A Multi-Model Analysis of Psychosocial Determinants of Recycling Intention.

A multi-model analysis of psychosocial determinants of recycling intention.

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Abstract

Since their inception in 1972, recycling collection programs across the United States have become commonplace for many local governments and municipalities across the United States, collecting more than 86.6 million metric tons of recycling. While programs become more common and concerns about the environment increase, participation in recycling programs has plateaued. For programs to be appropriately delivered and successful, we must recognize the individual and collective psychosocial dynamics involvement in recycling behavior. In this study, recycling intentions were examined using the Theory of Planned Behavior, Norm-Activation, Comprehensive Action Determination models. These models are three of the most commonly used, yet represent three distinct approaches to analyzing pro-environmental behavior. Using quantitative methods, the Comprehensive Action Determination Model was identified as explaining the most variance in individual recycling behavior. Findings also suggest that personal norms, perceived behavioral control, and the self-report habit index as the most significant explainer of recycling behavior. In addition, an examination of the relationships and the theoretical implications among the explanatory variables found in the models listed are discussed.

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Chapter 1 Introduction

Our understanding of climate change is not a modern discovery. With Fourier's description of the greenhouse effect (Fourier, 1822) the scientific consensus was building, describing the impact of carbon dioxide (CO_2) accumulation on our earth systems. Our knowledge continued to expand as Tyndall illustrated the radiative properties of elements and their role in Fourier's proposed heat-trapping effect (1864). Years later, Arrhenius proposed a connection between atmospheric CO_2 levels and a warming temperature, (Arrhenius, 1896) devising the first calculations that fossil fuel combustion would double atmospheric CO_2 concentrations leading to temperature rise. Arrhenius's model was mainly forgotten until 1930 when developments in infrared spectroscopy (the analysis of infrared light interacting with molecules) was utilized confirming that CO_2 (Callendar, 1938), as well as, methane (CH_4) and nitrous oxide (NO_2; Donner & Ramanathan, 1980) absorbed infrared radiation differently than water vapor (Plass, 1956). In the late 1950s and early 1960s, Charles Keeling started a review of the atmospheric CO_2 concentrations in Mauna Loa, Hawaii. Within a few years, Keeling presented his second Mauna Loa

Carbon Dioxide Project Report (Keeling, 1963) confirming Arrhenius's assertions that human-caused fossil fuel burning was increasing the atmospheric concentrations of CO_2 (Keeling, 1960) at a faster rate than the oceans could absorb (Bolin & Eriksson, 1958; Revelle & Suess, 1957).

With close to 200 years of scientific research, it is well understood that emissions from fossil fuel use, byproducts from agricultural activities, and waste management, contribute to a warming climate. These greenhouse gases (most commonly in the form of Carbon Dioxide – CO_2, Methane – CH_4, nitrogen oxides (NO_x) warm at differing rates depending on their ability to absorb energy (radiative efficiency) and how long they remain in the atmosphere (lifetime). Each gas is then assigned a calculated Global Warming Potential (GWP) or the "measure of how much energy ... 1 ton of gas will absorb, relative to ... 1 ton of carbon dioxide (CO_2) over a given period. The larger the GWP the more a given gas warms the earth compared to CO_2 over that period" (IPCC, 2013). This standardized measure provides researchers a common unit called carbon dioxide equivalents (CO_{2e}). For example, methane (CH_4) has a shorter atmospheric lifetime than CO_2 but a significantly higher radiative efficiency yielding a GWP of 25 (IPCC, 2014) implying that when 1 ton of methane is released, it is the equivalent of releasing 25 tons of CO_2 into the atmosphere or 25 CO_{2e}.

Globally, it is estimated that humans produced 36.183 gigatonnes (Gt is the equivalent to 1 million tons) of greenhouse gases in 2015 (Union of Concerned Scientists, 2017). These emissions far exceed the capacity that the oceans (9.6 Gt) and land (12.4 Gt) can adequately absorb (Le Quéré et al., 2016) resulting in a rise in atmospheric greenhouse gas levels to 408 - 410 ppm in 2016 (NOAA, 2016). This increase in 2016 alone, resulted in an additional 0.07 degree Fahrenheit (0.04° C) global temperature increase (Hansen, Ruedy, Sato, & Lo, 2010) compounding the already 1.64° F (0.9° C) increase over the 1880 baseline (NOAA, 2016). While this increase appears slight, a one- to two-degree drop plunged the Earth into the Little Ice Age (1645 - 1715), and a five-degree drop was enough to bury a large part of North America under a towering mass of ice 20,000 years ago (IPCC, 2014).

With the global temperature increases, the top 10 warmest years on record all have occurred since 1998 – with the hottest year recorded in 2016 surpassing 2015, which broke the record set in 2014 (EPA, 2016). Within the United States, temperatures in parts of the North, West, and Alaska have seen the most substantial increases. This increase has prompted dramatic water shortages, intensifying the risk of wildfires, and rising sea levels have impacted coastal flooding on the eastern seaboard, especially in Florida. Forests, farms, and cities face new pests, heat waves, torrential rains, and increased flooding, resulting in damage to agricultural

land and fisheries. Human health concerns have become more pervasive, specifically seasonal allergies and asthma due to increased growth of pollen-producing ragweed in locations where it was not originally native (EPA, 2016).

In total the United States is responsible for 5.312 $GtCO_{2e}$ (gigatons of Carbon Dioxide equivalents), 15.99% of the total emissions produced globally. The EPA estimates that 77% (3.847 $GtCO_{2e}$) of the country's total emissions are directly associated with the combustion of fossil fuels. That 77% can be further divided into two general categories: 40% (1.5388 $GtCO_{2e}$) are from electricity production, (combustion of coal accounts for 93% of emissions from the electric utility industry) and 33% (1.269 $GtCO_{2e}$) from our contemporary car culture and transportation required for globally sourced goods which rely heavily on petroleum-based fuels (EPA, 2009; Union of Concerned Scientists, 2017). With fossil fuels accounting for 77% of the total US emission portfolio, the remaining 23% is spread across a variety of other sectors. For this research we are interested in exploring 'end of life management' of consumer goods, accounting for 2.5% (0.124 $GtCO_{2e}$) of the total and 8.5% of the non-fossil fuel based greenhouse gas emissions.

'End of life management' refers to the last stage of a product's lifecycle after the consumer has finished using the item. Modern consumers are faced with two decision when they dispose of goods: landfill or recycle. Depending on their choice,

it can make a big difference in our environmental footprint. An overly simplistic, yet straightforward, example is what happens at the end of life for an aluminum beverage can. Disregarding the impacts of mining and distribution of the raw ingredients, when produced raw aluminum has a high energy intensity. Due to its high reactivity, aluminum cannot be refined economically using a chemical process alone. Instead, it is processed through electrolysis – a high voltage technique that separates the non-metallic particles from the metallic ones. According to Alcoa, the largest worldwide producer of aluminum, this process uses approximately 13-kilowatt hours (kWh) of electricity to produce one kilogram of raw aluminum (Alcoa, 2017). Alternatively, when scrap aluminum is recycled, it can be directly reprocessed, avoiding the energy-intensive electrolysis process. This reduces the energy and greenhouse gas emissions by 95% with no loss of quality (The Aluminum Association, 2011). Yearly, 2% of the global energy supply is used to produce 210 billion aluminum cans that end up in the hands of consumers (World Watch, 2016). In the United States, only 54.9% of these cans are recovered, resulting in 0.7 million tons (635,029,318 kg) of scrap aluminum disposed of in landfills (EPA, 2015). This failure to recycle results in the unnecessary consumption of 8.255 gigawatts (GW; 10^6 kilowatts) of energy to produce raw aluminum, enough to power 766,801 US houses for one year (EIA, 2017).

In addition to aluminum cans, consumers are responsible for the disposal of a multitude of products each day. Like aluminum, many of these paper/plastic products can be collected through consumer recycling programs, allowing for a discarded product to enter back into the supply chain. When consumers are faced with the choice between landfill and recycling, the choice has consequences for energy use and the environment.

Waste & Recycling

Modern recycling programs trace their foundations back to the salvage campaigns of the World War II era. These campaigns urged citizens to collect aluminum and expanded to include a broad range of products such as tires, paper, tin, household fats (for use in explosives), silk stockings, and even coats for Russian refugees. These programs quickly became very widespread and were marketed as ways that Americans at home could support the war effort. With traditional materials reserved for the war effort and in short supply domestically, companies like Dow Chemical invented alternative synthetic materials, like Styrofoam and Saran Wrap ("History," 2017). These products were quickly adopted by the US military. For example, saran film was utilized to protect airplanes, artillery, and other "sensitive military equipment" from salt and sea spray during overseas

shipments (Rogers, 2006). As World War II came to an end, companies like Dow Chemical and Swanson found alternative uses for their production infrastructure. Swanson transitioned away from making rations, offering the first individually packaged “TV dinner” in 1953. Dow Chemical created disposable plates and cups finding a different application for their closed-cell polystyrene (Styrofoam).

For many Americans, the resource scarcity of World War II gave way to prosperity and abundance creating a desire for a better quality of life. The August 1955 edition of Life Magazine entitled “Throwaway Living.” noted that humankind has "entered a kind of wanton Golden Age”. Time spent "cleaning up after ourselves is just one more quaint waste of time, and tossing more and more of our used-once items into the trash was another sign of modernity's relentless ascendancy over the drudgery of the past" (Life, 1955). This technological shift in materials transitioned many of the available consumer products away from traditional materials such as rubber, paper, glass, and metals to newer petroleum-based plastic products. Simultaneously, more sophisticated and complex advertising campaigns were shifting societal demand for disposable items.

Throughout the 1950s, advertising investments increased to unprecedented levels. J. Walter Thompson Co., reported its revenue climb from $78 million in 1945 to $172 million in 1955 and $250 million by 1960 (Fullerton, 2013). The decade saw

an industry growth from $1.3 billion in 1950 to $6 billion in 1960 (Fullerton, 2013). This increase in also corresponded with a shift in the way marketing was done. In the late 1940's and early 1950's - driven by a growing middle class, increased suburbanization and the previous scarcity of products advertising reflected a return to family values and a futuristic portrayal of the modern family enjoying their new home, automobile and leisure time together. As the 1950's progressed university researchers at major institutions – most notably at Harvard and the University of Chicago - refocused their research on uncovering the consumers underlying motivations for why they did what they did. Through "greater use of the behavioral fields," Joseph Newman – a Ph.D student of Harvard Business School and author of *'Motivation Research and Marketing Management'*- recognized "that buying and consumption are human acts serving human purposes about which marketing has known too little ... They can be better understood if ... behavioral theories, concepts, and methods enter the picture" (1957, p. 386). This era of research marked a switch from viewing the consumer as a totally rational decision maker – i.e. "economic man" or econ for short – to focus on the "sub-surface phenomena" (Lazarsfeld, 1943) tapping into the consumers' need for security, sex, social acceptance, style, luxury, and success. This paradigm shift was so crucial, a committee convened by the American Marketing Association concluded that this "research is so important to

the development ... of marketing that a constant effort should be made to see that the truest insights of the other social sciences be made available" (Fullerton, 2013). As the availability and demand for disposable products increased, this shift from naturally occurring materials to synthetic petroleum based products was not done concurrently with a change in waste collection programs. Very few modern facilities existed, and a significant portion of the waste was burnt at local processing plants or disposed of in open-air landfills. Air-pollution health alerts occurred in communities across the United States. Major fish kills occurred in many rivers, and some rivers actually caught on fire.

To curtail these environmental issues, several significant industry and policy changes were implemented to mitigate these dangers. In 1964 the all-aluminum beverage container was invented, and the collection of beverage cans expanded. In 1965 the Solid-Waste Disposal Act (SWDA) created regulations for Municipal Solid-Waste (MSW). In 1968 the Container Corporation of America (CCA) hosted a national art competition. The result was a winning submission by Gary Anderson, a senior at the University of Southern California, which introduced the Reduce, Reuse, Recycle chasing arrows.

In the spring of 1970, the celebration of the inaugural Earth Day brought renewed national attention to environmental concerns and the importance of solid

waste disposal and recycling. Spurred on by this call to action the city of Woodbury, New Jersey implemented mandatory curbside recycling in 1972, becoming a model for many other municipalities across the country. Municipal curbside recycling systems spread immediately, expanding from 1,050 (5.3% of all US Counties) in 1984 to over 8,660 of the 19,492 (44%) municipalities in 2006 (MacBride, 2012). In 2013, 70% of all American citizens (Michaels, 2014) lived in a community with an active recycling program collecting 86.6 million tons of material (34.5% of total municipal solid waste (MSW) volume). These collection programs prevented 186 metric tons of CO_{2e} from entering the atmosphere, the equivalent of removing 39 million passenger vehicles from the road for one year (EPA, 2015)

Since the 1965 Solid-Waste Disposal Act, waste has continued to be highly regulated. In 1975 the Resource Conservation and Recovery Act (RCRA) amended the 1965 Solid-Waste Disposal Act addressing concerns that it was not sufficiently structured to resolve the growing waste disposal issues facing the country. The RCRA mandated states close all active ‘dumps’ and develop a comprehensive plan to manage nonhazardous municipal solid waste. Most notably, the RCRA created a "cradle to grave" management program for handling the three to four billion tons of hazardous waste discarded annually. The third substantial amendment to the Solid-Waste Disposal Act was in 1984 when, due to the public's vocal opposition to

existing hazardous waste disposal practices, the Hazardous and Solid Waste Amendments were passed. These amendments closed loopholes in the SWDA, which permitted an estimated "40 million tonnes of hazardous waste to escape annually through unregulated burning" and created a federal fund to redevelop places contaminated by hazardous waste - more commonly known as "Brownfields" (EPA, 1985). In addition to these three substantial regulations, over 20 additional federal statutes have been enacted to oversee the various elements of the waste management system within the United States.

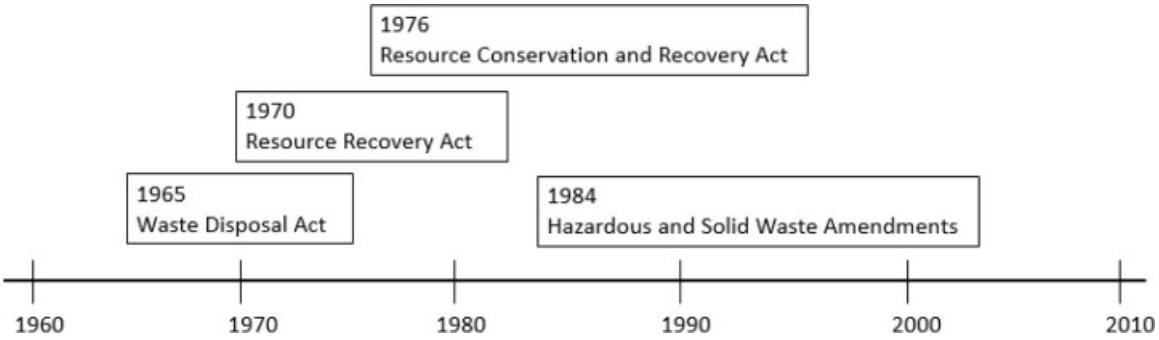

Figure 1: Timeline of legislative efforts regulating solid waste
(Liu, Ren, Lin, & Wang, 2015)

While regulations remain controversial to some, they have played a significant role in reducing the environmental impacts of solid waste (Malmberg, 2013). As we parse where the most significant impact was felt, we see a clear divide with regulation having a strong influence on corporate behaviors (King, 2000;

Johnstone, 2005; Croson, 2014) and a limited impact on individual consumer behavior (Schmid, Pratt, & Howze, 1995; Ferraro, 2009; Shove, 2010). With regulation not being proven as a way to encourage consumer recycling, many publications point to psychology/sociology as better way to understand why American consumers only recycle 34.5% of their waste (DEFRA, 2005; Jackson, 2005; Sustainable Consumption Round Table, 2006; Prendergast, Foley, Menne, & Isaac, 2008; Dilley, 2015).

Accordingly, this research examines three of the most regularly used psychosocial models - the Theory of Planned Behaviour (Ajzen, 1985, 1991), Norm-Activation Model (Schwartz, 1968, 1977), and Comprehensive Action Determination Model (Klöckner & Blöbaum, 2010; Kløckner, 2013) – in order to explore their viability for distinguishing individuals' intentions to recycle. In recent decades, there has been considerable attention applied to understand the factors that influence an individual's pro-environmental behaviors. These investigations have included behaviors such as household recycling (Kaiser & Gutscher, 2003), composting (Mannetti, Pierro, & Livi, 2004), travel choice (Bamberg & Schmidt, 2003) and the adoption of energy-efficient light bulbs (Harland, Staats, & Wilke, 1999). A majority of these studies have utilized the Theory of Planned Behavior (TPB) or its predecessor the Theory of Reasoned Action (TRA) (Taylor & Todd, 1995; Davies,

Foxall, & Pallister, 2002; Markle, 2013; Kløckner, 2013), while others have used Schwartz's Norm-Activation Model (NAM) (Schwartz, 1977; Stern, Dietz, Abel, Guagnano, & Kalof, 1999; Stern, 2000; Oreg & Katz-Gerro, 2006) as the basis of their investigations. While a substantial body of literature supports both the Theory of Reasoned Action/Planned Behaviour and the Norm-Activation Model, there are both structural (e.g. attitudes are measured in the Theory of Reasoned Action/Planned Behaviour but is omitted from the Norm-Action Model) and methodological differences (e.g. Theory of Reasoned Action uses a rational choice framework which is not present in the Norm-Activation Model) between them. Before the models can be compared, or an integrated model – the Comprehensive Action Determination Model – can be explored, a nuanced understanding of these models is needed.

Social-Psychological Models

Since the founding of the discipline of psychology by Wilhelm Wundt in 1879 (Carlson & Heth, 2010), evolution of the field has reflected subsequent changes in understanding of behavior. Beginning with functionalism (Dewey, 1896), structuralism (Titchener, 1896), and behaviorism (Pavlov, 1897; Watson, 1913; Skinner, 1938), psychologists laid the foundational understandings of behavior, both

human and animal. This initial work gave way to more nuanced and human-centric approaches such as humanistic psychology (Maslow, 1954), cognitive psychology (Miller, 1955), and cultural psychology (Bruner, 1991). While some of these theories have fallen out of favor, and others remain widely accepted, all have contributed to our understanding of human thought and behavior. Much of what we know about the social and cultural complexity of behavior has emerged thanks to this long lineage of various psychological theories.

Theory of Reasoned Action

A scientific theory presents an explanation about some aspect of human behavior which is supported through repeated testing and replicated findings. In psychology, a theory is a fact-based framework for describing a phenomenon.

The most popular and extensively used theory to understand behavior is the Theory of Reasoned Action (TRA) and its replacement the Theory of Planned Behavior (TPB) (Fishbein & Ajzen, 1975; Ajzen, 1985). Both use multiple explanatory variables to inform an individual's intention to complete a specific behavior with the expectation that the higher an individual's intention, the more likely they are to act on that particular behavior (see Figure 2).

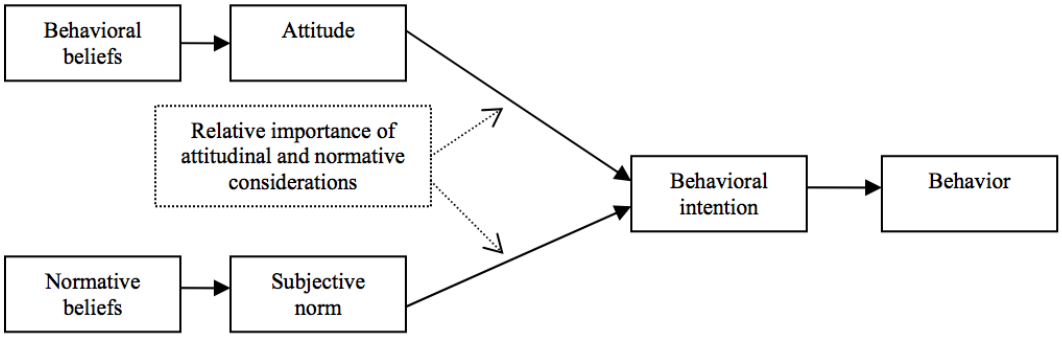

Figure 2: Theory of Reasoned Action (Fishbein & Ajzen, 1975)

As one antecedent of intention, the TRA utilizes an individual's attitudes toward a specific behavior. A combination of two factors further explains attitudes in this model: 1) one's beliefs regarding the positive (e.g., recycling will reduce pollution) or negative (e.g., recycling does not affect pollution) outcome of completing the behavior and 2) the positive or negative evaluation of the potential outcome (e.g., recycling and reducing pollution is a good thing for me to do). In addition to attitudes, subjective norms are the second explainer of intention. Like attitudes, this measure is comprised of two factors: 1) the normative belief of how an individual's valued associates (parents, friends, colleagues, et al.) would approve or disapprove of the specific behavior (e.g., "my parents think that recycling is good") and 2) the individual's "motivation to comply" and adopt the values of those associates. Ajzen felt that "the importance of people around him/her and their opinions on how he or she should act will determine the behavioral outcome" (Fishbein & Ajzen, 1980, p. 6).

Both of these variables - attitudes and subjective norms - are used to understand an individual's behavioral intention or “a person's subjective probability that they will perform some behavior” (Fishbein & Ajzen, 1975, p. 288). All measured variables, regardless of whether they are included in the TRA or not, can only affect an individual’s intention through the intention-behavior structural relationship which then results in behavioral impact. When proposing the Theory of Reasoned Action, Fishbein (1967) envisioned that intention would "capture all the motivational factors that influence behavior" acting as an "indicator of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behavior."

Initially, the Theory of Reasoned Action was one of the most popular models for researchers when investigating behavior (Thøgersen, 1996), but in 1985 Ajzen made revisions changing the name to the Theory of Planned Behaviour.

Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen, 1985; 1991) expanded upon the Theory of Reasoned Action by adding a third factor – perceived behavioral control (PBC) (see Figure 3).

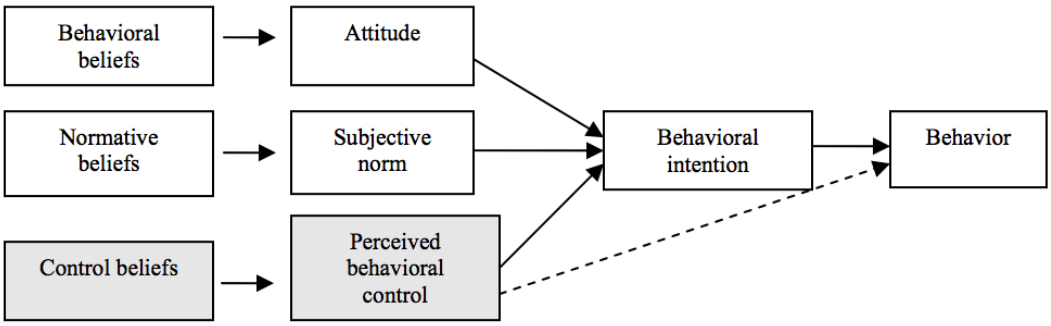

Figure 3: Theory of Planned Behavior (Ajzen, 1985)

With the addition of the PBC, Ajzen expanded the Theory of Reasoned Action to include the concepts from Bandura's self-efficacy theory (1977). Like the previous explanatory variables, attitude and subjective norms, perceived behavioral control is a function of two variables. The first is that an individual's belief that they can complete the behavior successfully (e.g., “I am sure I can recycle”) derived directly from Bandura’s understanding of self-efficacy. The second is that an individual’s perception of how external factors could inhibit or facilitate the behavior (Kraft, Rise, Sutton, & Røysamb, 2005) measuring their confidence within a specific set of physical or geographic parameters (e.g., “I am able to recycle within my building” or “I am sure I can recycle on vacation”).

Contrasting the other two explanatory variables - attitudes and subjective norms - which are internal perception measures, perceived behavioral control exists both internally and externally to the respondent.

The addition of perceived behavioral control also shifted the structure of the intention-behavior relationship. In the Theory of Reasoned Action, all explanatory variables informed an individual's intention to complete a behavior, and that intention was the sole explainer of behavior. With the addition of perceived behavioral control, the intention-behavior relationship remained, but PBC was included as a mediating variable directly influencing behavior. This structural connection was intended to help in understanding situations where an individual intended to complete a behavior, but factors beyond the individual's control, (e.g., lack of recycling bins), prevented them from completing the behavior. This explains many of the contradictions where subjects had high environmental attitudinal scores yet reported low or non-existent scores on behavioral measures (Koger & Winter, 2011; Stern, 2005).

For the Theory of Reasoned Action/Planned Behavior to "explain virtually any human behavior" (Fishbein & Ajzen, 1980) we have to agree to four base conditions: 1) a positive relationship exists between an individual's intent to complete a behavior and their likelihood of completing the behavior; 2) before acting, an individual utilizes all available knowledge to inform their behavior; 3) one always considers the implications of their actions before acting; and 4) behavior is always 100% voluntary and within an individual's control to complete the action

(Sheppard, Hartwick, & Warshaw, 1988). These conditions place the Theory of Reasoned Action and the Theory of Planned Behavior in a classification as a "social psychological variant of the general rational choice approach" (Fishbein, 1967; Anderson, 1971; Bamberg & Schmidt, 2003, p. 202) and is affirmed by Fishbein and Ajzen in their 1975 book on the subject.

> The totality of a person's beliefs serves as the informational base that ultimately determines his attitudes, intentions, and behaviors. Our approach thus views man as an essentially rational organism, who uses the information at his disposal to make judgments, form evaluations, and arrive at decisions (Fishbein & Ajzen, 1975).

This rationalist approach has been the subject of much debate and deliberation. Human behavior is extremely complex and consists of social, moral, and altruistic behaviors in addition to the merely self-interested motivations assumed in the Theory of Reasoned Action/Planned Behavior. Often, a behavior is also rooted in a collective, social, or habitual context which continually shapes or constrains individual preference for action. As one of the most well-established psychological models of individual decision making, the TRA/TPB model fails to consider many of these additional significant constructs.

Theory of Interpersonal Behavior

In this research, the Theory of Interpersonal Behavior will not be tested in the multi-model analysis. Multiple explanatory variables originate from the TIB - habit and facilitating conditions - and appear in the final analysis. Therefore, it is essential to have a broad understanding of this theory in order to test and interpret the others. Following on Fishbein & Ajzen's introduction of the Theory of Reasoned Action in 1975, Triandis released the Theory of Interpersonal Behavior (TIB) in 1977 (see Figure 4).

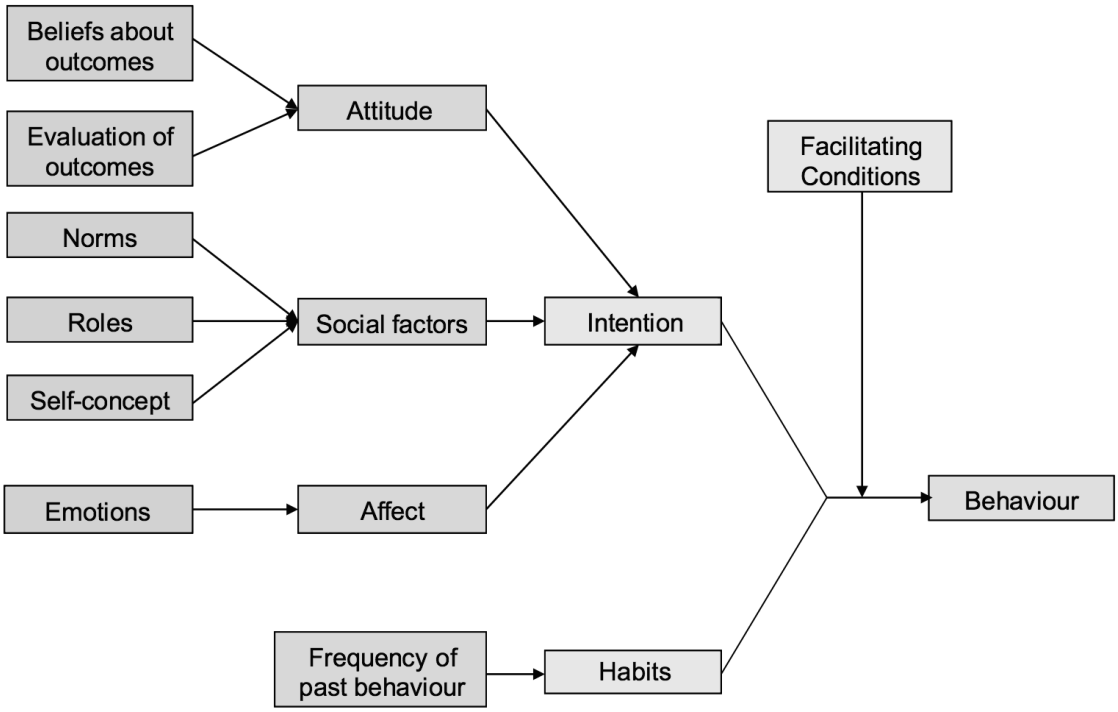

Figure 4: Theory of Interpersonal Action (Triandis, 1977)

Like the Theory of Reasoned Action, the objective of this theory is to understand an individual's behaviors. On its surface, the TIB could be perceived as an extended version of the Theory of Reasoned Action. Both employ the rational-choice approach, ascribe a positive correlation between intention and behavior, as well as uses similar frameworks to measure attitude, social factors/subjective norms, and intention. But, while Fishbein & Ajzen's approach was to capture the most variance with the least number of variables, Triandis attempted to "account for the most variance in total" believing that "even a small amount [of variance] may be relevant" (Triandis, 1977). This methodology is apparent when we look at the structural design of the models (see Figures 3 & 4).

The Theory of Reasoned Action contains seven nodes that inform intention, while the Theory of Interpersonal Action has 13 (Table 1) including specific measures for an individual role within a social group, their self-image, and extraneous interpersonal commitments - which Fishbein contends are already included in the TRA through the individual's attitude toward the behavior (1980).

Table 1: Comparison between TRA and TIB variables.

Theory of Reasoned Action		Theory of Interpersonal Behavior
Behavioral Intention	↔	Behavioral Intention
Attitude	↔	Attitude
Outcome Belief	↔	Outcome Belief
Outcome Evaluation	↔	Outcome Evaluation
Subjective Norms	↔	Subjective Norms
Valued Peers	↔	Valued Peers
Motivation to Comply		Roles
		Self-Concept
		Facilitating Conditions**
		Affect
		Emotions
		Habits
		Frequency of Behavior

*** added into the Theory of Planned Behavior (Ajzen, 1985)*

One additional construct in the TIB that is purposely measured, and not contested by Fishbein, is the addition of habits. Originating from the behaviorist school of psychology, our understanding of habits started as reinforcement-based where human action is motivated by external contingencies (Thorndike,1911; Skinner 1938; Hull 1943). Early social psychologists recognized habit-like effects during studies on operant conditioning - method of learning that occurs through rewards and punishments - which lead to the idea that attitudes form through rewards (Insko, 1965). Triandis took a different approach. He conceptualized habits as an "information-processing framework" claiming that as people repeat actions in the same context, the need for an intention-behavior relationship decreases and the

influence of habit on behavior increases (Ouellette & Wood, 1998). Habits become a "situation-behavior sequence that … have become automatic, so that they occur without self-instruction" (Triandis, 1980, p. 204).

Another addition to the Theory of Interpersonal Behavior is the inclusion of facilitating conditions. Facilitating conditions are the external factors within the environment that enable specific behaviors to be performed with ease (Triandis, 1977). In addition to being important conceptually, its role as a moderating variable between habit, intention, and behavior is also essential. This moderating effect suggests that an individual may have an intention to perform a particular act, but if the situation does not allow the individual to carry out the behavior their performance of that behavior will be hindered. For example, this moderating effect can be understood as cars trying to cross a drawbridge. When the conditions exist, and the bridge is down, travel is allowed. If the bridge is up cars cannot cross, regardless of other factors. While the moderating effect in the Theory of Interpersonal Behavior is not always binary like a bridge, the facilitating conditions variable acts as a control between ones intention and their ability to complete a behavior. For example, if recycling infrastructure is not present when an individual goes to recycle, they are unable to complete the behavior. In their update to the Theory of Reasoned Action, the Theory of Planned Behavior, Triandis' facilitating

conditions (1977) were integrated into the new variable – perceived behavioral control. While the concept of facilitating conditions did not change from Triandis' initial design, the nature of how it influences behavior did. Instead of acting like a bridge, directly inhibiting the intention-behavior relationship, perceived behavioral control is described both as an explanatory variable to behavioral intention (solid line) while simultaneously having a partial mediating effect (dotted) directly on behavior (see Figure 3). This partial mediation effect, to continue using the car analogy, means that perceived behavioral control acts more like a second lane to a road. The number of lanes does not directly influence [i.e. causally increase] the number of cars on the road but allows for a greater number of cars to travel more efficiently down the stretch of road. There is scholarly literature supporting both the moderating effect of facilitating conditions (Sharma, 2013; Khalil, 2017) and the mediating role of perceived behavioral control (Altawallbeh, 2015; Tan, 2016; Liu, 2013). With the current literature inconclusive, additional research is needed to understand what influences the moderating and mediating effects of perceived behavioral control.

Schwartz Norm Activation Model

A fourth model commonly utilized to explore behavior is the Norm-Activation Model (NAM) proposed by Shalom Schwartz in 1977. Schwartz

deemphasized the intention-behavior 'rational choice' linkage, choosing to focus on the role of personal norms have in completing altruistic behaviors (commonly referred to as norm-consistent behaviors; Cadwel, 2012; Onwezen, Antonides, & Bartels, 2013). For many, Schwartz's model offers a more agreeable starting point for understanding recycling behavior. Thogersen suggests that

> "in affluent societies, environmental behaviors like recycling are typically classified within the domain of morality in people's mind. Attitudes regarding this type of behavior are not based on a thorough calculation, conscious or unconscious of the balance of costs and benefits. Rather they are a function of the person's moral beliefs, that is the belief in what is right or wrong to do" (1996, p. 536).

Over time these contextualized norms form the "foundations that become an internalized part of the individual reconciliation between their identity and that of the group" (Schwartz, 1981).

When comparing the Norm-Activation Model with The Theory of Reasoned Action/Planned Behavior and Interpersonal Behavior models, there are two different norm measures. Within the 'rational choice' models (i.e., TRA, TPB, TIB) there a measurement of norms that focus on the "general expectations that exist external to the individual" (Schwartz, 1977). The Norm-Activation Model differentiates between social and personal norms allowing for an investigation of how an individual's "actions may be motivated by empathy and by concern about the welfare and rights

of others as well as for egotistic or practical concerns, such as one's social status or reputation, hope for direct or indirect reciprocity, or adherence to one's perceived system of fairness" (Carlson & Heth, 2010).

Unlike Fishbein and Ajzen's Theory of Reasoned Action/Planned Behavior, Schwartz did not intend for this model to explain all behavior, only in situations where an individual's personal norms are "activated." Norm activation occurs when an individual feels personally accountable (ascription of responsibility) and understands that their action, or lack of action, will have an adverse impact on the welfare of others (awareness of consequences). Only after individuals' acknowledge their responsibility and the potential for consequences of inaction are recognized is the influence of personal norms on behavior present (see Figure 5). If one or neither is activated, the individual does not realize they face a moral choice (Schwartz, 1981) and personal norms will not affect the behavioral choice.

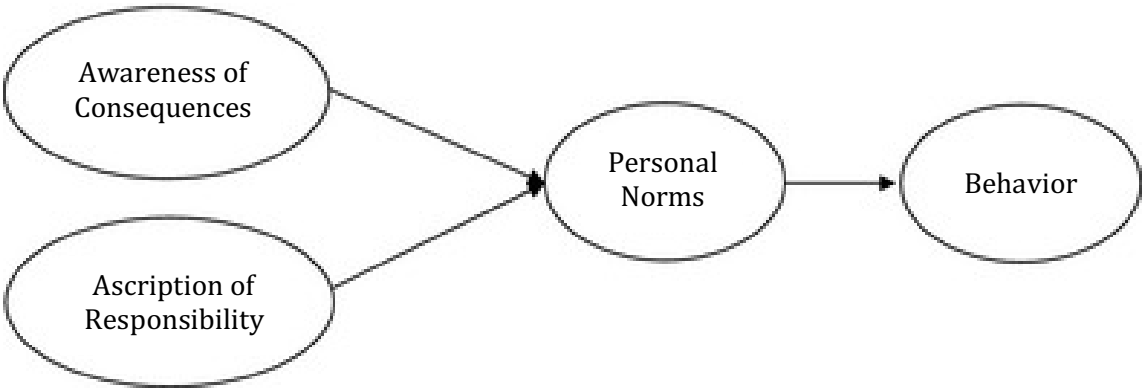

Figure 5: Schwartz's Norm Activation Model (Schwartz, 1968)

Previous research has identified the importance of personal norms in a variety of pro-environmental behaviors such as reducing car usage (Harland et al., 1999; Bamberg & Schmidt, 2003), energy conservation (Harland et al., 1999), and supporting environmental groups (Stern, Dietz, & Black, 1985) and Hopper and Nielsen (1991) found that social norms influenced recycling behavior only when an individual was aware of the consequences of failing to recycle.

Focus Theory of Normative Conduct

The Focus Theory of Normative Conduct (Cialdini, Reno, & Kallgren, 1990; 1991) attempts to understand the role that social norms have on an individual's behavior. Using norm-activation reasoning similar to Schwartz, Cialdini claims that "[social] norms are in play when they are salient, and people will act in ways that are consistent with socially acceptable behavior" (1990). By this reasoning, unless an individual is aware of the norm, regardless of how widespread it is, their social norm will remain non-active, limiting the effect on an individual's behavior.

Cialdini offers a different view of social norms than found in the Theories of Reasoned Action/Planned Behavior and Interpersonal Behavior. In previous models respondents self-selected their 'valued peers' as a referent group, regardless of their current setting. Cialdini acknowledged that norms have a strong impact on behavior, but need to be based on peers located within the same situation as the respondent,

not a self-selected 'valued peer.' For example, how an individual would act in their current church, mosque, or synagogue might be different from the one they attended growing up. If asked how a 'valued peer' would view an action within their current congregation, we create a situation where each respondent could draw upon a unique set of referents misrepresenting the social norms within the current environment. Cialdini posed that if peers should be restricted to the specific social setting.

The Focus Theory of Normative Conduct also sought clarity to what he claimed was the "current ambiguous role of norms in accounting for human action" (1991). Cialdini proposes there are

> “three distinct types of norms that are effective: social norms of the descriptive kind, which guides the behavior via the perception of how most others would behave; social norms of the injunctive kind, which guides the behavior via the perception of how most others would approve/disapprove of a person's conduct; and personal norms, which guides the behavior via the perception of how a person would approve/disapprove of his own conduct” (Cialdini et al., 1991)

Personal norms, which have been covered in the Norm-Activation Model, social norms were divided into two general categories. The injunctive social norm of what "ought” measures the "the moral rules of the group" (Cialdini, 1991) or the "widely shared beliefs or expectations about how people” (Perkins, 2002) should act.

Alternatively, the descriptive social norms focuses on individuals perceptions of what is "the most common actions actually exhibited in a social group" (Perkins, 2002) providing evidence as to the most "sensible thing to do or think or believe" (Cialdini 1988) within the current environment.

Recycling has been acknowledged to be a socially norm-moderated behavior (Yuan, Nomura, Takahashi, & Yabe, 2016; Miafodzyeva, Brandt, & Andersson, 2013; Schultz, 1999). While the Focus Theory of Normative Conduct will not be tested directly, a measure of descriptive norms (which is not currently included in any of the tested models) has been added to the assessment, with the aim of understanding how much additional power this explanatory variable adds to the tested models.

Comprehensive Action Determination Model

The psychosocial theories described previously do not provide a holistic understanding of an individual's behavioral motivations (Etienne, 2010). The Theory of Reasoned Action/Planned Behavior takes a firm 'rational choice' approach omitting many of the collective, social, or habitual contexts. Triandis's Theory of Interpersonal Behavior applies a less structured rational choice approach and includes the role of Habit and Facilitating Conditions but fails to include the integration of personal norms. Finally, the Norm-Activation Model and Focus

Theory of Normative Conduct expands our understanding of norms through the introduction of awareness of consequences and need, as well as injunctive and descriptive norms, but is limited only to the role of norms on behavior.

One attempt at integrating all of these models is the Comprehensive Action Determination Model (CADM: Klöckner & Blöbaum, 2010). Structurally, the model is divided into five meta-categories: intentional, habitual, and normative processes, situational influences, and ecological behavioral considerations deviating from the 'rational choice' approach with habit, situation, and intention having direct and mediating/moderating effects on intention (see Figure 6).

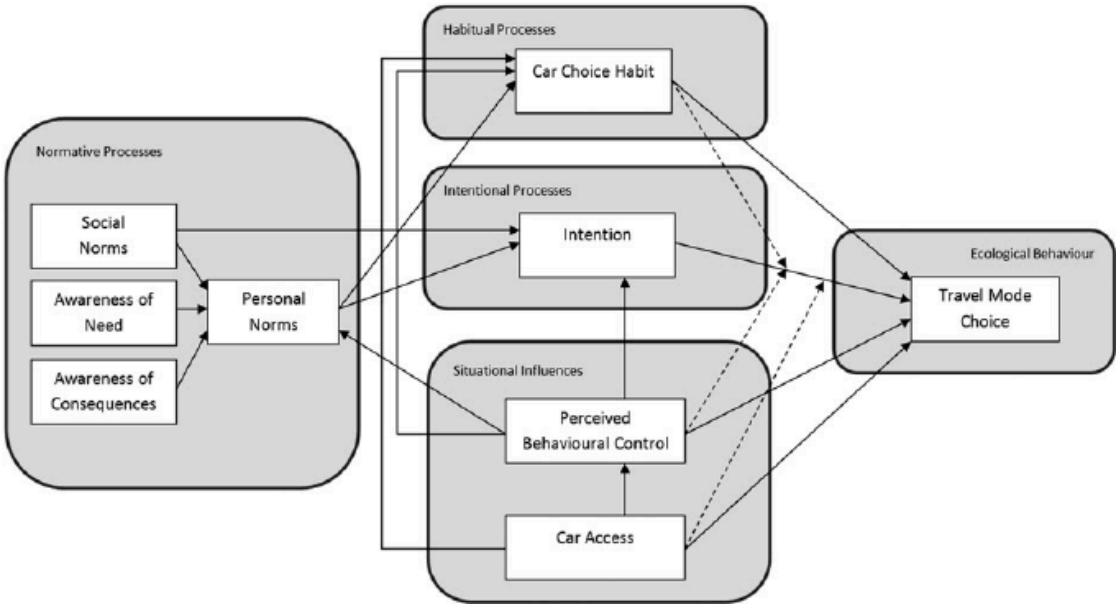

Figure 6: Comprehensive Action Determination Model (Klöckner & Blobaum, 2010)

This model consolidates explanatory variables from the Theory of Reasoned Action/Planned Behavior (social/subjective norms, perceived behavioral control, attitude), Interpersonal Behavior (habit and facilitating conditions), and Norm-Activation Model (personal norms, awareness of need, and awareness of consequences) into one holistic model allowing for the measurements of both altruistic and egotistic behaviors.

As we explore the model, the structure of the 'normative processes' category appears to be a direct analog of Schwartz's Norm-Activation Model - awareness of need and consequence directly inform personal norms and with the addition of a specific variable to measure social norms direct influence on behavioral intention. In his original design of the Norm-Activation Model, Schwartz suggested social norms informed personal norms but did not include it is a specific measure, raising the question of how Schwartz conceptualized social norms A review of the research done by Schwartz (1968, 1977, 1981, 1992) reveals that he described them as "general expectations that exist external to the individual", but he never formally measured or offered a framework for social norms. With Schwartz's previous work offering a limited understanding, a meta-analysis by Klöckner (the same author as the CADM) offered a more detailed structural model of the Norm-Activation Model

(see Figure 7) indicating that subjective norms - valued-peers - was the most commonly utilized composition of social norms in the Norm-Activation Model.

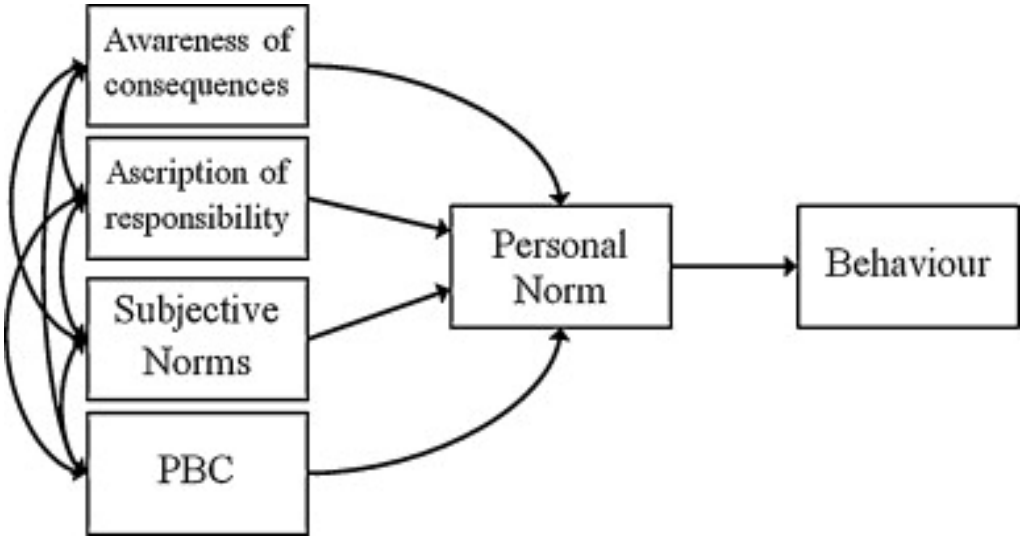

Figure 7: Expanded Norm-Activation Model (Klöckner, 2013). PBC refers to Percieved Behavioral Control.

The initial testing of the Comprehensive Action Determination Model was completed using students' mode of travel (car, bike, public transportation, etc) to locations around an urban campus. When model fit results were compared to the Theory of Planned Behavior and the Norm-Action Model, Klöckner & Blöbaum (2010)found that "all models had a good to excellent model fit explaining a substantial amount of variation in travel mode choice. The CADM, however, explained the greatest degree of variation as compared with the other models, at 65%" (2010). Although the Comprehensive Action Determination Model

outperformed the other models, there has been limited additional tests using the model, leading Klöckner & Blöbaum to point out that "the demonstrated support for the CADM in the domain of travel mode choice does not necessarily mean that the CADM is a valid model for other domains of ecological behavior." Two follow-up studies focusing on family residential recycling (Klöckner & Oppedal, 2011) and "the Mechanisms behind Changing People's Recycling Behavior" (Ofstad, Tobolova, Nayum, & Klöckner, 2017). Both showed that the "CADM model appears to be a good fit with the data" (Ofstad, Tobolova, Nayum, & Klöckner, 2017). No comparison, however, was made to the Theory of Planned Behavior or Norm-Activation Model, limiting our ability to determine if there was any additional explanatory power when analyzing recycling behavior. As part of this research, I analyze the ability of the Comprehensive Action Determination Model, Theory of Planned Behavior, and the Norm-Activation Model to explain the variance of an individual's intention to recycle.

Scope of Research

Individuals confront multiple times per day, is how we dispose of products at the end of their use. Making the choice to recycle can greatly decrease an individual's footprint, and doesn't require system-wide change. With Americans only recycling

34.5% of their waste, environmental regulation has worked to influence corporations but has had relatively minimal impact on individuals; there is a disconnect somewhere. A turn to psychology offers insights at the individual scale.

For the past century, psychology has attempted to understand how humans interact with each other, their environment and how they process information. Multiple theoretical models have been posited to understand the elements that motivate human behavior, and as environmental concerns rise, many have been applied to various pro-environmental behaviors. This research explores the connections between these models, and their applicability in understanding individuals' recycling behavior. The study examines the following two research objectives:

Research Objective #1 (RO_1): Compare the total variance in recycling behavior explained by the Theory of Planned Behavior, Norm-Activation Model, and the Comprehensive Determination Model.

This study will explore three socio-psychological models - Theory of Planned Behavior (Ajzen, 1991) and Norm-Activation Model (Schwartz, 1968) and Comprehensive Action Determination Model (Klöckner & Blöbaum, 2010) to determine the explanatory power in understanding recycling behavior.

Research Objective #2 (RO_2): Determine the increase in total variance in the recycling behavior by adding descriptive norms to the Comprehensive Action Determination Model.

In addition to a model comparison, this research is intended to expand our understanding of social/subjective norms found within the Comprehensive Action Determination Model, using the descriptive norms concept from the Focus Theory of Normative Conduct.

Chapter 2 Methodology & Methods

The goal of this study is to compare the ability of three commonly used psychosocial models – Theory of Planned Behavior, Norm-Activation Model, and the Comprehensive Action Determination Model – to explain an individual's intention to recycle. This chapter discusses the philosophy underpinning this research and the methods employed to address the research objectives.

Michael Crotty (1998) and John Creswell (2003) argue that a researcher has three central questions of inquiry while designing a research initiative: 1) "What epistemology - theory of knowledge embedded in the theoretical perspective - informs the research; 2) what theoretical perspective - philosophical stance - lies behind the methodology in questions; and 3) what methodology - strategy or plan of action that links methods to outcomes - governs the choice of methods?" (Crotty, 1998). Using these elements, a researcher can identify either a quantitative, qualitative or mixed methods approach to inquiry. (Creswell, 2003).

Methods

This research replicates the methods used by Klöckner & Blöbaum (2010) who applied various multiple regressions in their research on the Theory of Planned Behavior and Norm Activation models. Multiple regression is an excellent tool to explore the variance in a [normally-distributed] dependent variable, based on a series of independent variables (Tabachnick & Fidell, 2006) but only when the relationships between the variables are accurately identified. For example, attitude, subjective norms, and perceived behavioral control are known to influence behavioral intention in the Theory of Planned Behavior (Figure 3, PG 24) due to the extensive body of supporting literature. The relationships between these independent and dependent variables can be considered accurately identified and tested using a multiple regression. On the other hand, when the structural relationships between the independent and dependent variables are in question – either due to a lack of supporting literature or questioned by design - a Structural Equation Model (SEM) should be used (Saunders, Lewis, & Thornhill, 2009). Structural equation modeling simultaneously constructs the structural relationships between variables - path analysis - while completing multiple regressions between the independent and dependent variables. The results of completing a structural equation model is a visual representation –structural model – of how variables are

related to each other and measure –factor analysis - of the variance between the two related variables.

In this instance, the CADM is an integration of well-studied models – TBP and NAM – and the relationships can be assumed to be theoretically sound, meaning conducting a full SEM (both path and factor analysis) is not necessary. With the structural pathways assumed correctly identified, regressions will automatically be run between all the dependent and independent variables based on the relationships in the model. This process, also known as a confirmatory factor analysis, explores how well the collected data fits the already determined model.

Testing the Comprehensive Action Determination Model

A confirmatory factor analysis was run using the structural relationships designed by Klöckner & Blöbaum in the Comprehensive Action Determination Model (see Figure 6). All non-behavioral variables are included – subjective norms, attitude, perceived behavioral control, awareness of consequences, awareness of need, personal norms, habit, and intention. The analysis was completed using SPSS v24.0 for Mac and AMOS v25.0.

Testing the Theory of Planned Behavior

A confirmatory factor analysis was run using the structural relationships designed by Fishbein and Ajzen in the Theory of Planned Behavior (see Figure 3). All non-behavioral variables are included – subjective norms, attitude, perceived behavioral control, and intention. The analysis was completed using SPSS v24.0 for Mac and AMOS v25.0.

Testing the Norm-Activation Model

A confirmatory factor analysis was run using the structural relationships designed by Schwartz in the Norm-Activation Model (see Figure 5). All non-behavioral variables are included – awareness of consequences, awareness of need, and personal norms. The analysis was completed using SPSS v24.0 for Mac and CFM via AMOS v25.0.

Testing the Injunctive and Descriptive integration

One of the inquiries within this research is to understand if the addition of descriptive norms, from the Focus Theory of Normative Conduct, provide any increase in the overall variance explained with the model. A Confirmatory Factor Analysis was run using the structural relationships designed by Klöckner & Blöbaum in the Comprehensive Action Determination Model (Figure 6). Descriptive

norms are structurally added as an explanatory variable of personal norms alongside social norms, awareness of consequence, and awareness of need. The analysis was completed using SPSS v24.0 for Mac and AMOS v25.0.

Population and Sampling

The Pennsylvania State University main campus, where this research was conducted, has an on-campus residential population of 13,700 students, mandated by a first-year residency requirement. First-year residential students were chosen as the target population. This was done to ensure all respondents' perceptions were collected using a common recycling system and a common reference location when measuring descriptive norms.

A proportional stratified random sample of 2,200 students was acquired with the assistance of Penn State Student Affairs Research and Assessment. The method of stratified random sampling involves dividing the total population into smaller groups or strata based on specific characteristics. To ensure proportionality, the number of respondents selected from within strata are drawn to be representative of the whole population. For example, if males comprise 46% of the population, the sample population will also contain 46% males. For this study, the stratification was initially segmented by sex (male/female as indicated by the student to the university)

and then again by residential status (domestic/international based on the location of their 'home' address on file with the University). Both sex and residential status were included as indicators based on previous research indicating a relationship between and respondents sex (Swim & Geiger, 2018; Swim, Vescio, Dahl, & Zawadski, 2017) and country of origin (Martin, Williams, & Clark, 2006; Crociata, Agovino, & Sacco, 2015) and their propensity to engage in pro-environmental behaviors.

Survey Instrumentation

The survey instrument is a modified version of that used by Klöckner & Blöbaum for the Comprehensive Action Determination Model (2010) with the addition of descriptive (Carey, Henson, Carey, & Maisto, 2010), attitudinal (Tonglet, Phillips, & Read, 2004), and demographic variables (Table 2).

Due to the length of the instrument, multiple questions pertaining to a similar variable were grouped together using a 'blocking technique.' This construction method allows for questions pertaining to a specific variable (e.g. attitude, social/personal norms) to be asked in succession, while each set of questions are presented randomly to each participant. For example, respondent #1 will receive all 3 attitude questions, followed by the 7 perceived behavioral control, and then 3

subjective norms questions; while respondent #2 will receive the 7 perceived behavioral control, followed by 3 for attitude, and finally the 3 pertaining to subjective norms. Participants are asked to complete the entire instrument, but the order in which these constructs appear differ for each participant to counterbalance the ordering effects phenomenon (Strack, 1992). The order effect refers to the well-documented phenomenon that different orders in which the questions (or response alternatives) are presented may influence respondents' answers in a more or less systematic fashion (Schuman & Presser, 1981). Thus, Question A may be answered differently if it is asked before Question B compared with a situation in which the order of the two questions is reversed.

Table 2: Description of Variables

Variable Name	Annotation	Cronbach's Alpha	Collection Method / Source
Demographic Information			("Examples of Demographic Questions," 2011)
Awareness of Consequences	AC	0.829	3 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Ascription of Need	AN	0.59* *(AN3 removed)*	3 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Attitude	ATT	0.829	3 Questions - 7 pt. Likert scale (Tonglet et al., 2004)

Descriptive Norm	DN	0.816	3 questions – 7pt Likert Scale (Carey et al., 2010; Larimer et al., 2001)
Habit Response Frequency Measure	H_RFI	.0821	5 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Self-Report Habit Index	H_SRH	0.876	6 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Intention	INT	0.914	2 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Perceived Behavioral Control	PBC	0.810	7 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Personal Norm	PN	0.908	3 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)
Social Norm (Injunctive)	SN	0.819	3 Questions - 7 pt. Likert scale (Klöckner & Blöbaum, 2010)

Once the instrument was drafted, it was pretested to avoid problems with format and question-wording. First, seven undergraduate interns, employed by the Penn State Sustainability Institute, volunteered to pre-test the survey followed by a "respondent debriefing" (Vannette, 2015). Respondent debriefings were utilized to

learn if their individual interpretation of the questions aligned with the intended construct to be measured. Second, a pilot study was launched using a convenience sample of 50 undergraduate students in the Foundations of Leadership in Sustainability class (SUST 200) to identify any issues with e-mail distribution method or data collection methods. With that pilot data, a Cronbach's alpha was completed to assess the internal reliability within each question set. Completing a Cronbach's alpha at this early stage ensures that all question all question pertaining to a specific variable yield consistent answers. For example, when an instrument is well-constructed, there should be internal congruence within an individual's responses toward a specific variable – e.g., attitude. This congruence – referred to as reliability - indicates that the series of questions are all measuring a similar phenomenon, resulting in a high (> 0.75) Cronbach's alpha score. On the other hand, if an individual's responses to the questions differ significantly, the Cronbach alpha score will be low indicating a problem with the specific set of questions.

Reliability Testing

All constructs (except for Awareness of Need) returned a Cronbach's alpha between 0.816 and 0.914 (see Table 2), indicating an excellent to high reliability within all question groupings (Hinton, Brownlow, McMurray, & Cozens, 2004, p. 364). Awareness of Need returned an alpha indicating a weak reliability ($\alpha = 0.478$).

After investigating, it was concluded that a poorly constructed question confused multiple participants reducing the reliability within the question set. The question (AN3; Recycling contributes to pollution) remained in the final version of the survey but was omitted in any analysis raising the final alpha to 0.59 (see Table 3) indicating moderate reliability (Hinton et al., 2004, p. 363).

Table 3: Results of Cronbach's Alpha for Awareness of Needed

Question	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Cronbach's Alpha if Item Deleted
AN1: Recycling is an urgent problem for environmental protection	9.06	6.776	.411	.198
AN2: I believe that not recycling causes many environmental problems	8.77	8.100	.312	.376
AN3: Recycling contributes to pollution	10.86	6.076	.217	.587

Administration

The Dillman Tailored Design Survey Method (Dillman, Smyth, & Christian, 2009) was used to ensure a robust response rate. The sample population was contacted via their PSU e-mail address on September 25, 2017, with information that they had been selected for a research study, what to expect, and offer an opportunity to opt-out. E-mails containing the survey were sent to participants 10 days later on

October 5, 2017, with follow-up e-mails on October 9 and 12. A final survey reminder was sent out on October 16 and the survey remained open for an additional week to ensure ample time for participants to reply to the final notification.

Incentives

Incentives are a contested topic within the social science literature. Many of the publications focusing on e-mail based surveys found that the response rate "more than doubled when a monetary incentive was used" (Edwards et al., 2002; Yu et al., 2017) and "reduced item nonresponse" (Olsen, Abelsen, & Olsen, 2012). To encourage the sample population to participate in this survey, gift certificates for 1 free ice cream at the Penn State campus creamery (Berkey Creamery) were offered to all participants who completed the study at the cost of $4.00 per participant.

Limitations

This study mirrored the methods by Klockner and Blobaum (2010) which relied on self-report data and utilized quantitative methods to collect and analyze data. As with all research, this study has limitations. Due to time and resource limitations this study did not obtain any behavioral measurements relying solely on individuals self-report similar to Klockner and Blobaum. This study also utilized a

particular population – residential college students - as the sample. In the following sections, limitations will be outlined, and their potential impact on the research will be discussed.

Lacking Behavioral Measurements

This study did not include any direct measure of respondents' behavior. This lack of behavioral measurement potentially limits our understanding of how various explanatory variables may directly influence behavior. Even when collecting behavioral measurements, the timeframe in which they are collected is a concern. For example, when using the Theory of Reasoned Action/Planned Behavior Ajzen noted (1985) the "measure of intention … must reflect respondents' intentions as they exist just before the performance of the behavior" (Ajzen, 1985, p. 18). This creates a temporal limit on how the researcher can interpret the intention-behavior relationship. Simply put, unless the measurement of intention and behavior occur simultaneously, there is potential for low- explanatory accuracy. Smartphone sensing methods are poised to address this gap allowing researchers to collect behavioral data relatively objectively and unobtrusively (Boase, 2013; Wrzus & Mehl, 2015) and within the temporal gap proposed by Ajzen. In doing so, these methods may also help researchers address some of the retrospective self-reports shortcomings of and reduce reliance on artificial laboratory contexts. As this new

technology is adopted, we may also find the collection of data in real-world conditions maybe produce more generalizable findings about people's day-to-day behavioral tendencies (Harari et al., 2016).

Reliance on Self-Report

The second limitation of this research is the reliance on self-report - a conventional data collection method - as the primary data collection method. While common, studies that rely singularly on self-report are susceptible to a variety of biases. One well-researched phenomenon is the role of social desirability bias where respondents answering questions in a specific way perceived as favorable by the researcher. While no clear indication of this bias between environmental attitudes and socially desirable responses (Felonneau & Becker, 2008; Milfont, 2009; Oerke & Bogner, 2013), there is consensus within the health and nutrition literature that such bias is a significant factor in those fields. A meta-analysis of published in a popular peer-reviewed health research index (CINAHL) indicated that more than 43% of the reviewed studies were influenced by some type of social desirability bias (van de Mortel, 2005). It can be assumed that as environmental concerns become more widely acknowledged and efforts to mitigate personal impacts become more prolific, the role of social desirability must be more intentionally considered.

Sole use of Quantitative Methods

In addition to the bias inherent in self-reporting, this research also only utilized quantitative methods. By using one epistemological approach, the ability to understand a complex topic such as behavior was limited. Had time and other resources been available a mixed methodological approach could have been utilized allowing for the "inquiry to draw liberally from both quantitative and qualitative assumptions" (Creswell, 2003). Instead of utilizing only an objectivist approach, the application of subjective or constructive approaches would allow the study to "choose a broad range of methods, techniques, and procedures that best meet the researchers' needs and purposes" (Creswell, 2003). More specifically, a sequential exploratory mixed-methods design would be appropriate and strengthen this research. "A sequential exploratory mixed-methods design is a two-phase mixed methods approach where a researcher first explores a research problem by collecting and analyzing quantitative data. During the second phase, the researcher collects and analyzes qualitative data that build upon the initial quantitative findings" (Creswell, Plano Clark, & Hanson, 2003).

Population and Context Specificity

Finally, the population of this research is narrow, only collecting responses from first-year residential students at the Pennsylvania State University main

campus at University Park. The collegiate residential context is a unique experience when compared to many of the other situations, therefore the results – as it pertains to subjective and descriptive norms – is challenging to generalize to a broader non-college residential population.

Chapter 3 Results

A total of 750 students participated in the study, all traditional aged (18 - 24) and first-time residential students at Penn State's University Park campus. All respondents answered 10 blocks of questions corresponding to the psychosocial explanatory variables (Table 2; pg. 38) within three commonly used models – Theory of Planned Behavior, Norm-Activation Model, and Comprehensive Action Determination Model. In addition to the questions about the explanatory variables, four demographic questions – gender, residential status (international/domestic), transfer status, and college - were also asked. In this chapter, a review of the descriptive and demographic data will be presented followed by findings related to the two research objectives.

Participant characteristics

Four specific questions were asked of all respondents' regarding their gender identity, residential and transfer status as well as the college within which their chosen major was housed.

Gender Identity

More than half, 52.8% (n=419) of the participants identified as female and 34.6% (n=275) identified as male (see Table 4). Additional gender selections (transgender: people whose gender identity is the opposite of their assigned sex and genderqueer: a general category for gender identities that are not exclusively masculine or feminine) were available to survey participants to ensure inclusive data collection. Those who identified as non-cisgender (gender identity does not match the male/female sex that they were assigned at birth) was low (n=100; 12.6%) and cannot be included in any analysis.

Table 4: Gender distribution within respondents

	Frequency	Percent	Cumulative Percent
Woman	419	52.8	52.8
Man	275	34.6	87.4
Transgender	1	.1	87.5
Genderqueer or Gender nonconforming	3	.4	87.9
Prefer not to Answer	96	12.1	100.0
Total	794		

Previous research suggests that an individual's gender identity is a significant factor in how they embrace environmentally friendly products and behaviors. Care about the environment is traditionally perceived as feminine and a gender gap exists

when measuring attitudes, values, and perceptions (Brough, Wilkie, Ma, Isaac, & Gal, 2016; Swim et al., 2017; Swim & Geiger, 2018). This study found a similar relationship, with male respondents having a statistically significant ($p < 0.001$) negative correlation (-0.324 to -0.071) on all independent variables except for awareness of need and descriptive norms (see Table 5) when compared to female respondents. No significant association ($p = 0.267$) was found in the relationship between gender and pre-college recycling behavior (Habit: Response Frequency).

Table 5: Variable Correlation Coefficients including respondents' gender

	Pearson Correlation	Significance
Attitude	-.324	***
Perceived Behavioral Control	-.242	***
Personal Norms	-.209	***
Intention	-.202	***
Habit: Self Report Habit Index	-.192	***
Awareness of Consequences	-.171	***
Social/Injunctive Norms	-.161	***
Awareness of Need	-.096	0.022
Descriptive Norm	-.071	0.088
Habit: Response Frequency Index	-.046	0.267

*$p < 0.001$ ****

International v. Domestic

An intentional cross-section of international and domestic students was chosen in the sample population. International students were identified student

whose primary residence was outside the United States. Domestic students (US residents) were further divided into in-state (Pennsylvania residents) vs. out-of-state (non-PA residents). Of individuals who responded, 56.3% (*n=394*) identified as domestic/in-state, 36.1% (*n=253*) domestic/out-of-state, and an additional 7.6% (*n=53*) identified as an international/non-domestic student (see Table 6).

Table 6: Residential Status distribution within respondents

	Frequency	Percent	Cumulative Percent
International	53	7.6	7.6
Domestic / Out-of-state	253	36.1	43.7
Domestic / In-state	394	56.3	100.0
Total	700	100.0	

To understand if a respondent's residential status had an influence on their intention to recycle, a one-way ANOVA was conducted. An ANOVA - or analysis of variance - is a common statistical technique to understand if the difference in means between groups is statistically significant. For example, the mean scores for intention to recycle for all three groups - domestic/out-of-state students (*Mean = 5.80*), domestic in-state students (Mean = 5.66) and International (*Mean = 5.31*) - were compared to see if a respondent's residential status influenced their intention to recycle. ANOVA results indicated that residential status was a significant factor ($F(6, 679) = 3.717$, $p = 0.025$) on an individual's intention to recycle, with

international students displaying the lowest intention to recycle *(Mean = 5.31, SD = 1.392)* compared to their domestic peers (see Table 7).

Table 7: Intention to Recycle based on Residential Status

	Mean	Deviation from Average	N	Std. Deviation
Domestic / Out-of-state	5.80	+ 0.11	253	1.123
Domestic / In-state	5.66	- 0.03	394	1.217
International	5.31	- 0.38	53	1.392
Average	5.69		682	1.203

Transfer Status

The final demographic question was to distinguish if respondents identified as a transfer student - coming to Penn State after a residential experience at another college/university. Of respondents, a limited number, 1.8% (n=13), identified as a residential student before coming to Penn State (see Table 8). With such a limited number of the respondents' additional statistical analysis was not viable.

Table 8: Transfer Status distribution within respondents

	Frequency	Percent	Cumulative Percent
Transfer	13	1.8	1.8
Non-Transfer	688	97.7	99.6
Unsure	3	.4	100.0
Total	704	100.0	

College

In addition to identity measures, the college where the respondents' major is housed was also collected. The College of Engineering (*17% | n=135*), Undergraduate Studies (*11.3% | n=90*), and Eberly College of Science (*9.9% | n=79*) had the highest number of respondents. While, Information Science and Technology (*1.8% | n=13*), Earth and Mineral Science (*2.7% | n=19*), and Arts and Architecture (*2.7% | n=19*) had the lowest response rates (see Table 9).

Table 9: College distribution within respondents

	Woman	Man	Transgender	Genderqueer	Prefer not to Answer	
Agricultural Sciences	29	10	--	--	1	40
Arts and Architecture	8	10	--	1	--	19
Business	36	40	--	--	--	76
Communications	18	8	--	--	1	27
Earth and Mineral Sciences	7	12	--	--	--	19
College of Education	21	5	--	1	--	27
Engineering	47	86	--	--	2	135
Health and Human Development	60	14	--	--	--	74
Information Sciences and Technology	3	10	--	--	--	13
Liberal Arts	44	19	1	1	--	65
Nursing	22	1	--	--	--	23

Science	52	27	--	--	--	79
Undergraduate Studies	61	27	--	--	2	90
Unsure	11	6	--	--	1	18
Total	419	275	1	3	7	705

With 6 of the 14 (42.8%) colleges having less than 40 total respondents, our ability to understand the role of college in an individual's intention to recycle is limited. An adjusted ANOVA was completed with the subset of colleges who had more than 40 respondents. Results indicated that within the sub-set of colleges tested, no significant influence on respondents recycling intention was found ($F(6, 697) = .938$, $p = 0.466$).

Research Objective #1

Compare the total variance in recycling behavior explained by the Theory of Planned Behavior, Norm-Activation Model, and the Comprehensive Determination Model.

The first research objective was to understand the explanatory power of three psychosocial models – Theory of Planned Behavior, Norm-Activation Model, and the Comprehensive Action Determination Model – on an individual's intention to recycle. A confirmatory factor analysis was completed on all three models using the

pre-established theoretical pathways highlighting the strength of each explanatory variable, as well as the overall variance explained within each of the models.

Table 10: Original variable location

Variable Name	Annotation	Collection Method / Source
Habit Response Frequency Measure	H_RFI	Comprehensive Action Determination Model (Klöckner & Blöbaum, 2010)
Self-Report Habit Index	H_SRH	Comprehensive Action Determination Model (Klöckner & Blöbaum, 2010)
Descriptive Norm	DN	Focus Theory of Normative Conduct
Awareness of Consequences	AC	Norm-Activation Model (Schwartz, 1968)
Ascription of Need	AN	Norm-Activation Model (Schwartz, 1968)
Personal Norm	PN	Norm-Activation Model (Schwartz, 1968)
Perceived Behavioral Control	PBC	Theory of Planned Behavior (Fishbein & Ajzen, 1975; 1985)
Attitude	ATT	Theory of Reasoned Action/ Planned Behavior (Fishbein & Ajzen, 1975; 1985)
Intention	INT	Theory of Reasoned Action/ Planned Behavior (Fishbein & Ajzen, 1975; 1985)
Social Norm (Injunctive)	SN	Theory of Reasoned Action/ Planned Behavior (Fishbein & Ajzen, 1975; 1985)

Analysis of the Theory of Planned Behavior

Explanatory variables measured in the Theory of Planned Behavior indicated a healthy attitude toward recycling (ATT; Mean = 6.60, SD = 0.70) and if given a chance, respondents report having the ability to recycle successfully (PBC; Mean = 5.29, SD = 0.99). Additionally, yet to a lesser extent, respondents also indicated that there was a social pressure to recycle by their valued-peers (SN; Mean = 4.70, SN = 1.302).

The confirmatory analysis (see Figure 8) results showed that all explanatory variables have a statistically significant ($p < 0.001$) and positive relationship with the intention to recycle (I; Mean = 567, SD = 1.243) with β-coefficients ranging between 0.23 (attitude) to 0.337 (PBC).

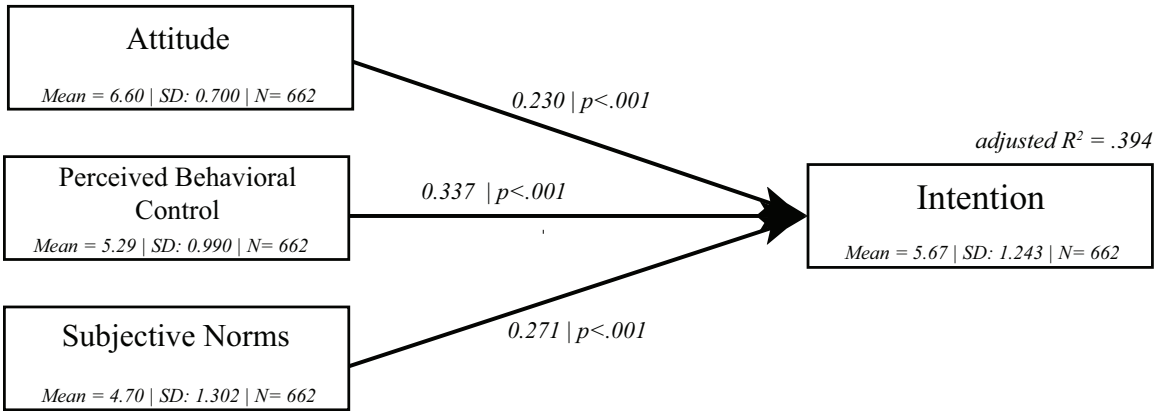

Figure 8: Confirmatory Factor Analysis for Theory of Planned Behavior

Overall the Theory of Planned Behavior model accounted for 39.4% (R^2 = 0.394) of all variance within the data.

Analysis of the Norm-Activation Model

The Norm-Activation Model proposed by Schwartz in 1968 is unique due to the role that awareness of need (AN) and awareness of consequences (AC) have on the activation of personal norms. While no formal measure of activation was identified in the literature, for this research I assume individuals with a higher than mean response denotes a norm activation.

Measurements of explanatory variables within the Norm-Activation Model (NAM) indicated that respondents have a feeling of responsibility for acting (AN; Mean = 5.44, SD = 1.210) and awareness that failing to recycle will have a negative impact on the environment (AC; Mean = 6.62, SD = 1.069). Based on the relationships designed by Schwartz (1968), awareness of consequences and need accounted for 37.2% (R^2 = 0.372) of the variance within the individual's personal norm responses, influenced mainly by their awareness of the consequences of not recycling (β-coefficient = 0.535, $p < 0.001$; see Figure 9). Respondents reporting both a high awareness of consequence and need indicated a strong personal norm response (PN; Mean = 5.30, SD = 1.229).

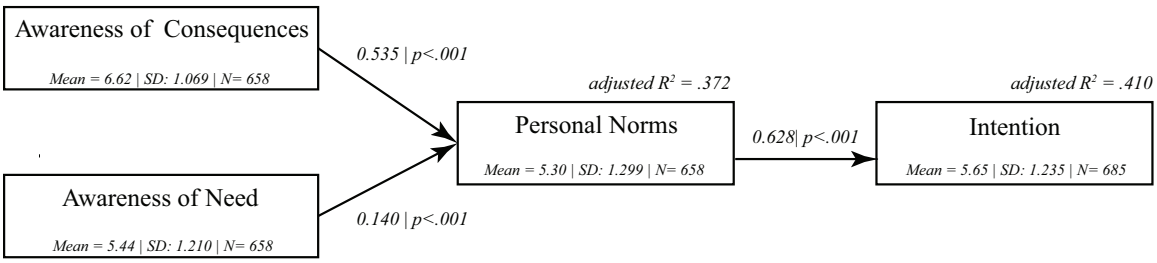

Figure 9: Confirmatory Factor Analysis for the Norm-Activation Model

Overall, the Norm-Activation Model accounted for 41% ($R^2 = 0.410$) of the total variance of respondents' intention to recycle (I; Mean = 5.65, SD = 1.235), with personal norms accounting for a large portion (β-coefficient = 0.628, $p < 0.001$) of that overall impact.

Analysis of the Comprehensive Action Determination Model

The Comprehensive Action Determination Model represents a 'holistic' model including explanatory variables that originate from the Theory of Planned Behavior – subjective norms, attitude, perceived behavioral control - and the Norm-Activation Model – awareness of consequences, awareness of need, personal norms – which are discussed earlier.

Respondents indicated they frequently recycled before living at Penn State (*H_RF; Mean = 5.44, SD = 1.210*) as well as have a strong connection between their recycling behavior and their self-identity (*H_SRF; Mean = 5.44, SD = 1.210*). Additionally, a strong linkage was identified between individual's perceived

behavioral control and their self-report index ($\beta = 0.594$, $p < 0.001$) indicating a connection between one's perceived ability to complete a behavior and their internalization of that behavior as part of their self-identity. We also find strong relationships between an individual Self-Report Index ($\beta = 0.622$, $p < 0.001$), Personal Norms ($\beta = 0.622$, $p < 0.001$), and Perceived Behavioral Control ($\beta = 0.525$, $p < 0.001$) and intention.

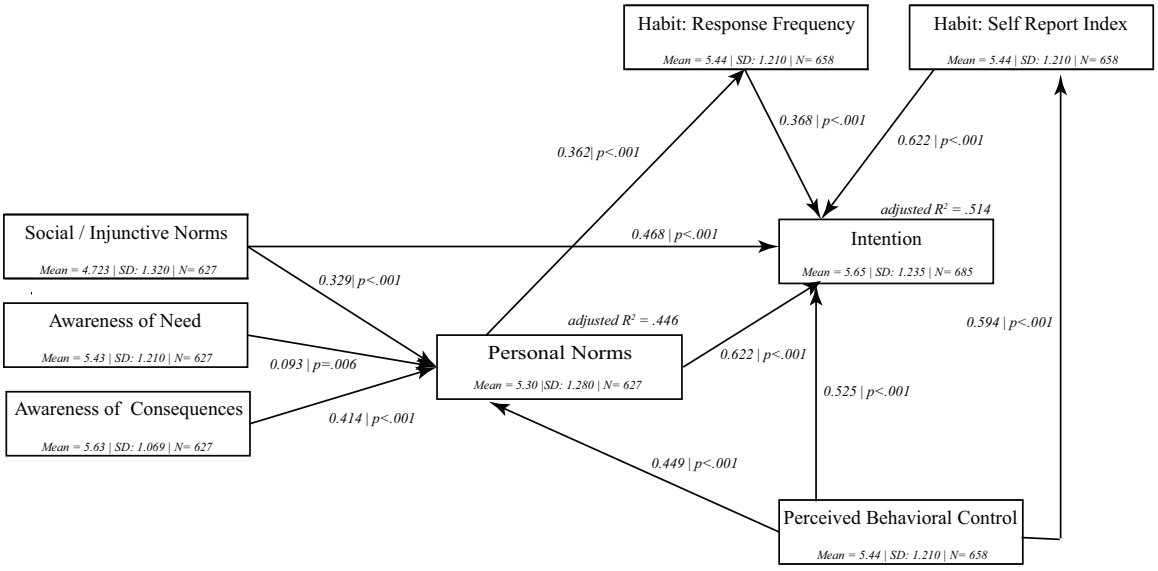

Figure 10: Confirmatory Factor Analysis for the Comprehensive Action Determination Model

Overall the CADM model explained a 51.4% ($R2 = 0.514$) of the total variance within the data, resulting in the highest explanatory power of all three models.

Comparison of Models

To ensure an accurate comparison across the models, adjusted R^2 values

were calculated to understand the percent of variance explained. An adjusted R^2 value is preferred due to the tendency for non-adjusted R^2 values to rise with the increasing number of independent variables added to the model, inaccurately providing a better fit. By using the adjusted R^2 value, that skew is accounted for, and models with a different number of independent variables can be compared (Tabachnick & Fidell, 2006).

As the least explanatory, the Theory of Planned Behavior (TPB) model resulted in a R^2 of 0.394, and the Comprehensive Action Determination Model (CADM) on the high end with an R^2 of 0.514. While the CADM represented the model with the largest percent of variance explained (*51.4%, TPB = 39.4%, NAM = 41.0%)* it also measured the largest number of psychological explanatory variables *(8, TPB = 3, NAM = 3*) and utilized the largest number of survey questions (*33, TPB = 15, NAM = 8*) as outlined in table 11

Table 11: Comparison of values across all tested models.

Model	Adjusted R^2	Antecedents measured	Number of Questions
Theory of Planned Behavior [a]	.394	3	15
Norm Activation Model [b]	.410	3	8
CADM [c]	.514	8	33

a. Perceived Behavioral Control, Attitude, Social/Injunctive Norm

b. Awareness of Need, Awareness of Consequences, Personal Norms

c. Perceived Behavioral Control, Attitude, Social/Injunctive Norm, Awareness of Need, Awareness of Consequences, Personal Norms, Habit: Self-Report, Habit, Response Frequency,

Research Objective #2

Determine the increase in total variance in the recycling behavior by adding descriptive norms to the Comprehensive Action Determination Model.

In an attempt to expand the explanatory power of the CADM beyond the already established 51.4%, descriptive norms were added as an explainer for Personal Norms. A stepwise-hierarchical regression was completed. This analysis allows for a staged, or stepped, regression to occur. The first step, regressed social/injunctive norms, awareness of need, and awareness of consequences on personal norms resulting in an adjusted R^2 of 0.446 ($p<0.001$). The second step added Descriptive Norms ($M=4.72, SD=1.30$) resulting in a decrease in the overall goodness of fit by 0.001 ($R^2 = 0.445$; Table 12).

Table 12: Stepwise regression of Personal Norms including Descriptive Norms

			Change Statistics				
Model	Adjusted R^2	Std. Error of the Estimate	R^2 Change	F Change	df1	df2	Sig. F Change
1	.446	.95317	.449	169.127	3	623	.000
2	.445	.95393	.000	.014	1	623	.905

a. Social/Injunctive Norms, Awareness of Need, Awareness of Consequences
b. Addition of Descriptive Norm

When added to the overall model, descriptive norms regressed on personal norms resulted in a non-significant ($p = 0.905$) β-coefficient of -0.004, therefore having no impact on the overall model (Figure 11).

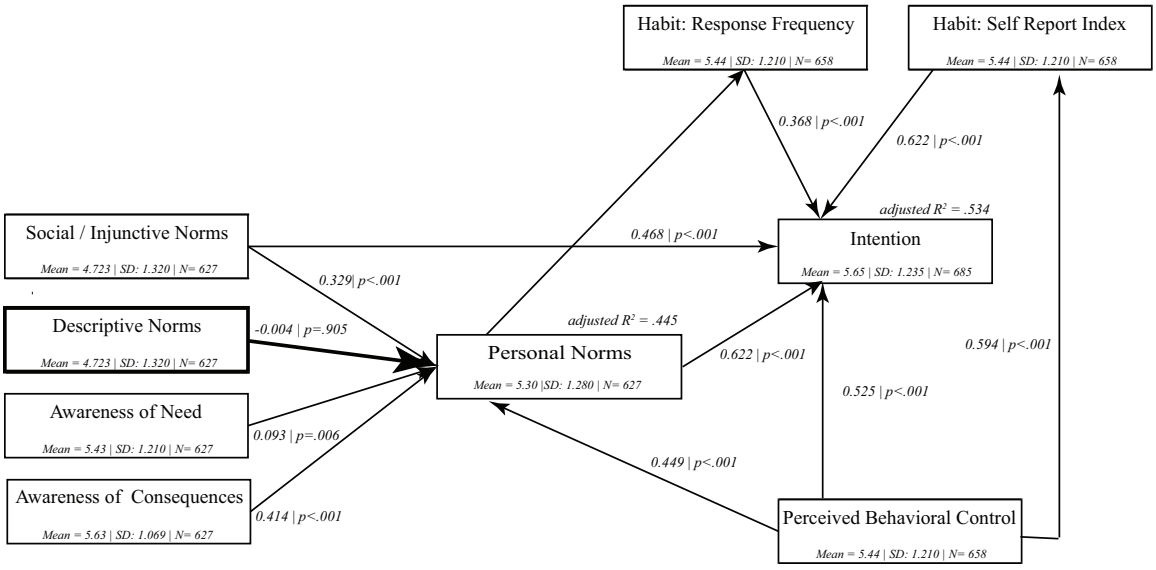

Figure 11: Confirmatory Factor Analysis for the CADM with the addition of Descriptive Norms

Summary of Key Findings

Responses were collected from 705 first-year residential students at Penn State University from September 25, 2017 through October 16, 2017 using explanatory variables from four psychosocial models – Theory of Planned Behavior (Ajzen, 1985), Norm-Activation Model (Schwartz, 1977), the Comprehensive Determination

Model (Klöckner & Blöbaum, 2010), and the Focus Theory of Normative Conduct (Cialdini et al., 1990). Key findings include:

- Gender was identified as a significant factor ($p < 0.001$) of an individual's intention to recycle with men indicating a negative correlation on most explanatory variables.
- Residential status, specifically international vs. domestic respondents, was identified as a significant ($p = 0.025$) variable as to an individual's intention to recycle.
- Transfer status and college affiliation were identified as non-significant indicators of respondents intention to recycle.
- The Comprehensive Action Determination Model was identified as the model which provided the highest explanatory power (*51.4%*) followed by the Norm-Activation Model (*41%*) and the Theory of Planned Behavior (*39.4%*).
- When Descriptive Norms were added into the Comprehensive Action Determination Model as a predictor of Personal Norms, no significant additional explanatory power was achieved ($\beta = 0.004, p = 0.905$).
- Finally, Self-Report Habit Index (H_SRH; reflection on previous behavior) had the largest individual impact on an individual's intention to recycle ($R^2 = 0.397$)

followed by Personal Norms ($\Delta R^2 = 0.093$, *total* $R^2 = 0.490$) and Perceived Behavioral Control ($\Delta R^2 = 0.020$, *total* $R^2 = 0.509$).

Chapter 4 Discussion

Recycling has grown to be a convenient way for individuals to reduce their environmental impact. Yet, as public awareness and concern for the environment increases, participation in recycling programs has not. This investigation explored multiple psychosocial models and their corresponding explanatory variables to understand better an individual's intention to participate in a particular pro-environmental behavior, recycling.

The Comprehensive Action Determination Model was proposed by Klöckner & Blöbaum (2010) as an attempt to integrate the Theory of Planned Behavior, Norm-Activation Model, and Theory of Interpersonal Behavior into one holistic explanatory model. When compared to the Theory of Planned Behavior and Norm-Activation Model the CADM provided more explanatory power than each of the models independently. In this study, I replicated the Klöckner & Blöbaum (2010) methods to explore how the CADM could be used to examine other pro-environmental behaviors, in this case, recycling.

As discussed previously, the CADM provided increased explanatory power when compared to the Theory of Planned Behavior and Norm-Activation Model. Results from both studies (see Table 12) indicate that the Theory of Planned Behavior had the lowest explanatory power ($R^2 = 0.54$) followed by the Norm-Activation Model ($R^2 = 0.59$).

Table 13: Model Comparison of total variance explained

Model	Recycling Behavior	Car Usage (Klöckner & Blöbaum, 2010)
Theory of Planned Behavior [a]	.39	.54
Norm Activation Model [b]	.41	.59
CADM [c]	.51	.65

a. Perceived Behavioral Control, Attitude, Social/Injunctive Norm
b. Awareness of Need, Awareness of Consequences, Personal Norms
c. Perceived Behavioral Control, Attitude, Social/Injunctive Norm, Awareness of Need, Awareness of Consequences, Personal Norms, Habit: Self-Report, Habit, Response Frequency,

It is clear that the CADM has increased explanatory power, confirming Klöckner's assertion that the CADM "clearly demonstrates promising potential" (2010). While it is interesting that the CADM is more explanatory than other models, I wanted to take a more nuanced approach, exploring how the explanatory variables interact with each other. A stepwise-hierarchical regression was completed (see Table 13) on all independent variables on the dependent variable. Self-report habit

index (H_SRH; reflection on previous behavior) was shown to have the largest individual impact on an individual's intention to recycle ($R^2 = 0.397$) followed by Personal Norms ($\Delta R^2 = 0.093$, total $R^2 = 0.490$) and Perceived Behavioral Control ($\Delta R^2 = 0.020$, total $R^2 = 0.509$).

Table 14: Stepwise Regression of all independent variables on Intention to recycle.

				Std.	Change Statistics				
Model	R	R Square	Adjusted R Square	Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.631[a]	.398	.397	.94752	.398	365.96	1	553	.000
2	.701[b]	.492	.490	.87164	.093	101.47	1	552	.000
3	.715[c]	.511	.509	.85537	.020	22.196	1	551	.000
4	.724[d]	.525	.521	.84427	.013	15.583	1	550	.000
5	.732[e]	.536	.532	.83527	.011	12.924	1	549	.000
6	.734[f]	.539	.534	.83298	.003	4.021	1	548	.045

a. Habit: Self Report Habit Index
b. Addition of Personal Norms
c. Addition of Perceived Behavioral Control
d. Addition of Awareness of Consequences
e. Addition of, Descriptive Norm
f. Addition of, Awareness of Need

The first three explanatory variables - self-report habit index, personal norms, and perceived behavioral control- accounted for 95% of the identified variance. It is also noted that these explanatory variables originate in and provide the largest explanatory weight within their specific model (Personal Norms = Norm

Activation; Perceived Behavioral Control = Theory of Planned Behavior; see Table 13). The combination of Personal Norms, Perceived Behavioral Control, and Self-Report Habit Index explained the largest amount of variance within their specific models and when combined into the CADM contributed to the expanded understanding of variance.

Table 15: Most explanatory antecedent within the TPB/NAM.

Model	antecedent	Antecedent adjusted R^2	Total Model R^2	% variance explained
TPB	PBC	.278	.390	71.2%
NAM	PN	.386	.410	94.1%

There is ample scholarly evidence to support all three explanatory variables as being strong explains of behavior. Personal Norms (Harland et al., n.d.; Bamberg & Möser, 2007; Carey et al., 2010; Onwezen et al., 2013; Mead, Rimal, Ferrence, & Cohen, 2014) and Perceived Behavioral Control (Kollmuss & Agyeman, 2002; Kidwell & D. Jewell, 2003) are established antecedents that explain pro-environmental behaviors. Self-Report Habit Index is also well supported in the scholarly literature. (Sniehotta & Presseau, 2011; Verplanken & Orbell, n.d., p. 1317).

While the body of scientific literature on this topic is robust, few studies have completed any multi-model comparisons. In the short-run completing single-model phenomenological research may produce interesting overall findings but substantially limits the ability to dive into the nuanced relationships. I raise this as a concern because one of the cornerstones of the scientific method is the ability to replicate or refute findings. It is our role as scientists to run and rerun studies to find if results hold-up to constant testing. If the findings are confirmed, then the hypothesis is strengthened. Failing to replicate is not a failure of science, but one of its core foundational tools. Through the identification of incongruence, we refine false claims improve our questions to seek out a better explanation for the phenomenon we study. Underpinning the necessity to test/retest is a series of assumptions.

One of these assumptions is the context for the study remains constant, remaining the same during the retest as when the initial research is completed. For specific fields of study, this precept holds true with context having a limited role in the results. In psychology, sociology, and social sciences, however, people do not remain in stasis waiting for the retest to occur. These contextual differences are termed “hidden moderators”(Bavel, Mende-Siedlecki, Brady, & Reinero, 2016) by researchers at the Reproducibility Project, a project that aimed to understand the

test/retest phenomenon in psychology. Their project reran 100 studies published in prominent psychology journals and finding that only 39% of the studies could be replicated without taking contextual factors into account (Bavel et al., 2016). Their results suggest that many variables in psychology cannot be understood apart from the cultural and historical contexts that define their meanings (Touhey, 1981). Researchers should move away from the paradigm that "manipulating one variable always and exclusively leads to a specific, deterministic change in another" (Bavel et al., 2016). In response, we have to embrace the nuance, explore it, and resist only reporting meta-findings. In an attempt to acknowledge the nuanced relationships, I raise the question, how are these three key explanatory variables in this study interrelated to each other?

To explore the relationships between the highest explanatory variables, three separate stepwise regressions (see Table 16, 17, 18) were completed to understand how the other variables within the dataset are interrelated.

Table 16: Stepwise Regression with Self Report Habit Index as dependent variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.598[a]	.358	.357	5.81715
2	.700[b]	.490	.489	5.18527
3	.766[c]	.587	.585	4.67118
4	.774[d]	.598	.595	4.61549

a. Predictors: (Constant), Personal Norms
b. Predictors: (Constant), addition of Perceived Behavioral Control
c. Predictors: (Constant), addition of Descriptive Norm
d. Predictors: (Constant), addition of Social/Injunctive Norms

Table 17: Stepwise Regression with Perceived Behavioral Control as dependent variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.591[a]	.349	.348	.79531
2	.611[b]	.373	.371	.78116
3	.617[c]	.381	.378	.77681
4	.621[d]	.386	.382	.77449

a. Predictors: (Constant), Habit: Self Report Habit Index
b. Predictors: (Constant), addition of Attitude
c. Predictors: (Constant), addition of Awareness of Consequences
d. Predictors: (Constant), addition of Descriptive Norm

Table 18: Stepwise Regression with Personal Norms as dependent variable

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.598[a]	.358	.357	1.03386
2	.717[b]	.514	.512	.89994
3	.740[c]	.548	.546	.86868
4	.754[d]	.568	.565	.84966

a. Predictors: (Constant), Habit: Self Report Habit Index
b. Predictors: (Constant), addition of Awareness of Consequences
c. Predictors: (Constant), addition of Attitude
d. Predictors: (Constant), addition of Social/Injunctive Norms

Self-Report Habit Index appeared as the explanatory variable with the best fit for Personal Norms ($R^2 = .358$) and Perceived Behavioral Control ($R^2 = .349$) as the

dependent variable. Personal Norms (R^2 = .358) and Perceived Behavioral Control (R^2 = .490) were the two explanatory variables that best described the variance when Self-Report Habit was the dependent variable. As we progressed further into the stepwise, a set of common explanatory variables rose making connections between Behavioral Control and Personal Norms and Self-Report Habit index (see Figure 12).

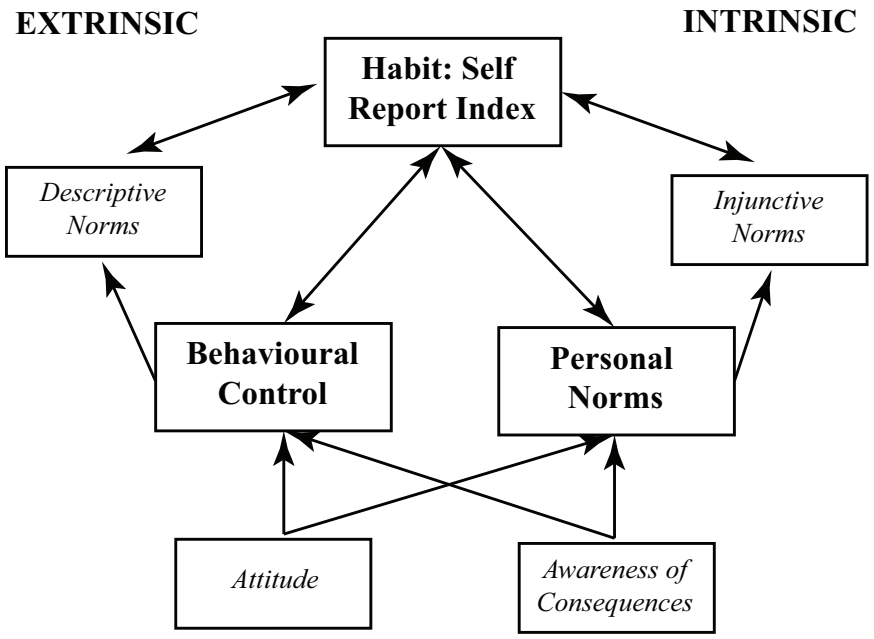

Figure 12: Explanatory variables relationships from stepwise regression results

First, behavioral control and personal norms are both underwritten by a shared set of antecedents - attitude and awareness of consequences. Further investigation is needed to understand the underlying relationship. With this connection and these constructs being conceptualized initially in two different

models, it indicates that there might be a more profound latent construct that needs further investigation.

Second, we see that the norms identified in the Focus Theory of Normative Conduct (Cialdini et al., 1990) – descriptive and injunctive – play a mediating role between behavioral control, personal norms and habit index. This relationship highlights that an individual's intention to complete an action (in this case recycling) is predicted by both intrinsic (i.e. personal, injunctive norms) and extrinsically (i.e. behavioral control, descriptive norms). This moderation might be helpful in clarifying why individuals have an incongruence between their reported attitude, belief, and intention toward action and their actual behavior. This phenomenon has arisen with many psychological studies of pro-environmental behavior (Blake, 1999; Kollmuss & Agyeman, 2002; Maio, 2011; Kowalska-Pyzalska, Maciejowska, Suszczyński, Sznajd-Weron, & Weron, 2014) and is referred to as the Value-Action Gap.

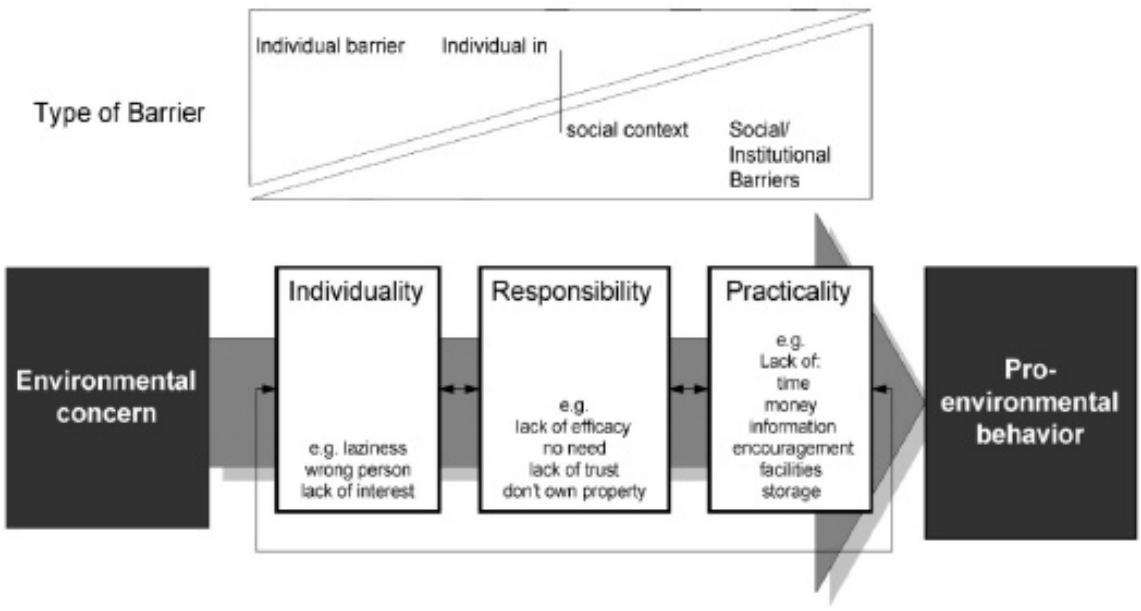

Figure 13: Value Action Gap Model (Blake, 1999)

Blake (1999) asserts that the common underlying assumption that the primary barrier between environmental concern and action is the lack of appropriate information. In his model, Blake (1999) proposes that this gap is not empty, but contains multiple personal, social, and structural barriers that prevent the individuals' environmental concern from manifesting in action. Blake's (1999) Value-Action Gap model identifies three categories of obstacles that exist between an individual's concern and their behaviors These categories - Individual, Responsibility, and Practical - are then further sub-divided into - individual and social/institutional - starting to mirror the injunctive and descriptive connections from this study (see Figure 13). In a review of the literature, three studies utilized

the Value-Action gap as a theoretical framework in exploring pro-environmental behavior. In the studies, portions of the Value-Action gap were used to investigate the social contexts surrounding personal carbon emissions (Chai, Bradley, Lo, & Reser, 2015; Babutsidze & Chai, 2018) and recycling (Chung & Leung, 2007). It is surprising with the multitude of studies indicating the incongruence between what people say and what people do, there has not been more investigation into this framework.

These findings also offer suggestions for practical implementation. With a shared set of antecedents (awareness of consequences and attitude) underlying two of the most significant contributors (personal norms and behavioral control) to recycling intentions we can redirect outreach resources toward these specific elements. We also must recognize the role that descriptive and injunctive norms have on personal norms and behavioral control is also a point for intervention by practitioners. We must transition away from an infrastructure centric-approach and allocate resources to changing the injunctive and descriptive norms. Lastly, practitioners must appreciate that individual's habits are location-dependent. Someone who at a previous location is more likely to recycle as they transition to a new place (Sniehotta & Presseau, 2011), but it is not guaranteed to complete the same action in the new location.. We have to move away from the preconception

that, because an individual received the message and adopted the practice when they were a freshman, they are 'good to go' as they progress through their university career. This results in a significant allocation of resources to first-year influence campaigns, with little committed to re-engagement later in a student's career. With limited resources, allocating them toward early interventions is a prudent approach, due to an increase in the likelihood that an individual will continue behavior. If funds allow, practitioners must embrace campaigns that can be customized to re-engage students as they transition to new living accommodations on their campuses.

While I feel the recommendations above are both practically and theoretically sound based on my professional and educational experience, I want to call the reader's attention back to the limitations of this study. Before more generalizable theoretical conclusions can be made, I want to acknowledge that the sample population within the study was residential, first-year college students where there is an intense pressure to make interpersonal connections and assimilate to the campus culture (Freeman et al., 2007; Pittman & Richmond, 2008) which might not be as strong within non-residential or non-student populations. Also, no formal behavioral measurements were collected preventing the ability to connect individuals survey response to their specific behavioral actions.

Conclusion

This study tested the explanatory power that three psychosocial models have in understanding recycling intention. Findings determined that the Comprehensive Action Determination Model explained the most substantial amount of variance given the data-set. While Klöckner & Blöbaum (2010) explained 65% of the variance, this research found that the CADM explained 51%. While these findings are significant, their interpretation should not stop here. We must embrace the entangled relationships between the individual parts of the model – each of the explanatory variables - and the model itself. Gestalt psychologist Kurt Koffka famously said that "the whole is something else than the sum of its parts" (1935, p. 175). Within this study, I tested three different models containing ten different explanatory variables along with four demographic markers. The goal was to understand the overall fit of models, so I created a method that allowed me to address that goal viewing each of these variables solely as addends to calculate the overall model fit. As I progressed through this project, I came to realize that the 'whole' – or the model fit - is not the beginning or the end of the project, but it is just one part. Like all the measured explanatory variables, the overall model fit statistic its own independent existence.

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As scholars, scientists, and researches, we channel our curiosity to make sense of the phenomena around us. We spend countless hours testing and re-testing our hypothesis to unlock one door, so other generations can walk through and open the next.

Doing research should offer new insights, both philosophically and practically. It is not enough to view research solely as a mechanical process of collecting and analyzing data, finding the answer to a question. When framed this way, I can see how someone could portend that it can be accomplished with detached objectivity. Research is not solely the process of answering a question, it is the process of actively constructing new knowledge and no one--the researcher included--,should remain the same. Even the way we frame and share our results, in peer-reviewed publications or conference presentations, does not acknowledge the reflexive nature of doing research. Just as important as the findings are the realizations that researches have about ourselves, our practice, our field, and the world around us. This reflexive practice involves a shift away from merely reflecting on how we could have done the research better, to an acknowledgment of how we are different - and I propose better - for having completed the project.

The Researcher Matters

Beyond the research design, I maintain that the physical and philosophical identity of the researcher - knowingly or unknowingly - impacts the nature of the research itself. This is the antithesis of the widely held belief that researchers are 'experts' able to remain impartial and unbiased from the study. Investigators "cannot suddenly switch off their personal predilections and purposes and stop being human in the name of 'objective' research" (Meighan & Siraj-Blatchford, 1997, pp. 228–229). We as researchers need to acknowledge that our own "values and assumptions influence the study and therefore need to be fully integrated in order to clarify the research decisions that are made" (Clough & Nutbrown, 2012).

Embrace the Tension

As a graduate student, I am accustomed to having more to learn than to offer when it comes to theoretical discussions. The simple act of reading and writing for this paper has provided confidence in my knowledge. Reading allowed me the breadth of knowledge to understand what questions I found interesting to investigate. By understanding this complexity, I was able to apply an investigative framework and use my analytical tools to seek an answer. Bloom's taxonomy (Bloom, 1956) comes to mind as a framework to understand this part of my journey. Via these first three steps - knowledge, understanding, and application - I was able to appreciate the

knowledge that existed, yet have the confidence to evaluate and analyze it. This is where the tension arises. As mentioned previously, the Theory of Planned Behavior is a commonly used model. Early on during my investigation, I was under the impression that since it was used so often, by so many different researchers, it must be something profound . The more I read into other models - Theory of Interpersonal Behavior, Norm-Activation Model, and Focus Theory of Normative Conduct - I started to become more critical of the TPB, asking questions:

- Why use subjective norms to measure social norms when injunctive makes more practical sense?
- Why use the TPB if we have more predictive models?
- Why keep using the rational choice framework when it is in direct contradiction to the approaches of people like Richard Thaler and behavioral economics?

At first, I was uncomfortable with this criticism. Since the model was so frequently used, I thought I was missing something. I was deferring to something it was my role to question. In doing so, I was experiencing the balancing act between hubris-- being critical of what I know-- and the humility of not knowing. As researchers and perceived 'experts,' this is the ever-present tension that we face balancing our knowns and unknowns.

The Academic Treadmill

By investigating multiple models spread across 50 years of academic literature, I found that some models are more commonly used than others. The Theory of Reasoned Action/Planned Behavior has been used pervasively since its inception in 1975. While arguably more predictive and a better representation of human behavior, the Theory of Interpersonal Behavior has been mostly forgotten. I compare fashion shows to academic publications. For a designer, the [importance and] location of the show, who attended, and how it is reviewed afterward is just as important as what clothing was on display. For an academic, the notability of the journal, its co-authors' identities, and the number of [citations and] follow-up studies may be as indicative of the work's 'success' [as it's inherent contribution to the field].

In an academic culture, the pre-tenured faculty are urged to show commitment to their institution through service, engaging students in the classroom, and producing cutting-edge research for their field (along with required grants for funding), all while balancing their administrative tasks. With faculty reporting working 60 hours per week, something has to give (Ziker, 2014; Flaherty, 2014). Given this constant pressure to perform - and keep your job - sometimes it merely becomes a numbers game.

With this culture in mind, we'll return to the Theory of Reasoned Action/Planned Behavior/Interpersonal Behavior to make the point. The Theory of Planned Behavior is a straightforward model; three explanatory variables inform intention, and intention informs behavior. After a total of 15 questions, you are ready to analyze using straightforward regressions. The Theory of Interpersonal Behavior, is more complicated, with 21 questions and multiple mediating variables to contend with during analysis. As a time-pressured faculty member trying to balance teaching, service, and administrative duties with a robust research program, which would you prefer?

This academic culture seems at times to be redefining the role of an expert in society. The idea of a professor spending years investigating a single phenomenon has long been replaced with junior faculty harvesting datasets for any publishable nugget to keep the treadmill going. As a future academic, I am drawn to the scholarship because of the potential that research has to make me, my field, my community, and the world better.

Appendix 1 Survey Instrument

The survey was assembled using a question format derived from multiple previous studies (Table 2; PG 19) resulting in a final 38-question survey. The instrument was composed using qualtrics and the average time to completion was 7.4 minutes. This approach was approved by Harvard University's Committee on the Use of Human Subjects.

All questions, with the exception of Attitude and Habit Response Frequency (scales listed below), utilized a seven-point Likert scale with the following scale; Strongly Disagree (1), Disagree (2), Somewhat Disagree (3), Neither agree or disagree (4), Somewhat Agree (5), Agree (6), and Strongly Agree (7).

Awareness of Need (AN):

- Recycling is an urgent problem for environmental protection
- I believe that not recycling causes many environmental problems
- Recycling contributes to pollution *(Question was asked, but removed during analysis due to ambiguity)*

Awareness of Consequences (AC):

- My personal recycling efforts affects the quality of life for future generations
- If I reduce what I put into the landfill, I contribute to environmental protection

- My personal decision to NOT recycle has consequences for global ecological damage

Personal Ecological Norm

- Due to values important to me, I feel obliged to recycle as much as possible.
- I feel personally obliged to reduce my waste by recycling
- According to my values/principles, it would be wrong of me not to recycle my waste

Subjective/Social Ecological Norm (injunctive)

- People who are important to me expect that I should recycle my waste
- People who are important to me suggest that I should consider environmental protection when disposing of my waste
- People who are important to me support me when I recycle

Social Ecological Norm (descriptive)

- My fellow students at Penn State regularly recycle their waste
- I observe peers within my residence hall recycling frequently when they dispose of their waste
- Actions of peers living in my Residence Hall signify that environmental protection is important

Ecological Intention

- My intention to recycle my waste in the next seven days is strong
- I intend to recycle my waste in the next seven days

Perceived Behavioral Control

- It would be difficult to manage my waste through recycling
- I know where to take my waste for recycling
- I know what items can be recycled
- I have plenty of opportunities to recycle my waste
- Recycling is inconvenient
- Recycling is too complicated

- Recycling takes up too much time

Habit (Response Frequency) – mean score of the four items.

- Before Living in the Residence Halls, how often did you recycle the following:

Likert: Never, Rarely, Sometimes, Often, Always

  - Paper
  - Plastics
  - Aluminum, Steel, Tin Cans
  - Glass

Habit (Self-Report Habit Index) – mean score of the six items

- Recycling is something that:
  - gives me a strange feeling when I do it
  - I do totally automatically
  - I do without thinking about it
  - Is part of my routine
  - Is typical for me
  - does not require any active thought

Attitude

- Recycling is:

Likert: 7-pt bi-polar matrix table

  - good/bad
  - useful | a waste of time
  - rewarding | not rewarding
  - responsible | not responsible
  - sensible | not sensible

Demographic Questions:

With which gender do you identify? (Select all that apply)

- Woman

- Man
- Transgender
- Genderqueer or gender nonconforming
- An identity not listed, self-identify_____

What is your student residency as declared by the Pennsylvania State University?

- Out-of-state student
- In-state student
- International student

Are you a transfer student?

- Yes
- No

In which academic college is your major at PSU? (Select all that apply if more than one major)

- Agricultural Sciences
- Arts and Architecture
- Smeal College of Business
- Donald P. Bellisario College of Communications
- Earth and Mineral Sciences
- Education
- Engineering
- Health and Human Development
- Information Sciences and Technology
- The Liberal Arts
- College of Medicine
- College of Nursing
- Eberly College of Science
- Division of Undergraduate Studies
- Schreyer Honors College

Appendix 2 Survey Invitation | Reminder E-mails

A sample of incoming first-year residential students was provided with the assistance of Penn State Student Affairs Research and Assessment. All students were sent the initial e-mail (see below) inviting them to participate in the study. Follow-up e-mails were scheduled utilizing the Dillman method (Dillman et al., 2009) resulting in a 36% overall response rate and a 71% open-completion rate.

Language for initial e-mail

Dear [Name]

Welcome to Penn State and the whole Penn State community is excited for you to join us on campus this summer. Once you are here, you will discover that one of Penn State defining characteristics is that the work we do on campus improves lives and helps communities across Pennsylvania and the world. In addition to teaching, one way that we accomplish this is by doing research, and we need your help.

You have been selected to participate in a research study to understand student's recycling behavior here at Penn State. Your responses to this survey will help the Penn State's Sustainability Institute evaluate the effectiveness of the recycling system on campus and offer us valuable insight into ways to reduce our communities environmental and social impact.

The survey is very brief and will only take about 5 minutes to complete, in return you will be gifted a gift certificate for a free ice cream at the Penn State Creamery. Please click the link below to go to the survey Web site (or copy and paste the link into your Internet browser) to begin the questionnaire.

INSERT LINK HERE

All of your responses will be kept confidential. No personally identifiable information will be associated with your responses to any reports of these data. The Penn State Institutional Review Board has approved this survey.

Thank you very much for your time and cooperation.

Language for follow-up e-mails

This is a friendly reminder to please complete our survey regarding the research study you have been selected for. The survey is brief, and every response is critical.

Below is the original message you received on with instructions for accessing the survey. If you have any questions or concerns, please feel free to contact me using the information provided below. Thank you.

Appendix 3: Extended Charts | Tables

Analysis of the Descriptive Statistics

Intention * What is your student residency as declared by the Pennsylvania State University?

	Mean	N	Std. Deviation
International student	5.3137	51	1.39270
Out-of-state student	5.8061	245	1.12359
In-state student	5.6697	386	1.21744
Total	5.6921	682	1.20348

	Mean	N	Std. Deviation
Agricultural Sciences	5.9474	38	1.26699
Arts and Architecture	5.4412	17	1.65720
Business	5.7400	75	1.03767
Communications	5.4038	26	1.44235
Earth and Mineral Sciences	5.8421	19	1.32343
College of Education	5.8462	26	1.02732
Engineering	5.5602	133	1.35546
Health and Human Development	5.7292	72	1.06460
Information Sciences and Technology	5.7692	13	.99195
Liberal Arts	5.8308	65	1.08713
Nursing	5.8478	23	1.52580
Science	5.8506	77	1.07625
Undergraduate Studies	5.4882	85	1.26297
Unsure	5.3235	17	1.14484

Total	5.6859	686	1.21820

Analysis of the Theory of Planned Behavior

Overall: Descriptive Statistics

	Mean	Std. Deviation	N
Intention	5.6571	1.24384	662
Attitude	6.60	.700	662
Social/Injunctive Norm	4.70	1.302	662
Perceived Behavioral Control	5.29	.990	662

Overall: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
	.630[a]	.396	.394	.96859

a. Predictors: (Constant), Perceived Behavioral Control, Attitude, Social/Injunctive Norm

Overall: Variable Coefficients

	Unstandardized Coefficients		Standardized	t	Sig.
	B	Std. Error	Beta		
Attitude	.408	.058	.230	7.005	.000
Social Norm	.258	.032	.271	8.105	.000

Perceived Behavioral Control	.423	.042	.337	9.980	.000

a. Dependent Variable: Intention

Analysis of the Norm Activation Model

Overall: Descriptive Statistics

	Mean	Std. Deviation	N
Awareness of Need	5.44	1.210	658
Awareness of Consequence	5.62	1.069	658
Personal Norm	5.30	1.299	658
Intention	5.65	1.235	685

Analysis of the Comprehensive Action Determination Model

Overall: Descriptive Statistics

	Mean	Std. Deviation	N
Intention	5.66	1.247	581
Attitude	6.60	.711	581
Social/Injunctive Norm	4.71	1.312	581
Perceived Behavioral Control	5.29	1.002	581
Awareness of Need	5.43	1.209	581
Awareness of Consequence	5.62	1.056	581
Personal Norm	5.29	1.284	581
Habit: Response Frequency	14.9983	3.84909	581
Habit: Self Report Index	29.6678	7.26670	581

Overall: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.735[a]	.540	.533	.852

a. Predictors: (Constant), Habit: Self Report Index, Awareness of Need, Attitude, Social/Injunctive Norm, Habit: Response Frequency, Awareness of Consequence, Perceived Behavioral Control, Personal Norm

Overall: Pearson Coefficients

Intention	Attitude	Social Norm	Perceived Behavioral Control	Awareness of Need	Awareness of Consequence	Personal Norm	Habit: Response Frequency	Habit: Self Report Index
1.000	.420	.452	.517	.348	.493	.623	.351	.627
.420	1.000	.290	.321	.245	.392	.476	.123	.346
.452	.290	1.000	.352	.284	.422	.503	.256	.451
.517	.321	.352	1.000	.206	.351	.436	.256	.583
.348	.245	.284	.206	1.000	.451	.354	.125	.263
.493	.392	.422	.351	.451	1.000	.614	.228	.390
.623	.476	.503	.436	.354	.614	1.000	.345	.595
.351	.123	.256	.256	.125	.228	.345	1.000	.543
.627	.346	.451	.583	.263	.390	.595	.543	1.000

Analysis of the Comprehensive Action Determination Model w/ Descriptive Norms Included

Overall: Descriptive Statistics

	Mean	Std. Deviation	N
Intention	5.66	1.247	581
Attitude	6.60	.711	581
Social/Injunctive Norm	4.71	1.312	581
Perceived Behavioral Control	5.29	1.002	581
Awareness of Need	5.43	1.209	581
Awareness of Consequence	5.62	1.056	581
Personal Norm	5.29	1.284	581
Descriptive Norm	4.55	1.249	581
Habit: Response Frequency	14.9983	3.84909	581
Habit: Self Report Index	29.6678	7.26670	581

Overall: Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.742[a]	.551	.544	.842

a. Predictors: (Constant), Habit: Self Report Index, Descriptive Norm, Awareness of Need, Attitude, Habit: Response Frequency, Social/Injunctive Norm, Awareness of Consequence, Perceived Behavioral Control, Personal Norm

Variable Pearson Correlations

Attitude	ATT_1	ATT_2	ATT_3	ATT_4	ATT_5
1.000	.729	.798	.819	.799	.837
.729	1.000	.743	.387	.554	.545
.798	.743	1.000	.495	.526	.614
.819	.387	.495	1.000	.505	.537
.799	.554	.526	.505	1.000	.720
.837	.545	.614	.537	.720	1.000

Awareness of Need	AN1	AN2	AN3
1.000	.860	.822	Removed
.860	1.000	.418	from
.822	.418	1.000	Analysis

Awareness of Consequences	AC1	AC2	AC3
1.000	.879	.844	.867
.879	1.000	.673	.617
.844	.673	1.000	.571
.867	.617	.571	1.000

Personal Norms	PN1	PN2	PN3
1.000	.936	.921	.900
.936	1.000	.833	.753
.921	.833	1.000	.714
.900	.753	.714	1.000

Descriptive Norms	DN1	DN2	DN3
1.000	.830	.888	.842
.830	1.000	.613	.532
.888	.613	1.000	.631
.842	.532	.631	1.000

Social Norms	SN1	SN2	SN3
1.000	.889	.837	.847
.889	1.000	.607	.679
.837	.607	1.000	.526
.847	.679	.526	1.000

Perceived Behavioral Control	PBC1_r	PBC2	PBC3	PBC4	PBC5_r	PBC6_r	PBC7_r
1.000	.742	.562	.548	.530	.767	.778	.805
.742	1.000	.227	.198	.166	.598	.570	.612
.562	.227	1.000	.551	.364	.240	.253	.283
.548	.198	.551	1.000	.507	.173	.210	.200
.530	.166	.364	.507	1.000	.187	.269	.213
.767	.598	.240	.173	.187	1.000	.581	.696
.778	.570	.253	.210	.269	.581	1.000	.676
.805	.612	.283	.200	.213	.696	.676	1.000

Habit: Response Frequency	H_RF_1	H_RF_2	H_RF_3	H_RF_4
1.000	.717	.796	.846	.852
.717	1.000	.490	.407	.421
.796	.490	1.000	.598	.554

.846	.407	.598	1.000	.700	
.852	.421	.554	.700	1.000	

Habit: Self Report Habit Index	SRI_1_r	SRI_2	SRI_3	SRI_4	SRI_5	SRI_6
1.000	.240	.920	.918	.900	.894	.848
.240	1.000	.032	.038	.052	.076	-.012
.920	.032	1.000	.901	.816	.803	.777
.918	.038	.901	1.000	.800	.796	.785
.900	.052	.816	.800	1.000	.864	.721
.894	.076	.803	.796	.864	1.000	.693
.848	-.012	.777	.785	.721	.693	1.000

Variable Beta Coefficients

	Unstandardized Coefficients		Standardized Coefficients
	B	Std. Error	Beta
ATT1	.200	.000	.159
ATT2	.200	.000	.214
ATT3	.200	.000	.413
ATT4	.200	.000	.215
ATT5	.200	.000	.243
AN1	.500	.000	.626
AN2	.500	.000	.561
AC1	.333	.000	.382
AC2	.333	.000	.336
AC3	.333	.000	.440

PN1	.333	.000	.357
PN2	.333	.000	.352
PN3	.333	.000	.380
DN1	.333	.000	.370
DN2	.333	.000	.422
DN3	.333	.000	.378
SN1	.333	.000	.395
SN2	.333	.000	.404
SN3	.333	.000	.367
PBC1_r	.143	.000	.228
PBC2	.143	.000	.163
PBC3	.143	.000	.185
PBC4	.143	.000	.185
PBC5_r	.143	.000	.238
PBC6_r	.143	.000	.230
PBC7_r	.143	.000	.221
H_RF_1	1.000	.000	.312
H_RF_2	1.000	.000	.255
H_RF_3	1.000	.000	.316
H_RF_4	1.000	.000	.359
SRI_1_r	1.000	.000	.202
SRI_2	1.000	.000	.214
SRI_3	1.000	.000	.214
SRI_4	1.000	.000	.208
SRI_5	1.000	.000	.198
SRI_6	1.000	.000	.228

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