*AN EVALUATION OF THREE LITTER CONTROL
PROCEDURES—TRASH RECEPTACLES, PAID
WORKERS, AND THE MARKED ITEM TECHNIQUE*

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This study assessed the effectiveness of three litter control procedures on the grounds of a residential retardation facility. Fifty-seven areas were divided into five groups according to the amount of litter they contained. Daily litter counts were made in one randomly chosen area for four of the groups and weekly litter counts were made from one randomly chosen area from the fifth group. After the baseline period, trash receptacles were placed at high traffic areas on the grounds of the facility. This was followed by the payment of two resident workers for picking up trash. In the next phase, marked pieces of litter were placed on the grounds, and residents voluntarily collected litter and turned it in at a central location. When a marked piece was turned in, that resident received \$1.00 and had his or her picture taken and posted. This phase was followed by a return to the trash receptacles phase and then a return to the marked item phase. The results indicated that the marked item procedure was effective in reducing the amount of litter on the campus grounds, but the use of trash receptacles and the payment of resident workers for picking up litter did not noticeably reduce the amount of litter. The results are discussed in terms of the cost effectiveness of the procedures.

DESCRIPTORS: litter control, marked item technique, retardates

With the increasing interest in the application of behavior analysis to environmental problems, several procedures have been designed to control littering (see Geller, 1979 for a review). Hayes, Johnson, and Cone (1975) and LaHart and Bailey (1975) introduced a procedure in which the reward was contingent upon turning in specially marked items of litter. However, in discussing the application of this procedure, Hayes et al. questioned its practicality in terms of the time required to examine all of the collected litter for marked pieces.

The present study assessed the effectiveness of the marked item technique, which was modified in order to decrease the amount of time required to detect marked litter. This procedure was compared with two other litter control procedures: the placement of trash receptacles on campus and the payment of resident workers in a residential facility for the retarded.

METHOD

Subjects and Setting

This research was supported in part by Hudspeth Retardation Center, Whitfield, Mississippi. The authors gratefully acknowledge the support of Mrs. Helen Wilroy, Director, and the staff of Hudspeth Center throughout all phases of this study. Reprints may be obtained from either Ansley Bacon-Prue, Mississippi University Affiliated Program, 1100 Robert E. Lee Building, Jackson, Mississippi 39201, or Ronald S. Drabman, Psychology Division, Department of Psychiatry, University of Mississippi Medical Center, 2500 North State Street, Jackson, Mississippi 39216.

The study was conducted at Hudspeth Retardation Center, a 400-bed state retardation facility in Whitfield, Mississippi. Approximately 100 of the residents had unsupervised ground privileges. Machines that sold candy, cigarettes, and soft drinks were available at two locations, and much of the litter was generated from these items. The administration of the center had tried several approaches to control litter,

including asking staff to come in on Saturday morning to pick up litter.

Data Collection

The campus was divided into 57 approximately equal areas, each measuring about 1,225 square meters (13,225 square feet). First, the areas were categorized into five different groups based on litter counts performed during a pre-baseline period. The definition of litter was that used by Hayes *et al.* (1975): "Items were counted if they were as long, wide, or as great in volume as a closed matchbook. Broken glass that appeared to be from one bottle was counted as one piece. Items specifically not counted were: animal droppings, nails, string, wire less than 12 inches (31 cm) in length, cellophane tear strips and tops from cigarette packages, cigarettes, cigarette butts, rocks, twigs, or tabs from beverage containers" (p. 382). Table 1 shows the litter count range and the number of areas in each group.

Daily litter counts were made on weekdays between 4:30 p.m. and 5:00 p.m., weather permitting, on one randomly chosen area from each of the first four groups. Weekly litter counts were made on a randomly chosen area from the extremely littered areas in Group 5. For Groups 1-4, the areas were randomly chosen with the restriction that each area was counted at least once in each condition.

Data were collected by three primary observers. During the prebaseline count, reliability was assessed for six randomly chosen areas. After that, at least one reliability check was con-

ducted for one area in each group during each phase. Four of the reliability checks were conducted by an observer who was unaware of the experimental conditions. When reliability was assessed, the two observers started at opposite ends of an area. Interobserver agreement was calculated by dividing the smaller count by the larger count and multiplying by 100. The overall mean agreement between the observers was 92% ($n = 37$) with a range of 80% to 100%. Reliability between the primary observers and the naive observers was 89% ($n = 4$) (range = 80 to 100%) and the agreement between the primary observers was 92% ($n = 33$) (range = 81 to 100%).

Procedure

Baseline. A baseline phase was in effect for 14 weekdays. No trash pickups or prompting occurred during this time.

Trash receptacles. Trash receptacles were placed in the high traffic areas of the campus. Prior to this, no outdoor trash receptacles were present. This phase was in effect for 11 days, and the trash receptacles were left in place for the remainder of the study.

Resident workers. In this phase two residents who were employed in a resident worker program were paid \$1.10 per hour to pick up litter from 3:00 p.m. to 4:00 p.m. each weekday. A "Cottage Parent" was assigned to supervise the residents during this time. Each day during this phase, the resident workers and the Cottage Parent met at the Psychology Department where the Cottage Parent reviewed the litter count data that showed the up-to-date counts in each area in graphic form. On the basis of these data, the Cottage Parent decided where to direct the resident workers to pick up litter. Resident workers were provided with 50-gallon garbage bags each day. This phase was in effect for 12 days.

Marked items. In this phase 10 pieces of litter were marked and placed on the campus according to the density of the litter in the areas in each group as shown in Table 1. The areas in which the marked pieces were placed were ran-

Table 1

Litter count range, number of areas in each group, and criteria according to which location of marked items was determined.

Group	Litter count	Number of areas	% of areas with marked items
1	0-200	30	3
2	201-400	11	9
3	401-600	7	20
4	601-1000	6	50
5	>1000	3	100

domly chosen for each group. Instructions to the residents were read in school classes, at an adult activity center where several of the residents worked, and at recreation classes. Also, copies of the instructions were sent to the cottages. The instructions were as follows: "On special days, between 3:00 p.m. and 4:00 p.m., you may go to the Recreation Hall, pick up a garbage bag with your name on it, and go pick up litter from the grounds. At 3:50 p.m., a loud bell will be rung. When you hear this bell, you should go back to the Recreation Hall immediately and turn in your bag of litter. (You may turn in your litter earlier, and you may get another bag.) Some of the pieces of litter on the grounds are marked in a secret way. At 4:00 p.m., a staff member will determine which residents have the secretly marked pieces. If you have any marked pieces in your bag, you will win \$1.00 for each marked piece and you will have your picture taken. The pictures of the winners will be on display in the Recreation Hall for a week. At the end of the week, each winner will get his or her picture to keep. Remember, the secretly marked pieces could be any type of litter, including paper, cans, pop tops, cigarette butts, etc. However, leaves and grass will not be marked. This is a volunteer activity. Your teachers and your cottage parents will tell you on the day when this activity is scheduled." This activity was conducted once per week during this phase.

The pieces of litter were marked by spraying them with Clue Spray.¹ This is a fluorescent material which when sprayed lightly on an object cannot be seen unless the object is placed under an ultraviolet light. When a resident touched a marked piece of litter, the fluorescent particles were transferred to the resident's hand. At 4:00 p.m., when the activity was over and the residents returned to the Recreation Hall, a staff member checked the residents' hands under a black light. If a resident had fluorescent

particles on his or her hands, they would show up with a bright yellow glow. When this was detected, the litter collected by the resident was inspected under the black light. If at least one of the pieces was covered with clue spray, the resident was a winner. The winners were announced after all of the residents' hands were checked and after the winners from the previous week were awarded their pictures. In addition, a group picture of all of the participants was taken and posted with the individual pictures of the winners. Marked pieces of litter that were not returned were left on the grounds, and each week 10 new pieces were placed. This phase was in effect for 32 days, followed by a return to the Trash Receptacles Only phase for 16 days and then a return to the Marked Item phase for 18 days.

RESULTS

Figure 1 shows the mean number of pieces of litter per day for the areas in Groups 1-4 and the number of pieces of litter for each count made for areas in Group 5. During baseline the mean for Groups 1-4 averaged was 609, and the mean for Group 5 was 1742.6. During the first Trash Receptacles condition, the phase mean for Groups 1-4 increased 17% to 714.8. The mean for Group 5 decreased 9% to 1578.5. In the Resident Workers condition, the mean for Groups 1-4 was 690.2, a decrease of 3% from the previous phase. For Group 5 the mean was 1783.3, an increase of 13%. The first Marked Item phase showed a mean of 382.3 for Groups 1-4, a 45% decrease, and a mean of 953.2 for Group 5, a 47% decrease from the previous phase. In the second Trash Receptacles condition, the mean for Groups 1-4 increased by 30% to 497.5, and the mean for Group 5 decreased by 10% to 853.6.

During the last phase, the mean for Groups 1-4 decreased to 238.3, a 52% decrease, while that for Group 5 decreased to 360, a 58% decrease from the previous phase. The percent decrease in these means from baseline was 61% for Groups 1-4 and 79% for Group 5.

¹Clue Spray is commercially available from Sirche Laboratories, P.O. Box 30576, Raleigh, North Carolina 27612, at \$12.25/6 oz. can.

A total of 130 different residents participated in the Marked Item phase with an average of 25 residents per week (range = 18 to 39). Approximately 10 of the residents participated almost every week, but because of discharges, admissions, and competing activities, other residents participated only intermittently. There was an average of six winners per week (range = 4 to 10).

Cost Effectiveness

In all of the phases except baseline, trash receptacles were emptied between 3:00 p.m. and 4:00 p.m. on weekdays by two resident workers who were supervised by a staff member. The resident workers were paid \$1.10 per hour, and the staff member was paid \$2.65 per hour. About fifty 50-gallon garbage bags were used per week, at a cost of \$4.70 per week. The

total weekly cost of trash receptacle maintenance was \$27.95.

In the Resident Worker phase, two resident workers (\$1.10 per hour each) were supervised by a staff member (\$2.65 per hour) as they picked up litter from the grounds between 3:00 p.m. and 4:00 p.m. on weekdays. The weekly cost, including two 50-gallon garbage bags per day, was \$24.19 plus \$27.95 for trash receptacle maintenance, or a total of \$52.14. During this phase, about 200 gallons of litter were collected by the resident workers each week.

In the Marked Item phase, one staff member spent a total of 1.5 hours per week. A maximum of \$10.00 was needed for prize money, the film cost was a maximum of \$5.50, and the amount of Clue Spray used per week cost about \$0.50. Approximately forty 30-gallon garbage bags, at \$2.32, were used. The weekly cost was

Fig. 1. The mean number of pieces of litter per day for Groups 1-4 and the number of pieces of litter for Group 5, across each phase.

\$22.30 plus \$27.95 for trash receptacle maintenance, for a total of \$50.25. This does not include the initial one-time cost of the fluorescent bulb which was \$8.06. Approximately 1,200 gallons of litter were collected during each weekly activity in the Marked Item phase. In summary, the maintenance cost was somewhat less than paying two resident workers to pick up trash and resulted in about six times as much trash being collected per week.

DISCUSSION

The Marked Item procedure was clearly effective in reducing the amount of litter on the campus. The use of trash receptacles and paying resident workers for picking up litter did not noticeably reduce the amount of litter.

The cost effectiveness of the Marked Item procedure compared favorably with that of the other, less effective procedures. In addition, the cost could be reduced in a number of ways. For example, the number of marked pieces can be decreased, or once the litter is decreased to relatively low levels, the litter collection activity could be held less often than once a week. In fact, at this point, those activities are being held every other week at Hudspeth Center, and casual observation and comments from staff and administration suggest that the litter is being maintained at acceptable levels.

The present method of marking items has an advantage over that used by Hayes et al. (1975). Instead of having to examine each bag of litter turned in, only the bags belonging to residents whose hands had Clue Spray on them were examined. With this procedure, the time spent in examining litter was greatly reduced. Several times, the bags could be held up to the light and the marked pieces would show up through the bag, thereby eliminating the need for a thorough examination. Additionally, Clue Spray on a marked item would still show up on the item and the resident's hand after several days or weeks of being placed on the grounds.

Several marked items which were placed 3 to 5 weeks earlier were turned in, and the Clue Spray was evident on the item and the resident's hand.

The residents seemed to enjoy the marked item procedure. Several residents repeatedly asked when the next litter pickup (or paper hunt) was going to be held. During the 16 days of the second Trash Receptacles phase, 12 residents asked a psychology staff member a total of 31 times when the next litter pickup was scheduled. Also, the pictures of the residents seemed to be a very powerful reinforcer. For example, after the first few litter collection activities, several residents were seen in the Recreation Hall in the evening with their chairs grouped around the pictures of the winners instead of the TV. Also, several of the losers from the first activity were upset because they didn't have their pictures taken. Therefore, a group picture of all participants was taken after each litter collection activity and posted with the individual pictures of the winners.

Although the use of Clue Spray was an improvement over the way in which Hayes et al. (1975) marked the litter and made the use of the Marked Item technique more practical on a larger scale, the present study raised several questions. First, the present study was conducted in a closed environment (a retardation center) as was the Hayes et al. (1975) study (a correctional facility). In both cases, there was a "captive audience." The question of the generality of the results in unstructured settings remains unanswered. Second, in the Marked Item phase, the procedure contained several components, such as instructions, individual photographs, group photographs, money, the "social" aspects of the activity. The effects of each of these components need to be individually assessed.

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Received December 22, 1978

Final acceptance September 19, 1979