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WASTE RECEPTACLE DESIGNS AS INTERVENTIONS FOR LITTER CONTROL*

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ABSTRACT

Two experiments in an indoor shopping mall examined relationships between trash-receptacle design and litter-disposal behaviors. For the first study, the trash deposited in six trash receptacles was weighed three times a week for forty-one weeks. For the intervention two of the standard shopping-mall receptacles were replaced with two obtrusive receptacles that were shaped like birds and conveyed an antilitter prompt. The ABABA design showed the bird cans to attract substantially more litter than the unobtrusive receptacles (e.g., an overall weekly average of 15.05 lbs. per bird can vs. 9.34 lbs. per regular can). Litter counts showed markedly less litter in the vicinity of the bird receptacles.

For the second experiment the litter items in three ash trays were systematically dichotomized (and counted) as appropriate or inappropriate disposals on forty-eight consecutive days. A direct relationship between ash tray-trash can proximity and the frequency of appropriate ash-tray disposals was consistently found. For example, daily averages of 22.19 appropriate and 2.64 inappropriate disposals were obtained with a special receptacle containing separate areas for ash-tray and trash-can litter; whereas these means were 3.17 appropriate versus 16.33 inappropriate disposals for an ash tray that was located more than 100 ft. from a trash can.

Litter is misplaced solid waste, from the carelessly discarded cigarette butt to the rusting hulk of an abandoned automobile. As the environmental accumulation of litter increases each year, so does the nation-wide cost of collecting litter from

* The environmental intervention in Experiment 1 was made possible by the donation of special trash receptacles by the Jackson Company, Pomona, California.

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community settings. For example, just to combat the four million tons of litter found along our highways [1] each state spends an average of $1 million annually, ranging from $35,000 in Alaska to $4 million in California [2, 3]. Environmental defacement (accompanied by huge clean-up costs) is perhaps the most frequently published and advertised consequence of littering. However, other less popular liabilities of littering are even more serious, such as the fact that litter breeds rats, flies, mosquitoes and spreads disease, and the estimates "that 500 to 1,000 people are killed each year in the United States as a result of vehicles striking or swerving to avoid litter on highways . . . [and] every twelve minutes a home is destroyed or damaged by a fire starting in rubbish and litter." [4, p. 1] Furthermore, environmental litter has perilous effects on wildlife. For example, birds are frequently strangled by metal pull-tab rings from throwaway drink containers or the plastic binders used to hold a six-pack of throwaway cans [1]. One final negative consequence of littering is that it represents a waste of energy if the litter could have been prevented by waste reduction techniques, or if the litter could have been re-used in the production of goods. See reviews by Geller [5] and Osborne and Power [6].

As reviewed by Geller [7], Osborne and Powers [6], and Tuso and Geller [8], applications of behavioral analysis to litter problems have been preventative (i.e., attempting to discourage littering before it occurs) or remedial (i.e., attempting to encourage the removal of trash from littered environments). The preventative antilitter approaches have relied on the manipulation of environmental conditions preceding opportunities to litter such as including antilitter instructions on disposable materials [9-11]. On the other hand, the remedial antilitter procedures have focused on the delivery of positive reinforcers for litter-collection behaviors, such as offering children small monetary remuneration or inexpensive trinkets for filling bags of theater litter [12], collecting litter from campgrounds or nature trails [13, 14], or for clearing litter from neighborhood yards [15].

A few behavioral studies have examined the role of using specially decorated trash receptacles as a preventative approach to litter control. In particular, Finnie counted the litter that accumulated along six blocks in downtown St. Louis, while rotating three trash-can conditions among three pairs of blocks each week for six weeks [16]. Daily litter-count comparisons between blocks with no trash receptacle and those with a fifty-five-gallon drum receptacle showed an overall 3.15 per cent litter reduction due to trash-can availability. Further, the overall litter reduction was reduced by 14.7 per cent when the blocks contained a special, colorful "Clean City Squares" litter can which was decorated obtrusively with identifications of corporate sponsors. However, these antilitter effects of beautified trash receptacles must be considered with caution because of Finnie's suggestion that litter may have blown out of the uncovered, steel-drum receptacles, and because relatively few observations were taken and reliability checks of the litter counts were not reported.

The few additional studies that demonstrated advantages of beautified trash receptacles may also be suspect because of the paucity of observations and/or the absence of reliability checks. More specifically, inter-observer reliability checks were not taken by Miller, Albert, Bostic and Geller who observed at a high school football game more frequent use of a beautified trash receptacle (shaped like a bird) than a standard fifty-five-gallon drum, and found less littering in the vicinity of the bird can than the regular can [17]. Nor were reliability checks reported by O'Neill, Blanck and Joyner who observed after ten college football games that a special trash can (resembling a hat and displaying a "thank-you" sign when its lid was pushed) contained markedly more litter and had less ground litter in its vicinity than did a bright orange, fifty-five-gallon drum [18]. Finally, in a third field study, Geller, Mann and Brasted found significantly more individuals to pick up experimenter-planted litter when it surrounded an obtrusive bird-shaped trash can than when it surrounded a fifty-five-gallon drum [19]. Although measurement reliability was demonstrated in this study the observation periods were relatively short-termed (i.e., approximately eight hours per condition).

The first experiment reported herein compared the antilitter advantages of beautified trash receptacles over a relatively long period of time (41 weeks), and included procedures to assure reliable measurements. The setting was a large, indoor shopping mall, and the dependent variables were the weight of trash found in obtrusive vs. unobtrusive trash receptacles and the amount of litter found in the vicinity of obtrusive vs. unobtrusive receptacles. Intermittent observations during this first experiment indicated frequent use of the ash trays in the shopping mall for inappropriate disposals (e.g., paper, cans, bottles, cups), and suggested that such inappropriate use of ash trays was an inverse function of the proximity of a trash receptacle. The second experiment studied systematically the relationship between ash-tray usage and the proximity between an ash tray and a trash can.

EXPERIMENT 1

Method

Subjects and setting—The subjects were visitors to an indoor shopping mall in Blacksburg, Virginia. The mall is patronized by local townspeople of all ages, including many students and personnel of Virginia Polytechnic Institute and State University. As shown in Figure 1, there is one main entrance to the T-shaped mall; and the mall provides entrances to twenty-two stores, a restaurant and a bank. Three large stores (Woolco, Peoples, and Heironimus) provide entrances/exits to the indoor mall as well as to the large outdoor parking lot. Most of the stores have the same shopping hours (i.e., from 10.00 a.m. until

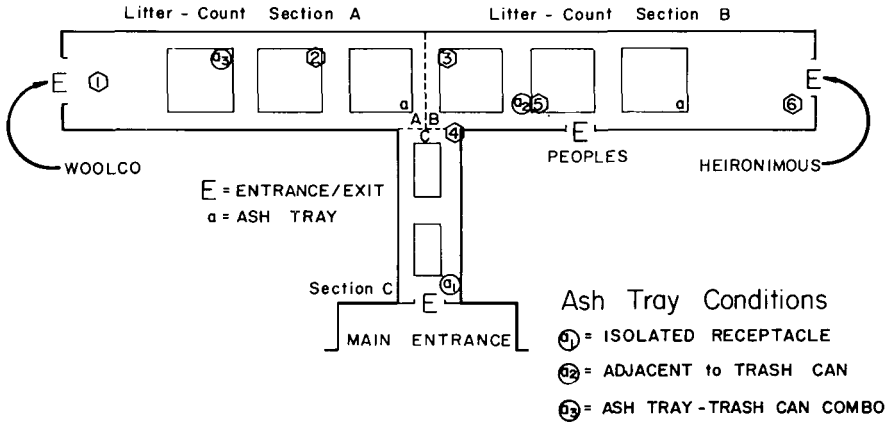

Figure 1. Diagram of the University Shopping Mall, showing the division into three sections for the litter counts and the locations of six trash receptacles and four ash trays. The three special ash tray-trash can conditions were only in effect during Experiment 2.

9.00 p.m. Monday through Friday, and from 10:00 a.m. until 6:00 p.m. on Saturday).

Throughout the eleven months of the study, six trash receptacles and five ash trays were located in the positions depicted in Figure 1, except that the special ash-tray conditions shown in Figure 1 were not in effect for this experiment. That is, an ash tray (a_2) was not adjacent to Trash Can 5 (as shown), but was located in the adjacent square, opposite the corner where Trash Can 3 was positioned; and a_3 was a standard ash tray rather than a special ash tray-trash can combination. The standard trash cans and ash trays of the mall were 4-ft. high and made out of 1 X 4 in. pine boards arranged vertically, and stained to match the wood used as a decorating motif in the mall interior.

The beautified trash receptacles were 4½ ft. tall, of fifty-gallon capacity, and were constructed from sheets of steel. The cans were shaped and painted to resemble a bird, being quite obtrusive but in good taste. One of these receptacles (depicted in Figure 2) represented an eagle (the national bird). The message, "Please be a litter bit thoughtful cries the eagle" was boldly painted on each side of the eagle can, and the front of this can conveyed a "Keep America Clean" emblem in bright red, white and blue colors. The second beautified trash can used in this experiment was shaped and painted to resemble the state bird of Virginia (i.e., the cardinal); on both sides of the Cardinal can was printed the message, "Please be a litter bit thoughtful sings the cardinal."

Procedure–Each of the six trash receptacles in the mall contained a plastic trash bag of thirty-gallon capacity. All plastic bags were systematically collected,

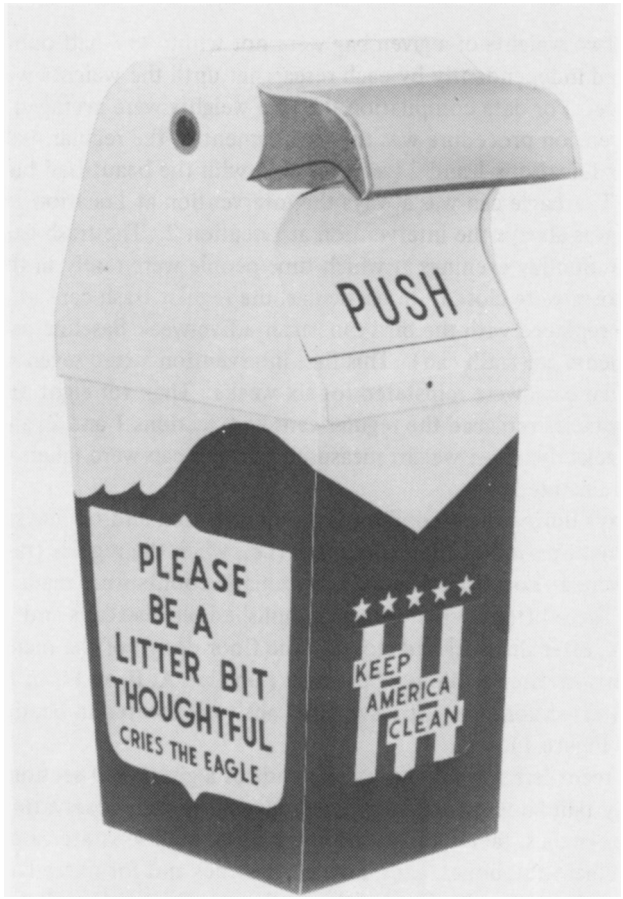

Figure 2. The special Eagle trash receptacle, manufactured by the Jackson Co., Pomona, California. The dimensions are: height = 53", length = 26", width = 18". The capacity is fifty gallons; the weight is 74 lbs. and the colors are bright and authentic with brown body, white head, orange bill and a red, white and blue, America insignia.

weighed, and replaced on three occasions during each of forty-one weeks (i.e., at 10:00 p.m. after the mall closed on Wednesday, Friday and Saturday). Thus, beginning on Monday morning, trash was collected after three days, then after two days, and finally after one twenty-four-hour period (from Friday to Saturday night). This collection schedule was used to avoid having a filled trash can, since prior observations had indicated that the amount of shopping usually increased as the week progressed.

Two data recorders (i.e., one of the authors and an undergraduate research assistant) weighed each plastic trash bag independently on a platform, produce

scale. If the two weights of a given bag were not within one-half ounce the bag was re-weighed independently by each researcher until the weights were within one-half ounce. For data compilation the two weights were averaged.

The intervention procedure was the replacement of the regular mall receptacles at Locations 1 and 2 (see Figure 1) with the beautified bird receptacles. The Eagle can was always the intervention at Location 1, and the Cardinal can was always the intervention at Location 2. The trash-can changes were made on Sunday evenings at which time people were rarely in the mall area since most stores were closed. In particular, the regular trash cans at Locations 1 and 2 were replaced with the bird cans after a five-week Baseline period (i.e., 15 measurements per trash can). This first intervention lasted seven weeks, and then the regular cans were reinstated for six weeks. Then for eight more weeks the bird receptacles replaced the regular cans at Locations 1 and 2; and finally for fifteen weeks the three weight measurements per can were taken with the regular cans reinstated.[1]

For ten days during the second bird-can intervention and ten days during the last measurement period of the experiment (i.e., when the regular trash receptacles were at Locations 1 and 2), systematic counts were made of all litter in the mall. These litter counts were accomplished on Tuesdays and Thursdays at 10:00 p.m., after the mall had closed. The floor design of the mall enabled separate counts in three sections of the mall (labelled A, B, and C in Figure 1). During the intervention, the obtrusive bird cans were located in Section A (as illustrated in Figure 1).

Two data recorders started at opposite ends of a given mall section and systematically tabulated on a standardized data sheet each observation of litter on the floor, benches, tables and in shopping carts, with separate categories for paper, cups, cigarettes, boxes, cans, bottles, matches and for miscellaneous items. The checkered design on the floor of the mall made floor litter relatively easy to detect and tabulate systematically. After canvassing a particular section the two observers compared their data, under supervision by one of the authors. If there were no more than three disagreements between the two litter tabulations, the observers initiated the litter count for another section. However, if more than three disagreements occurred the research supervisor took the data sheets, and discussed possible reasons for the discrepancy with the data recorders. Then the data recorders re-counted the litter in the section. This litter-count and check procedure was repeated until the total number of disagreements between the two independently derived litter tabulations were not different by more than three litter categorizations. The data recorders for these litter counts were undergraduate psychology majors in the senior author's Behavior Modification course,

[1] Except for three weeks in August and one week in September, the forty-one weeks of this experiment occurred continuously from the last week in January, 1976. We had planned to reinstate the bird cans midway through the last follow-up period, but the eagle can was stolen from the mall storage room where we kept the extra receptacles.

who were completing one of three data-recording exercises that were required for the class.[2]

Results

The frequent and carefully scheduled emptying of the six trash receptacles in the mall resulted in no incidences of a filled trash bag. Weight comparisons between the six trash cans during each condition indicated that the bird cans contained consistently more solid waste than the regular cans. In fact, for all but one weight measurement the amount of litter in the two bird cans was higher than any other pair of trash cans. Figures 2 and 3 depict the average pounds of trash for each of three pairs of trash cans over 123 measurement days (or 41 weeks). As shown in Figure 1, the trash-can pairings used for the data shown in Figures 2 and 3 provide the closest approximations for having one trash-can pair per litter-count area.

Although Locations 1 and 2 were often the most popular trash-disposal areas, it is evident that these locations were prominently more popular when the bird receptacles were used. More specifically, when the bird cans were not used the trash receptacles in Locations 1 and 2 attracted the most litter on five out of fifteen measurement days during the first baseline period, twelve out of eighteen measurement days during the first follow-up period, and thirteen out of forty-five days for the second follow-up. In contrast, for the twenty-one measurement days during the first intervention period the birds had the greatest weight on all but one day, and for each of the twenty-four measurement days during the second bird-can intervention the obtrusive bird receptacles collected the most trash.

The mean pounds of trash per trash-can pair per week were as follows for each of the sequential experimental conditions: 1) Baseline (5 weeks) = 16.1 for Cans 1 and 2, 14.4 for Cans 3 and 4, and 7.9 for Cans 5 and 6; 2) Birds 1 and 2 (7 weeks) = 25.6 for Cans 1 and 2, 11.0 for Cans 3 and 4, and 6.6 for Cans 5 and 6; Follow-up I (6 weeks) = 16.3 for Cans 1 and 2, 13.3 for Cans 3 and 4, and 8.1 for Cans 5 and 6; Birds 1 and 2 (8 weeks) = 34.6 for Cans 1 and 2, 16.1 for Cans 3 and 4, and 13.7 for Cans 5 and 6; and Follow-up II = 23.7 for Cans 1 and 2, 22.1 for Cans 3 and 4, and 16.4 for Cans 5 and 6. The overall weekly average was 15.05 lbs. of trash per bird can versus 9.34 lbs. per regular can.

It is noteworthy that the average weekly totals across all six receptacles were consistently higher when the birds were in Locations 1 and 2, indicating that the beautified trash cans did not only influence a redistribution of the trash that would normally be disposed of in one of the standard mall receptacles; but the bird cans seemed to attract litter that would *not* have been disposited in another mall receptacle. For example, the total mean pounds of trash collected per week

[2] There was a course option whereby students could write a short class-related paper instead of participating in the measurement exercises.

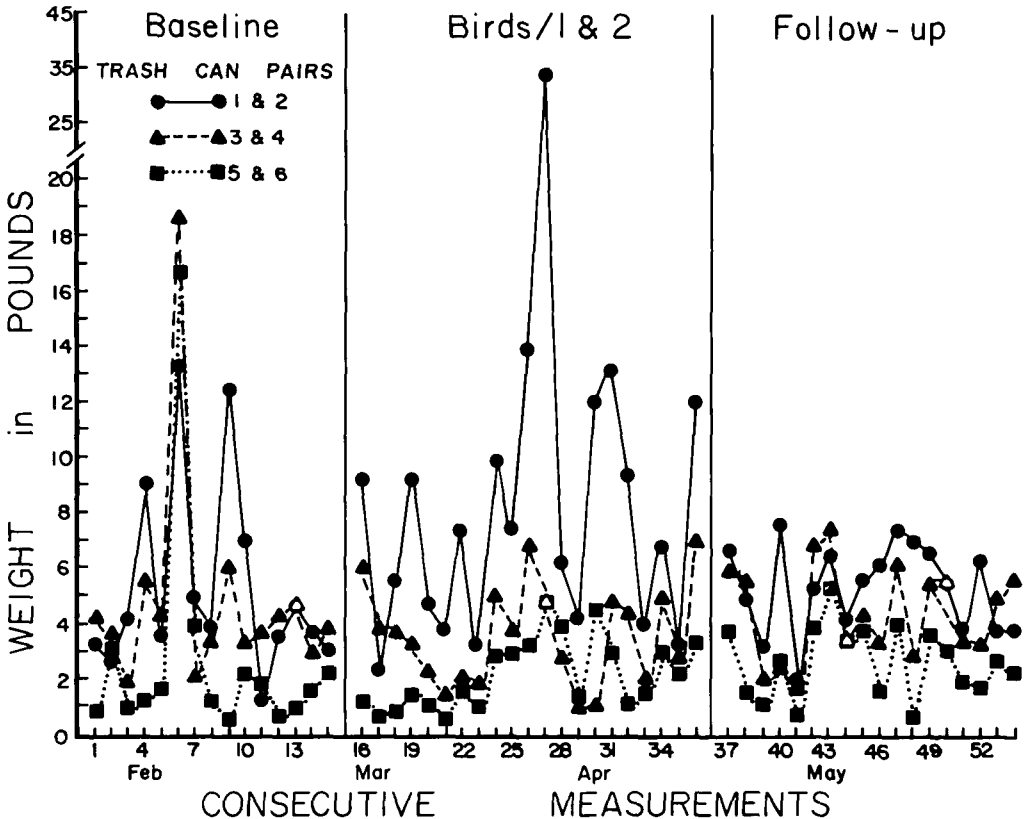

Figure 3. Weight measurements for pairs of trash receptacles (Measurement Days 1-54).

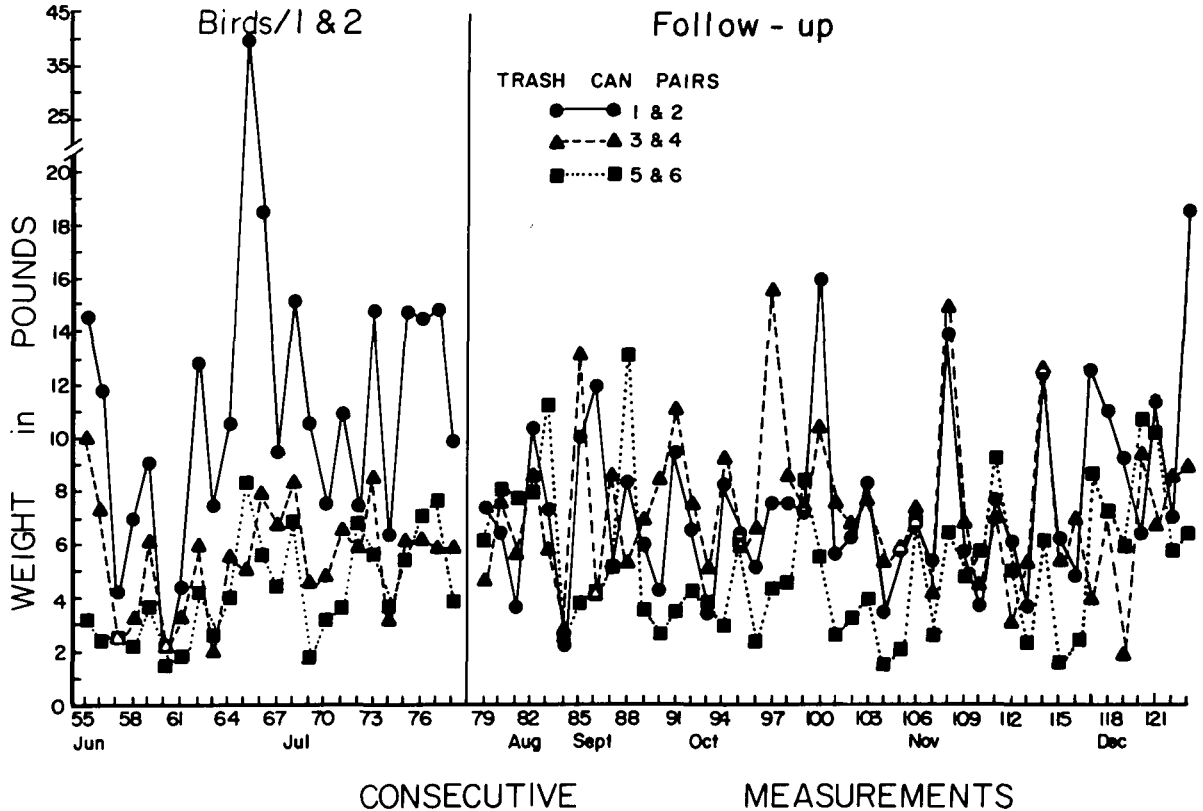

Figure 4. Weight measurements for pairs of trash receptacles (Measurement Days 55-123).

Table 1. Distribution of Litter Among Three Sections of the Shopping Mall for Ten Days per Receptacle Condition ($\chi^2 = 21.77$, $p < .001$)

Sections of Mall	*Bird can in Section A*	*Regular can in Section A*	*Totals*
Section A	388 items 38%	451 items 48%	839 items
Section B	429 items 42%	313 items 34%	742 items
Section C	198 items 20%	169 items 18%	367 items
Totals	1015 items	933 items	1948 items

Note: The item frequencies were derived by averaging the ten-day totals for each data observer and rounding to the nearest whole item.

for each experimental period respectively was 38.4 for Baseline, 43.2 for the first Bird-Can intervention, 37.7 for the first Follow-up, 64.4 for the second Bird-Can period, and 62.2 for the second Follow-up.

Table 1 depicts the distribution of litter throughout the three mall sections for ten days with the bird cans in Section A and ten days with the regular cans in Section A. The frequency and percentage of litter per matrix cell indicates that the overall amount of litter in the mall did not change when the attractive bird receptacles were used, but the distribution of the litter throughout the mall was significantly influenced by the presence of the beautified trash receptacles, χ^2 (2) = 21.77, $p < .001$. Less trash was deposited in the vicinity of the special bird receptacles than in the vicinity of the regular cans, but the areas more remote from the bird cans (Sections B and C) actually contained less litter when Section A had regular cans rather than beautified cans.

DISCUSSION

The weight data suggest that decorated trash receptacles are consistently effective in prompting trash disposals over periods of seven and eight weeks, respectively. Thus, the trash-collection advantages of beautified trash receptacles that had been observed previously during relatively short-term observations was demonstrated over a relatively long period of time in the present study [16-19].

Although these findings suggest that the litter-control efficacy of beautified trash receptacles may be expected to last for extended periods of time, the intervention periods were probably not long enough to rule out novelty as a significant litter-control factor. The beautified receptacles were located in public spaces where several people passed daily and relatively few individuals would be expected to experience repeated exposures.

The litter-count data indicated that attractive trash receptacles decrease the probability of littering in the vicinity of the antilitter prompt, as was also shown by Finnie [16] and by O'Neill et al. [18]; but the decrease in litter around the obtrusive cans was accompanied by increased litter counts in the areas remote from the attractive cans. It was as if the attractive receptacles (with their antilitter prompts) merely influenced "litterbugs" to avoid littering at the location of the antilitter prompt. Thus, the extra trash which the bird cans consistently attracted was probably from individuals who would not have littered the trash in the mall area. On the other hand, it is possible that the bird receptacles influenced some people to clean litter from the area surrounding the bird cans, while actually increasing the probability that other individuals would litter in order to regain freedom threatened by the antilitter prompts on the bird cans.

This latter speculation is based on a theory of psychological reactance and has some support from two recent field studies of litter control [20]. Specifically, at a public swimming pool Reich and Robertson found significantly more children to litter handbills that conveyed the instruction "Don't you dare litter" or "Don't litter" than handbills with the message "Help Keep Your Pool Clean" or "Keeping the Pool Clean Depends on You." [21] Also, in the shopping-mall milieu for the present experiment, Mann, Brasted and Geller found significantly less compliance with handbill instructions that *demanded* a disposal response in a remote trash can than with instructions that *politely* requested handbill disposals in the same remote trash receptacle [22].

EXPERIMENT 2

Method

Subjects and setting—This experiment was initiated approximately one month after the last measurement day of Experiment 1 at the same indoor shopping mall. Throughout the forty-eight days of this experiment, the six regular trash receptacles and five ash trays were located in the mall as shown in Figure 1. Of particular importance in this study were the locations of three ash trays (labelled a_1, a_2, and a_3 in Figure 1), because these ash trays represented the three experimental conditions of the study. The regular ash trays in the mall looked identical to the regular trash cans, except that instead of a flip-top trash-can cover there was a sand-filled pan (6 in. deep × 18 in. in diameter) at the top.

Two of the ash trays used in this field study were of this design. One of these (a_1 in Figure 1) was positioned in the mall with 100 feet between it and the nearest trash can; the other regular ash tray (a_2 in Figure 1) was located immediately adjacent to a regular mall trash can with a similar design and appearance.

A special combination ash tray-trash can was also used in this study (a_3 in Fibure 3) which was similar in appearance to the standard trash cans and ash trays of the mall, except that it included a sand-filled pan at the top for ash-tray litter and a large opening below the pan for trash-can litter. It was constructed by extending the four vertical pine boards at the corners of the regular trash can approximately 1.5 feet higher and inserting an ash-tray pan at the top of these boards. While combining two receptacles in one, this trash can-ash tray combination was no more obtrusive than the regular mall ash tray or trash can (except that it was somewhat taller).[3]

Procedure–On each of forty-eight consecutive nights at 10:00 p.m. (after the mall had closed), two of the authors independently categorized the items discarded in each of the three ash trays as appropriate disposals (i.e., cigarette butts, cigar butts and matches) or inappropriate disposals (e.g., candy, paper, peanut shells, toothpicks, gum, cans, bottles, straws, pull tops, cups and tops, etc.), and then counted their tallies. The independent item counts were repeated for each ash tray until full agreement was reached or until five trials made it obvious that complete agreement would be impossible. This latter situation only happened on seven occasions when small pieces of paper and/or peanut shells were counted. For these cases the average of the two closest counts (one from each observer) was used for the data analysis. On five of these measurement days the trash can and the ash tray in Condition a_2 had been moved from their adjacent positions and therefore forty-three rather than forty-eight measurements were taken for this condition.

Results

Figure 5 depicts the daily frequency of appropriate and inappropriate ash-tray disposals for each of the three ash-tray conditions. For the condition with the maximum proximity between ash tray and trash can (i.e., the ash tray-trash can combination), the largest number of appropriate disposals were consistently observed (daily average = 22.19 appropriate items) and the fewest number of inappropriate disposals occurred (daily average = 2.64 inappropriate items). In contrast, for the minimum proximity condition (i.e., the ash tray alone with no nearby trash can), the fewest number of appropriate disposals were consistently

[3] Line drawings of this special receptacle as well as the regular mall ash tray and trash can will be furnished upon request to the senior author.

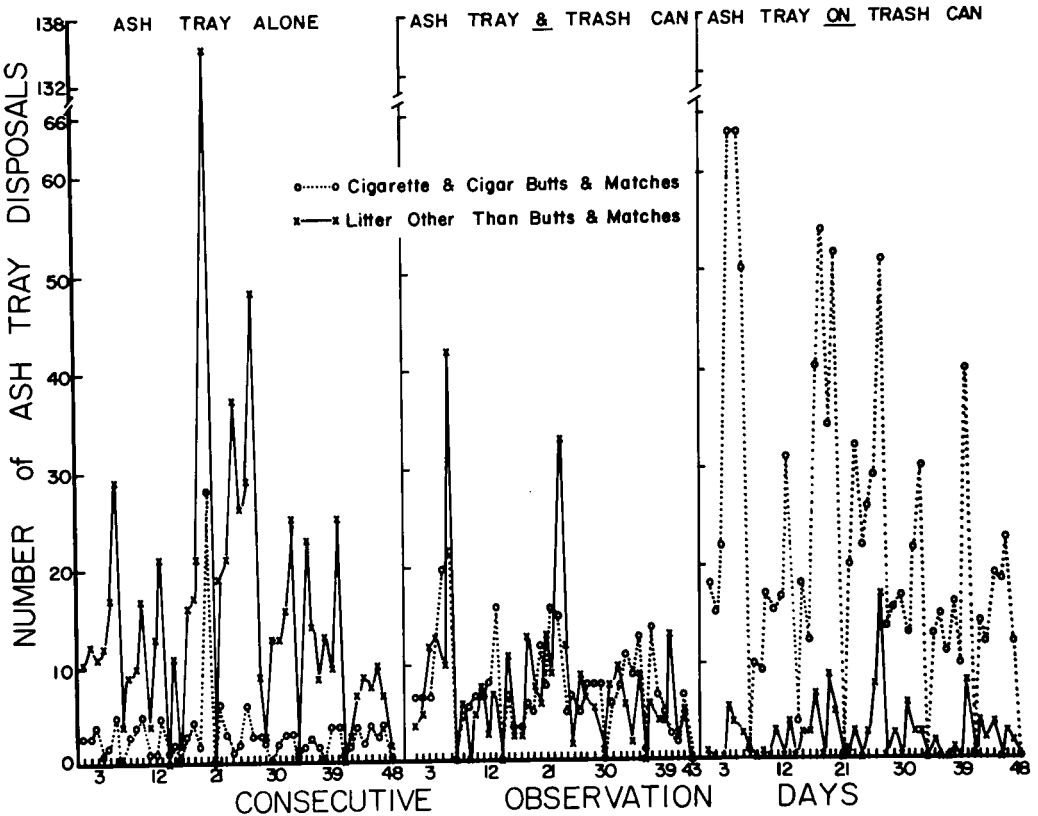

Figure 5. Daily frequency of appropriate and inappropriate ash-tray disposals during the three ash tray-trash can proximity conditions that occurred on each observation day.

observed (daily average = 3.17 appropriate items) and the largest amount of inappropriate disposals were found (daily average = 16.33 inappropriate items). The intermediate proximity condition (i.e., ash tray adjacent to trash can) resulted in intermediate frequencies of appropriate and inappropriate disposals (daily averages = 7.67 appropriate items and 7.56 inappropriate items).

Discussion

The results of this study of ash-tray litter were striking and quite relevant for the designing of trash receptacles. That is, a direct relationship between ash tray-trash can proximity and the number of appropriate ash-tray deposits was consistently observed. Thus a simple change in the design of a trash receptacle influenced marked increases in appropriate ash-tray use, which not only improved environmental aesthetics but also reduced the likelihood of a fire caused by mixing paper disposals with cigarette butts. Furthermore, the observation that most people separated their disposals appropriately when it was convenient to do so has important ramifications for community recycling [5]. Would it not be possible to design large trash receptacles for public use that have separate openings and removable containers for paper, glass, metals and biodegradables?

CONCLUSIONS

The two field experiments reported herein demonstrated rather consistent antilitter effects of special waste-receptacle designs over relatively long-term measurement periods that provided for reliability checks of the dependent variables. The results of the first study implied that beautified trash receptacles with antilitter prompts were used more frequently than standard, unobtrusive trash receptacles. Furthermore, less litter was found in the area surrounding beautified receptacles than in the vicinity of relatively unobtrusive trash cans, because some people were less apt to litter in the vicinity of the decorative trash cans and/or because some people were more likely to pick up litter in the vicinity of the beautified trash cans. The relative contribution of these two possible stimulus-control effects of beautified trash receptacles is an important topic for subsequent antilitter research. Further litter-control research should also determine the optimal number (and placement) of beautified trash receptacles, especially since an obtrusive antilitter prompt may elicit perceptions of threat to one's freedom (or personal control) and thus encourage littering behavior.

The second experiment reported herein showed a prominent relationship between the usage and the placement of waste receptacles, which can be interpreted by intuitive reference to notions of response convenience. Thus, the number of inappropriate ash-tray disposals decreased substantially when a trash can was placed next to an ash tray, thus making it convenient to use the trash can for inappropriate ash tray litter. Such response discrimination was even

more prominent when a single receptacle included separate (and convenient-to-use) locations for ash-tray and trash-can litter. One additional empirical question for further antilitter research is whether even more perfect disposal discrimination would occur if the special, ash tray-trash can combination (used in Experiment 2) was made more obtrusive and included antilitter prompts (like the special receptacles in Experiment 1).

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