Numerous researchers and theorists have attempted to explain the existence of the gap between the possession of environmental knowledge and awareness and the display of pro-environmental behavior (Glasser, 2007; Kollmuss & Agyeman, 2002). Behavior analysis is uniquely aligned to contribute to this discussion through its emphasis on the role of controlling variables in behavior change. A growing number of behavioral research studies address the challenges of group-contingencies in an effort to solve real-world gaps (Lehman & Geller, 2004). This study was designed as a continuation of the line of behavioral research designed to increase recycling rates and also as an attempt to solve an issue presented in an academic building. During baseline measures, 20-30% of the landfill waste was comprised of recyclable material. Bins for plastic/glass/metal were not present in classrooms and classroom landfill bins were being utilized for disposal of bottles and cans. The treatment package included removal of all classroom bins, addition of centrally located, integrated landfill and recycling bins, along with the development of new signage. Results showed a decrease in the amount of recyclable material inaccurately sorted into landfill receptacles. These findings vary from previous recommendations that recycling bins be placed in all possible areas of waste generation.
THE EFFECTS OF REPLACING DISPERSED TRASH AND RECYCLING BINS WITH INTEGRATED WASTE RECEPTACLES ON THE ACCURACY OF WASTE SORTING IN AN ACADEMIC BUILDING

by

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A Thesis
Submitted to the
Faculty of The Graduate College
in partial fulfillment of the requirements for the Degree of Master of Arts
Department of Psychology
Advisor: Wayne Fuqua, Ph.D.

Western Michigan University
Kalamazoo, Michigan
December 2012
ACKNOWLEDGMENTS

I credit the completion of this project fore mostly to the individual contributions of my committee members. Dr. Wayne Fuqua’s guidance, patience, and flexibility allowed me to fully explore this relatively uncharted research territory. His belief in my abilities as a researcher continues to inspire and encourage me. Dr. Harold Glasser pushed me in directions that were both challenging and rewarding. This project is more complex, relevant, and applicable and I am a more effective researcher, graduate student, and story-telling primate as a result of his steadfast support and guidance. Dr. Richard Malott is to blame for my undying devotion to behavior analysis and I will forever be in his debt. Thanks for shakin’ my world view Uncle Dickie.

I owe a lifetime supply of coffee to my enthusiastic research assistants who never balked at 7:45 am meeting times and never complained about the stinky task of sorting through other people’s garbage. Caitlin Prior, Daniel Flack, Sean Hagerty, Jacqueline Scholz, Emily Gadzinski, Julia Hillegonds, Amani Gaillard, and Katie Switras all deserve a high-five the next time you see them.

My wonderful, patient, and committed friends earned extra special cool points for their toleration and remediation of my behavior on “thesis days”. From Kevin’s thesis day breakfasts to my housemates’ post-deadline celebrations, their support ensured my physical and mental health throughout this process. Andrew English
Acknowledgments—Continued

deserves special consideration for enduring my constant pestering and abuse of his awesome statistical analyses skills. I wish I could list him as a co-author.

Above all, my parents, Pamella and Charles Binder, deserve credit for the development of the scholastic abilities that made this research possible. They are singularly responsible for the belief that I could even attempt to attain a graduate level degree. Their unending support has made me who I am today and I hope that I can “pay it forward” in some small way through my contributions in academia and beyond.

Katherine J. Binder
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INTRODUCTION

“Our fate and future is and always has been intertwined with nature, despite the widespread failure of most humans to act in a manner that reflects a deep understanding of this relationship (Glasser, 2007).” This failure is referred to as the “gap” between the possession of environmental knowledge and environmental awareness, and the display of pro-environmental behavior (Kollmuss & Agyeman, 2002; Glasser, 2007). Exploration of the gap is central to innumerable theoretical and experimental analyses attempting to account for the persistent and seemingly senseless destruction of the environment resulting from human behavior. Because of its emphasis on the contextual controlling variables that contribute to the emergence of behavior, the field of behavior analysis is uniquely aligned to contribute to this body of work. Although behavior analysis has historically focused on single-subject interventions, a strong line of environmentally focused group-design research has emerged.

The Behavior Analysis Approach to Saving the Environment

Behavior analysts began confronting the challenges of group contingencies in the context of environmentally relevant behaviors as early as the 1980s. Geller, Winett, and Everett (1982) described the emergence of applied behavior analysis research focusing on a range of environmental issues including litter and waste reduction, energy conservation, transportation, and water conservation.

A decade later, Dwyer, Leeming, Cobern, Porter and Jackson (1993) documented the frequency of the publication of articles that took intervention approaches to
environmentally relevant behaviors from 1970 to 1990 and offered a review of articles published after 1980. Their analysis depicted a steady increase in articles published after 1970, peaking at 14 in 1977 and steadily declining to two or less per year by 1990. They attributed this decline in research interest to lack of support and challenges faced in creating the necessary changes within large systems and institutions including public policies and deeply ingrained cultural practices.

The new millennium brought a renewed interest in environmental research among psychologists. In the May, 2000 issue of American Psychologist, a series of commentaries called for the continued involvement of psychologists. Stuart Oskamp’s “A Sustainable Future for Humanity? How can Psychology Help?” provided a detailed overview of the impacts of human behavior on the environment and made a powerful case for psychologists to join environmentalists in the “…war against the common enemy of an uninhabitable Earth…(2000).”

The Fall 2010 issue of The Behavior Analyst contained commentary in the form of a special section titled “The Human Response to Climate Change: Ideas From Behavior Analysis”. Multiple intervention-based research studies were presented along with opinion pieces suggesting future directions for behavioral environmental research. It was later criticized for failing to address the issue of consumerism as a main target of change (Grant, 2011).

In an update of the Dwyer, et al (1993) review, Lehman and Geller (2004) noted a decline in the number of articles evaluating behavioral interventions and an increase in research attempting to correlate traits such as attitudes, affluence, income, and demographics of individuals to pro-environmental behavior. They reported that these
articles outnumbered the intervention-based articles by seven to one. Trait-based analysis of pro-environmental behavior has indeed enjoyed a long and prolific history, dating back to the 1970s and continuing today (Maloney, Ward, & Baucht, 1975; Lounsbury & Tornatzky, 1977; Catton & Dunlap, 1978; Dunlap & Mertig, 1983; Jones & Dunlap, 1992; Leiserowitz, Kates, & Parris, 2005; Leiserowitz, 2006). Although this form of research may prove beneficial in the development of incentive programs and other intervention-based research, Lehman and Geller point out that trait-focused research has no direct potential to result in interventions that incite behavior change.

In an attempt to reorient the focus of environmental research toward a more behavior analytic approach, Lehman and Geller (2004) outlined six main areas where human behavior impacts the environment and reviewed research that has made attempts to create behavioral change in these areas. The areas include: 1) air pollution, 2) climate change, 3) water pollution and depletion, 4) solid waste, 5) soil erosion and contamination, and 6) loss of green space and species diversity.

The various interventions and settings discussed included litter control in theaters, increasing the rate and efficiency of recycling, decreasing energy used in buildings, altering transportation-related behavior, and altering consumers’ purchasing behavior. Lehman and Geller (2004) divided intervention strategies into two categories, antecedent strategies and consequence strategies. The antecedent interventions included information and education, prompting, modeling, commitment, and environmental design. The consequence based strategies included rewards and feedback. Geller and Lehman also addressed the issues of choosing behavioral targets, maintaining pro-environmental
behavior, the differences between curtailment and efficiency behaviors, response maintenance, permanent interventions, and the challenge of dissemination.

Lehman and Geller (2004) also pointed out that behavior analysts have focused their research on only three main targets, 1) increasing recycling-related behavior, 2) decreasing residential energy use, and 3) reducing environmental litter. They opined that these targets provide convenient research topics because they provide easy to measure outcomes. This is especially true of recycling research studies, where the product of the target behavior is tangible and can be weighed or counted. Lehman and Geller (2004) challenged behavior analysts to test interventions that have the potential to make a greater impact. Increasing recycling is a worthy target, but more attention should be paid to the consumption and reuse aspects of consumerism versus the disposal of items at the end of the waste stream.

The Behavior Analysis Approach to Recycling

Given this powerful argument, one might wonder why yet another behavioral analytic recycling research project is necessary when there are obviously much larger issues at hand. The issue is that the book is not closed on research related to recycling behavior. The current recycling and material recovery rates in the United States leave significant room for improvement. In 2010, only 8.2% of plastics generated were recovered for recycling followed by 27.1% of glass, 35.1% of metals, and 62.5% of paper (United States Environmental Protection Agency [U.S. EPA], 2010). Additionally, every
community, event, residence, and building is different and presents its own unique situational challenges, most of which are unaccounted for by the current research.

Until a comprehensive guide providing solutions tailored to as many conceivable settings as possible is complete and recovery rates for all recyclable material reach 100%, our work is not done. Given the relative ease with which this form of research can be conducted, it is surprising that such attempts have not yet been made. The current research project is designed as a strategic continuation of the line of research outlined below and is one of many campus projects that, when combined, have the potential to create a guide for effective and ideal recycling programs for various institutional settings.

Porter, Leeming, and Dwyer (1995), published the only known review of behavioral research designed exclusively to increase recycling. They discussed 31 research studies, 21 of which used antecedent interventions, 10 that used consequence-based interventions, and one that used both. The antecedent interventions included written and oral prompts, commitment strategies, environmental alterations, goal setting, and both prompts and environmental alteration. Of these, goal setting was deemed to be the most promising technique for increasing recycling. Consequence based interventions included feedback, rewards, and penalty for failure to recycle. Of these, reward-based consequences proved to be the most effective interventions.

It can be difficult to compare recycling research across settings for many reasons. Curbside recycling programs capitalize on a captive audience because participants do not generally vary from day to day. Because of this, public posting, feedback, commitment, goal-setting and individualized consequence-based contingencies are made more feasible. For the purposes of this recycling study, a more narrow review of literature is necessary.
The following review outlines the relevant research studies that have been performed in settings similar to a college campus or academic building. Some of the research was included in the Porter, et al (1995) review and some was published afterward.

In 1980, Geller, Brasted, and Mann studied the effects of aesthetically pleasing bird shaped trash receptacles when compared to typical unobtrusive trashcans on litter rates in an indoor mall setting. Two of the typical trashcans were replaced with bird shaped receptacles. They found that litter rates decreased substantially in the areas surrounding the bird receptacles and that much more litter was placed in the bird receptacles compared to the typical trash cans, concluding that aesthetic bins are more effective.

Jacobs, Bailey, and Crews (1984) studied participation in curbside recycling programs when residents were presented with varying collection programs. The programs included various forms of media prompts and coinciding the trash and recycling collection days. The most effective intervention noted was the distribution of specialized containers to help residents easily sort recyclables, along with frequent prompting. Even though the curbside setting of this research study differs greatly from a college campus setting, the findings have interesting applications. Beyond providing prompts and educational materials, presenting residents with specialized containers had the most substantial and longest lasting effects on participation in the recycling program. This suggests that creating an easy system for sorting recycling from trash may lead to increased recycling rates in an academic setting.

Austin, Hatfield, Grindle, and Bailey (1993) explored the effects of the proximity of signage along with the proximity of recycling receptacles to waste receptacles on the
percentage of items recycled in two separate academic departments. During baseline, in Department A, a waste bin and a recycling bin were positioned next to each other. In Department B, the waste and recycling bins were 4 m apart. All receptacles had small stickers affixed to them describing proper items for each. In a proximal prompt condition in Department A, large signs detailing what items were appropriate for each receptacle were positioned above the receptacles. In Department B, a prompt condition was initiated where signs were also posted above the receptacles, but the signs and receptacles remained 4 m apart. After several sessions, the receptacles and signs in Department B were moved next to each other to replicate the proximal prompt condition in Department A. In Department A, an increase from 51% in baseline to 84% during the proximal prompt condition was found. Department B showed also showed a rate of 51% during baseline increasing to 60% during the prompt condition and 66% during the proximal prompt condition. These findings suggest that positioning waste and recycling receptacles in close proximity and positioning signage directly above receptacles results in an increased rate of recycling.

Werner, Rhodes, and Partain (1998) studied effects of signage on the amount and cleanliness of polystyrene containers recycled in a school cafeteria setting. The cafeteria in this study had switched from washable dishware to polystyrene dishware and made many failed attempts at encouraging all students to recycle the new polystyrene containers. Problems included lack of recycled items placed into bins, as well as contamination of the bins by placement of food items, cans, and other non-polystyrene items. The original signage consisted of printed 8.5 x 11 inch signs placed about three feet above recycling bins. The signs bore messages simply encouraging students to
By taking into account the participants’ expectations about their physical environment and events, the authors created new signs that were noticeable, clearly written, and memorable. The new signs focused on three concepts: recycle, polystyrene, and how. Large signs were placed at eye level above each bin and were readable from across the room. Samples of used polystyrene items that had been sufficiently cleaned (food items scraped off) were attached to the signs demonstrating what could be placed in the bins and how clean they should be. As a final prompt, the words “STOP. DO NOT CONTAMINATE” were placed around the rims of the recycling bins. The authors note that their intervention was not designed to convince people to recycle, only to give instructions on how to recycle. The dependent variable established in this study was the estimated amount of recycling in bins. After a four day baseline period, each of the four bins was approximately one quarter full of polystyrene. This small amount of polystyrene was contaminated and not recyclable. During the intervention, however, 3.5 bins were full after every day. The polystyrene was scraped and uncontaminated, all of it was recyclable.

Duffy and Verges (2009) examined the effects of the presence of specialized waste receptacle lids on recycling compliance in public settings. They compared the number and accuracy of items deposited in waste stations with lidless bins to the items deposited in bins with specialized lids that reflected the shape of items meant to be deposited. The trash lid consisted of a traditional flap lid, the aluminum, glass, and plastic lid had a circular hole in it for bottles and cans, and the paper lid had 2-inch wide slits. Each station included three bins: trash, paper recycling, and aluminum/glass/plastic recycling. All were located in a 5-story academic building. They found that the presence
of the lids increased recycling compliance, measured by the number of items recycled rather than thrown in the trash bin, by 34%. Additionally, in the lidless condition, a majority of the recycling bins contained trash items that contaminated the recycling stream. The lid present condition only had one bin containing a trash item, meaning that accuracy of items recycled was increased by 95%.

Brothers, Krantz, and McClannahan (1994), studied the effects of the placement of recycling receptacles on the amount of paper recycled in an office setting. Using an AB design, they first collected data on the percentage of paper recycled with the presence of a central recycling bin. During treatment, they provided desktop recycling bins. During the baseline condition, 28% of paper was recycled compared to 85% – 94% during treatment. Follow up assessments 1, 2, 3, and 7 months later showed a maintained rate of 84% - 98% paper recycled.

Ludwig, Gray, and Rowell (1998) also studied the effects of the receptacle location on the number of recycling items placed in the receptacles. They used a multiple baseline ABA design in two different academic buildings. During baseline conditions, receptacles were placed in a central location of the building. During the intervention, a receptacle was placed in each classroom. The researchers collected cans from both the recycling receptacles and all trash bins in the building. The dependent variable was calculated by dividing the number of cans in a recycling or trash bin divided by the total number of cans collected that day. In Building A, 40% of cans were placed in recycling receptacles during baseline, 63% during intervention, and 40% during withdrawal. In Building B, 35% of cans were placed in recycling receptacles during baseline, 65% of cans during treatment, and 29% of cans during withdrawal.
O’Conner, Lerman, Fritz, and Hodde (2010) pointed out that the success of Ludwig et al. (1998) could have been due to the increase in recycling receptacles from the baseline to treatment condition rather than simply the placement of the recycling receptacles. In order to test this theory, they performed a replication with an added condition. Before recycling receptacles were placed in classrooms, they were first placed outside of each classroom in the hallway. The increased number of receptacles had no effect on the rate of recycling and the findings of Ludwig et al. (1998) were replicated – classroom placement is indeed the critical factor.

This research suggests a framework for the creation of effective recycling programs that consists of at least 5 components. First, aesthetically pleasing, specialized containers that make sorting simple resulted in a statistically significant improvement in recycling rates over baseline measures (Geller, Brasted, & Mann, 1980). Second, adding lids to all receptacles with openings that reflect the predicted shapes of intended waste streams resulted in a 30-54% improvement (Duffy & Verges, 2009). Third, the addition of signage that is simple, directional and avoids the use of general pro-recycling statements increased recycling rates significantly (Werner, Rhodes, & Partain, 1998). Fourth, placing both signage and all receptacles in close proximity resulted in a 47-71% improvement (Austin, Hatfield, Grindle, & Bailey, 1993). Lastly, placement of recycling receptacles in all areas of consumption increased recycling rates by 20-40% (Brothers, Krantz, & McClannahan, 1994; Ludwig, Gray, & Rowell, 1998; O’Conner, Lerman, Fritz, & Hodde, 2010). This research project seeks to measure the effect of these elements when combined and implemented as a treatment package.
Research Overview

Prior research has isolated individual variables that affect waste sorting behavior and increase recycling rates. The goal of the research reported here is to construct a multicomponent recycling program by incorporating elements from previous research in an effort to further evaluate and expand the results of this line of research. Implementation of the recycling program will also explore an ongoing issue at Western Michigan University. During the Spring 2011 waste audits in Brown Hall, up to 30% of landfill waste was found to be recyclable material that had been inaccurately sorted. The intervention presented here attempts to address the issue by using two strategies suggested by the literature along with one untested strategy.

The first component is new, aesthetically pleasing, and integrated waste receptacles designed with three shaped openings as dictated by the findings of Duffy and Verges (2009). The receptacles accept all types of waste sorted into the three waste streams that WMU accepts (landfill, paper/cardboard recycling and plastic/glass/metal recycling). This design also allows the three different types of receptacles to be in very close proximity, as suggested by the findings of Austin, Hatfield, Grindle, and Bailey (1993) and greatly simplifies the sorting process, as suggested by the findings of Jacobs, Bailey, and Crews (1984).

The second component is the addition of new signage. The signage was created to clearly outline what can be placed in each opening, demonstrating both what and how to recycle, instead of only providing general pro-recycling messages as prescribed by the findings of Werner, Rhodes, and Partain (1998). Additionally, the signs are mounted on
the bins directly above each opening as suggested by the findings of Austin, Hatfield, Grindle, and Bailey (1993).

The last component concerns the placement of the integrated waste receptacles. In contrast to the findings of Gray, et al (1998), Brothers, et al (1994), and Fritz, et al (2010), the integrated waste receptacles were placed in a central location on each floor of the building. However, in addition, all extraneous trash and recycling bins were removed from classrooms and public areas. The integrated receptacles were literally the only option for waste disposal. To the author’s knowledge, no research has studied the affects of centralized receptacles in the absence of any other options, making this research novel, while at the same time addressing monetary and maintenance issues. Large receptacles are costly and in order for this study to represent a recycling program that may actually be implemented campus-wide and adopted by other institutions in the present economic climate, it must be cost-effective. Furthermore, reducing the number of recycling and trash bins that require emptying both reduces the time needed to maintain them and adds to the practical utility of the program along with the aesthetic environment of campus.
METHODS

Participants

Participants included all faculty, staff, students, and community members who utilized Western Michigan University’s Brown Hall during the Fall 2011 and Spring 2012 semesters. Data were collected as the weight of waste, a product of behavior, with no identifying information.

Setting

The study took place in Brown Hall on Western Michigan University’s main campus. The building consists of 4 floors, all containing a combination of classrooms, labs, and lounges. The building contains two office areas with full time staff. Each floor of Brown Hall contains one hallway with classrooms and offices on either side. Floors 1 and 2 have entrances in the central area of the hallway. In place of entrances, Floors 3 and 4 have large stairwells in the central area of each hallway. All floors have smaller stairwells on either end of the hallways. Floors 1 and 2 have a large lecture hall in the central area that blocks visibility from one end of the floor to the other. Floors 3 and 4 are completely straight and any objects placed in the hallways are highly visible from any spot in the hallway. Floor 2 is unique in that it contains a student lounge with vending machines along with the School of Communication’s library, which includes the building coordinator’s office and an additional student study area.

The baseline recycling program in Brown Hall included multiple groups of trash and recycling receptacles in each hallway and common area with no signage. These
receptacles consisted of large grey plastic trashcans with vertical push lids, short round blue plastic bins with white lids that have circular holes for bottle and can recycling, and tall, rectangular yellow plastic bins with blue lids that have a slot for paper recycling.

Groups of these bins were located in three places on each floor, near the central entrance/stairwell areas and the stairwells at the ends of each hallway. One group of bins was also located in the 2nd floor common area. Each classroom and office area also had a small metal, open top trashcan. Most classrooms and offices had, in addition, a small, rectangular yellow plastic open-top paper recycling bin.

During the intervention phase, the current recycling bins and trash receptacles were removed on two of the floors in Brown Hall. One or two multifunction recycling/trash bin was placed near the central entrance/stairwell areas of each of these floors. In computer labs, small yellow paper recycling bins were placed under each printer and all other bins removed. Students are not permitted to have food and beverages in the labs so the only waste produced is paper from printers. Waste receptacles remained in all bathrooms. Reference Appendix A for detailed floor plans along with baseline and intervention locations of recycling bins and trash receptacles.

This research study was designed to test the intervention in classroom settings only. As a result, it was determined that it was not acceptable to expect office occupants to utilize a central bin. The two full-time staff offices experienced no change.
Materials

Materials included new, integrated recycling/trash receptacles along with detailed signage. See below for descriptions of both and reference Appendix B for images. Other materials included rubber dish gloves, wooden dowels, and a first aid kit that was onsite during trash sorting. Also, laminated tags were created for labeling waste bags by floor. A digital shipping scale was used for weight measurements. The scale has a stainless steel platform and a hand held digital display. Its maximum weight is 330lbs.

Dependent Variables

The primary dependent variable recorded was the weight of the contents retrieved from both the old style trash and recycling receptacles, and the new integrated recycling/trash receptacles. The weight measurements were used to calculate a percentage of trash that is recyclable material that has been improperly sorted.

In order to collect these data, student recycling staff and research assistants sorted and weighed all waste. Data collection was supervised by the researcher and other staff members. Custodial staff collected trash from throughout the building and student staff collected recycling. For the first 15 data collection periods, only the first shift landfill waste was collected. Both shifts were represented for most of the remainder of the study.

In order to ensure consistent data collection, prior to each data collection sorting session with new data collectors, supervising staff members presented a review of items that data collectors will be likely to find while sorting and whether or not they are
recyclable. The WMU guide for recyclable items was used during this review and can be found in Appendix C.

Weight of Waste

All landfill and recycling waste collected from the building during the study was weighed and used to calculate the dependent variable percentage measures. In order to determine the weight of waste bags, data collectors weighed each individual bag of waste according the protocol in Appendix D.

Waste was measured and recorded in two main categories. Trash and improperly sorted recycling waste included all the waste that had been placed in trash receptacles. Recycling waste includes all waste that has been placed in recycling receptacles. Additionally, all bags of waste were weighed separately by floor. To ensure that the trash and recycling waste from each floor remained separate, custodial staff were given small laminated signs for labeling waste bags.

Trash and Improperly Sorted Recycling Waste

Custodial staff typically collect trash each weekday morning and afternoon and deposit it in the dumpster outside Brown Hall. During the study, custodians labeled all trash bags and left them on the Brown Hall loading dock to be sorted and weighed. Each weekday, data collectors processed trash that was brought to the dock the previous
afternoon and that morning. After data collection, data collectors placed trash in the appropriate dumpster.

During data collection sessions, all landfill waste was first sorted to remove all recycling items that were incorrectly placed in landfill receptacles. These incorrectly placed recycling items were weighed separately. The resulting two measures are the weight of landfill waste, and the weight of recycling waste (paper/cardboard and plastic/glass/metal) that was incorrectly placed in landfill receptacles. From these two weight measures, an accuracy measure of landfill receptacles was calculated for each floor. The accuracy of items placed in the trash receptacle is calculated as a percentage by comparing the overall weight of landfill to the weight of the inaccurately placed recycling.

No bathroom waste was sorted during the study for health and safety reasons. Bathroom waste is primarily composed of paper towel and hygiene products, neither of which are recyclable. Bathroom waste was weighed and added to the correctly sorted landfill waste total for each floor.

All research assistants and data collection volunteers were made familiar with the Data Collection Protocol in Appendix D. The protocol outlines how to safely sort and handle waste bags and what to do in case of an accident.

Recycling Waste

Student recycling staff members typically empty the paper and plastic/glass/metal recycling bins in Brown Hall twice each week and place the recycling waste in the
appropriate dumpsters outside of the loading dock. During the study, data collectors emptied and weighed the contents of all recycling bins from each floor every morning. Data were collected as the weight of paper/cardboard and weight of plastic/glass/metal recycling.

The accuracy of items placed in recycling bins was not an issue in Brown Hall, and had not been on campus overall, so recycling was not sorted daily for accuracy.

**Waste Discarded in Classrooms**

It was deemed likely that in the absence of in-classroom waste receptacles, students would discard waste on the floor. This is a legitimate cause for concern due to the potential for additional workload for custodial staff. In order to measure the occurrence of waste on classroom floors and ensure that custodial staff did not experience an additional workload, a supplementary measure was taken. Once each week during the study, custodial staff left a labeled bag of floor waste from all classrooms. Data collectors counted the number of waste items, recyclable or not, and recorded it. Baseline measures were compared to treatment measures. A protocol was developed in the event that the amount of waste found during treatment significantly exceeded the amount of waste found during baseline. If that situation had occurred, an old style trash can, plastic/glass/metal bin, and paper/cardboard bin would have been placed at either end of all treatment floors and data collection would have continued.
Experimental Conditions

General Procedures

All four floors in Brown Hall first experienced a four-month baseline condition. Nothing changed except for the implementation of data collection practices. Thereafter, Floors 1 and 2 experienced the treatment package with new integrated waste and recycling bins and new signage in a multiple baseline pattern. Floors 3 and 4 remained in the baseline condition throughout the study to serve as control measures.

Baseline

The baseline condition represented the current campus waste collection program, including multiple centralized but separate landfill, paper, and bottle/can receptacles along with small classroom trash bins and paper recycling bins.

Independent Variables

The independent variables made up the treatment package, including the new waste receptacles and new signage along with removal of the old receptacles.

Waste Receptacles

The new multifunction waste receptacles were made from stainless steel with openings on the top horizontal section and frames for signage on a vertical backing behind the openings. The two right side openings are a slot and round shaped for
paper/cardboard recycling and glass/plastic/metal recycling. The left side opening is a large rectangle for landfill. Each opening is centered on a removable tray for future changeability of the openings. The vertical back portion of the receptacles has three open faced frames for signage and an open top for easy replacement of signs. Reference Appendix B for images of the receptacle.

**Signage**

The new signage consisted of three signs mounted on the receptacles directly above each of the three openings. The signs are designed with consideration of the findings of Werner, Rhodes, and Partain (1998). Each sign contains a label for the opening it is located above (plastic/glass/metal, paper/cardboard, landfill) along with a list of what can be sorted into the opening. Each of the three signs is a bright color that corresponds with the color scheme of the old style recycling bins. Yellow for paper/cardboard, blue-green for plastic/metal/glass, and red for landfill. Matching flyers were posted in classrooms and hallways where trashcans were removed directing users to the new multifunction receptacle. Reference Appendix B for images of the signage.

**Experimental Design**

The study was a concurrent multiple baseline with a control component. All floors began in a baseline condition. After a full semester of the baseline condition, the treatment package was implemented on Floor 1. After nine data collection sessions, the treatment package was then implemented on Floor 2, and after seven additional data
collection sessions, a second bin was placed on Floor 2. Floors 3 and 4 remained in the baseline condition for the entirety of the study to serve as an additional control component.

**Interobserver Agreement**

Interobserver agreement was performed during at least one data collection session per week. One bag of trash was sorted by one data collector out of sight of the other data collectors. The data collector then weighed the recycling and landfill and mixed it back into the same bag. A different data collector then re-sorted the bag and weighed the sorted recycling and landfill again. Each bag of waste typically took five minutes to sort, meaning that the entire process normally took less than fifteen minutes. IOA was calculated as a percentage difference between the two independently collected weights of recycling and landfill for one floor for an entire day. A protocol was developed that called for additional training sessions if IOA is calculated at less than 80%. This situation never occurred and IOA was calculated to be 90% agreement over 19% of sessions. Reference Appendix D for the full interobserver agreement protocol.
RESULTS

51 days of data collection are represented by the results. Data are discussed first in terms of the percentage and weight of recyclable materials that were found in landfill receptacles daily. This measure will then be broken into its categories of paper/cardboard and plastic/glass/metal. Accurately sorted recyclable materials will then be presented, followed by the daily weights of all waste streams separately and combined. The average daily weight of waste will also be presented for each category of waste and the differences between baseline and intervention phases will be highlighted. The results conclude with classroom litter data, and social validity survey results.

Recyclable Material Inaccurately Placed in Landfill

Recyclable Material as a Percentage of Landfill Waste

A decrease in the percentage of recycling inaccurately placed in landfill following the implementation of the treatment package was found on Floors 1 and 2 with a further decrease following the addition of a second comprehensive bin on Floor 2 (see Figure 1). During the baseline phase, the percentage showed an upward trend on all floors except Floor 3, which trended slightly downward. During intervention phases, all data show a significant downward trend. The level of variability also showed marked change during intervention phases. R-squared values for trend lines during baseline varied between .014 and .187 while intervention values ranged as high as .588 and .651. The highest correlation was found on Floor 2 after the first bin was installed (see Table 1)
Figure 1
Daily Percentage of Landfill Waste that is Inaccurately Sorted

Recyclable Material by Floor

Recyclable Material as a Percentage of the Weight of Daily Landfill Waste

Observation Days
Weight of Recyclable Material Found in Landfill

The weight of recycling inaccurately placed in landfill was broken into its components, paper/cardboard and plastic/glass/metal. The levels of both categories are similar over the first 15-20 data points on each floor and increasingly separate from each other during baseline. More plastic/glass/metal was found than paper/cardboard during the baseline phase on all floors. Following the implementation of the treatment package on Floors 1 and 2, the level of plastic/glass/metal decreases significantly and becomes less variable (see Figure 2).
Figure 2

Types of Recyclable Materials Found in Landfill Daily

- Floor 1: Baseline
- Floor 2: One Receptacle
- Floor 3: Two Receptacles
- Floor 4

Legend:
- Plastic/Glass/Metal - Both Shifts
- Plastic/Glass/Metal - First Shift Only
- Paper/Cardboard - Both Shifts
- Paper/Cardboard - First Shift Only

Observation Days

Weight in Pounds
Weight of Accurately Sorted Recyclable Materials

The weight of recycling placed in recycling receptacles was broken into the weight of its separate categories, paper/cardboard and plastic/glass/metal (see Figure 3). Paper/cardboard accounted for more of the accurately sorted recycling than plastic/glass/metal. Paper/cardboard was also found to be more variable with an overall standard deviation of 2.18 compared to .84 for plastic/glass/metal (see Table 2). Also, plastic/glass/metal showed notable increases following the implementation of the intervention package on Floors 1 and 2 that were greater than the increases found on Floors 3 and 4.

Table 2

Accurately Sorted Recyclable Materials

<table>
<thead>
<tr>
<th>Floor</th>
<th>Accurately Sorted Paper/Cardboard Recyclable Material</th>
<th>Accurately Sorted Plastic/Glass/Metal Recyclable Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>1</td>
<td>1.31</td>
<td>2.50</td>
</tr>
<tr>
<td>2</td>
<td>4.85</td>
<td>2.26</td>
</tr>
<tr>
<td>3</td>
<td>1.12</td>
<td>1.08</td>
</tr>
<tr>
<td>4</td>
<td>0.85</td>
<td>0.76</td>
</tr>
<tr>
<td>Average</td>
<td>2.03</td>
<td>1.65</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Floor</th>
<th>Accurately Sorted Plastic/Glass/Metal Recyclable Material</th>
<th>Accurately Sorted Plastic/Glass/Metal Recyclable Material</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>1</td>
<td>0.64</td>
<td>0.92</td>
</tr>
<tr>
<td>2</td>
<td>0.81</td>
<td>0.81</td>
</tr>
<tr>
<td>3</td>
<td>0.39</td>
<td>0.54</td>
</tr>
<tr>
<td>4</td>
<td>0.54</td>
<td>0.49</td>
</tr>
<tr>
<td>Average</td>
<td>0.60</td>
<td>0.69</td>
</tr>
</tbody>
</table>
Figure 3

Daily Weight of Accurately Sorted Recyclable Materials by Type and Floor

Observation Days
Daily Weight of Waste

**Weight of Recycling and Landfill**

The daily weight of recycling and landfill are considered separately in Figure 4. On each floor, the weight of both recycling and landfill waste follow similar paths over the first 15-20 data points and separate over the course of the baseline phase with more landfill waste collected than recycling. Landfill levels remained higher than recycling on Floors 3 and 4 for the remainder of the data collection period. Upon implementation of the intervention package on Floors 1 and 2, landfill levels decreased significantly and recycling levels increased somewhat. Reductions can be seen in the variability of both waste categories during intervention phases.
Figure 4

Weight of Recycling and Landfill Waste Daily

Floor 1
Baseline
One Receptacle
Floor 2
One Receptacle
Two Receptacles
Floor 3
Floor 4

Weight in Pounds

Observation Days
Total Weight

The weight of all waste collected daily showed a significant upward trend over the entire data collection period, increasing from about 30 lbs to almost 60 lbs per day. During the baseline period, this trend was somewhat steeper when compared to the overall trend. During the intervention phases the weight of waste trended downward (see Figure 5). All total daily weight data was highly variable with R-squared values of .208 overall, .270 during baseline and .046 during intervention.

Figure 5

Daily Weight of Waste

Total Weight by Floor

The weight of waste collected on Floors 1 and 2 showed very slight upward trends throughout the data collection period. Floors 3 and 4 showed significant upward trends.
When divided into phases at the point of the first intervention, Floor 1 showed a slightly steeper upward trend when compared to the trend of the total data collection period on that floor and repeated that trend during the intervention phase. Floor 2 showed a significant upward trend during baseline, followed by depressed levels and downward trends during intervention phases (see Figure 6).

Based on the trend lines for the total weight of waste (reference Figure 5), expected changes in weight for each floor were weighted and calculated for baseline and intervention phases. Over the entire data collection period, Floors 3 and 4 experienced disproportionate increases in weight that were almost double what could be expected.

During the intervention phase, Floors 1 and 2 experienced levels of weight that were 1.5 – 3 times lower than what was predicted by the intervention phase total weight trend line. Additionally, the average of the daily weight of waste collected on Floors 1 and 2 was similar during baseline and intervention while the average weight increased by 47% on Floor 3 and doubled on Floor 4. See Appendix E and Table 3 for charts of expected and actual changes in weight based on trend lines along with the average weight for each floor during each phase.
Figure 6

Daily Weight of Waste by Floor

Floor 1: Baseline, One Receptacle
Floor 2: One Receptacle, Two Receptacles
Floor 3
Floor 4

Weight in Pounds

Observation Days
Averages Analysis

In an effort to summarize the changes found on each floor from baseline to intervention phase, the average daily weight of each category was calculated along with the difference between phases (see Table 3). Decreases in the weight of landfill and recycling found in landfill were found on Floors 1 and 2 along with increased or relatively stable weights of recycling. Floors 3 and 4 experienced gains in weight across all categories.

The percentage of average weight for each waste category by floor was then calculated using the daily averages (see Table 3). Again, Floors 1 and 2 were set apart from Floors 3 and 4 with decreases in recycling found in landfill and increases in the percentage of recycling collected daily. Additionally, Floor 1 experienced a large decrease in the percentage of landfill collected daily. Floors 3 and 4 experienced both increases in the percentage of landfill and recycling found in landfill as well as decreases in recycling.

The average daily weight of each waste category was also used to determine the amount of accurately sorted recycling as a percentage of the total potential recyclable material found daily on each floor. This includes both recyclable material placed accurately in recycling receptacles and recyclable material inaccurately placed in landfill receptacles. This information is depicted in Table 3. Floors 1 and 2 experienced notable increases in the percentage of correctly sorted recyclable waste, while Floors 3 and 4 both experienced a decrease in correctly sorted recyclable waste.
Table 3

Averages Analysis

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Intervention</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Landfill</td>
<td>R in L</td>
<td>Recycling</td>
</tr>
<tr>
<td>Floor 1</td>
<td>7.06</td>
<td>1.43</td>
<td>2.42</td>
</tr>
<tr>
<td>Floor 2</td>
<td>8.83</td>
<td>2.20</td>
<td>4.90</td>
</tr>
<tr>
<td>Floor 3</td>
<td>6.02</td>
<td>1.33</td>
<td>1.60</td>
</tr>
<tr>
<td>Floor 4</td>
<td>4.00</td>
<td>0.61</td>
<td>1.47</td>
</tr>
<tr>
<td>Average</td>
<td>6.48</td>
<td>1.39</td>
<td>2.60</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.02</td>
<td>0.65</td>
<td>1.59</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Intervention</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Landfill</td>
<td>R in L</td>
<td>Recycling</td>
</tr>
<tr>
<td>Floor 1</td>
<td>65%</td>
<td>13%</td>
<td>22%</td>
</tr>
<tr>
<td>Floor 2</td>
<td>55%</td>
<td>14%</td>
<td>31%</td>
</tr>
<tr>
<td>Floor 3</td>
<td>67%</td>
<td>15%</td>
<td>18%</td>
</tr>
<tr>
<td>Floor 4</td>
<td>66%</td>
<td>10%</td>
<td>24%</td>
</tr>
<tr>
<td>Average</td>
<td>63%</td>
<td>13%</td>
<td>24%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>5%</td>
<td>2%</td>
<td>5%</td>
</tr>
</tbody>
</table>

Percentage of Potential Recycling Accurately Sorted

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Intervention</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Floor 1</td>
<td>63%</td>
<td>81%</td>
<td>18%</td>
</tr>
<tr>
<td>Floor 2</td>
<td>69%</td>
<td>80%</td>
<td>11%</td>
</tr>
<tr>
<td>Floor 3</td>
<td>55%</td>
<td>45%</td>
<td>-10%</td>
</tr>
<tr>
<td>Floor 4</td>
<td>71%</td>
<td>58%</td>
<td>-13%</td>
</tr>
<tr>
<td>Average</td>
<td>64%</td>
<td>66%</td>
<td>1%</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>7%</td>
<td>18%</td>
<td>15%</td>
</tr>
</tbody>
</table>

Note. The intervention phase on Floor 2 began on March 27th, all other floors on February 27th. R in L represents inaccurately sorted recycling found in landfill.
Classroom Litter

The amount of waste left in classrooms increased substantially from baseline to intervention phases, with a baseline mean of 2.6 items and intervention mean of 6.4. An increase in variability was also documented with a standard deviation of 2 during baseline and 4.6 during intervention. Reference Figure 7.

Figure 7

Items Found in Classrooms

Social Validity

Social validity was measured with a satisfaction survey. The survey was made available to participants on paper and through the Survey Monkey website. Paper surveys were located in the Communications Library on Floor 2 of Brown Hall. Reference Appendix G for the survey that was distributed.

Of the 45 surveys collected, 15 were paper surveys and 30 were submitted through the Survey Monkey website. Results indicate that 38-67% of participants liked
the new comprehensive receptacles and believed that their presence made it easier for
them to dispose of recycling and landfill while accurately sorting recyclables. The
question regarding the likelihood of leaving waste behind in classrooms resulted in the
greatest level of mixed response. 26% of the respondents marked that they agree or
strongly agree with the statement, “Because of the new waste receptacles, I am more
likely to leave litter in classrooms or other work areas.” 62% disagreed or strongly
disagreed with this statement (see Figure 8). Reference Appendix F for full
documentation of responses to the open-ended survey questions.

Figure 8

Comprehensive Waste Receptacle Satisfaction Survey Results
RESULTS

Results indicate that removal of classroom bins and addition of a centrally located, integrated receptacle along with detailed signage increases the accuracy of waste sorting behavior (see Figure 1). Improvements were seen in the amount of recycling collected during intervention phases accompanied by reductions in both landfill waste and recycling inaccurately placed in landfill. These results counter the conclusions drawn by previous research that recommend an increased number of dispersed recycling/landfill clusters over centralized clusters. This is notable when considering the resources necessary to implement a dispersed recycling program compared to one that is centralized. The purchase and maintenance of multiple additional bins for all areas of consumption is much more costly than the purchase and maintenance of a small number of centralized receptacles. Further investigation is warranted before a campus-wide program can be recommended, but these results suggest that this recycling program may be a viable, effective improvement to the public area recycling strategies in academic buildings.

Several measures reflect the positive effects of the treatment package on the accuracy of waste sorting behavior. The decrease in the percentage of landfill waste comprised of inaccurately sorted recyclable material following the implementation of the intervention package on Floors 1 and 2 is notable (reference Figure 1). The increased R-squared values associated with this measure during the intervention phases further suggests that there is a high correlation between the percentage of inaccurately sorted material and the data collection days (reference Table 1). Furthermore, the considerable
increase in the percentage of potential recycling that was accurately placed in recycling receptacles on Floors 1 and 2 accompanied by a decrease in this percentage on Floors 3 and 4 (reference Table 3) indicates that the treatment package was the key factor in collecting accurately sorted waste and increasing recycling rates.

During baseline, plastic/glass/metal accounted for more of the recyclable material found in landfill than paper/cardboard. This is most likely a result of the current campus waste collection system that calls for landfill and paper/cardboard receptacles in every classroom, but no plastic/glass/metal receptacle. Because many students consume beverages during class, the proximity of a landfill receptacle in these areas of consumption resulted in significant amount of plastic/glass/metal inaccurately sorted into the classroom landfill receptacles. During the intervention phases on Floors 1 and 2, the amount of plastic/glass/metal found in landfill waste decreased significantly (reference Figure 2) and the amount of plastic/glass/metal correctly placed in recycling receptacles increased (reference Figure 3). It can be assumed that this is a result of the removal of classroom landfill receptacles on Floors 1 and 2 and addition of the integrated receptacles. The baseline response cost of accurately disposing of plastic/glass/metal waste generated in classrooms was relatively high because of the requirement to carry empty bottles and cans past a landfill receptacle and out to hallway receptacles. During intervention phases, occupants on Floors 1 and 2 were forced to use the comprehensive receptacles when disposing all waste. The reduction in the response cost associated with accurate waste sorting when all waste stream disposal options are presented in close proximity contributed to this increase in accurately sorted material.
Differences in Intervention Effectiveness

There are noticeable differences in the effectiveness of the treatment package on Floor 1 when compared to Floor 2. The percentage of inaccurately placed recyclable material found in landfill is higher on Floor 1 (reference Figure 1). It can be hypothesized that differences after placement of one bin on Floors 1 and 2 are attributable to the characteristics of each floor. Floor 1 is designed so that building users cannot see from one end of the hallway to the other. A large lecture hall sits in the middle of the hallway and obstructs the view. On Floor 2, the first bin was placed in a central location that was visible from both ends of the hallway. It is possible that the increased visibility resulted in more usage on Floor 2 compared to Floor 1.

Additionally, on Floor 1, the bathrooms are located near a number of relatively high traffic classrooms. Many building occupants utilized the bathroom trash receptacles for all waste including recycling, most likely as a result of the proximity to waste generation areas. This issue may have also contributed to the higher percentages of inaccurately sorted recyclable material on Floor 1 compared to Floor 2. This may have also been an issue on Floor 2 before the introduction of the second bin. It may also account for the additional decrease in the percentage of inaccurately sorted recyclable material following the placement of the second bin.

Accounting for Increase in Predicted Weight

The disproportionate increase in weight on Floors 3 and 4 coupled with the decrease in weight on Floors 1 and 2 during the intervention phases is somewhat
concerning. It cannot be accounted for with an increase in the number of classes held on those floors during the intervention phase (see Table 4). Another possible explanation could include differences in class assignments. If professors assigned more in-class homework or printing assignments during class time, especially in the upstairs rooms with printers, it is possible that students would dispose of paper waste within the building and an increase in weight would result. However, this theory is disproven by an analysis of Figure 3. There was no notable increase in paper recycling on those floors during the intervention phase. Additionally, Figure 4 indicates that the increasing category of waste on those floors was landfill and not recycling. Of the landfill waste on Floors 3 and 4, plastic/glass/metal showed increases over paper/cardboard (see Figure 6). It can be surmised, then, that as a result of the restricted number of receptacles on Floors 1 and 2 during the intervention phases, building occupants may have carried their waste to the other floors for disposal. Many students who use Brown Hall major in communications or foreign languages and have multiple classes in the building, there is some likelihood that students might carry waste with them as they travel between classes and floors within the building. It is also possible that, resulting from the reduction in number of bins, more building occupants on Floors 1 and 2 packed waste away instead of travelling to the centrally located bin and took it with them as they left the building. In this scenario, it would be assumed that all floors would have increased equally had the intervention not been implemented.
Table 4

Number of Classes Held in Brown Hall by Floor

<table>
<thead>
<tr>
<th>Floor</th>
<th>Fall 2011</th>
<th>Spring 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>49</td>
<td>48</td>
</tr>
<tr>
<td>2</td>
<td>67</td>
<td>63</td>
</tr>
<tr>
<td>3</td>
<td>94</td>
<td>89</td>
</tr>
<tr>
<td>4</td>
<td>92</td>
<td>85</td>
</tr>
</tbody>
</table>

Classroom Litter

Despite the substantial increase in the amount of waste found in classrooms (reference Figure 7), custodial staff remained extremely positive about the intervention. They anecdotally claimed that classrooms and hallways were cleaner during the intervention phases. They also stated that the hallways were easier to keep clean and looked more appealing with fewer waste receptacles and that treatment floors were easier to manage after the removal of the classroom bins.

Because the WMU custodial staff are unionized and helping them to clean classrooms would be considered an infringement of their duties, all classroom litter samples were collected by the staff during routine classroom cleaning. This made supervision and verification of the samples difficult. Additionally, rotating staff members made communication about classroom litter sample collection difficult and many samples were mislabeled or not labeled at all. Future research should attempt tighter control over these data in an effort to gain more samples and to better assess the effects of this treatment package on the amount of waste left in classrooms.
Special Situations

Brown Hall contains one computer lab that is open for all students to use during business hours. The lab is secluded and contains no windows and lab supervision is minimal. Despite a strict no food or drink rule in all computer labs, this lab initially saw a number of food and drink related waste items. Because the treatment package called for the elimination lab area trash bins, this waste landed in the lab paper-recycling receptacle. This was only an issue for the first week of intervention, but it should be noted for future application of this treatment package.

Unexpected waste volumes were also experienced during the last two weeks of the semester. Despite a campus wide policy stating that food is not allowed in classrooms, many professors host end-of-semester parties. These parties resulted in an overflow of waste. Some survey participants voiced frustration with this issue. The new bins are not large enough to accept plastic cups, plates, and pizza boxes from multiple parties and the landfill and recycling began to overflow onto the top of the bins and the floor surrounding the bins. The overflow problems most likely affected the accuracy of waste sorting during that time. In the future, custodial staff will place mobile recycling and waste bins inside classrooms that are hosting food parties. This should alleviate the issue by providing a space just for party waste, but the issue should continue to be monitored.
Weight as a Form of Data Collection

Weight of waste was chosen as the dependent variable for a number of reasons, however the utilization of this measure is not free from considerations. Relying on the weight of disposed waste or recyclable products is an indirect measure, really a response product, of the behaviors that actually resulted in the placement of waste or recyclable materials into a disposal bin. This type of response product measure is appealing because of its simplicity and objectivity as a measure of waste sorting behavior. However, it does not provide direct information about the form of the behavior that produces the waste nor does it provide information about the authorship of the response product (e.g., who and how many people engaged in behaviors that produced the waste material in a disposal bin). Counting the number of items discarded, while potentially a more sensitive measure, would become quite tedious and would be nearly impossible when small items such as shredded paper are presented during data collection. Direct observation of waste disposal is potentially the most accurate and sensitive data collection method, however direct observation is time intensive and potentially reactive. Additional measures such as demographic information, foot traffic patterns, and time spent near the bins and signage immediately prior to disposal could be considered along with data about the items being disposed of.

Limitations

The current findings suggest that the treatment package is effective in decreasing the amount of recycling that is inaccurately sorted as landfill while also increasing the amount of recycling collected. However, these results are not without limitations. The
current sample size was relatively small, making it difficult to draw definite conclusions. The intervention phases were short and took place during the Spring 2012 semester only. Building occupants experienced baseline for a portion of the semester and then various levels of the intervention. Continuing data collection into a new semester would have allowed for the assessment of the long-term effects of the intervention package. All trend lines showed increasing improvement throughout the intervention phases and it is impossible to determine how far this trend would have continued. Continuing data collection into a new semester could potentially assess the effect of the intervention package on a new group of building occupants who may not have become accustomed to the baseline system in Brown Hall before experiencing the intervention.

Additionally, the low volume of waste measured daily creates difficulty when drawing conclusions from the data. Because of its size and function, Brown Hall does not generate a substantial amount of daily waste. As a result, on floors or days with relatively low levels of waste, one or two mis-sorted items can result in an exacerbated percentage of inaccurately sorted material by weight. This issue is also apparent when considering the trend line analysis. Some floors were predicted to change over time by such small increments that it is impossible to determine whether or not the predictions and actual outcomes are significant without the analysis of a larger data set.

The lack of second shift data during the initial data collection period presents a data analysis issue. All data points lacking this additional information look somewhat different from the data points that include both shifts. Analysis of the weight of recycling and landfill collected daily along with the breakdown of recyclable material found in landfill were the measures greatest impacted by this lack of information (reference
Figures 2 and 4). In the case of the weight of landfill and recyclable material, a substantial increase in the amount of landfill waste collected daily can be seen following the inclusion of second shift data. Similarly, the amount of plastic/glass/metal found in landfill shows higher levels after addition of second shift data. Further investigation is warranted, as this could indicate interesting differences in the composition of first and second shift waste collected in Brown Hall.

The use of the top two floors of Brown Hall as comparison to the intervention floors also presents drawbacks. Floors 1 and 2 present a number of important differences from Floors 3 and 4. Exits from the building are located on Floors 1 and 2 only. Additionally, Floors 1 and 2 house a variety of specialized spaces including computer and communication labs along with large lecture halls, student lounges and staff offices. Floors 3 and 4 contain classrooms almost exclusively. It is possible that the differences in the physical characteristics of each floor account for some of the changes noted in the results.

The narrow scope of the application of this intervention presents limitations to the generalizability of the results. It can be assumed that the positive effects of the package might transfer only to other similar academic settings with similar student-based populations. Application of the intervention package to other building types in different cultures or regions may result in altered effects. The general age of building occupants may also alter the effectiveness of the intervention.

The presence of the “Looking for the Trash?” posters presents another possible limitation to this investigation. Prompting building occupants to look in the hallway for the integrated receptacles may have constituted a confounding variable to the analysis of
the utilization of the receptacles. Because the intervention took place in the middle of a semester, it was recommended by multiple university officials that the alterations to the waste collection system be announced in some way. The immediate and prolonged effects of the intervention may be altered in the absence of these directional posters and should be considered in the future.

Behavioral Mechanisms

It can be assumed that social contingencies are responsible for supporting the general behavior of waste receptacle utilization. The vast majority of waste generated in the public areas of a university is placed in receptacles and not discarded on the ground as litter. That said, having a waste item in possession could be considered aversive. Trash has a negative social connotation and its transportation can present cleanliness issues (such as with used gum, an apple core, or a dirty wrapper). The disposal of the item may result in reinforcement through the removal of an aversive condition. These conditions lead to the use of the existing classroom receptacles ahead of hallway clusters because they are the most accessible to building occupants consuming food and beverages and creating paper waste inside classrooms. Issues arise when the type of waste created does not correspond with the available waste receptacles. At WMU, and most likely in other similar settings, this occurs regularly because classrooms do not contain plastic/glass/metal receptacles. When this category of waste is generated inside a classroom, it is most likely disposed of in the landfill bin located in that classroom because of its proximity and the lack of a corresponding receptacle. The response cost for
appropriately sorting plastic/glass/metal waste from within a classroom is relatively high because it involves prolonging the possession of waste by passing a classroom landfill receptacle and taking it to a hallway cluster. When classroom bins are removed and hallway receptacles represent all waste streams, the response cost for disposing of any type of waste from within a classroom relatively increases, but the response cost for accurately sorting decreases substantially. Because all categories of waste are represented any point waste is discarded, accurate sorting requires no additional effort above simple disposal.

Additionally, there may be further social influences involved with the correct disposal of recyclables. Although, these contingencies may not be as strong in some social communities as in others, as it seems less common for social mediation in the case of correct recycling behavior over general waste bin usage. Nonetheless, positive and negative classifications of behavior probably result and may be utilized along with the covert verbal behavior associated with waste sorting. Recycling behavior may be established as “good” or “pro-environmental” and landfill as “bad” or “environmentally irresponsible.” Because of its descriptive landfill vs. recycling labeling system, covert classification behavior may be stronger in the presence of the signage developed for this study, meaning that the positive and negative stimuli associated with both may be more effective in controlling behavior.
Future Research

The improvement in sorting behavior on intervention floors speaks to the effectiveness of the intervention package. However, further research is necessary to fully explore the effects of the intervention and address the limitations of the research and analysis presented herein.

Future research should also aim to establish guidelines for the number of bins necessary to achieve positive effects. Integrated receptacles are costly and in order make campus-wide recommendations, it is necessary to establish a minimum requirement per floor, square foot, or based on the number of entrances or exits. This would help to dictate the most cost-effective strategy for collecting waste streams that are sorted to the highest possible level of accuracy. It is not currently clear whether or not additional bins would result in additional positive effects. If this is found to be the case, the placement of additional integrated receptacles may be warranted.

A detailed cost-benefit analysis is also missing from this investigation. The integrated receptacles cost $1,500 each. This price is comparable to other mass manufactured receptacles with multiple openings. However, it is not clear whether or not the increase in recycling rates warrants the initial costs, especially since WMU pays to have its recycling removed from campus. An increase in recycling rates may not translate to any waste handling savings for the university. However, benefits of the integrated receptacle may be measured in other ways. A reduction of the number of bins in an academic building most likely translates to labor savings for custodial staff, as entering every room in an academic building to empty bins is quite time consuming. This time
savings needs to be quantified in future research. Additionally, an increasing number of university rating systems put emphasis on recycling and waste reduction including the American College & University Presidents’ Climate Commitment, the College Sustainability Report Card, and the Princeton Review’s Guide to Green Colleges. Good performance in these reviews can result in important publicity, increased enrollment, and grant money.

Impacts to the area surrounding the intervention site should also be explored. If the increased weight of waste on Floors 3 and 4 is found to be attributable to the restricted number of receptacles on Floors 1 and 2, it can be surmised that if an entire building transitioned to this system of waste collection, an increase may be found in the amount of waste in the area surrounding the building. Essentially, the intervention may shift waste disposal behavior from inside the building to either outdoor receptacles or adjacent buildings. If appropriate waste receptacles are not present in either of these locations, an increase in mis-sorted materials may be found in these areas. Similarly, if over time the integrated receptacles become familiar enough to the campus population, it is feasible that individuals may seek them out when waste disposal is necessary. In this case, a reduction in the amount of waste in the areas surrounding the intervention site may be witnessed along with a possible increase in the accuracy of waste sorting as a result of the effects of the integrated receptacle.

The current intervention did not attempt to alter the waste disposal system in staffed offices. Previous research has addressed this area through the addition of desk-side paper recycling bins (Brothers, Krantz, & McClannahan, 1994); however, no attempts have been made to test integrated receptacles that include landfill waste or other
recyclable materials in office settings. Future research in this setting should integrate the office waste collection strategy with the strategy used in the building at large.

Future research should also test alternative intervention methods. The intervention package presented here constitutes multiple antecedent alterations. Prompts were used inside classrooms and as part of the updated signage. Environmental alteration was also utilized in the design of the new bins. Other interventions could alternatively test consequence-based interventions. These could include feedback on the accuracy of waste sorting behavior and the delivery of consequences based on appropriate behavior. No known research has attempted to evaluate consequence-based interventions in the context of public settings. Such analysis may contribute greatly to the effectiveness of interventions intended to increase the accuracy of waste sorting.

A theoretical consideration of the establishing operations associated with the accuracy of waste sorting should also be made. Many universities credit the success of their recycling and waste minimization programs to a campus-wide “culture of sustainability” (Noack, 2012). However, the elements that create this culture remain to be explored, as does a viable method for measuring and assessing the components of such a culture. It is conceivable that the presence of strategic physical structures related to the sustainability efforts of a university or organization may alter the value of reinforcing effects associated with engaging in pro-environmental behavior along with the punishing effects of anti-environmental behavior performed within that context. Physical structures could highlight and validate a university or organization’s value of the behaviors associated with that structure. In the case of a recycling program, this could mean that the presence of unified, aesthetically pleasing receptacles may increase the reinforcing
effects arising from correct utilization of the receptacles. Research in this area could help to dictate future directions for sustainability efforts that when implemented strategically could increase the rates of pro-environmental behaviors across settings as a result of the development of a culture of sustainability and subsequent alteration of the relevant establishing operations.

Conclusion

Recycling and waste reduction efforts are responsible for the recovery of almost 65 million tons of waste per year that were destined for landfill in the United States. Recycling rates per capita have increased from 10% in 1980 to 34% in 2010 (U.S. EPA, 2010). However, improvements are still to be made. In 2010, 54% of the solid waste created in United States was discarded in landfills (U.S. EPA, 2010). With increased emphasis on these efforts, it is likely that recycling research studies will become more frequent, especially within university settings. The history and development of this line of research needs to be considered and utilized in the development a research agenda.

Previous research has suggested that placement of receptacles in all possible areas of waste generation has the greatest impact on waste sorting behavior and results in increased rates of recycling. However, implementation of this system can prove difficult for many universities and organizations because it requires additional material resources along with increased management and maintenance resources. The current findings revealed that this might not be necessary. Introducing centrally located, integrated receptacles with detailed signage while also removing extraneous bins may create similar
effects. With this system, fewer additional resources are necessary and the management and maintenance of the system is substantially decreased, making it a viable alternative and providing a straight-forward tool for universities to utilize as a means for making progress toward their sustainability goals.
REFERENCES


Appendix A

Brown Hall Floor Plans
FLOOR 1 Baseline

- + = Landfill Receptacle
- = Paper Recycling Receptacle
- = Plastic/Metal/Glass Recycling Receptacle
- = Comprehensive Receptacle
FLOOR 1

Intervention

- Landfill Receptacle
- Paper Recycling Receptacle
- Plastic/Metal/Glass Recycling Receptacle
- Comprehensive Receptacle
Intervention
Floor
Second Receptacle

Floor 2
Baseline

= Landfill Receptacle
= Paper Recycling Receptacle
= Plastic/Metal/Glass Recycling Receptacle
= Comprehensive Receptacle
FLOOR 2

Intervention

Red = Landfill Receptacle
Yellow = Paper Recycling Receptacle
Blue = Plastic/Metal/Glass Recycling Receptacle
Green = Comprehensive Receptacle

First Receptacle
Second Receptacle
FLOOR 3
Baseline and Intervention

- Landfill Receptacle
- Paper Recycling Receptacle
- Plastic/Metal/Glass Recycling Receptacle
- Comprehensive Receptacle
Appendix B

Intervention Package Design
Original Recycling and Trash Bins

Hallway cluster

Classroom cluster
Comprehensive Waste Receptacle Design
Signage

**PLASTIC**
- #1
- #2
- #3
- #4
- #5
- #6
- #7
- Beverage Containers
- Detergent Containers
- Milk Cartons
- Orange Juice Cartons
- Plastic Bottles
- Plastic Containers
- Plastic Cups
- Plastic Plates

**METAL**
- Aerosol Cans
- Aluminum Foil
- Jars
- Metal Lids
- Soda [Pop] Cans

**GLASS**
- Brown Glass
- Clear Glass
- Green Glass

**PAPER**
- Brochures
- Business Cards
- Catalogues
- Construction Paper
- Envelopes
- File Folders
- Index Cards
- Magazines
- Pamphlets
- Post-it Notes
- Posters
- Printer Paper
- Shredded Paper
- Telephone Books

**CARDBOARD**
- Boxboard
- Cereal Boxes
- Corrugated Cardboard
- File Folders
- Mail
- Paperboard
- Post Cards
- Shoe Boxes
- Tissue Boxes
<table>
<thead>
<tr>
<th>Landfill</th>
<th>Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue Glass</td>
<td>Paper Cups</td>
</tr>
<tr>
<td>Candy Wrappers</td>
<td>Paper Plates</td>
</tr>
<tr>
<td>Cigarette Boxes</td>
<td>Pens</td>
</tr>
<tr>
<td>Cigarette Butts</td>
<td>Pizza Boxes</td>
</tr>
<tr>
<td>Egg Cartons</td>
<td>Plastic Bags</td>
</tr>
<tr>
<td>Foam Core</td>
<td>Plastic Wrappers</td>
</tr>
<tr>
<td>Food Waste</td>
<td>Polystyrene Foam</td>
</tr>
<tr>
<td>Frozen Dinner Boxes</td>
<td>Sandwich Bags</td>
</tr>
<tr>
<td>Ice Cream Containers</td>
<td>Straws</td>
</tr>
<tr>
<td>Juice Boxes</td>
<td>Styrofoam Take-Out Boxes</td>
</tr>
</tbody>
</table>
LOOKING FOR THE TRASH?
Check out the new bins in the hallway!

LOOK FOR THESE LABELS

RECYCLING  LANDFILL
Appendix C

WMU Recycling Guide
## What Can I Recycle?

<table>
<thead>
<tr>
<th>WHAT DOES WMU RECYCLE?</th>
<th>HOW TO PREPARE MATERIALS FOR RECYCLING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Plastics</strong></td>
<td>Check bottom of the container for number</td>
</tr>
<tr>
<td>#1-#7 bottles</td>
<td>Rinse and drain</td>
</tr>
<tr>
<td>Yogurt containers</td>
<td>Do not store in plastic bags</td>
</tr>
<tr>
<td>Margarine tubs</td>
<td></td>
</tr>
<tr>
<td>Shampoo bottles</td>
<td></td>
</tr>
<tr>
<td>Milk jugs</td>
<td></td>
</tr>
<tr>
<td>Beverage containers</td>
<td></td>
</tr>
<tr>
<td><strong>Metals</strong></td>
<td>Rinse and drain</td>
</tr>
<tr>
<td>Beverage and food cans</td>
<td>Be sure that aerosol cans are completely empty</td>
</tr>
<tr>
<td>Aluminum foil</td>
<td>Do not store in plastic bags</td>
</tr>
<tr>
<td>Metal lids</td>
<td></td>
</tr>
<tr>
<td>Pie tins</td>
<td></td>
</tr>
<tr>
<td>Empty aerosol cans</td>
<td></td>
</tr>
<tr>
<td><strong>Glass</strong></td>
<td>Remove caps</td>
</tr>
<tr>
<td>Clear, Brown, and Green jars/bottles</td>
<td>Rinse and drain</td>
</tr>
<tr>
<td><strong>Paper &amp; Cardboard</strong></td>
<td>Do not break</td>
</tr>
<tr>
<td>Printer and notebook paper</td>
<td>Do not store in plastic bags</td>
</tr>
<tr>
<td>Newspaper</td>
<td></td>
</tr>
<tr>
<td>Magazines/Catalogues</td>
<td></td>
</tr>
<tr>
<td>Post-it notes</td>
<td></td>
</tr>
<tr>
<td>File folders</td>
<td></td>
</tr>
<tr>
<td>Business cards</td>
<td></td>
</tr>
<tr>
<td>Fax and NRC papers</td>
<td></td>
</tr>
<tr>
<td>Envelopes</td>
<td></td>
</tr>
<tr>
<td>Telephone books</td>
<td></td>
</tr>
<tr>
<td>Corrugated boxes</td>
<td></td>
</tr>
<tr>
<td>Cereal boxes</td>
<td></td>
</tr>
<tr>
<td><strong>No plate glass or light bulbs!</strong></td>
<td></td>
</tr>
</tbody>
</table>
| **Polystyrene Foam**  
Take-out clamshells  
Cups and plates  
Egg cartons  
Meat trays  
Computer packaging  
Furniture/Appliance packaging | **Rinse and drain**  
**Contact R & WS** for pickup at 387-8165  
**Packing peanuts cannot be recycled** please reuse them instead!! |
|---|---|
| **Plastic Bags** | Please make sure bags are **empty** and **clean**  
Place in the **box marked for plastic bags at the Bernhard Center** |
| **Others**  
Batteries  
Inkjet cartridges  
Cell phones  
Clothing  
Laser toner cartridges  
Fluorescent bulbs  
Tyvek envelopes  
Transparencies  
Scrap metal | **Contact R & WS** for proper recycling at 387-8165 |
Appendix D

Data Collection Protocol
General Procedures

Every weekday morning: Data collectors will first collect and weigh recycling from throughout the building. They will then process the trash waste from the previous day. The trash will be left on the loading dock by custodial staff. Data collectors will process it by sorting misplaced recycling out of the trash. The sorted recycling and trash will then be weighed separately and placed into appropriate dumpsters.

Once per week: Data collectors will sample a classroom or lecture hall specified by the researcher. They will collect and weigh any waste left in the room following the Classroom Sample Protocol.

Once per week: Data collectors will perform the Interobserver Agreement Protocol.

Before handling waste
- Bandage all cuts and scrapes on hands and arms, even on areas that will be covered by gloves

After handling waste
- Wipe down leather gloves with disinfectant wipes
- Wash hands thoroughly

Dress code
While participating in any aspect of data collection, data collectors must, AT ALL TIMES, follow the dress code:
- Leather gloves, provided by the researcher
- Closed-toed shoes
- Long pants
- Long sleeves

Daily Protocol
Handling waste bags
- Never load a bag or bin to the point where it is too heavy for you to carry
- If it is necessary to lift a bag of waste out of a bin or brute barrel, tip the barrel on its side and draw out the bag slowly to avoid creating a vacuum, making the bag extremely hard to lift and risking injury.
- While carrying waste bags, hold them away from your body and do not let them rub against your legs. This may require you to only carry one bag at a time in order to have enough strength to hold it away from your body.

Recycling Collection
- Take recycling cart from loading dock and collect recycling from each floor
- Place paper recycling into one bin on the cart and plastic/glass/aluminum in the other
- Empty paper bins by overturning the classroom or hallway bin into the collection bin. Empty the Aluminum/Plastic/Glass bins by removing the lid
and remove items individually. If the bin’s bag is over half full, remove the entire bag and place into collection bin.

- Bring all recycling to the loading dock on the cart. If there is too much to fit on the cart, make two trips. Do not carry it.
- Weigh and record the recycling following the Weighing protocol below.
- Be aware of dangerous items (listed below) and if one is found, stop collection immediately and notify the data collection supervisor.

Trash Sorting
- Spread out the plastic sheet on the loading dock floor
- Each data collector will sort one bag of trash at a time on the plastic sheet. If there are smaller bags inside the large bag, take one out at a time and sort them next to the large bag.
- Before sorting, open the bag up as widely as possible by pulling outward on the upper edges. Cut a 10-12-inch slit down the side of the large bags in order to open them wider. Cut a 5-inch slit into smaller bags if necessary.
- Pull out visible recycling items and place them into separate plastic bags (one for paper/cardboard, one for aluminum/plastic/glass). Leave trash in the original bag.
- Move trash inside the bag to uncover recycling items only by using a push stick and never your hand.
- Remember to only touch items that are fully visible.
- Do not allow fingers or hands to reach around a recyclable item where a syringe or sharp object might be concealed.
- Be aware of dangerous items (listed below) and if one is found, stop collection immediately and notify the data collection supervisor.
- Trash bags and sorted recycling bags must be weighed and recorded separately after sorting is complete and liquids emptied, reference the Emptying Liquids and Weighing/Disposing protocol below.

Emptying Liquids
- Some recyclable containers that are found in the trash will have liquids in them (soda cans, coffee cups, Gatorade bottles, etc). Use the first large container found as the liquid reservoir and empty all other liquids into it.
- Empty liquids slowly and from a close proximity so they do not splash.
- Once data collection is complete for that day, empty the reservoir container into a toilet in the 1st floor restroom. Pour slowly to avoid splashing. If splashes do occur, wipe up with a disinfectant wipe.

Dangerous Items
- If potentially dangerous items are discovered, do not touch it and immediately stop sorting that waste bag. Report the item to the researcher or data collection supervisor. They will take the proper action for handling and disposal.
- If you come in contact with a potentially harmful powdery or liquid substance, go immediately to the nearest restroom and wash thoroughly with soap and water. Notify the data collection supervisor after substance has been washed off.
- If you become cut, scraped, or require other medical attention, notify the data collection supervisor immediately. A first aid kit will be located on the loading dock.

- Dangerous items can include:
  o Broken glass
  o Needles
    ▪ Plastic liquid laundry containers and pop cans may sometimes be used for diabetic needle disposal
  o Empty containers for toxic, flammable, or otherwise harmful materials including cleaning agents, aerosol cans, etc.
  o Bandages, Kleenex, or other item containing blood or other bodily fluid
  o Toner cartridges or any powdery substance that could possibly be inhaled. If cartridge is intact, set it aside and continue sorting the bag. It will be processed as recycling.
  o Bottles that appear to be expanding, under pressure, or contain anything unusual

Weighing
- All items need to be weighed after collection/sorting.
- Landfill waste should be weighed in bags. Recycling that is collected in bins should be weighed in the bins. Recycling that is sorted out of the trash may be weighed in it’s new bag.
- Always weigh one bag or bin of waste at a time by placing it gently on the scale.

Depositing
- Once bags are weighed and recorded, they may be deposited into the appropriate dumpster. Do not attempt to open dumpster lids while carrying waste bags. Either set the bags down first or open dumpster lids before carrying waste bags outside.
- When depositing bags, hold them over the open dumpster and drop them. Do not toss them from any distance.

**Classroom Sample Protocol**
- One classroom or lecture hall per week will be sampled. The room will be designated by the researcher.
- Use the recycling cart and one rolling trashcan (with a trash bag in it) from the loading dock. Collect all waste discarded in the classroom.
- **Remember to wear gloves!**
- Sort the waste into landfill, paper/cardboard, and aluminum/plastic/glass bins while collecting.
- Weigh and record classroom sample waste separately from all other waste before depositing it into the appropriate dumpster.

**Interobserver Agreement Protocol**

- When prompted by the researcher during one data collection session per week, data collectors will perform the Interobserver Agreement Protocol.
- The researcher will select one bag of waste to test and one data collector will sort and weigh it according the above protocol while a second data collector is out of sight.
- Also out of sight of the second data collector, the researcher will then mix the recycling back into the trash bag by setting the recycling items into the trash bag and using a push stick to mix them in.
- The second data collector will then re-sort and weigh the same bag of waste.
- The waste can then be deposited into the appropriate dumpsters.

---

**Waiver of Liability**

for

**Western Michigan University**

**Graduate Student Research Protocol**

I have read and understand the Data Collection Protocol. I understand that there are risks associated with the collection and sorting of waste and agree to follow the protocol in order to minimize my risk. I further agree to release, hold harmless and indemnify researcher, Katherine Binder, Western Michigan University, and/or any of its Departments and affiliates from any suits, claims and damages of every kind and nature which may arise relating to this graduate student research protocol.

---

Signature

Date
Appendix E

Weight Trend Line Analysis
<table>
<thead>
<tr>
<th>Floor</th>
<th>Baseline Expected increase weighted by total mass per floor</th>
<th>Increase as a percent of expected</th>
<th>Baseline Expected decrease weighted by total mass per floor</th>
<th>Decrease as a percent of expected</th>
<th>Intervention Expected increase weighted by total mass per floor</th>
<th>Increase as a percent of expected</th>
<th>Baseline and Intervention Expected increase weighted by total mass per floor</th>
<th>Increase as a percent of expected</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4.35</td>
<td>4</td>
<td>92%</td>
<td>1.92</td>
<td>-3</td>
<td>-156%</td>
<td>5.62</td>
<td>0.50</td>
</tr>
<tr>
<td>2</td>
<td>6.44</td>
<td>8.5</td>
<td>132%</td>
<td>2.94</td>
<td>9</td>
<td>306%</td>
<td>7.85</td>
<td>1.50</td>
</tr>
<tr>
<td>3</td>
<td>10.33</td>
<td>6.5</td>
<td>63%</td>
<td>3.02</td>
<td>0.05</td>
<td>17%</td>
<td>6.25</td>
<td>11.176%</td>
</tr>
<tr>
<td>4</td>
<td>7.88</td>
<td>8.2</td>
<td>104%</td>
<td>2.52</td>
<td>2</td>
<td>79%</td>
<td>4.78</td>
<td>12.251%</td>
</tr>
<tr>
<td>Average</td>
<td>7.25</td>
<td>6.8</td>
<td>98%</td>
<td>2.6</td>
<td>2</td>
<td>61%</td>
<td>6.13</td>
<td>6.25</td>
</tr>
</tbody>
</table>
Appendix F

Answers to Open Ended Survey Questions
Looking good OfS

I don't need to discuss this in person, but the new recycling system is great!

More trash is ending up on floors and left on desks because of the trash receptacles being out of the classroom. I would rather have more stuff going to a landfill than more trash sitting in classrooms that I pay a lot of money to be in.

My only wish is that there was a pop return bin either included or next to it. I love the sorted approach. I think it works to both educate the public about what is recyclable as well as serving its obvious purpose. If there were a bin on every floor, then I would have answered "agree" to number 2.

I like the new waste receptacles because they made it easier to recycle however it was difficult at times to dispose of my trash because the trash bins in the new receptacles a lot of times were full to overflowing.

I used to have to carry my recycling items until I got to another recycling bin on campus.

I have a lot of classes in brown hall and love the new receptacles! Thank you!

I was confused why all the trashcans were gone and couldn’t figure our where to put my trash.

I would say keep the recycling bins in the classrooms as well

Good Job 😊

It is all about convenience. The more there are, the easier. It will be to Promote Recycling.

Keep the new waste receptacles, they help a lot with doing the right thing!

Thank you Kate Good Job.
Appendix G

Satisfaction Survey
During the Spring 2012 semester, a research study took place in Brown Hall to evaluate the effectiveness of a new waste and recycling collection program. The program involved new centralized receptacles and signage along with the removal of all trash and recycling bins from classrooms. We greatly appreciate your participation and patience during this time and welcome any feedback you have about the program.

1) I am a...
   o Student
   o Staff member
   o Faculty member

2) The new waste receptacles have made it easier for me to recycle
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

3) The new waste receptacles have made it easier to dispose of trash
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

4) Because of the new waste receptacles I am less likely to throw recycling into trashcans
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree
5) Because of the new waste receptacles I am more likely to leave litter in classrooms or other work areas
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

6) I like the new waste receptacles in Brown Hall
   o Strongly Agree
   o Agree
   o Neutral
   o Disagree
   o Strongly Disagree

7) OPTIONAL: additional comments

For more information about this research please contact:

Kate Binder
Graduate Assistant
WMU Office for Sustainability
k3binder@gmail.com
Appendix H

HSIRB Approval Letter
Date: March 18, 2011

To: Kate Binder, Student Investigator

From: Amy Naugle, Ph.D., Chair

Re: Approval not needed

This letter will serve as confirmation that your project “WMU’s Brown Hall: Testing the Effectiveness of a Newly Designed Comprehensive Trash/Recycling Bin” has been reviewed by the Human Subjects Institutional Review Board (HSIRB). Based on that review, the HSIRB has determined that approval is not required for you to conduct this project because you will be analyzing trash and you are not collecting personal information about individuals.

Thank you for your concerns about protecting the rights and welfare of human subjects.

A copy of your protocol and a copy of this letter will be maintained in the HSIRB files.