Stand-Alone Garbage Bins Negligible Impact on Litter Quantity in Auditoriums

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Litter, in its simplest form, is trash of any type thrown where it does not belong. This experiment examined the relationship between stand-alone garbage bin placement and littering behavior in large auditoriums. If garbage bins are removed from auditoriums is there a littering problem? The locations of the stand-alone garbage bins were manipulated in three conditions, bins outside, bins inside and a control condition in the form of no bins. Ultimately, this study finds that stand-alone garbage bins did not have an impact on the quantity of litter left in auditoriums. Marginally significant results indicate that stand-alone garbage cans inside of auditoriums may have a detrimental effect on food scrap removal, and so opens up a wealth of possibility for future research. In addition, the data that was acquired provides comprehensive and practical implications that create a thought-provoking foundation that can be used for additional investigation by UBC Sustainability.

Keywords: stand-alone garbage bins, litter, sustainability

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There is an existing assumption that garbage bins are required to prevent litter in large auditoriums. The University of British Columbia has developed their waste disposal operations based on this assumption. According to the UBC Building Operations and Sustainability, littering is of environmental primacy because it attracts pests and rodents, which requires great quantities of money to remedy. As a proactive measure, stand-alone garbage bins were placed inside large auditoriums across campus. This study evaluates the accuracy of this assumption and examines the relationship between stand-alone garbage bins and littering behavior. Our research question is how is littering behavior affected by the presence or absence of stand-alone garbage bins inside large auditoriums? More specifically, if garbage cans are removed from an auditorium, is there a littering problem in the room? It is hypothesized that stand-alone garbage bin placement will not influence the quantity of litter left in auditoriums.

Methods

The study took place over seven days from 11:00AM to 2:00PM on weekdays. The participant population consisted of UBC undergraduate students and faculty ($n \approx 1500$). The precise number of participants is unknown as the perceived presence of researchers might have become a confound, so a head count was not included. Participant number is an estimation based on room capacity. Oral consent was not required because our study is observational. The study was conducted in three large auditoriums on UBC Vancouver campus; Buchanan A rooms 102, 103 and 104. Even though an arts building, Buchanan was selected as there are a diverse range of lectures that are taught there, such as statistics, French, and psychology. The rooms were selected based upon their identical structure and capacity. Existing multisystem recycling and composting stations exist in the mutual lobby area shared by all three auditoriums. The layout of the building results in all students passing by a minimum of one multisystem station to access their classrooms, regardless of the direction they enter the building.

The presence of the garbage bins was manipulated. The controls include the locations, the time, and presence of a multi-system recycling station outside the lecture halls. This is a between subject design; each lecture hall was assigned one of three conditions. The three conditions were: garbage bins inside the lecture hall, garbage bins right outside the lecture hall and the control condition in which was no garbage bins were present. To minimize the effects of having concurrent conditions we assigned room 104 to the bins outside condition because less people pass by that room as they are leaving their classes (reference Appendix A to see layout).

The units of litter found is the dependent variable. One unit of litter is quantified as any individual piece of trash found on the ground. If a piece of paper were ripped in two pieces, it would count as two units of litter; the rationale being that janitorial staff would be required to collect these pieces separately. Litter content was categorized as recyclable containers, recyclable paper, food scraps and garbage according to the SEEDS sorting guide (Appendix A, Figure 1). For example: a coffee cup and sleeve could include two pieces of ‘paper’ and one item of ‘recyclable container’ and would be classified as such. Litter content was categorized to allow for analysis to be done measuring the differences between the various types of litter and how that was affected by bin placement.

One hour prior to the specified lecture period researchers positioned the stand alone garbage bins according to the condition to avoid being seen by the participants taking part in the

study. Two garbage bins were placed on opposite sides of the lecture halls, either inside near the doors, outside near the doors, or not at all (Appendix A, Figure 1). The standard bins that were originally inside the rooms were hidden and replaced with bigger bins to ensure them being seen and their effect significant. The researchers then removed any litter already in the auditoriums to prevent contamination from previous classes, and a re-check was done right before the specified period to ensure the area was free of litter. Immediately after the three hours of lecture time researchers counted and classified the litter found in the lecture halls. This was repeated for a total of seven week-days, with each auditorium maintaining the same condition it was originally assigned.

The analysis included a one-way ANOVA to compare the units of litter found between each conditions (e.g. units of litter in no bin condition, bin outside condition, and bin inside condition), one-way ANOVAs to compare the units of the specific types of litter between each of the conditions (e.g. garbage, food scraps, recyclable plastics and recyclable paper in the no bin condition), and one-way ANOVAs to compare the units of the different types of litter in each condition (e.g. food scraps in the no bin condition, bins outside condition, and bins inside condition).

Results

Eight One-way ANOVAs were conducted to analyze whether statistically significant differences existed between the three conditions: no bin, bins inside and bins outside. (Appendix F, Table 4)

The average quantity of litter in the no bin condition was (4.86 pieces/day), the bin outside condition (3.43 pieces/day) and the bin inside condition (4.14 pieces/day). There was no significant difference in the average quantity of litter in the three conditions (p= 0.6121). As for the amount of each type of litter noted in each room, no statistical significance between the conditions for paper (p= 0.801), recyclable containers (p= 0.7562) and garbage (p= 0.6770). Marginally significant results were found between the three conditions in regards to food scraps (p= 0.0619), with the bins inside condition yielding the largest average (0.86 pieces/day) compared to the bins outside (0.14 pieces/day) and no bin (0.14 pieces/day) conditions. Within each condition, a one-way ANOVA was conducted to identify whether significant differences in the subcategories of litter existed (Appendix F, Table 4). There was a marginally significant difference in the bins outside condition (p= 0.0672), with garbage as the largest component of the litter (1.29 pieces/day), followed by recyclable containers (1.14 pieces/day), paper (0.86 pieces/day), and food scraps (0.14 pieces/day). The no bin condition (p= 0.1829) and the bins inside condition (p= 0.7712), were both found to be statistically insignificant.

Discussion

Stand-alone garbage bin placement did not influence the quantity of litter found in large auditoriums. Overall, no significant difference in the total amount of litter left in the auditoriums was found between the three conditions (p= 0.6121). No significant difference was found between the three conditions in the total amount of paper (p= 0.8018), recyclable containers (p= 0.7562), or garbage (p= 0.6770) left in the auditoriums. Marginally significant differences were found between the three conditions in regards to the amount of food scraps (p= 0.0619). The condition where bins were placed inside of the auditorium yielded the highest quantity of food

scraps (0.86 pieces/day) compared to the no bin and bins outside conditions (0.14 pieces/day and 0.14 pieces/day, respectively) (Appendix F, Table 4). This result appears to be counter intuitive, as the auditorium with the easiest accessibility to stand-alone garbage bins, the bins inside condition, had the most food scraps. This marginal difference may suggest that stand-alone garbage bins have a detrimental effect to the proper disposal of food scraps, although this result may have come about due to sampling error as our sample was quite small. It was predicted that stand-alone garbage bin placement would not influence the quantity of litter left in each auditorium. These results support the hypothesis and demonstrate that stand-alone garbage bin placement does not influence the quantity of litter left in auditoriums. The results indicate that the content of litter may be influenced by bin placement, as marginally significant difference in food scraps were identified, with bins inside of the auditorium yielding the largest amount.

Within each condition, the composition of the litter was not significantly influenced by stand-alone garbage bin placement. In the no bin condition, there was no significant difference found in the quantity of paper, food scraps, recyclable containers or garbage that composed the total amount of litter left in the auditorium (p= 0.1829). Non-significant results were also found in the bins inside condition (p= 0.7712). A marginally significant difference was identified in the bin outside condition (p= 0.0672), with garbage formulating the largest component of the litter (1.29/3.43 pieces) (Appendix F, Table 4). This counterintuitive result suggests that stand-alone garbage bins placed directly outside of auditoriums may increase the garbage content within that room. These results are consistent with the hypothesis and suggest that littering behavior was not significantly influenced by stand-alone garbage bin placement. However, marginally significant results may indicate that bins outside of auditoriums may increase garbage litter to a marginal extent.

This experiment has some limitations. One potential confound was that every condition was executed concurrently along one narrow hallway. Participants from the no bin and bins inside conditions may have been exposed to the treatment of the bins outside condition. Researchers were aware of this confound and structured the layout of conditions to minimize its effect, however it is not known to what extent this may have influenced the results. The quantity of litter found in each condition was relatively small, approximately four pieces of litter per day. If significant differences do exist, there is the potential that these results would not be detectable due to the limited data. Future studies could be conducted in auditoriums with more severe base-rate littering problems. The study was conducted over the period of seven week-days. Ideally, these results would be replicated in a longitudinal follow-up study that increased the duration of time of observation. This study was only conducted in one Faculty of Arts building; Buchanan A. Future research could vary the location of study across campus to improve the generalizability of the results to other faculty and student populations. This experiment was conducted with the cooperation of the buildings managerial staff. It was requested that the researchers remove the garbage bins from the auditoriums after each use. As a result, researchers were required to place the stand-alone garbage bins one hour prior to the start of the study. This is a potential confound as students may have arrived to class early and witnessed the experimenters placing the bins and altered their behavior accordingly.

Future research can approach the topic of littering behavior and its relation to stand-alone garbage bins in a variety of ways. While this study demonstrated no significant difference in stand-alone bin placement in regards to littering quantity, future studies may examine the influence stand-alone garbage bin placement has on the use of multisystem recycling and compost stations in lobby areas. It is important to find out whether or not people are taking the

extra step and sorting their trash appropriately when bins are removed, and how to promote this behavior. Similarly, studies may investigate whether visual cues that promote the use of recycling stations are made more or less effective based on bin placement. These visual prompts could take many forms, such as lecture slides, notes on a whiteboard or signs that indicate that multi-system recycling stations are located outside of the room.

The results of this study have important implications on UBC operations. The results of this study indicate that stand-alone garbage bins do not influence the total amount of litter left in auditoriums. Stand-alone garbage bins may in fact have counterproductive effects on littering behavior in auditoriums as marginally significant results indicate that bins inside an auditorium increase food scraps and bins outside of auditoriums increase garbage. Based on this finding, it is suggested that all stand-alone garbage bins be removed from auditoriums across campus. This may result in economic savings due to less maintenance required to upkeep the existing stand-alone garbage bins. Efforts have already been undertaken to divert waste from landfills by introducing multisystem recycling and composting stations across campus as part of UBC's zero-waste initiative. The removal of stand-alone garbage bins, as suggested by this study, may indirectly promote the use of and expansion of this program, as students who wish to discard their waste will be required to use the multisystem stations.

Appendix A

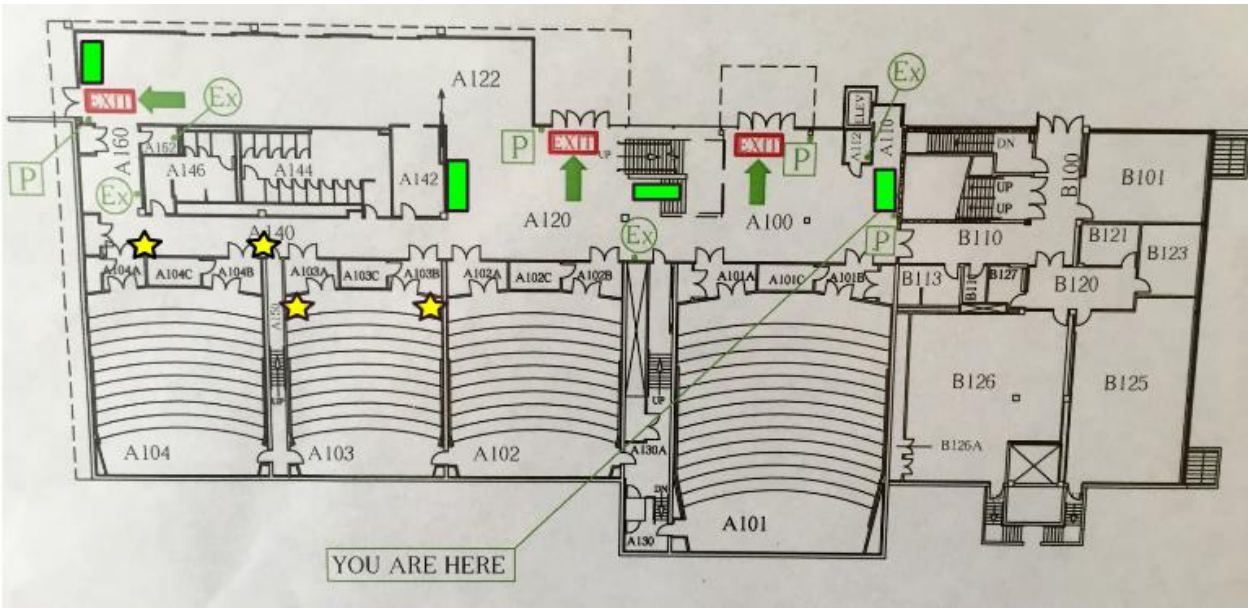

FIGURE 1 Buchanan A first floor footprint. Yellow stars symbolize the placement of stand-alone garbage bins. Green rectangles symbolize multi-system recycling and compost stations. The three conditions include: Bins Outside (A104), Bins Inside (A103) and No Bins (A102).

Appendix B

	Food Scraps	Recyclable Containers	Paper	Garbage
Yes	Cooked food waste Raw fruit, vegetables & grains Paper towels & napkins Bones & Egg shells Dairy products Compostable plates Coffee grounds & filters Tea bags Wood chopsticks	Plastic #1 - 7 Glass bottles & jars Metal cans Recyclable plastic bottles Recyclable cups & cutlery Coffee cups & lids Juice boxes Tetrapak containers Milk cartons	Newspapers & magazines Envelopes Computer paper Cup sleeves Cereal boxes Telephone books Sticky notes	Plastic bags Styrofoam Non-recyclable cutlery Waxed paper
No	Plastic bags & containers Coffee cups, lids & sleeves Biodegradable bags All cutlery & plastic chopsticks Diapers	Plastic bags Styrofoam Dishes, glassware or ceramics Aerosol cans Windows or mirrors Unstamped plastics	Milk cartons Used paper cups & plates Pizza boxes	Anything compostable or recyclable

Figure 2 UBC's SEEDS Sorting Guide. Litter is categorized into one of four categories: Food Scraps, Recyclable Containers, Paper or Garbage.

Appendix C

DATE	Food Scraps	Recyclable Containers	Paper	Garbage
Friday March 6	0	1	0	0
Monday March 9	0	0	1	0
Tuesday March 10	0	1	1	5
Thursday March 12	0	0	0	3
Friday March 13	0	1	3	2
Tuesday March 17	0	2	6	0
Thursday March 19	1	3	1	3

Table 1 Units of litter found in the no bins condition

Appendix D

DATE	Food Scraps	Recyclable Containers	Paper	Garbage
Friday March 6	2	0	2	1
Monday March 9	2	0	2	1
Tuesday March 10	0	0	0	0
Thursday March 12	1	1	0	5
Friday March 13	0	1	4	0
Tuesday March 17	1	3	2	0
Thursday March 18	0	0	0	1

Table 2 Units of litter found in the bins inside condition

Appendix E

DATE	Food Scraps	Recyclable Containers	Paper	Garbage
Friday March 6	0	2	2	2
Monday March 9	0	2	2	2
Tuesday March 10	0	0	2	2
Thursday March 12	0	2	0	1
Friday March 13	0	0	1	1
Tuesday March 17	1	0	1	1
Thursday March 19	0	0	0	0

Table 3 Units of litter found in the bins outside condition

Appendix F

	No Bins	Bins Inside	Bins Outside	P-Value	F	DF
Total Litter/Day	4.86 pcs/day*	4.14 pcs/day*	3.43 pcs/day*	0.6121	0.5045	2
Food Scraps	0.14 pcs/day*	0.86 pcs/day*	0.14 pcs/day*	0.0619	3.261	2
Paper	1.14 pcs/day*	0.71 pcs/day*	0.86 pcs/day*	0.8018	0.2234	2
Recyclable Container	1.71 pcs/day*	1.43 pcs/day*	1.14 pcs/day*	0.7562	0.2838	2
Garbage	1.8 pcs/day*	1.14 pcs/day*	1.29 pcs/day*	0.677	0.3987	2
P-value	0.1829	0.7712	0.0672			
F	1.7537	0.3758	2.714			
DF	3	3	3			

Table 4 The compiled results of the effects of bin placement on litter quantity.
*Average units of litter found per day in each condition.