

*EFFECTS OF NUMBER AND LOCATION OF BINS ON  
PLASTIC RECYCLING AT A UNIVERSITY*

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The proportion of plastic bottles that consumers placed in appropriate recycling receptacles rather than trash bins was examined across 3 buildings on a university campus. We extended previous research on interventions to increase recycling by controlling the number of recycling receptacles across conditions and by examining receptacle location without the use of posted signs. Manipulating the appearance or number of recycling bins in common areas did not increase recycling. Consumers recycled substantially more plastic bottles when the recycling bins were located in classrooms.

*Key words:* antecedents, plastic recycling, response effort

Keep America Beautiful (2006) estimated that Americans produce 251.3 million tons of waste per year. In 2006, U.S. consumers recycled only 28% of their recyclable waste (“More Recycling Facts and Statistics,” 2008). The emergent market for water sold in polyethylene terephthalate plastic bottles is partially responsible for the increasing amount of recyclable waste in the United States (Gitlitz & Franklin, 2007). The use of petroleum to replenish the supply of plastic bottles exploits valuable resources, produces harmful greenhouse (carbon) gases, and damages air and water quality.

One solution to this growing problem is to increase the amount of plastic bottles that

consumers place in recycling receptacles rather than in trash cans. Research indicates that a number of interventions can increase appropriate disposal and recycling behavior (e.g., Jacobs, Bailey, & Crews, 1984; Witmer & Geller, 1976). However, many of these interventions require a high degree of planning and expense that make them unattractive options for institutions with limited resources.

A few studies have examined low-cost methods for increasing recycling. In particular, placing recycling bins closer to the point of consumption greatly changed recycling behavior (e.g., Brothers, Krantz, & McClannahan, 1994; Ludwig, Gray, & Rowell, 1998). Although results of this research suggest that simply changing the location of recycling containers can be highly effective, the studies are limited in several respects. Most important, the experimenters often failed to control for the number of recycling receptacles available across conditions and paired the interventions with signs or memos to prompt use of the recycling containers. Ludwig et al., for example, compared the amount of recycling when a single recycling bin was located in each of four hallways to when a single bin was located in each of 19 classrooms.

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Ryan O'Connor is now at Texana Center, Developmental Disabilities Services.

We thank Sarah Brown and Joy Jones for their assistance with data collection. We also thank Michelle Dotter, Vice President for Administration and Finance; Derrell Means, Director of Grounds and Custodial Services; and the university maintenance staff for their support and assistance in the conduct of this study.

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doi: 10.1901/jaba.2010.43-711

Thus, it is unclear whether a mere increase in the number of bins, regardless of the location, or whether the location of the bins, in the absence of additional prompts, would have similar effects. The purpose of the current study was to extend previous research by controlling the number of recycling receptacles across conditions and by examining receptacle location without the use of posted signs.

## METHOD

### *Participants and Setting*

Participants included the population of students, administrators, staff, and visitors at a public university located in southeast Texas. A sample of trash and recycling containers located in high-traffic areas of three academic buildings was selected for the study. The buildings (A, B, and C) had a high number of trash cans in both classrooms and hallways but only a few recycling bins that were limited to hallways. One of the buildings (C) had no recycling bins. The targeted areas contained four (Building A), five (Building B), and seven (Building C) classrooms and one common area. Each classroom contained one trash can and no recycling bins. The common areas initially contained five (Building A), five (Building B), and two (Building C) trash cans and one (Building A), one (Building B), and zero (Building C) recycling bins. In common areas that initially contained a recycling bin, each bin was located within 2 m of a trash can. Buildings A and C were similar to each other, whereas Building B was much larger than the other buildings and contained a bookstore, library, cafeteria, and computer labs.

### *Response Measurement, Interobserver Agreement, and Procedural Integrity*

Recyclable plastic bottles included bottles that displayed the Recycling Codes 1 and 2. The total number of recyclable plastic bottles placed in each trash receptacle and each recycling bin in the designated areas of each

building was determined daily, during each week that class was in session. The first author, fourth author, and two graduate students in psychology collected the trash and recycling bags in the designated area of each building daily, at 7:00 p.m. Monday through Thursday. (The building's maintenance staff did not collect bags from the targeted trash and recycling bins at any time during the course of the study; thus, Monday's collection included all bottles placed in trash and recycling bins between Thursday night and 7:00 p.m. on Monday.) Plastic bottles with Codes 1 and 2 were scored as either "plastic in trash container" or "plastic in recycling container." The total number of plastic bottles in the targeted recycling bins for each building was divided by the total plastic in the targeted area of each building to obtain a percentage of plastic in the recycling containers. A second observer independently sorted the contents and counted plastic bottles in the targeted bins during 31 observation sessions (46% of total sessions) for each building across all phases of the study. Mean agreement between observers, calculated by dividing the lower recorded frequency by the higher recorded frequency and converting the ratio to a percentage, was 99.7% (range, 0% to 100%). The lower agreement percentages occurred on collection days with few plastic bottles in a given bin (e.g., Observer A scored a 0 for a bin, and Observer B scored a 1).

The first author monitored procedural integrity an average of three times during each week of data collection. He used a map and a checklist to ensure that all bins were in the appropriate locations. One bin in each building was discovered out of place during no more than 6% of sessions. If a bin was out of place, the first author immediately returned it to the appropriate location. He used a different checklist to verify that all bags from trash and recycling receptacles had been collected and counted during data-collection sessions. All recycling and trash bags were accounted for

during 100% of total sessions, including sessions in which a bin was not in the appropriate location.

### *Design and Conditions*

A concurrent multiple baseline design across settings was used to assess the effects of recycling interventions across the three buildings on the university campus. The experimenters provided no information to students or staff about the existence of a recycling research study, except for the few administrative staff who initially approved the project. These administrative staff were asked to refrain from informing anyone about the recycling project. In addition, all research assistants and informed administrative staff were asked to refrain from recycling on campus throughout all conditions of this study.

*Baseline.* The experimenters did not manipulate the positioning or number of trash or recycling receptacles, except to ensure that the positions remained consistent across sessions.

*New bins (Buildings A and B).* During baseline, the university's recycling bins in Buildings A and B were unadorned, gray, and the same size and color as the trash bins. Thus, to increase the saliency of the recycling bins, we replaced the original bins with blue bins prior to increasing the number or location of the bins. The blue bins had green lids and a label to identify the function of the receptacle. This condition was conducted to determine if manipulating the appearance of the bins alone would influence recycling behavior (e.g., O'Neill, Blanck, & Joyner, 1980). Building C was not exposed to this condition because no recycling bins were present during baseline.

*Increased number of recycling bins.* Additional blue recycling receptacles with green lids, similar to those in the previous condition, were placed outside of classrooms throughout the targeted area of each building (i.e., in common areas, hallways, atriums). The number of bins added to each building was equivalent to the

number of bins needed in the subsequent classroom location condition.

*Classroom location of recycling bins.* The additional bins placed in the buildings during the previous condition were relocated to classrooms, so that a single bin was present in each classroom of the targeted areas. These bins were placed within 2 m of the classroom's trash can. Recycling bins that were present in the new bins condition remained in their original locations. Because Building C did not have recycling bins at the start of the study, all receptacles introduced in the previous condition were moved into classrooms.

## RESULTS AND DISCUSSION

Figure 1 displays the percentage of plastic recycled in the three buildings over the course of this study. Baseline levels of recycling did not change when the original recycling bins were replaced with new bins ( $M_s = 33\%$  and  $17\%$  in Buildings A and B, respectively) or when additional bins were added to the common areas ( $M_s = 40\%$ ,  $12\%$ , and  $33\%$  in Buildings A, B, and C, respectively). Recycling increased substantially when recycling bins were located in the classrooms ( $M_s = 64\%$ ,  $47\%$ , and  $71\%$  in Buildings A, B, and C, respectively). Table 1 displays the mean weekly number of plastic bottles placed in recycling bins and in trash bins during each condition of the study for each building. When the recycling bins were moved to the classrooms, the mean weekly number of plastic bottles placed in the recycling bins increased substantially, and the mean weekly number of plastic bottles placed in the trash bins decreased.

These findings are consistent with those of Brothers et al. (1994) and Ludwig et al. (1998), indicating that the location of recycling receptacles is a critical factor in affecting the level of recycling receptacle usage. It is likely that the location of purchases on the university campus (i.e., vending machines in hallways) differed

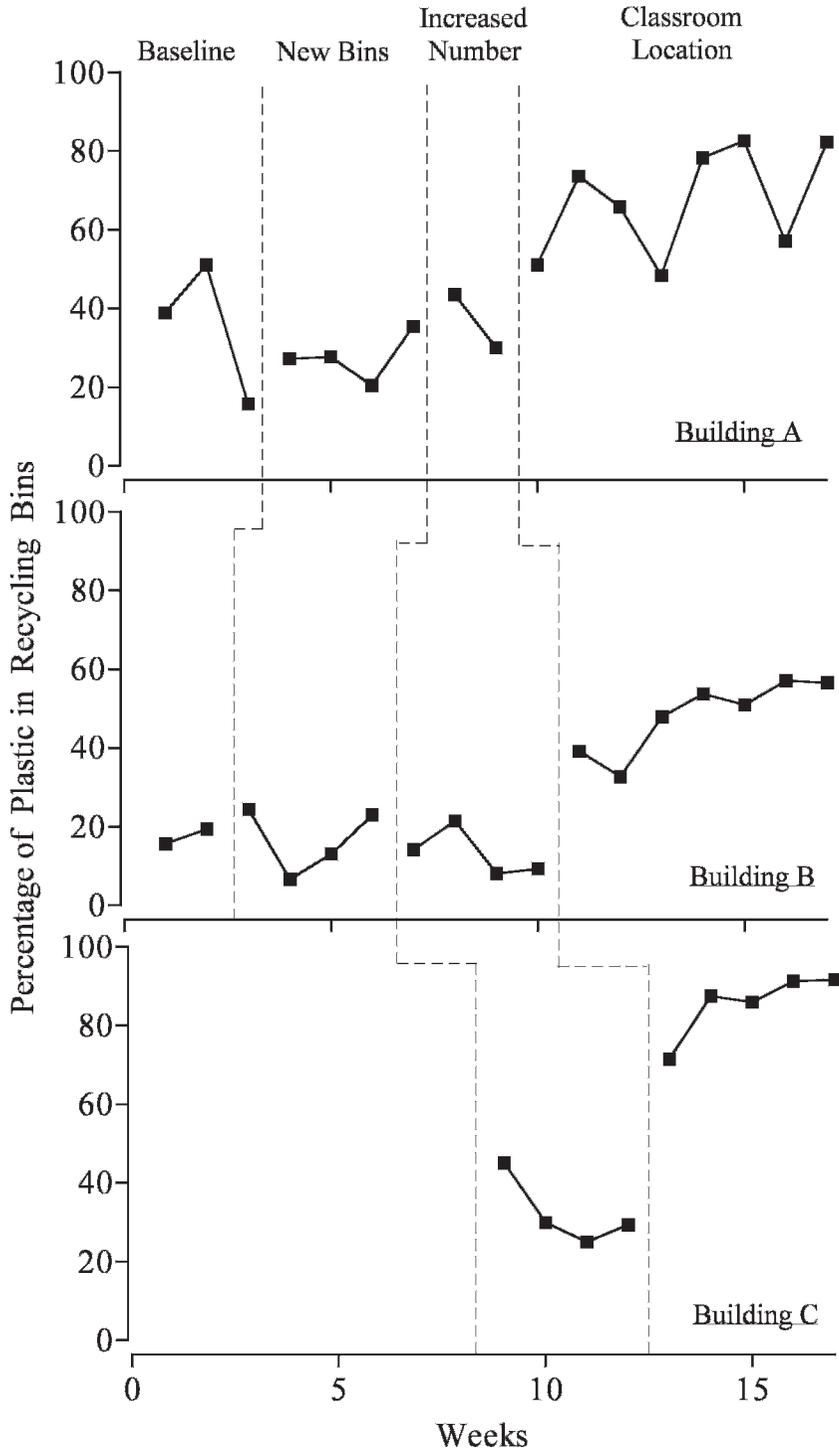


Figure 1. The percentage of plastic bottles counted in recycling bins each week in Buildings A, B, and C. A 4-week winter break occurred between Weeks 5 and 6.

Table 1  
Mean Weekly Number of Plastic Bottles Placed in Trash  
Bins and Recycling Bins Across Conditions for  
Each Building

Condition	Building A		Building B		Building C	
	Trash	Recycle	Trash	Recycle	Trash	Recycle
Baseline	25	14	159	34	19	
New bins	24	9	119	26		
Increased number	28	16	141	22	16	7
Classroom location	12	24	92	84	3	21

from the setting in which consumption occurred (i.e., in classrooms). By determining the most common point of consumption, the response effort necessary to recycle plastic bottles was potentially decreased. Consumers placed more than twice as many plastic bottles in the recycling receptacles when the receptacles were presumably closer to the point of consumption. In fact, the increases obtained in the current study were more substantial than those obtained by Ludwig et al., who combined a change in the number and location of bins with informational signs. This highly cost-efficient intervention was maintained without using any resources outside the initial procurement of the recycling bins.

Nonetheless, results may be limited to the particular sequence of conditions. For example, the additional recycling bins in the common areas may have increased the saliency of the bins, such that consumers were more likely to recycle when the bins were located in classrooms. The schedule of events (e.g., banquets, town hall meetings, class parties, cancelled classes) in the buildings during the week and on the weekends also varied in an uncontrolled manner across the duration of the study. This might account for some of the variability in the data.

We focused on plastic recycling due to the increasing consumption of beverages in these

types of containers. Recycling of plastic bottles is particularly important in light of the harmful environmental effects associated with the manufacture of these products (Gitlitz & Franklin, 2007). It would be ideal if consumers disposed of nearly all plastic bottles in recycling containers. Thus, other potential interventions, such as arranging social consequences for recycling or increasing the effort needed to place recycling bottles in the trash, warrant further study.

## REFERENCES

- Brothers, K. J., Krantz, P. J., & McClannahan, L. E. (1994). Office paper recycling: A function of container proximity. *Journal of Applied Behavior Analysis, 27*, 153-160.
- Gitlitz, J., & Franklin, P. (2007). *Water, water everywhere: The growth of non-carbonated beverages in the United States*. Retrieved from <http://www.container-recycling.org/assets/pdfs/reports/2007-waterwater.pdf>
- Jacobs, H. E., Bailey, J. S., & Crews, J. I. (1984). Development and analysis of a community-based resource recovery program. *Journal of Applied Behavior Analysis, 17*, 127-145.
- Keep America Beautiful. (2006). *Waste reduction and recycling*. Retrieved from [http://www.kab.org/site/PageServer?pagename=Focus\\_Waste\\_reduction](http://www.kab.org/site/PageServer?pagename=Focus_Waste_reduction)
- Ludwig, T. D., Gray, T. W., & Rowell, A. (1998). Increasing recycling in academic buildings: A systematic replication. *Journal of Applied Behavior Analysis, 31*, 683-686.
- More recycling facts and statistics. (2008). Retrieved from [http://www.environment-green.com/More\\_Recycling\\_Facts\\_and\\_Statistics.html](http://www.environment-green.com/More_Recycling_Facts_and_Statistics.html)
- O'Neill, G. W., Blanck, L. S., & Joyner, M. A. (1980). The use of stimulus control over littering in a natural setting. *Journal of Applied Behavior Analysis, 13*, 379-381.
- Witmer, J. F., & Geller, E. S. (1976). Facilitating paper recycling: Effects of prompts, raffles, and contests. *Journal of Applied Behavior Analysis, 9*, 315-322.

Received December 10, 2009

Final acceptance March 10, 2010

Action Editor, David Wilder