
<td>11</td>
<td>Do Not Accelerate or Brake Hard. By anticipating the traffic and applying slow steady acceleration and braking, fuel economy may increase by as much as 20%.</td>
</tr>
</tbody>
</table>
12. **Don't Be One Of "Those" Drivers.** Always use only your right foot for accelerating and braking. That way you can't accidentally ride the brake and use excessive gas. The left foot belongs by the clutch or firmly planted on the floor board.

13. **Mind The Tank!** Don't overfill your gas. It could leak or spill in heat or on a hill. Make certain your gas cap fits properly to avoid gas loss due to sloshing or evaporation.

14. **Plan Ahead.** Make a grocery list and do all the grocery shopping no more than once or twice a week. Daily shopping is extremely wasteful.

15. **Shop Smart.** When comparison shopping, check the internet and call ahead if possible. Avoid driving from store to store to store just to check prices.

16. **Look Ahead.** When you see a hill ahead, build up speed before you reach it, then maintain your speed on the slope. Then coast down the other side. Accelerating up a hill uses much more fuel than "pre-accelerating" on a flat or down-slope.

17. **Keep It Sleek.** Remove items that cause wind resistance, such as luggage racks.

18. **Keep Windows Closed.** Open windows, especially at highway speeds, increase drag and result in decreased fuel economy of up to 10%. Note, though, that driving with open windows is still 10% more efficient than driving with the A/C on.

19. **Organization Is Bliss.** Organize activities and perform as many errands as possible in one trip.

20. **Avoid High Speeds.** As your speed increases, your aerodynamic drag increases in an exponential fashion. Driving 62 mph (100 km/h) vs 75 mph (120 km/h) will reduce fuel consumption by about 15%.

21. **Leave Early To Avoid Speeding.** Better planning reduces the need for speeding, to get there in time.

22. **Keep Tires Properly Inflated.** Keep tire air pressure at the level recommended by your vehicle manufacturer (usually found on a sticker on the driver or passenger door frame). A single tire under inflated by 2 PSI, increases fuel consumption by 1%. All tires lose pressure as the weather turns cold.

23. **Use A/C Sparingly.** When the air conditioner is on it puts extra load on the engine forcing more fuel to be used (by about 20%). The defrost position on most vehicles also uses the air conditioner.
F. LIST OF ACTION TYPES AND DESCRIPTIONS

On the Actions page, participants were asked to report any and all conscious actions that they took to conserve gasoline. Though they were welcome to add their own, the following is a list of pre-defined types of actions that they could choose from.

Table 21: Action Types and Descriptions

<table>
<thead>
<tr>
<th></th>
<th>Action Types and Descriptions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Car-pooled to a destination <strong>Okay, this may or may not save YOU any gas, depending on who's doing the driving, but it is bound to save. Whether going work or school or dinner or a bar, think about joining forces with friends.</strong></td>
</tr>
<tr>
<td>2</td>
<td>Combined multiple errands into a single outing <strong>Making a lot of trips to and from a bunch of places is almost always worse than one longer one. It just makes sense to try and combine multiple trips into a single outing.</strong></td>
</tr>
<tr>
<td>3</td>
<td>Put off or cancelled an optional outing <strong>Seems straightforward, but this is perhaps the single best way to save gas. Before you turn the key, think: “Do I REALLY need to go where I'm going?”</strong></td>
</tr>
<tr>
<td>4</td>
<td>Rode a bike instead of driving <strong>Most places you go on a daily basis you COULD probably ride a bike instead. For short trips, it might even be faster. And I bet most folks won't even care if you're a little bit sweaty at your destination.</strong></td>
</tr>
<tr>
<td>5</td>
<td>Took public transportation <strong>Taking a bus or a train may not seem the most glamorous way to travel, but if it's going you're way anyway, why not?</strong></td>
</tr>
<tr>
<td>6</td>
<td>Walked instead of driving <strong>Sure, most of the time you drive somewhere it is just too far to walk. But cars are at their least efficient in the first mile, and those short trips are almost always walkable. Plus, it's healthy!</strong></td>
</tr>
</tbody>
</table>
G. LIST OF EMAIL NOTIFICATIONS USED IN EXPERIMENT

This appendix lists the text of all of the emails sent as part of the day-to-day workings of the social media system used in this study.

<table>
<thead>
<tr>
<th>[NAME] has commented on your post</th>
</tr>
</thead>
<tbody>
<tr>
<td>From: <a href="mailto:pound.the.pump@gmail.com">pound.the.pump@gmail.com</a></td>
</tr>
<tr>
<td>To: [PARTICIPANT]</td>
</tr>
<tr>
<td>This message is to let you know that [NAME] has commented on your Pound the Pump post. The reply is:</td>
</tr>
<tr>
<td>Full text of the comment included here</td>
</tr>
<tr>
<td>To view this message and/or reply to this comment, copy and paste the following link into your browser's address bar (or click on it if you can):</td>
</tr>
<tr>
<td>[LINK]</td>
</tr>
<tr>
<td>Thanks again for playing and don't forget to keep your mileage data up to date!</td>
</tr>
</tbody>
</table>

**Figure 93: Notification of Response to a Post**

<table>
<thead>
<tr>
<th>[NAME] also commented on &lt;NAME&gt;’s Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>From: <a href="mailto:pound.the.pump@gmail.com">pound.the.pump@gmail.com</a></td>
</tr>
<tr>
<td>To: [PARTICIPANT]</td>
</tr>
<tr>
<td>This message is to let you know that [NAME] has commented on a Pound the Pump post that you also commented on. The reply is:</td>
</tr>
<tr>
<td>Full text of the comment included here</td>
</tr>
<tr>
<td>To view this message and/or reply to this comment, copy and paste the following link into your browser's address bar (or click on it if you can):</td>
</tr>
<tr>
<td>[LINK]</td>
</tr>
<tr>
<td>Thanks again for playing and don't forget to keep your mileage data up to date!</td>
</tr>
</tbody>
</table>

**Figure 94: Notification of Response to a Comment**
[NAME] likes your Post

From: pound.the.pump@gmail.com
To: [PARTICIPANT]

This message is to let you know that [NAME] likes your [post/mileage post/action post/trip post/commitment] from [DATE OF POST]. The text of this post was:

Full text of the post included here.

Thanks again for playing and don't forget to keep your mileage data up to date!

Figure 95: Notification of a Like

Your team has been active!

From: pound.the.pump@gmail.com
To: [PARTICIPANT]

Just wanted to let you know that other members of your Pound the Pump team were active in the system yesterday. In chronological order, here's what they've been up to. Click on any individual post to view it in full or to comment on it.

- [NAME] created a status post:
  Full text of the post included here.

- [NAME] took a trip:
  Full text of the post included here.

- [NAME] reported a fill-up:
  Full text of the post included here.

- [NAME] shared an action:
  Full text of the post included here.

- [NAME] made a commitment:
  Full text of the post included here.

Figure 96: Daily Digest of Team Member Posts
H. LIST OF ACHIEVEMENTS

The following is a comprehensive list of achievements that can be earned by participants in the system, along with the level of activity or gas-saving performance required to earn each.

Table 22: List of Achievements

<table>
<thead>
<tr>
<th>Achievement Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>No Social Participation Achievement</td>
<td></td>
</tr>
<tr>
<td>Social Participant</td>
<td>More than five posts, comments, and/or likes.</td>
</tr>
<tr>
<td>Sociable</td>
<td>More than five posts, comments, and/or likes each week for three straight weeks.</td>
</tr>
<tr>
<td>Socialite</td>
<td>More than ten posts, comments, and/or likes each week for three straight weeks.</td>
</tr>
<tr>
<td>No Commitment Acceptance Achievement</td>
<td></td>
</tr>
<tr>
<td>Committed</td>
<td>At least one commitment accepted.</td>
</tr>
<tr>
<td>Dedicated</td>
<td>At least three commitments accepted.</td>
</tr>
<tr>
<td>Devoted</td>
<td>Five or more commitments accepted.</td>
</tr>
<tr>
<td>No Trip Reporting Achievement</td>
<td></td>
</tr>
<tr>
<td>Casual Traveler</td>
<td>At least one trips reported.</td>
</tr>
<tr>
<td>Traveler</td>
<td>At least three trips reported.</td>
</tr>
<tr>
<td>World Traveler</td>
<td>Five or more trips reported.</td>
</tr>
<tr>
<td>Achievement</td>
<td>Description</td>
</tr>
<tr>
<td>--------------------------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>No Action Reporting Achievement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Occasional Saver</strong></td>
<td>At least one action reported.</td>
</tr>
<tr>
<td><strong>Active Saver</strong></td>
<td>Five or more actions reported.</td>
</tr>
<tr>
<td><strong>Activist</strong></td>
<td>Five or more actions reported each week for three straight weeks.</td>
</tr>
<tr>
<td><strong>No Mileage Reporting Achievement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mileage Reporter</strong></td>
<td>At least one mileage report.</td>
</tr>
<tr>
<td><strong>Mileage Monitor</strong></td>
<td>Three or more mileage reports without a skip.</td>
</tr>
<tr>
<td><strong>Pump Pounder</strong></td>
<td>Five or more mileage reports without a skip.</td>
</tr>
<tr>
<td><strong>No City Mileage Achievement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Lightfoot</strong></td>
<td>One “city” fill-up above the EPA City MPG estimate.</td>
</tr>
<tr>
<td><strong>Urban Avenger</strong></td>
<td>One “city” fill-up within 5% of the EPA Combined MPG estimate.</td>
</tr>
<tr>
<td><strong>Stop’n’go Superhero</strong></td>
<td>Three “city” fill-ups within 5% of the EPA Combined MPG estimate.</td>
</tr>
<tr>
<td><strong>No Mixed Mileage Achievement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Mileage Minder</strong></td>
<td>One “mixed” fill-up within 5% of the EPA Combined MPG estimate.</td>
</tr>
<tr>
<td><strong>Suburban Sipper</strong></td>
<td>One “mixed” fill-ups above the EPA Combined MPG estimate.</td>
</tr>
<tr>
<td><strong>Suburban Sensation</strong></td>
<td>Three “mixed” fill-ups above the EPA Combined MPG estimate.</td>
</tr>
<tr>
<td><strong>No Highway Mileage Achievement</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Highway Hound</strong></td>
<td>One mostly- or entirely-highway fill-up within 5% of the EPA Highway MPG estimate.</td>
</tr>
<tr>
<td><strong>Interstate Inspiration</strong></td>
<td>One mostly- or entirely-highway fill-up above the EPA Highway MPG estimate.</td>
</tr>
<tr>
<td>----------------------------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td><strong>Hypermiler</strong></td>
<td>Three mostly- or entirely-highway fill-ups above the EPA Highway MPG estimate.</td>
</tr>
</tbody>
</table>
I. SOCIAL MEDIA SYSTEM DATA MODEL

As has been noted, this experiment required the creation of a custom, web-based social media system. Technically, this system was created using Microsoft ASP.Net MVC (Model-View-Controller) version 2.0, X/HTML 1.0, CSS 2.0, jQuery 1.4.1, and a number of jQuery plug-ins all running on a Microsoft Windows Server 2008 r2. However, at the core of the system was a standard relational database running hosted by Microsoft SQL Server 2008. Over half a terabyte of data were collected which formed the basis for much of the analysis carried out herein. This appendix describes this data model at a high-level so that we can present the queries and resulting data in the following appendix.

Figure 97, below, shows the high-level entity-relationship diagram of the transactional tables used by the system. In the pages that follow, each table (in alphabetical order) will be described in some detail. Note that in most cases, the table names were pluralized following common relational database naming conventions. However, the object-relational modeling tool used by the system and leveraged to capture these diagrams (Microsoft Entity Framework) singularized the table names to conform to standard object-oriented modeling conventions. In the detailed descriptions, the proper table names are used.
Figure 97: Social Media System Entity-Relationship Diagram
Table 23: Social Media System Database Table Descriptions

The ActionLogs table records each and every click that each user makes while using the system. For performance reasons, the table has no explicit relationships defined in the database, although the UserGUID is able to be used to reference the specific user performing the action during data analysis.

The Actions table holds each of the individual, conscious actions taken by participants to conserve gas. Note that MilesSaved would be more accurately termed “UnitsSaved,” as the units may not be miles. The actual units used are stored in the ActionUnits field.

Relationships:
- The User taking the action.
- The Post reporting the action on the news feed.

The ActionTypes table is simply a lookup used when providing the participant a choice of types of gas saving actions. If the user performs an action not in the list of actions stored in this table, the ActionTypeCode in the Actions table is left null and the description of the action (provided by the participant) is recorded in the OtherTypeDescription field.
The *Cars* table stores detailed performance and gas consumption data regarding every vehicle measured by the United States Environmental Protection Agency (EPA). The *TankSize* data is not tracked by the EPA, so had to be manually entered using data obtained from Edmunds. Both the EPA and Edmunds were very helpful in providing raw data files.

**Relationships:**
- The *User(s)* who own/operate the car. *UserCars* is a junction table supporting the many-to-many relationship between the Users and Cars tables.

The *Comments* table stores participants’ comments on posts. *Comments*, when deleted by participants, are actually “hidden” so as to preserve the ability to analyze the data in the future.

**Relationships:**
- The *Post* upon which the Comment is being made.
- The *User* making the Comment.
The *Commitments* table is a lookup table holding all of the gas conserving actions that a user can commit to.

**Relationships:**
- The *User(s)* accepting the Commitment. The *UserCommitments* table is a junction table supporting the many-to-many relationship between Users and Commitments.
- The *Commitment* that must be successfully completed in order to “escalate” to the Commitment (if applicable).
- The *FollowupQuestions* asked of the User on completion of the Commitment. “Completion” here happens when *FollowupDays* have elapsed, not necessarily when a participant actually performs the action.

The *FollowupAnswers* table stores the answers that a participant can choose from when answering a *FollowupQuestion*.

**Relationships:**
- The *FollowupQuestion* to which the FollowupAnswers are associated.
The *FollowupQuestions* table holds the individual question(s) that should be answered by the participant at the end of a Commitment period.

**Relationships:**
- The *Commitment* to which the questions are associated.
- The *FollowupAnswers* that a user can choose from when answering the question.
- The *Answers* provided by the *User*.

The *Images* table stores images uploaded by the participant as binary large objects (BLOBs). In this case, the only images uploaded by participants were custom profile images, or *avatars*. 
The *Mileages* table records all of the details of a participant’s fuel fill-up.

**Relationships:**
- The *User* recording the fill-up.
- The *Post* reporting the fill-up on the news feed.

The *Notifications* table stores each and every notification presented by the system to a participant.

**Relationships:**
- The *User* to whom the Notification is being presented.
- The *PreDefinedNotification* (if applicable) being presented.
The PostLikes table records each time a participant “likes” a particular Post.

Relationships:
- The User liking the Post.
- The Post that is liked.

Forming the system’s “news feed,” the Posts table stores each and every post made by a user, including standard “status” posts, actions, trips, fuel full-ups, and (if they are “public”) commitments and subsequent follow-ups. Posts are never deleted, even if requested by the user. Rather, they are “hidden” to allow future analysis.

Relationships:
- The User making the Post.
- Any Comments on the Post.
- Any Likes of the Post.
- The related Trip, Action, or Mileage record, depending on the PostType.
The *PostSurveys* table records each of the responses provided by the user to the post-experiment survey. Though not explicitly defined in the data model, the *UserGUID* key is used to determine the *User* providing the responses. Only one set of responses can be recorded per participant.

**Relationships:**
- The one-to-many responses provided regarding each of the participant’s team members (recorded in *PostSurveyTeams*). 

Really an extension of *PostSurveys*, *PostSurveyTeams* records the responses given by the participant regarding each of their team members. Though not explicitly defined as a relationship in the data model, the *TeamUserGUID* can be used to reference the participant about whom the response is being recorded.

**Relationships:**
- The *PostSurvey* to which these responses are associated.

The *PredefinedNotifications* table stores notifications that generally would be presented to every participant *en masse*. It is primarily a means of saving space since the notification text does not have to be duplicated for each recipient.

**Relationships:**
- The individual *Notifications* presenting the predefined *NotificationData*. 
The \textit{PreSurveys} table records each of the responses provided by the user to the pre-experiment survey. Though not explicitly defined in the data model, the \textit{UserGUID} key is used to determine the \textit{User} providing the responses. Only one set of responses can be recorded per participant.

\underline{Relationships:}
- The one-to-many responses provided regarding each of the participant’s team members (recorded in \textit{PreSurveyTeams}).
Really an extension of PreSurveys, PreSurveyTeams records the responses given by the participant regarding each of their team members. Though not explicitly defined as a relationship in the data model, the TeamUserGUID can be used to reference the participant about whom the response is being recorded.

Relationships:
- The PreSurvey to which these responses are associated.

A component of the system’s authorization subsystem, the Roles table is simply a lookup table. A participant need not be assigned to a Role unless they needed special permissions or special treatment. The only meaningful roles defined are “Administrator” and “Special”, assigned respectively to the system administrator and those using the system but not included as part of data analysis.

Relationships:
- The User(s) assigned to the role. There is a junction table, UserRoles, excluded from the diagram as it is purely there to support a many-to-many relationship and is hidden by Microsoft Entity Framework.

The Teams table provides a lookup for each of the teams that a participant could be assigned to.

Relationships:
- The User(s) assigned to the Team.
**Unused.** Intended to record when a participant “likes” a specific Tip, this functionality was never implemented.

The *Tips* table stores each of the tips-of-the-day from which the system can choose when displaying the system home page.

The *Trips* table records each out-of-the-ordinary trip taken by participants.

**Relationships:**
- The *UserCar* used to take the trip.
- The *Post* reporting the trip on the news feed.
Primarily a junction table linking *Users* to *Cars*, the *UserCars* table also allows a user to record a car that is not listed in the *Cars* table—in this case the *CarGUID* will be null and the car’s *Description* will be stored. It is also the entity against which *Trips* and *Mileages* (fill-ups) are recorded.

**Relationships:**
- The *User* to whom the car belongs
- The *Car* owned by the user (optional)
- The *Trips* taken using this car.
- The *Mileages* recorded for this car.

The *UserCommitmentAnswers* table stores the participant’s answers to follow-up questions.

**Relationships:**
- The *UserCommitment* which is being followed up on.
- The *FollowupQuestion* which is being answered.
The *UserCommitment* table represents a participant’s acceptance or rejection of a specific *Commitment*. A record is created when a participant either actively accepts a commitment or if the system requests the commitment of the participant.

**Relationships:**
- The *User* accepting or rejecting the commitment.
- The *Commitment* being accepted or rejected.
- The answers to any *FollowupQuestions*, if applicable.
The UserProfiles table stores additional information about a User. It is essentially an extension of the User table—there is a one-to-one relationship between these two tables. It is not specifically part of the authentication and authorization subsystem, and is thus kept in a separate table for performance reasons. Most of the data stored in this table is maintained by the participant using the Profile section of the site. Also stores achievement levels. Team member choices (provided during registration) are also stored here.

**Relationships:**
- The User to whom the profile data belongs.
The *Users* table represents each individual participant in the system. All registrants have records in this table regardless of whether they have been approved for the experiment or have participated to any extent. Because user information is cached aggressively in memory for performance reasons, the table was kept relatively lean. It contains only those fields necessary for authentication and authorization as well as those which are very frequently accessed (as when displaying large numbers of individual posts on the news feed). The remainder of the data pertinent to an individual participant table is stored in the *UserProfiles* table.

**Relationships:**
- The *UserProfile* associated with the *User*.
- Any *Actions* taken by the *User*.
- Any *Comments* made by the *User*.
- Any *Posts* made by the *User*.
- Any posts *liked* by the *User*.
- The *User’s Team*.
- The *User’s Car(s)* (a user may have multiple).
- Any *Commitments* accepted by the *User*.
- The *User’s system Roles* (if any).
J. DATA ANALYSIS QUERIES

In this section we will detail the database views and queries created to extract the data necessary to test each of our hypotheses. This section is organized by proposition.

J.1 Proposition 1

This proposition required that we measure both the difference between the closeness ratings for a pair of participants as well as a count of each interaction between those two participants. Recall that an interaction between Participant A and Participant B is defined as any of the following:

- Participant A likes Participant B's post
- Participant B likes Participant A's post
- Participant A comments on Participant B's post
- Participant B comments on Participant A's post
- Participant A comments on a post that Participant B commented on
- Participant B comments on a post that Participant A commented on
- Participant A views Participant B's profile or wall

This analysis required quite a bit of processing, so to help keep the queries manageable, four database views were created. Finally a single large query was constructed to assemble all of the necessary data. These steps are described below.

AnalysisUsers View. This view filtered out all entries from the Users table that we did not want to analyze. This includes all participants that did not complete the post-experiment survey as well as those who played the game but were not part of the sample.
All non-sample users were part of a single team, so it was relatively simple to exclude them. This view was used extensively in the analysis of the remaining Propositions, as well. The view was defined as follows:

```
SELECT *  
FROM Users  
WHERE (TeamGUID <> 'A6235A4B-FD9C-4C5E-A48E-3D93B58ED636')  
AND (IsPostSurveyComplete = 1)
```

Figure 98: AnalysisUsers View SQL Listing

**VisiblePosts View.** Because participants were allowed to “delete” posts and this simply flipped the IsHidden flag, we needed to eliminate any hidden posts from consideration. The view was defined as follows:

```
SELECT *  
FROM Posts  
WHERE IsHidden = 0
```

Figure 99: VisiblePosts View SQL Listing

**ProfileViews View.** We also needed to count each time a user viewed another user’s profile. This information was captured in the LogView table, but proved to be quite tricky to extract because the viewed user’s alias was embedded within specific URL string patterns (e.g., “/profile/details/[Alias]”, “/profile/feed/[Alias]”, or “/profile/feed/[Alias]/[PostGUID]”). The query required the use of multiple string functions to extract only the alias from only those URL strings with the desired pattern. The aliases then had to be converted to UserGUID’s by joining to the AnalysisUsers view. The results are a view that contains a record for each time any user views any other user’s profile and was defined as follows:
SELECT u1.UserGUID AS ViewingUserGUID,
       u2.UserGUID AS ViewedUserGUID
FROM
  (SELECT Alias,
       CASE CHARINDEX('/', ViewedAlias)
       WHEN 0 THEN ViewedAlias
       ELSE LEFT(ViewedAlias, CHARINDEX('/', ViewedAlias) - 1)
       END
       AS ViewedAlias
FROM
  (SELECT Alias,
       SUBSTRING(ViewedAlias, 2, 999) AS ViewedAlias
FROM
  (SELECT Alias,
       REPLACE(REPLACE(LOWER(FullURL), '/profile/details', ''),
               '/profile/feed', '') AS ViewedAlias
FROM LogView
   WHERE (Controller = 'Profile') AND
         (Action = 'Details' OR Action = 'Feed')
  ) AS ProfileViewsInner2
WHERE ViewedAlias <> ''
  ) AS ProfileViewsInner1
) AS pv
JOIN dbo.AnalysisUsers AS u1
  ON u1.Alias = pv.Alias
JOIN dbo.AnalysisUsers AS u2
  ON u2.Alias = pv.ViewedAlias
WHERE pv.Alias <> pv.ViewedAlias

---

**Figure 100: ProfileViews View SQL Listing**

**DeltaCloseness View.** The final view necessary for this analysis displays the change in closeness between the pre- and post-experiment surveys for each pair of team members. The view was defined as follows:
SELECT pre.UserGUID AS RatingUserGUID,  
pre.TeamUserGUID AS RatedUserGUID,  
pre.Closeness1 AS preCloseness1,  
pre.Closeness2 AS preCloseness2,  
pre.Closeness3 AS preCloseness3,  
pre.Closeness4 AS preCloseness4,  
post.Closeness1 AS postCloseness1,  
post.Closeness2 AS postCloseness2,  
post.Closeness3 AS postCloseness3,  
post.Closeness4 AS postCloseness4,  
pre.Closeness1 + pre.Closeness3 + pre.Closeness4  
AS PreCloseness,  
post.Closeness1 + post.Closeness3 + post.Closeness4  
AS PostCloseness,  
post.Closeness1 + post.Closeness3 + post.Closeness4 -  
pre.Closeness1 - pre.Closeness3 - pre.Closeness4  
AS DeltaCloseness  
FROM dbo.PreSurveyTeam AS pre  
JOIN dbo.PostSurveyTeam AS post  
ON pre.UserGUID = post.UserGUID AND  
pre.TeamUserGUID = post.TeamUserGUID  

Figure 101: DeltaCloseness View SQL Listing

**Final Query.** Finally, we construct the query to count each user interaction and  
join the results with the *DeltaCloseness* and *AnalysisUsers* views. The result is a matrix  
that displays both the interaction count among each and every team member alongside  
their change in closeness. The query is as follows.
SELECT RatingUsers.UserGUID RatingUser,
       RatedUsers.UserGUID RatedUser,
       PostCloseness2 OfflineInteraction,
       PreCloseness,
       DeltaCloseness,
       InteractionCount
FROM DeltaCloseness dC1
LEFT OUTER JOIN
(
  SELECT UserGUID, InteractingUserGUID, COUNT(*) InteractionCount
  FROM
  (
    SELECT UserGUID, InteractingUserGUID
    FROM
    (
      /* Participant A likes Participant B's Post */
      SELECT p.UserGUID UserGUID, pl.UserGUID InteractingUserGUID
      FROM VisiblePosts p
      JOIN PostLikes pl
        ON p.PostGUID = pl.PostGUID
      UNION ALL

      /* Participant B likes Participant A's Post */
      SELECT pl.UserGUID UserGUID, p.UserGUID InteractingUserGUID
      FROM VisiblePosts p
      JOIN PostLikes pl
        ON p.PostGUID = pl.PostGUID
    ) UNION ALL

    /* Participant A comments on Participant B's Post */
    SELECT p.UserGUID UserGUID, c.UserGUID InteractingUserGUID
    FROM VisiblePosts p
    JOIN Comments c
      ON p.PostGUID = c.PostGUID
  ) UNION ALL

    /* Participant B comments on Participant A's Post */
    SELECT c.UserGUID UserGUID, p.UserGUID InteractingUserGUID
    FROM VisiblePosts p
    JOIN Comments c
      ON p.PostGUID = c.PostGUID
)
```sql
/* Participant A comments on Participant B also commented on */
SELECT c1.UserGUID UserGUID, c2.UserGUID InteractingUserGUID
FROM Comments c1
JOIN VisiblePosts p
  ON c1.PostGUID = p.PostGUID
JOIN Comments c2
  ON p.PostGUID = c2.PostGUID
WHERE c1.UserGUID <> c2.UserGUID
  AND p.UserGUID <> c1.UserGUID
  AND c2.CommentDate > c1.CommentDate
UNION ALL
/* Participant B comments on Participant A also commented on */
SELECT c2.UserGUID UserGUID, c1.UserGUID InteractingUserGUID
FROM Comments c1
JOIN VisiblePosts p
  ON c1.PostGUID = p.PostGUID
JOIN Comments c2
  ON p.PostGUID = c2.PostGUID
WHERE c1.UserGUID <> c2.UserGUID
  AND p.UserGUID <> c1.UserGUID
  AND c2.CommentDate > c1.CommentDate
UNION ALL
/* Participant A views Participant B's profile or wall */
SELECT ViewedUserGUID, ViewingUserGUID
FROM ProfileViews
) AS UserInteractions
) AS UserInteractionsEx
GROUP BY UserGUID, InteractingUserGUID
) AS Interactions
ON dCl.RatedUserGUID = Interactions.UserGUID AND
  dCl.RatingUserGUID = Interactions.InteractingUserGUID
JOIN AnalysisUsers RatingUsers
  ON RatingUsers.UserGUID = dCl.RatingUserGUID
JOIN AnalysisUsers RatedUsers
  ON RatedUsers.UserGUID = dCl.RatedUserGUID
ORDER BY RatingUser

Figure 102: Proposition 1 SQL Query Listing
```
J.2 Proposition 2

The analysis of Proposition 2 required that we determine both a change in “subjective distance” (the difference between perceived and actual social norm) and the average closeness score that a participant felt towards all of the members of his or her team. Here, we chose to attack this as a single monolithic query, although we do again leverage the AnalysisUsers view. We actually had to write two queries: one for norms related to gasoline consumption and another related to environmental concern. Only the consumption query is shown below. The environmental concern query is identical except all instances of SocialConsX are replaced with SocialEnvX.

```
SELECT PreSNactQ.UserGUID,
       PreSNact,
       PostSNact,
       PreSNpcvd,
       PostSNpcvd,
       (PreSNact - PreSNpcvd) AS PreSDist,
       (PostSNact - PostSNpcvd) AS PostSDist,
       (ABS(PreSNact - PreSNpcvd) - ABS(PostSNact - PostSNpcvd))
       AS DeltaSDist,
       PreCloseness,
       PostCloseness,
       Closeness
FROM
   (SELECT users1.UserGUID AS UserGUID,
            AVG(pre.SocialCons3 + pre.SocialCons4 * 1.0) AS PreSNact
       FROM AnalysisUsers users1
       JOIN AnalysisUsers users2
       ON users1.teamguid = users2.teamguid
       JOIN PreSurvey pre
       ON users2.userguid = pre.userguid
       WHERE users2.userguid != users1.userguid
       GROUP BY users1.userguid
     ) AS PreSNactQ
JOIN
<<<< continued >>>>
```
(SELECT users1.UserGUID AS UserGUID,
    AVG(post.SocialCons3 + post.SocialCons4 * 1.0) AS PostSNact
FROM AnalysisUsers users1
JOIN AnalysisUsers users2
    ON users1.TeamGUID = users2.TeamGUID
JOIN PostSurvey post
    ON users2.UserGUID = post.UserGUID
WHERE users2.UserGUID != users1.UserGUID
GROUP BY users1.UserGUID
) AS PostSNactQ
ON PreSNactQ.UserGUID = PostSNactQ.UserGUID

JOIN
(  SELECT UserGUID, (SocialCons3 + SocialCons4) AS PreSNpcvd
  FROM PreSurvey
) AS PreSNpcvdQ
ON PreSNactQ.UserGUID = PreSNpcvdQ.UserGUID

JOIN
(  SELECT UserGUID, (SocialCons3 + SocialCons4) PostSNpcvd
  FROM PostSurvey
) AS PostSNpcvdQ
ON PreSNactQ.UserGUID = PostSNpcvdQ.UserGUID

JOIN
(  SELECT users.UserGUID AS UserGUID,
    AVG(pre.Closeness1 + pre.Closeness3 + pre.Closeness4 * 1.0)
      AS PreCloseness,
    AVG(post.Closeness1 + post.Closeness3 + post.Closeness4 * 1.0)
      AS PostCloseness,
    (AVG(pre.Closeness1 + pre.Closeness3 + pre.Closeness4 * 1.0) +
     AVG(post.Closeness1 + post.Closeness3 + post.Closeness4 * 1.0))
    / (2.0) AS Closeness
  FROM AnalysisUsers users
JOIN PreSurveyTeam AS pre
    ON users.UserGUID = pre.UserGUID
JOIN PostSurveyTeam AS post
    ON users.UserGUID = post.UserGUID
GROUP BY users.UserGUID
) AS ClosenessQ
ON PreSNactQ.UserGUID = ClosenessQ.UserGUID

Figure 103: Proposition 2 SQL Query Listing
J.3 Proposition 3

The analysis of Proposition 3 was quite similar to Proposition 2, except that it required that we calculate a normative distance (difference between subjective and moral norm) rather than a subjective distance (difference between perceived and actual social norm). Again, we construct two large queries: one for norm related to gasoline consumption and another related to environmental concern. Again, only the consumption query is shown. The environmental concern query is identical except all instances of SocialConsX and MoralConsX are replaced with SocialEnvX and MoralEnvX, respectively.

```sql
SELECT users.UserGUID,
       PreSN,
       PreMN,
       PostSN,
       PostMN,
       (PreSN-PreMN) AS PreNDist,
       (PostSN-PostMN) AS PostNDist,
       ABS(PreSN-PreMN)-ABS(PostSN-PostMN) AS DeltaNDist,
       PreCloseness,
       PostCloseness,
       Closeness
FROM AnalysisUsers users
JOIN
( SELECT UserGUID,
       ((socialcons3 + socialcons4) / 2.0) PreSN,
       ((moralcons1 + moralcons2 + moralcons3) / 3.0) PreMN
FROM PreSurvey
) AS PreQ
ON users.UserGUID = PreQ.UserGUID
JOIN
<<< continued >>>
```
(SELECT UserGUID, 
   ((socialcons3 + socialcons4) / 2.0) PostSN, 
   ((moralcons1 + moralcons2 + moralcons3) / 3.0) PostMN 
FROM PostSurvey 
) AS PostQ 
ON users.UserGUID = PostQ.UserGUID 
JOIN 
( 
   SELECT users.UserGUID AS UserGUID, 
   AVG(pre.Closeness1 + pre.Closeness3 + pre.Closeness4 * 1.0) 
   AS PreCloseness, 
   AVG(post.Closeness1 + post.Closeness3 + post.Closeness4 * 1.0) 
   AS PostCloseness, 
   (AVG(pre.Closeness1 + pre.Closeness3 + pre.Closeness4 * 1.0) + 
   AVG(post.Closeness1 + post.Closeness3 + post.Closeness4 * 1.0)) 
   / (2.0) AS Closeness 
FROM AnalysisUsers users 
JOIN PreSurveyTeam AS pre 
   ON users.UserGUID = pre.UserGUID 
JOIN PostSurveyTeam AS post 
   ON users.UserGUID = post.UserGUID 
GROUP BY users.UserGUID 
) AS ClosenessQ 
ON users.UserGUID = ClosenessQ.UserGUID 

---

**Figure 104: Proposition 3 SQL Query Listing**

## J.4 Propositions 4 and 5

With only some simple filtering which could be performed in R, Propositions 4 and 5 could both be supported by a single data set. This data set contains a record for each system-assigned commitment, with fields for whether commitments are private for the participant, whether the commitment was accepted, and the average subjective and moral norms for the participant. The SQL query to generate this data set is shown below.
SELECT users.UserGUID,
    CAST(up.AreCommitmentsPrivate as int) Private,
    ((PreSN + PostSN) / 2.0) SNavg,
    ((PreMN + PostMN) / 2.0) MNavg,
    Accepted
FROM AnalysisUsers users
JOIN UserProfiles up
    ON users.UserGUID = up.UserGUID
JOIN
    (SELECT UserGUID,
        ((socialcons3 + socialcons4) / 2.0) PreSN,
        ((socialcons1 + moralcons2 + moralcons3) / 3.0) PreMN
    FROM PreSurvey
    ) AS PreQ
    ON users.UserGUID = PreQ.UserGUID
JOIN
    (SELECT UserGUID,
        ((socialcons3 + socialcons4) / 2.0) PostSN,
        ((socialcons1 + moralcons2 + moralcons3) / 3.0) PostMN
    FROM PostSurvey
    ) AS PostQ
    ON users.UserGUID = PostQ.UserGUID
JOIN
    (SELECT UserGUID,
        CAST(IsAccepted as int) Accepted
    FROM UserCommitments uc
    WHERE (uc.IsAccepted = 1 or uc.IsRejected = 1)
        AND uc.CreationDate <> uc.AcceptRejectDate
    ) AS CommitmentQ
    ON users.UserGUID = CommitmentQ.UserGUID

Figure 105: Propositions 4 and 5 SQL Query Listing

J.5 Proposition 6

Though similar to Propositions 4 and 5, a separate query was created for Proposition 6 because we no longer wish to examine only system-generated commitments. This data set contains a record for each system-assigned commitment, with
fields for whether commitments are private for the participant, whether the participant complied with the commitment, and the average subjective and moral norms for the participant. The SQL query to generate this data set is shown below.

```
SELECT users.UserGUID,
       CAST(up.AreCommitmentsPrivate as int) Private,
       ((PreSN + PostSN) / 2.0) SNavg,
       ((PreMN + PostMN) / 2.0) MNavg,
       (CASE UPPER(AnswerValue)
          WHEN 'TRUE' THEN 1
          WHEN 'YES' THEN 1
          ELSE 0
        END
       ) AS Complied
FROM AnalysisUsers users
JOIN UserProfiles up on users.UserGUID = up.UserGUID
JOIN
  (SELECT UserGUID,
       ((socialcons3 + socialcons4) / 2.0) PreSN,
       ((moralcons1 + moralcons2 + moralcons3) / 3.0) PreMN
    FROM PreSurvey
  ) AS PreQ
ON users.UserGUID = PreQ.UserGUID
JOIN
  (SELECT UserGUID,
       ((socialcons3 + socialcons4) / 2.0) PostSN,
       ((moralcons1 + moralcons2 + moralcons3) / 3.0) PostMN
    FROM PostSurvey
  ) AS PostQ
ON users.UserGUID = PostQ.UserGUID
JOIN

<<< continued >>>
```
J.6 Proposition 7

This data set contains a record for each commitment, however assigned, that was either accepted by a participant. The data are later filtered using R during analysis. It contains fields for Whether the commitment has follow-up answers (Answered), whether those answers were obtained during the experiment or after (Followup), whether or not commitment acceptance (and follow-up compliance) were made public (IsPublic), whether the participant complied with the commitment (Complied), and whether or not the commitment was system-generated or actively assigned (Active). As with many of the fields included in these queries, the Active field was not needed for hypothesis testing, but was included for exploratory purposes. The SQL query to generate this data set is shown below.
SELECT
  ( CASE
      WHEN (
        SELECT COUNT(*)
        FROM UserCommitmentAnswers uca
        WHERE uca.UserCommitmentGUID = uc.UserCommitmentGUID
      ) > 0 THEN 1
      ELSE 0
    END
  ) AS Answered,
  ( CASE
      WHEN (
        SELECT COUNT(*)
        FROM UserCommitmentAnswers AS uca
        JOIN FollowupQuestions AS fq
          ON fq.FollowupQuestionGUID = uca.FollowupQuestionGUID
        WHERE fq.DisplayOrder = 0
          AND (uca.AnswerValue = 'TRUE' OR uca.AnswerValue = 'YES')
          AND uca.UserCommitmentGUID = uc.UserCommitmentGUID
      ) > 0 THEN 1
      ELSE 0
    END
  ) AS Complied,
  ((up.AreCommitmentsPrivate - 1) * -1) AS IsPublic, /* invert */
  CAST(up.ShouldGetCommitmentFollowups as int) AS Followup,
  ( CASE
      WHEN uc.CreationDate = uc.AcceptRejectDate THEN 1
      ELSE 0
    END
  ) AS Active
FROM UserCommitments AS uc
JOIN AnalysisUsers AS u
  ON u.UserGUID = uc.UserGUID
JOIN UserProfiles AS up
  ON up.UserGUID = u.UserGUID
WHERE u.IsPostSurveyComplete = 1
  AND uc.IsAccepted = 1

Figure 107: Proposition 7 SQL Query Listing