

## REINFORCEMENT AND RATE OF LITTER DEPOSITING<sup>1</sup>

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A study was conducted concerning the frequency of litter deposits in a single experimental trash receptacle located in a high-use, urban park setting. There were four two-week periods of alternating no-contingency, contingency conditions during which reinforcement and incentive were evaluated. It was found that reinforcement resulted in the highest rates of behavior and improvements in the aesthetic appearance of the area.

The control of littering behavior has been the focus of two recent behavior analysis studies: Clark, Burgess, and Hendee (1971) and Burgess, Clark, and Hendee (1972). In the first of these studies, the effectiveness of several different anti-litter procedures on the percentage of litter returned to trash containers by children attending a movie matinee was evaluated; offering an incentive of 10 cents for returning a litter bag was found to be the most effective. The second study assessed the effect of an incentive on the number of pieces of "planted" litter that was collected by children who were offered a variety of items.

As an extension of the above research, the present study was concerned with evaluating a reinforcement procedure on the behavior of depositing litter in an appropriate trash container in a high-use urban park setting. This research was focused on the effects of a contingency delivered analogous to a variable-ratio reinforcement schedule. To facilitate application of behavior-analysis procedures, the present study spanned a longer period of time than previous work and involved indigenous litter. In addition to frequency measures of litter depositing, an

evaluation of experimental procedure on the aesthetic appearance of the experimental area was conducted.

### METHOD

#### *Setting and Subjects*

The experiment was conducted at the Woodland Park Zoo in Seattle, which is the only free-admission zoo in the metropolitan area. Precise data on zoo patrons are not available but appeared to consist of persons from a wide variety of age and socio-economic status. A single, standard park trash receptacle (28 gallon garbage can with a lid) located near the concession stand and "monkey island" was selected as the experimental trash receptacle. This area, located in the central portion of the zoo, was selected as the experimental site because there appeared to be a considerable amount of ground litter in the area, even though there were 12 trash receptacles within a 50-ft radius of the experimental trash receptacle. The subjects who participated in this study were "self-selected".

#### *Procedure*

The experiment was conducted 8 hr per day over an eight-week period from mid-June to mid-August. The eight-week period was divided into four two-week experimental sessions: (a) Baseline I, (b) Reinforcement I, (c) Baseline II, and (d) Reinforcement II, which are described

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in more detail below. All litter deposits in the experimental trash receptacle were recorded and daily photographs of the experimental area were obtained during the last four weeks. A sign indicating that data were being collected was on display for the duration of the study.

### *Data Collection*

Litter deposit data were collected daily between the hours of 12:00 and 8:00 p.m. in the following manner. Two student research assistants observed the experimental trash receptacle from a distance of approximately 3 ft. One of the assistants was designated an Experimenter and the other a Reliability Checker. A wood and cloth screen was used to separate the Experimenter and Reliability Checker such that they were unable to view each other's data recording activities. Each time a litter deposit occurred, the Experimenter transferred a 3 by 5 in. index card from a storage bin to a large manila envelope. At 20-min intervals, the manila envelope was sealed and a new one was used. The envelopes were consecutively numbered and 24 such envelopes were accumulated for each 8-hr session. The Reliability Checker followed a similar procedure except recorded data only on every other 20-min interval. Twenty-minute intervals were timed on a kitchen timer that "dinged" when 20 min had elapsed. The Reliability Checker also recorded the temperature and ranked sky conditions as 3 = sunny, 2 = cloudy, and 1 = rainy for every 20-min interval.

A litter deposit was defined as any deposit into the experimental litter container, provided that: (1) all the litter the subject was carrying was deposited, (2) peanut shells were deposited by the handful, and (3) the subject was not observed taking litter out of other litter receptacles in the area. Deposits by subjects that did not meet the above criteria resulted in the experimenter informing the subject about the criteria if the subject made an inquiry.

To provide some information on "who" was depositing litter, informal data concerning the sex and age of the subjects were collected during

96 matched pairs of 20-min intervals of the Baseline II and Reinforcement II sessions. A single observer categorized litter depositers as to whether they were male or female and were in one of the following age groups: under 10 yr; 10 to 20 yr; more than 20 yr.

At approximately 6:00 p.m., another research assistant photographed pre-selected areas near the experimental trash receptacle. Daily parking lot receipts of the zoo parking area were also obtained.

### *Experimental Conditions*

*Baseline I.* During the first two weeks of the study, data were collected but there were no experimental contingencies.

*Reinforcement I.* During the second two-week period, a litter deposit resulted in a contingency on a predetermined schedule. The contingency was a ticket that was redeemable for a soft drink at the concession stand. The Experimenter gave the ticket to the Subject and said: "Thank you for throwing litter into a proper container. As a reward we would like to give you this coupon which will entitle you to a free Pepsi at the concession stand (point to stand) any time today."

Reinforcement was delivered on a variable-ratio schedule, that is, the number of deposits required before any particular reinforcement was delivered was variable but the average number of deposits per reinforcement was fixed; VR 10 and 7 were used on the first three days and VR 20 was used on the remaining 11 days.

The reason for shifting to the VR 20 schedules was due to the unanticipated high response rates and large number of Pepsis delivered under VR 10 and VR 7. A limited number of reinforcers were available for this phase of the study and a VR 10 or 7 schedule would have exhausted the supply before the two-week period would have been completed. Reinforcements were scheduled by making an "R" on the 3 by 5 cards used for counting litter deposits. The Experimenter could not see the "R" cards until a to-be-reinforced deposit was made.

In addition to the contingency described above, a sign that read: "At times persons depositing litter in this container will be rewarded," was placed near the experimental trash container. This "incentive" sign was present for the entire two weeks of Reinforcement I.

*Baseline II.* During the third two-week period, the sign stating that deposits would be rewarded was present but there were no contingencies for litter deposits. Other than the presence of the sign, procedures were the same as Baseline I.

*Reinforcement II.* The conditions for the fourth two-week period were the same as Reinforcement I except a VR 10 schedule of reinforcement was used to obtain data on the effects of a higher reinforcement frequency.

## RESULTS

The cumulative number of litter deposits for each of the four experimental conditions is given in Figure 1. The contingent conditions resulted in the highest rates of litter deposits with totals of 4577 and 6032 for Reinforcement I and II as compared to 723 and 2403 for Baseline I and II.

A Pearson correlation coefficient was computed for the responses recorded in comparable 20-min intervals by the Experimenter and Reliability Checker for each week of the study and the lowest coefficient was 0.9916.

Thirty five mm color slides of two areas, Scene A and Scene B, near the experimental trash receptacle were available for most of the days during the last four weeks of the experiment. Scene A showed a large expanse of paved area, and Scene B showed a grassy area behind a bench. The slides were grouped into four sets for each scene, one for each of the last four weeks. Thus, two of these sets for a given scene were obtained under Contingency II conditions and two under Baseline II conditions.

Two carousel projectors were used to project simultaneously two slides at 4-sec inter-stimulus intervals onto the right and left portions of a viewing screen. Five student volunteers were

asked to judge whether the right- or left-hand set showed more litter. Slide sets from baseline and reinforcement conditions were counterbalanced for right- and left-hand sides. The set of slides showing Scene B was not reliably judged to be different for baseline and reinforcement conditions. The set of slides showing Scene A was judged to contain more litter under baseline conditions than under reinforcement conditions by all five judges 100% of the time.

An analysis was conducted on the possible relationship of several other variables to the number of litter deposits. An analysis of temperature, sky conditions, and parking lot receipts was conducted in the following way. First, the following Pearson correlation coefficients were obtained for daily means: sky condition  $\times$  temperature, 0.7128; sky condition  $\times$  parking lot receipts, 0.5819; temperature  $\times$  parking lot receipts, 0.4282. All of the above were based on an N of 56 and were significant at the 0.001 level. To control for the variability in litter-deposits that might be a result of the number of persons who happened to utilize the zoo on any given day, an adjusted daily total of litter deposits was computed by dividing the number of litter deposits by the parking lot receipts. These adjusted frequency measures showed the same trends and relationships to experimental variables as the raw frequencies. For example, the total number of deposits for each consecutive two-week period was 723, 4577, 2403, and 6023, which can be compared to the adjusted scores of 0.1218, 0.8344, 0.3542, and 0.9212.

The observations of the sex and ages of the litter depositors indicated that there was no difference between sexes; however, age groupings showed the following changes from Baseline II to Reinforcement II conditions. Persons judged to be older than 20 yr declined from 34.38% to 6.62%. Those between 10 and 20 yr increased from 15.93% to 43.80%. Children under 10 yr of age appeared unaffected with an increase from 49.68% to 50.04%. It would thus appear that the contingency increased the percentage of children who deposited litter and

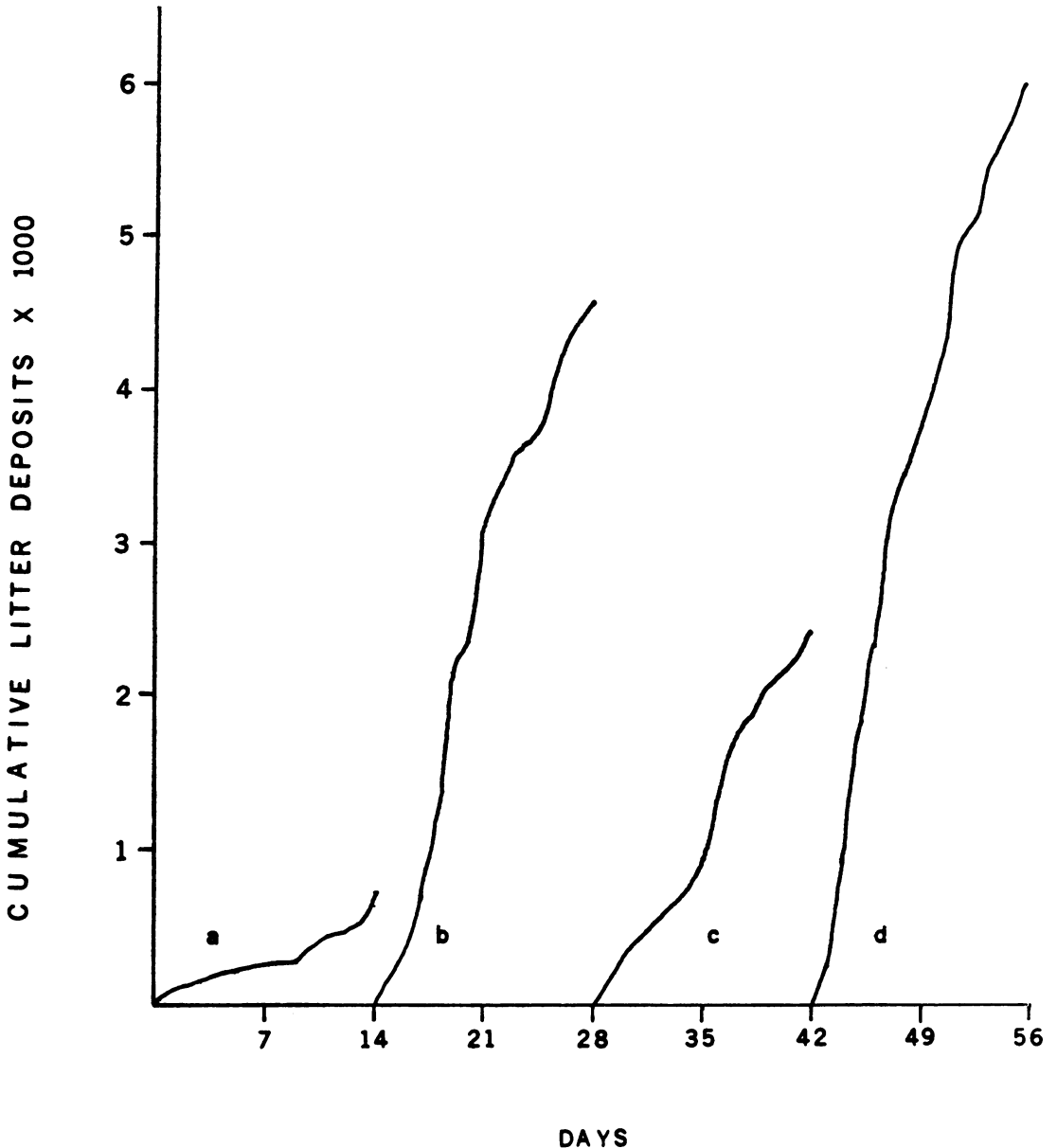


Fig. 1. The cumulative number of litter deposits for each of the two-week experimental conditions: (a) Baseline I; (b) Reinforcement I; (c) Baseline II; (d) Reinforcement II.

decreased the percentage of adults. These changes may be the result of the particular reinforcer used in this study or may simply reflect that this approach to litter may have greater effects on younger people.

The data were obtained during 20-min intervals each day, beginning at 12:00 noon and ending at 8:00 p.m. An analysis of the mean responses during each 20-min interval for each

of the experimental conditions is given in Figure 2, which shows that the rates of responding decreased markedly during the last several 20-min intervals of the data collection period.

## DISCUSSION

One of the concerns of the present study was that of evaluating the effects of a contingency

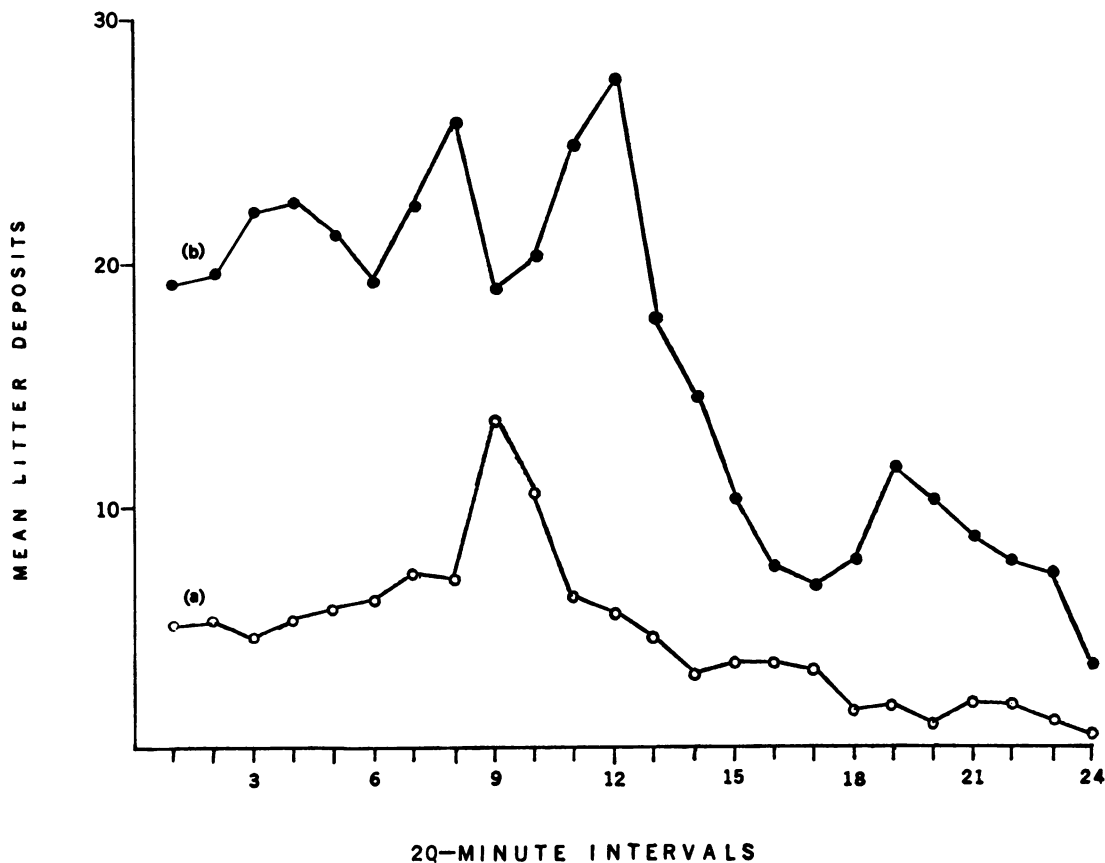


Fig. 2. The mean number of litter deposits for consecutive 20-min intervals during the 8-hr data collection period for (a) Baseline I and II (b) Reinforcement I and II. The first 20-min interval was between 12:00 and 12:20 p.m.; the last 20-min interval was between 7:40 and 8:00 p.m.

as opposed to an incentive or offer of reward. The data indicated that a contingency resulted in increased rates of litter depositing; this was particularly apparent in the difference between rates obtained during Baseline II and Reinforcement II conditions, since the sign offered a reward was present during both.

In terms of application, a central issue of the present study was that of reducing the amount of trash observed on the ground. Although it seemed apparent on the basis of casual observation that the entire area near the experimental trash receptacle was spotless, only one vista (Scene B) of the two photographed yielded reliable results. Scene B showed a grassy area of approximately 4 by 20 ft, whereas Scene A was a paved area of approximately 30 by 150 ft. It seems to be important to select areas for photo-

graphic analysis of litter that are not too large and include high contrast between litter and ground colors. Other measures of litter on the ground, such as the number of pieces or weight of litter found in a test area, might have been more sensitive to the experimental manipulations.

The applied value of obtaining rates for small time segments is apparent from consideration of trend in rates over the 8-hr data collection period. In order to reduce costs and still maintain the benefits of the reinforcement procedures, it appears that the contingency could be in effect for considerably less than the full 8 hr.

The results of both the present study and previous work indicate that contingency and incentives have marked effects on the behavior

of litter depositing. At this point, the most relevant applied question is that of cost-efficiency. An incentive or reinforcement type system of litter control that can be continuously used should be tested and compared to conventional programs for both effectiveness and costs. It should be pointed out that a reinforcement approach, as used in the present study, would tend to result in continuous litter control, that is, there would tend to be less litter at any given moment during the day. Conventional approaches involve the use of a litter-pickup crew, which results in a litter-free area immediately after the crew has finished and a gradual accumulation of litter on the ground thereafter. The relative effectiveness of these two particular approaches would therefore be influenced by such variables as the rate at which ground litter accumulates and the effect of quantity of litter on the aesthetic appearance of the area.

There were large differences in the conditions under which the present study was conducted and the usual classroom, hospital, or laboratory setting in which most applied behavior research has been done. The subjects in the present study may have been exposed only once to an experimental condition and use of the terms "reinforcement" or "extinction" may not be appropriate. There was, however, a great deal of similarity between the "reinforcement" operations in the present study and the usual reinforcement procedures. That is, the addition of a contingency resulted in an increase in rate. Although precise data are not available, casual observation indicates that some of the rate increases during reinforcement conditions were the result of "repeaters" or subjects who would return several times to the experimental trash container. One young man reportedly earned 16 soft drinks in a 4-hr period. In part, the effect of the con-

tingency may also have been derived from its discriminative properties for other people in the area, that is, bystanders may have observed a reinforcer being delivered, which then served as an incentive.

The VR 20 schedule was in effect for most of Reinforcement I and VR 10 for Reinforcement II. The design does not permit an unambiguous interpretation of this type of schedule effect, and the differences in rates between these two periods should be interpreted with caution. If part of the effect of the contingency is derived from its discriminative properties for other people in the area, it seems reasonable to suggest that a richer reinforcement schedule would expose more bystanders to the experimental contingency and thereby serve as a more effective incentive. If cost is a consideration, however, it is questionable if doubling the reinforcement density can be justified by the data.

From both a theoretical and applied viewpoint, it would be interesting to test behavior analysis concepts and procedures in a field setting in which the subject population is constantly changing. At the present time, however, the primary applied issue is that of designing effective and cost-feasible procedures of litter control.

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