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DEVELOPMENT AND ANALYSIS OF A COMMUNITY-BASED RESOURCE RECOVERY PROGRAM

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Five studies were conducted over a 10-month period to determine the effectiveness of specific procedures in encouraging recycling among residential neighborhoods. Results indicated that: (a) initial levels of participation in neighborhoods were frequently related to housing values; (b) weekly recycling pick-ups that coincided with garbage collection days resulted in higher levels of participation than pick-ups that occurred at other times; (c) notifying homes about the recycling program through distributed door-to-door brochures was more effective than soliciting participation through newspaper ads; (d) distributing containers to help residents separate recyclable from nonrecyclable material proved to be an effective procedure, especially when combined with frequent prompting (prompting alone did not have much effect); and (e) procedures that facilitated the greatest levels of participation were not always cost-effective. The subsequent combination of these procedures into a package program resulted in high levels of neighborhood participation that were cost-effective and maintained over a 6-month period.

DESCRIPTORS: recycling, systems analysis, community applications, cost-effectiveness

Public officials face an increasing complexity of administrative and social problems. Growing populations require new and varied programs at a time when revenues are declining. Citizens are demanding more input into political processes and greater program accountability (Taylor, 1974; Webb & Hatry, 1973). Although a good deal of effort has been directed toward developing empirical community evaluation procedures (Campbell, 1969, 1971; Hatry, Fisk, & Winnie, 1973) less effort has been directed toward the development of functional and accountable units of measure in program evaluation (Deutscher, 1969; Malott, 1975). As a result, generalized or correlative measures that are not directly related to the question at hand have often been used, resulting in programs that fail to meet public objectives (La Piere, 1934, 1969; Weiss & Rein, 1969).

Research in applied behavior analysis, however, has provided numerous methods for defining and measuring functional units of behavior (Baer, Risley, & Wolf, 1968; Skinner, 1953), and behavioral measurement technology offers important tools for the evaluation of municipal systems and their functions. For example, Stokes and Fawcett (1977) used a multiple-baseline design to evaluate a pilot refuse packaging program that was subsequently incorporated into a local community ordinance. Schnelle, Kirchner, Casey, Uselton, and McNees (1977), Schnelle et al. (1978), and Schnelle, Kirchner, McNees, and Lawler (1975) have reported the evaluation of a variety of police patrol and surveillance strategies using quasi-experimen-

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tal and single-subject designs. When a local county government began to develop a community-based recycling program, it became possible to extend the methodological applications of the earlier research to a new program area.

Program Concept

Americans dispose of over 190 million tons of waste products each year (U.S. EPA, 1974) at an annual cost exceeding $3 billion (National Center for Resource Recovery, 1976). As the nation's trash piles continue to expand by 3%–4% per year, the need to alter the behavioral processes associated with our throw-away society becomes increasingly apparent both for economic and environmental reasons (Geller, Winett, & Everett, 1982; Milliken & Powell, 1979).

Disposal is only one alternative because most solid waste can be economically recycled (Heron, 1976; Levy & Rigo, 1976; State of Florida Resource Recovery Council, 1977). As a result, over 120 communities have implemented residential resource recovery programs during the past decade. Despite the number of programs, there has been little systematic data for communities to follow in developing their own recycling systems, and program success has been highly variable (Cohen, 1978). Most available literature covers only basic strategies for implementing a recycling program with little guidance on how to maximize productivity. Specific information on effective community publicity programs, cost-effective material collection procedures, methods for increasing household participation, data management, and evaluation systems are generally not available.

With the exception of the Marblehead-Sommerville Demonstration Project (U.S. EPA, 1976), the primary work in these areas has been conducted by behavioral scientists working in diverse settings. Luyben and Bailey (1979) noted an increase in the amount of paper collected by children across mobile home parks when small toys were offered as reinforcers compared to a no prize condition. Hamad, Cooper, and Semb (1977) reported similar results among elementary school students when prizes were awarded for paper recycling and class efforts were posted. In a series of studies evaluating how raffles, contests, and prompts could facilitate recycling within university dormitories, Geller, Chaffee, and Ingram (1975) and Witmer and Geller (1976) reported that each of the incentive conditions was superior to prompting in increasing the amount of paper recycled. Reid, Luyben, Rawers, and Bailey (1976) noted that the amount of paper collected in an apartment recycling program was significantly increased when more recycling containers were provided and their presence noted through door-to-door prompting.

More recently, Jacobs and Bailey (1982–1983) conducted a comparative evaluation of different recycling procedures within a 700-family neighborhood. Using a comparative AB within-treatments vs. control-group design (Bailey & Bostow, 1979), results indicated that the individual treatments of biweekly prompting, paying participants for recycled material, a $5 lottery for participating households, and an increased frequency of collection program each increased participation over baseline levels, but none of the procedures was cost-effective. This problem has been noted in many studies and appears to be related to low levels of participation during treatment and the costs of material collection. It appears necessary that a program demonstrate self-sufficiency before its adoption at the municipal level.

The purpose of this investigation was to determine if cost-effective procedures could be developed to facilitate participation in a community-based, residential recycling program. Inherent in this goal was the development and demonstration of systematic evaluation procedures that could be used to analyze and modify other large-scale community systems.

GENERAL METHOD

Participants and Setting

Study participants were selected from the 6,500 households that participated in the overall Leon County Recycling Program. All houses were located in predominantly single family dwelling neighborhoods and represented approximately 25% of all homes in Leon County, Florida.

Each household was informed about the recycling service by a brochure that was placed on their front door 4–7 days before the first weekly pickup. The brochure explained the purpose of the program, when and how to participate, and gave a phone number to call for further information.

On the appropriate weekly collection day, the program truck drove through the designated neighborhood route, stopping to pick up all newspaper and aluminum that was left at curbside. Because the recycling truck and garbage trucks operated independently of each other, recycling pickups occurred both before and after garbage collection. Garbage truck crews were informed about the project and did not tamper with recycling materials. To minimize the possibility of missed pickups, program participants were asked to leave recyclables at the curbside one-half hour before collection. The recycling truck also followed the same route in each neighborhood each week to ensure that every home was covered.

Data Collection

Data were maintained on the frequency of recycling by each household over sessions as well as the amount of newspaper and aluminum collected at each pickup. Households were identified by their address each time material was collected in front of the dwelling. Newspapers that lay flat on the ground with a single center fold (as they come from the news stand) were measured at the center of the lowest wide side of the bundle for the total number of inches, to the nearest ⅛ in. Piles of newspapers that were folded in half again were similarly measured but the resulting figure was divided in half to account for the doubling of the paper. Paper that was not bundled was considered loose paper and recorded accordingly.

Weighing the paper may have been more aligned with recycling industry standards, but it could not be done in our research because up to 2,200 homes were scheduled to be collected from each day. Using a scale would have required the truck to come to a complete stop at each pickup point and remain stationary while the paper was loaded onto a scale, measured, and then thrown into the back of the vehicle. Measuring the paper could be done where the paper lay, independently of a scale attached to the truck, required less handling and subsequently less time. Correlative data collected throughout the program indicated that each inch of paper weighed 1.66 lb and this served as the conversion figure in determining the weight of the material for the cost-benefit analyses.

Because aluminum was often bagged and in small quantities, this material was weighed with a pocket hand scale and recorded to the nearest pound.

Reliability

Reliability was conducted on 50 of the 131 experimental days. During each reliability session, the reliability observer drove through the route in a separate vehicle recording the address of each participating household, inches of paper and pounds of aluminum collected per pickup. All reliability sessions were conducted in the early morning because they had to occur before material was picked up by the regular collection crew. Recycling program staff had no knowledge of when reliability was being assessed.

Reliability percentages were computed according to the formula of agreements/(agreements + disagreements) × 100 for all measures. Mean results for reliability of correctly identified homes participating in the program that day (only homes with pickups were recorded) was 97% (range 83%–100%) with no systematic variation observed throughout the program period. The mean percent agreement on the inch measurement for paper was 77.3% (range 55%–100%) across sessions with an allowance of 1 inch (2.54 cm) variability between the reliability and collector's measurement per pickup. The mean percent agreement for aluminum was 82.2% (range 33%–100%) with no allowance for variability and 96.2% (range 33%–100%) allowing ±1 lb (0.45 kg) variability.

Cost-Benefit Analysis

Cost-benefit analyses determined the direct cost of each treatment relative to its revenues. Costs included the expenses associated with the general program such as truck operation, labor, and program notification, as well as the combinations of

Table 1
Treatment Component Cost Expenditures (per Household Basis)

Component	Description	Cost per household (in cents)	Used in experiments
Collection	Weekly pickup of material based on the costs of operating one truck at 50¢ per mile on a 50-mile route, one driver and one collector at $3.00 per hour each for an 8-hour day; distributed across a 2,200 home route per day	3.32	1, 2, 3, 4, 5
Program brochures (initial notification)	Design and development ($350/6,500 brochures = 5.38¢ per brochure) Printing = 8.00¢/brochure	13.38	1, 2, 3, 4, 5
Prompts	Handbills distributed door-to-door during treatment program (printing costs only)	1.00	1, 4, 5
Distribution of brochures or prompts or both	At a rate of 70 per hour at a cost of $3.00 per hour	4.28	1, 2, 3, 4, 5
Re-Cyclit source separation containers	Three compartment plastic containers	600.00	4, 5
Distribution of Re-Cyclit containers	At a rate of 20 per hour at $3.00 per hour; enclosed instructions cost 2.25¢ per set of three sheets	17.25	4, 5
"We Recycle" stickers	6.40 by 8.94 cm self-adhesive stickers distributed to participating households	4.48	5
Newspaper display ad space	21-column-inch ad at $6.10 per column inch	131.00–181.00	3

costs incurred by the specific interventions. Costs related to data collection and experimental analysis were not included, as these would not be components of an ongoing municipal program.

Because the size of treatment areas varied, all costs were reduced to a cost-per-house-on-route basis. Accordingly, all expenses associated with a specific neighborhood were distributed across all homes serviced in the area (not just those participating in the program) because all households in treatment areas were potential participants and the costs of municipal programs are typically distributed across the entire population to be served (Hatry et al., 1973). Volumes of material collected and revenues generated were determined in a similar manner.

Table 1 presents a breakdown of the costs considered during the investigation. Collected paper was sold for 2.5¢/lb (0.45 kg) and aluminum earned 20¢/lb (0.45 kg). Disposal cost savings from each ton (907.2 kg) of material recycled rather than landfilled were not considered because the county paid a fixed fee for burial regardless of tonnage. These data are based on the cost of the program operation in Leon County and could vary in other communities due to different collection, disposal, and market prices. Analyses of the individual interventions used in the different studies are contained in individual program descriptions.

These combined procedures in the general method section constituted standard program operations during the course of the investigation. Exceptions made as a function of experimental manipulations in each of the following studies are noted within the specific experiment.

EXPERIMENT 1

Neighborhood Participation as a Function of Economic Index

Previous research has provided little information about predictive indicators for residential partici-

pation. Hansen (1975) noted that participation in both mandatory and voluntary recycling programs increased with program duration. Cohen (1978) analyzed participation trends of 218 residential recycling programs and determined that cities with higher mean income levels had greater levels of participation than those with lower mean income levels. Although this provides a possible indicator of expected participation levels, the survey was conducted after the programs were established, and it evaluated mean income levels of entire cities rather than different economic levels within a given municipality. The purpose of our normative assessment was to determine if participation trends within neighborhoods were associated with economic level and if this indicator could also be used to project participation trends in other areas.

Method

Participants and Setting

Four neighborhoods within Leon County were selected based on their heterogeneous representation of different economic levels. Economic levels were based on the average price per home in each area as noted by the Leon County Planning Department. This was based on the assumption that the income level of each household was a determining factor in the type of housing inhabited, and that housing prices could subsequently be used to determine the economic level of a neighborhood (Holleb, 1969). The resulting economic groups and corresponding housing values based on 1979 dollars were: lower income (n = 417, average price per home = $14,000), lower middle income (n = 555, average price per home = $25,000), middle income ($n$ = 225, average price per home = $35,000) and upper middle income (n = 260, average price per home = $53,000).

Procedure

Program implementation and recycling services were conducted according to standard project procedures with neighborhood areas scheduled for pickups on different days of the week that coincided with their garbage collection schedules. Handbills were distributed to all households in the upper middle and middle income areas to remind them about the program 4 days prior to the fifth session. Similar prompts were distributed to the lower middle and lower income areas 4 days prior to the sixth session to attempt to control for time and historical variables across groups. Data were collected weekly for 11 experimental sessions.

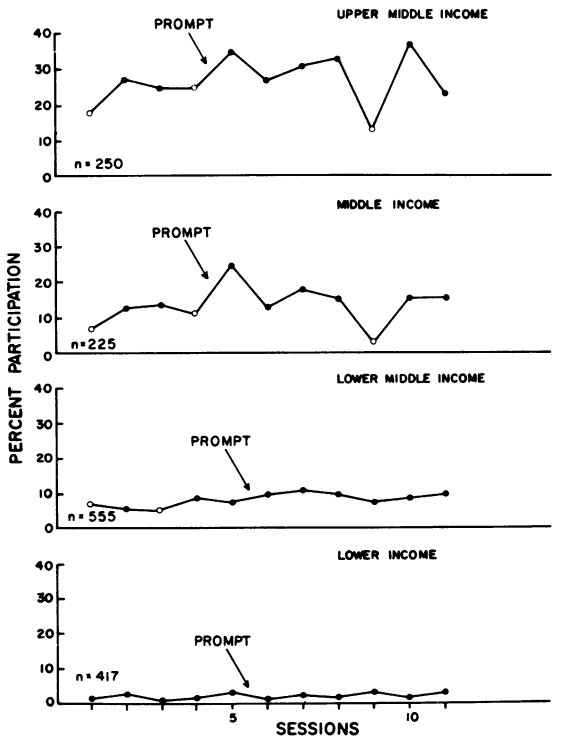

Figure 1. Percentage of households recycling weekly as a function of economic group. Prompts were delivered 4 days prior to the fifth recycling session for the upper middle income and middle income groups, and 4 days prior to the sixth session for the lower middle income and lower income groups. Open circles denote days of inclement weather.

Results

Figure 1 shows consistently higher levels of weekly participation among neighborhoods with proportionately higher housing values. Distribution of the prompts had a transient effect on weekly participation among the upper middle and middle income neighborhoods but no effect in the lower middle and lower income areas.

Cumulative participation also appeared to fol-

low housing cost. Of all homes in the upper middle income group, 66% recycled at least once during the study followed by the middle income group (51%), lower middle income group (29%), and the lower income area (10%). Participating upper middle income homes also recycled more frequently (4.4 times) during the study than the other three groups which recycled between 2.3 and 3.0 times per participating household.

Newspaper subscription records in each neighborhood were compared with participation rates to determine if subscription levels influenced program outcome; they did not appear to influence results in the upper middle, middle, or lower middle income areas where 89% to 99% of all homes were newspaper subscribers. They did affect the outcome data in the lower income group where only 14% of the homes subscribed to the local paper. In this situation, 71% of all subscribing homes participated in the program, compared to an overall neighborhood participation rate of 10%. Thus, in extreme situations the amount of material available for recycling may have a strong impact on participation.

Approximately 99% of all pickups across groups involved the collection of newspaper with little variability in the amount collected per pickup across groups (range 5.2 in. (13.2 cm)–4.7 in. (11.9 cm). Aluminum collections were proportionately related to income levels ranging from 6.8% per week in the upper middle income group to only two pickups during the entire study in the lower income group. The average amount of aluminum collected per pickup ranged unsystematically between 1.0 lb (0.45 kg) and 1.8 lb (0.82 kg) across all groups.

Generalization

To test the relationship between economic levels and participation further, the mean weekly rate of participation of four additional neighborhoods that began recycling during this study and continued to participate for at least 12 sessions was plotted as a function of economic level. As noted in Figure 2, with the exception of the upper income group (average price per home = $87,000), a nearly linear relationship existed between economic levels and participation levels among the combined eight groups. A local school that was conducting its own recycling campaign may have interfered with participation in the upper income group.

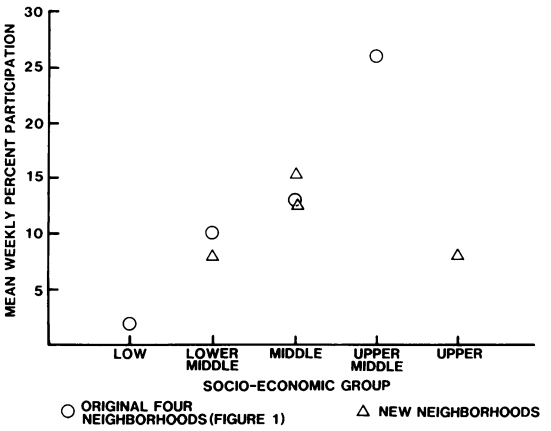

Figure 2. Mean percentage of households recycling weekly as a function of economic level. Circles represent the four original neighborhoods of Figure 1 and the triangles represent four additional neighborhoods that participated in the program during the same period of time.

Cost-Benefit Analysis

The total cost for servicing each household during the existing 11-week program was 59.46¢. The majority of this cost (36.52¢) was related to weekly collection activities; the remainder was allocated to program publicity. Only the upper middle income area approximated self-sufficiency, losing 0.28¢ per household over 11 weeks with subsequently lower income levels losing progressively more money per household (middle income = −30.31¢; lower middle income = −41.31¢; lower income = −56.82¢).

Discussion

The results of this normative assessment indicated that home values may help to identify rates of participation in residential recycling programs. Although the design of investigation did not allow for a functional analysis of the results and the 11-week duration of the study did not allow for a

long-term analysis, previous findings appear consistent with the present data (Cohen, 1978). In addition, 5 months after the end of the study, the upper middle and lower middle income groups still exhibited proportionate levels and volumes of participation. No data were available on the lower income group which was terminated due to continued low levels of participation, or for the middle income group which was transferred to a different recycling schedule to observe other program effects. Results also generalized to most of the other neighborhood areas involved in the recycling program with the exception of one upper middle income and two middle income neighborhoods that exhibited transient slumps during the summer months.

Because participation in all residential areas was below cost-effective levels, additional improvement in program treatment and design was required. Subsequent studies addressed these issues.

EXPERIMENT 2

Rate of Participation as a Function of Weekly Recycling Schedule

Although several published sources (Cohen, 1978; U.S. EPA, 1977) recommend that recycling pickups coincide with garbage collection schedules, there are few empirical studies to support this suggestion. Proponents of same-day recycling service suggest that it is easier for households to remember to recycle on the same day that garbage is collected than to remember separate schedules. This assumption is especially important to evaluate if differences in participation are noted due to schedule variations. When a large middle income neighborhood was identified where different areas were serviced by separate garbage routes on different days, it was possible to evaluate this proposal through a quasi-experimental analysis.

Method

Participants and Setting

A middle income neighborhood of 644 households participated in the study. Based on garbage collection routes, 369 of the houses received twice weekly garbage collection on Monday and Thursday and the remaining 275 homes received similar service on Tuesday and Friday.

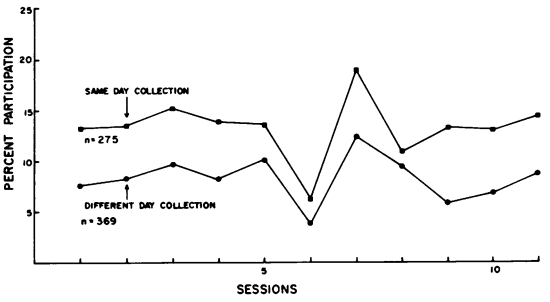

Figure 3. Percentage of households recycling weekly as a function of same-day recycling and garbage pickups or different-day garbage and recycling pickups.

Procedure

A between-groups, quasi-experimental design was used. All homes in the neighborhood were notified of weekly Tuesday curbside recycling service according to standard program procedures. This resulted in one group of 275 homes receiving recycling service on the same day as one of their two weekly garbage collection days (same-day collection group) whereas the second group of 369 homes received recycling service on a different day from their garbage collection schedule (different-day collection group). Data were collected on the number of households participating per week in each group for 11 sessions.

Results and Discussion

As noted in Figure 3, weekly participation by the same-day collection group was approximately 5% higher (M = 13.3%) than the different-day collection group (M = 8.3%) across sessions. This represented proportionately 60% greater participation by the same-day group as compared to the different-day group.

Because it was not possible to assign individual homes randomly to the two treatment conditions a quasi-experimental design had to be used where two already established groups were randomly assigned to treatment conditions. Although the two groups appeared equivalent in terms of geographic

location, housing diversity, and values of the homes, the quasi-experimental design did not allow the same degree of control over the issue of equivalence as a pure experimental design. Hence, it is possible that other unidentified variables may have contributed to the outcome. It is also reasonable that the recycling schedule did influence levels of participation. Because scheduling options did not cost the program any money and appeared to have a positive effect, all pickups within the county recycling program were rescheduled to concur with garbage collection schedules.

EXPERIMENT 3

Type of Media Notification and Rates of Residential Recycling

Although the standard program relied on individually distributed brochures to publicize recycling service, other methods of notification were available. Because all households receiving a daily newspaper were potential recyclers, the effects of notifying homes through the newspaper compared with the standard brochure procedure were examined.

Method

Participants and Setting

Participants consisted of one well-defined middle income subdivision of 126 homes that had been built by one developer, was segregated from other developments within the county, and had a single entrance with the subdivision name in front. Residents readily identified themselves with the name of the subdivision.

Procedure

Four days prior to the first recycling session a ⅛ page (21-column in.) ad was run in the only local daily newspaper announcing the beginning of recycling service in the subdivision. The ad included a map of the subdivision, information on when and how to recycle, and a phone number to call for more information. It was conspicuously placed at the top of the second page in the first section of the paper.

Program brochures were also distributed to ½ (63) of the homes in the subdivision on the same day that the ad appeared to create two distinct groups—one group that could only learn about the program through the newspaper and a second group that could learn about the program both through the ad and the brochure. Four days prior to the ninth session, brochures were also distributed to the ad-only group. Data were collected for a total of 15 weekly sessions.

Replication

The same procedures were replicated in a second subdivision of 124 middle income homes. Due to a typographical error, several streets listed on the newspaper map were incorrectly labeled but correctly drawn. The rest of the ad contained no errors. Brochures were distributed to households in this ad-only group 4 days prior to the seventh session.

Results

As noted in Figure 4, both of the brochure and ad groups exhibited two to four times the levels of participation witnessed in the respective ad-only groups. Participation in each ad-only group increased to the equivalent level of their respective brochure-and-ad group following the distribution of the brochures. Analysis of the cumulative frequency of homes beginning recycling in the ad-only groups (Figure 5) indicated that increases in participation followed the distribution of the brochures and were related to new homes beginning to recycle rather than an increased frequency among existing recyclers.

The door-to-door distribution of brochures was also more economical. Individual brochures cost 17.66¢ to develop, print, and distribute. Each newspaper and cost $128.00, or between $1.31 and $1.81 per household when distributed over the number of residences targeted in each ad-only group. Approximately 10 times as many homes would have to be included in each ad-only group

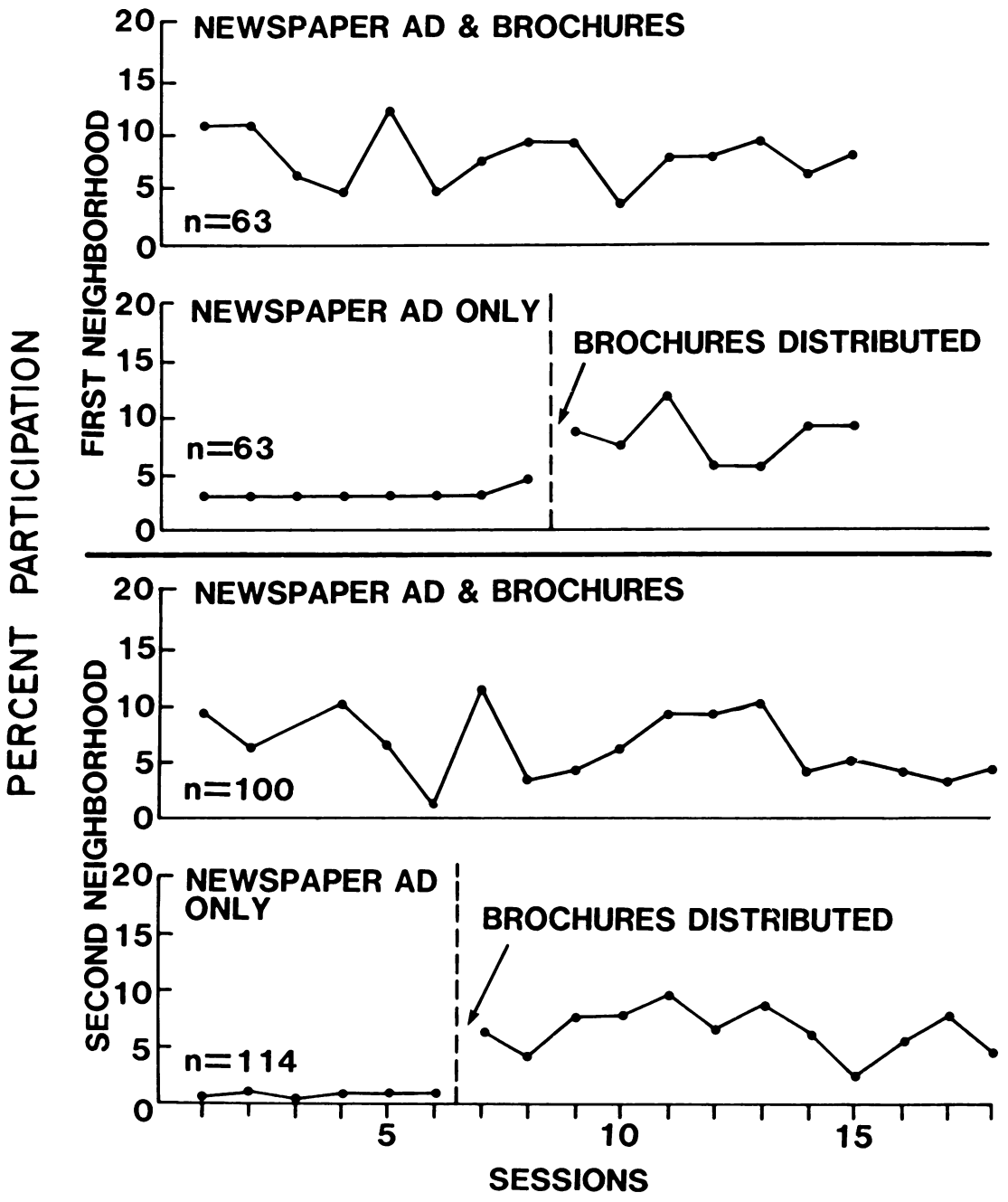

Figure 4. Percentage of households recycling weekly as a function of sessions for each neighborhood group.

to make the ads as economical a notification system as the brochures. This would still not take into account the lower participation levels and revenues by the ad-only groups or that larger and more expensive ads might have to be used to reach larger groups of homes.

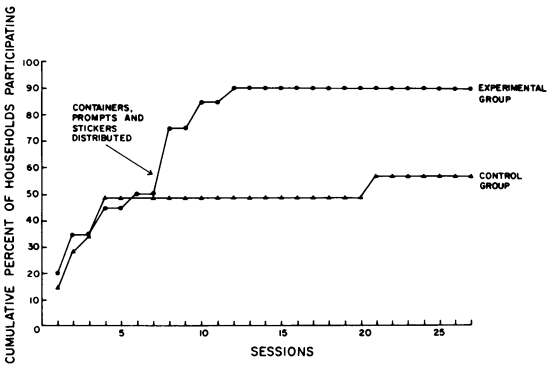

Figure 5. Cumulative percentage of households beginning to recycle in each group as a function of sessions. Newspaper ads and brochures (combined or separate as per the experimental design) were distributed 4 days prior to the next experimental session following the arrows.

Discussion

Given the low levels of participation by both ad-only groups before brochure distribution, it is unlikely that the ad alone was responsible for much of the effect observed in the combined brochure-and-ad groups either. It is possible that the combination of the ad and the brochures produced a greater effect than either method would have produced alone, although weekly participation levels of the four groups following receipt of the brochures were within the range of other program neighborhoods that only received brochures. However, this specific point was not investigated.

Several factors representing basic differences between newspaper ads and brochures may have been responsible for the noted outcomes. Both the ad and the brochure provided the essential information required to become involved in the program but because of its greater space and display options, the brochure provided more information. Although the ad was prominently placed in the newspaper, it may have been missed by some people and discarded the next day, unlike the brochure that may have been retained. Finally, the door-to-door distribution of brochures may have been considered a more personalized approach because it specifically identified each home as being able to participate in the program unlike the group identification inherent in the newspaper ad.

This study was not designed to assess which, if any, of the above parameters may have contributed to the results or how characteristics of ad design may affect participation. This is a separate area of inquiry that has been under investigation (Geller, 1975; Geller, Farris, & Post, 1973; Witmer & Geller, 1976) with mixed results noted. The purpose of this study was to demonstrate one way that a program can empirically select between several different product options that inherently have their own advantages and disadvantages.

EXPERIMENT 4

Facilitating Participation Through Separation Containers and Multiple Prompting Procedures

Experiment 1 indicated that basal participation rates among lower middle income neighborhoods were not cost-effective. Because of the large number of lower-middle income neighborhoods within the county, it was important to identify procedures that would increase participation.

Prompting is often suggested as a means of increasing participation (Hansen, 1975; Milliken, Bryden, & Downing, 1971; U.S. EPA, 1976). Though there have been conflicting reports about the effectiveness of this procedure (Geller et al., 1975; Humphrey, 1978; Jacobs & Bailey, 1982–1983; Luyben & Bailey, 1979; Reid et al., 1976; Witmer & Geller, 1976), its wide use (Cohen, 1978) and low cost make it an important technique to evaluate.

Source separation containers are a second means of encouraging participation (Humphrey, Bord, Hammond, & Mann, 1977). According to this procedure, households are asked to store recyclable material in separate containers as it is discarded. Then, on regularly scheduled recycling days, the presorted material can be taken out for collection. By intervening early in the disposal chain, as waste is being discarded, it may be possible to encourage greater follow-through and increased recycling.

The purpose of this study was to evaluate the effects of these procedures to increase participation in a lower middle income neighborhood.

Method

Participants and Setting

Approximately 350 homes in a lower middle income area began recycling via standard program brochures and regular weekly curbside collection. Following 11 baseline sessions, four groups of 18–20 households each, which exhibited relatively equivalent baseline measures, were randomly assigned to treatments. Each group was situated on an individual street in close proximity to one another. Recycling service continued across the entire neighborhood area throughout the study to maintain a sense of community continuity.

Apparatus

A 64 × 33 × 40 cm green plastic container called a Sears Re-Cyclit, served as the source separation container. Each container had three compartments 16 × 28 × 40 cm that could hold a standard ⅙ bushel kraft paper grocery bag allowing newspaper, aluminum, and trash to be separated as they were discarded. On the appointed recycling day, the bags could be removed from the container and placed outside for collection.

Procedure

Five days before the 12th experimental session, Re-Cyclit containers and instructions were distributed to all households in Container Group 1 along with a handbill reminding participants of their weekly recycling day. This package was personally presented to a member of the household if anyone was home at the time of distribution; otherwise the package was left by the front door. To evaluate the effectiveness of prompting alone, the same handbills were distributed to Prompt Group 1 at the same time according to the same personalized presentation procedure.

Prior to the 23rd session, twice weekly prompting was initiated in both Container Group 1 and Prompt Group 1 for a 5-week period by placing handbills in the door of each house both 5 days and 1 day before each recycling session. Four different handbills were used. One handbill that listed the weekly recycling day and explained how to participate was distributed at each prompting session. Three other handbills that addressed environmental and economic issues were distributed on a rotating basis along with the other flier.

Follow-up data were collected for 14 weeks after the end of the intensive prompting campaign. Households retained their Re-Cyclits for the remainder of the study.

The same prompting and prompting-plus-container distribution procedures were implemented across two additional treatment groups in a multiple-baseline design. Container Group 2 received Re-Cyclit containers and prompts prior to the 17th session, at the same time that Prompt Group 2 received the initial prompt. The intensive twice weekly prompting campaign began prior to the 27th session for both groups and remained in effect for a total of 5 weeks. The investigation was terminated across all four groups following 41 weekly sessions.

These combined procedures resulted in a hybrid experimental design consisting of (1) an additive (ABCB) multiple baseline across container groups 1 and 2 for the evaluation of containers and multiple prompting; (b) an additive (ABCA) multiple baseline across prompt groups 1 and 2 for the evaluation of single vs. multiple prompting; and (c) two between-group comparisons of containers and prompts vs. prompting only (Container Group 1 vs. Prompt Group 1 and Container Group 2 vs. Prompt Group 2).

Results

Distribution of the containers to homes in both container groups resulted in marked increases in weekly participation that gradually declined over time (Figure 6). No similar increases in participation were noted among the prompt groups. Implementation of the twice weekly prompting procedure increased weekly levels of participation in the two container groups above previously observed levels, but had a negligible effect on the prompt groups. Termination of the intensive prompting procedure resulted in a return to post-container levels in both container groups and had no major immediate effects in either prompt group

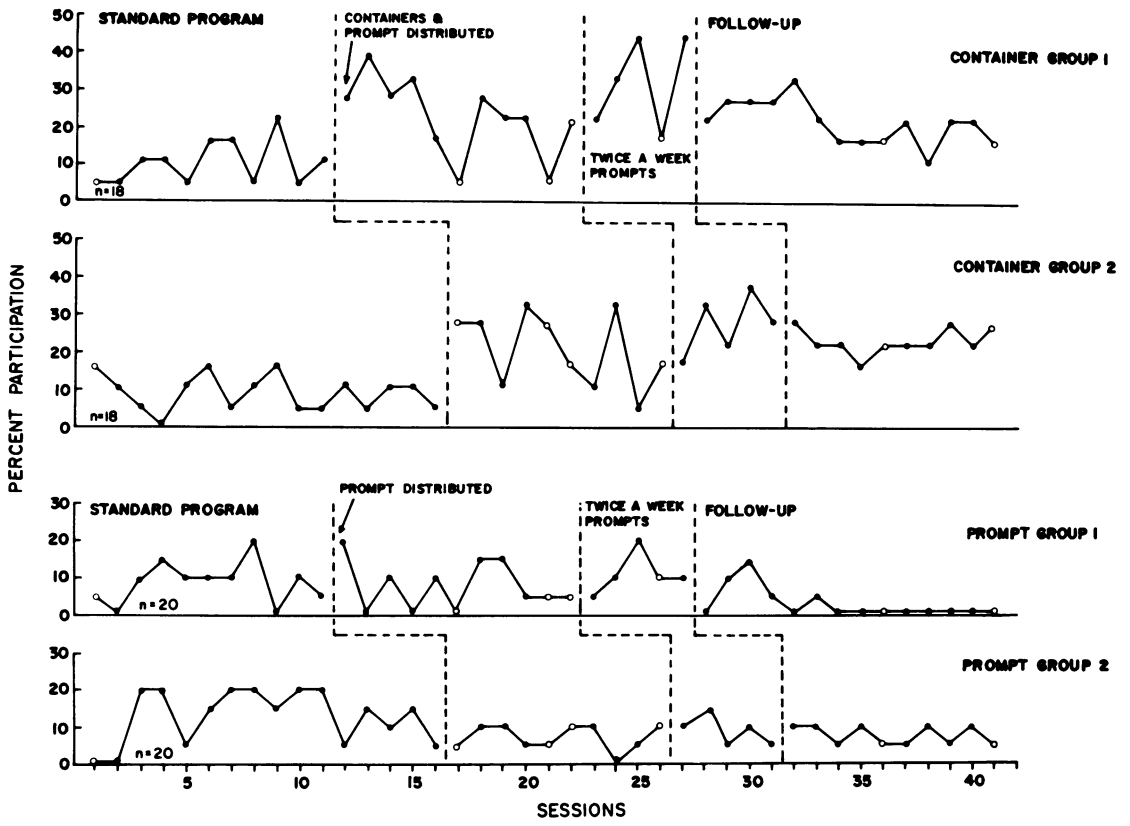

Figure 6. Percentage of households recycling weekly as a function of treatment conditions. The independent variables for Container Group I and Prompt Group I were introduced on the same time schedules. A similar procedure was followed by Container Group 2 and Prompt Group 2. Open circles denote days of inclement weather.

although participation declined to zero in Prompt Group 1 near the end of the investigation.

The treatment components also increased the percentage of new households beginning to recycle. Distribution of containers was followed by the initiation of recycling among 26% and 17% of the households in Container Groups 1 and 2, respectively. This compared to an increase of 10% and 5% in Prompt Groups 1 and 2 during the same period. New household participation further increased by 12% and 4% in Container Groups 1 and 2 after the twice weekly prompting program began whereas no increases were noted in either prompt group.

Cost-Benefit Analysis

Developing an accurate cost-benefit analysis depended on an equitable amortization of component costs. Although the containers were used for 25 to 30 weeks in the study, each container was designed for at least 6 years usage based on the product warranty. Each container was therefore depreciated over a 6-year interval, resulting in a cost of 1.93¢ per household per week. Costs and revenues associated with specific treatment components (baseline, container distribution/prompt, twice weekly prompting, and follow-up) were computed separately and summarized for the time that they were used. Costs for materials or activities used across the study, such as beginning recycling service and weekly collection, were distributed over the entire course of the study.

Table 2 provides a detailed summary of individual weekly costs and revenues as a function of

Table 2
Weekly Cost (in Cents) per Household per Treatment Component: Experiment 4

Line item	Container group			Prompt group		
	Cost	Revenue	Profit/deficit	Cost	Revenue	Profit/deficit
			Baseline			
Collection	3.32			3.32		
Brochures	0.43			0.43		
Total	3.75	2.62	−1.13	3.75	3.27	−0.48
			Container/prompt distribution			
Collection	3.32			3.32		
Brochures	0.43			0.43		
Prompt	0.10			0.10		
Materials distribution	0.46			0.41		
Container	1.93					
Total	6.24	7.11	.87	4.26	2.12	−2.14
			Twice weekly prompting program			
Collection	3.32			3.32		
Brochure	0.43			0.43		
Prompts	2.00			2.00		
Distribution	8.56			8.56		
Container	1.93					
Container distribution	0.46					
Total	16.70	6.45	−10.25	14.31	2.12	−12.19
			Follow-up			
Collection	3.32			3.32		
Brochure	0.43			0.43		
Container	1.93					
Container distribution	0.46					
Total	6.14	4.98	−1.16	3.75	1.37	−2.38

treatment conditions. The variance in revenues noted across the analysis reflects changes in the composition and quantity of material collected during each treatment period.

Both container groups operated on a cost-effective basis immediately following the distribution of the containers, although the downward trend noted over time questions the longevity of this self-sufficient status. Though the highest levels of weekly participation for the container groups occurred during the twice weekly prompting, the corresponding increase in participation and material was not sufficient to offset the higher costs of this procedure. Terminating the twice weekly prompting resulted in similar levels of participation to the period following container distribution but lower revenues due to a decline in the amount of paper collected per household in Container Group 1. It is possible that the follow-up period would have been cost-effective if the paper level had not declined.

The prompt groups were not cost-effective throughout the program. These groups lost the least money during baseline whereas the largest deficits occurred during the follow-up period.

Discussion

The fact that prompting was only effective when combined with the source separation containers indicates the importance of considering the synergistic effects among independent variables (Fuller, 1979). The combined effects of the two procedures

could not have been estimated from their individual results alone.

Informal comments from participants indicated that the containers provided a convenient place to store recyclables and served as an effective prompt. As shown in an earlier investigation (Jacobs & Bailey, 1978), most of the containers, because of their size and appearance, were kept in carports instead of in kitchens. A more attractive container amenable to in-house use may have fostered higher levels of participation.

Although the intensive prompting procedure produced the highest levels of participation, it was not cost-effective. The separation container alone appeared to be the most cost-effective procedure, but some supplementary assistance may be required to maintain long-term participation. One alternative would be to collect containers from nonparticipating households and redistribute them where they would be used, thereby reducing the cost per household by concentrating only on participating families.

It is possible that some neighborhoods will never be economically self-sufficient. In these cases it will be necessary to ensure that the income from profitable areas covers deficits from less productive neighborhoods, or that less costly methods of collection are used in marginal areas. This might be accomplished by combining recycling and garbage collections on one truck and route, or using neighborhood drop-off points instead of curbside service. In this study, we demonstrated that it was possible to increase participation in marginal areas through program modification. The specific procedures to use can be determined through careful analysis of resident participation.

EXPERIMENT 5

Effects of Combined Program Variables

In earlier studies it was noted that participation was affected by many programmatic and neighborhood variables. In Experiments 1, 2, and 3, we investigated the differential effects of individual program components and in Experiment 4 we demonstrated the importance of evaluating combined procedures. In this experiment, we evaluated the combined long-term effects of program variables that had previously increased residential participation. In addition, public posting was added to the treatment package based on the findings of Seaver and Patterson (1976) that this procedure facilitated energy conservation and ecological behaviors.

Method

Participants and Setting

Participants were selected from a 250-home area of middle to upper middle income households. All homes were notified of the start of weekly recycling service via standard program procedures. Prior to the eighth session, two streets of homes were selected based on their relative equivalence in weekly and cumulative levels of participation and upper middle income levels. One group ($n = 20$) was randomly assigned to receive the treatment package, and the remaining group ($n = 14$) served as a control.

Procedure

Prior to the eighth session, each home in the treatment group personally received a package consisting of: (a) a Re-Cyclit container with instructions; (b) inclusion in a 5-week, twice weekly prompting program similar to Experiment 4; and (c) a letter explaining that homes that participated in the program would have a 6.4 cm × 8.94 cm sticker placed on their mail box indicating their support of the program. The sticker featured a tree with the words "WE RECYCLE," and was placed on the participating home's mail box by program staff the first time they recycled. The study was concluded after 27 weekly sessions.

Results

Weekly participation averaged 20% to 25% for each group during baseline (Figure 7). The experimental package doubled weekly participation to approximately 50% in the treatment group even after the intensive prompting procedure was discontinued, whereas weekly participation in the control group continued at baseline levels.

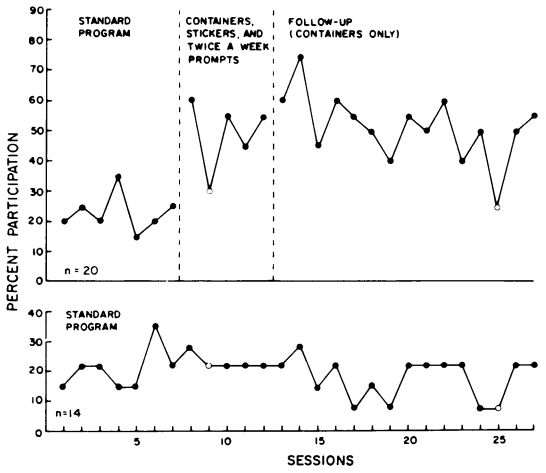

Figure 7. Percentage of households recycling weekly as a function of treatment conditions. Open circles denote days of inclement weather.

Approximately 50% of the households in each group recycled at least once during the first seven baseline sessions. An additional 40% of the homes in the treatment group that had not previously recycled began participating over the next five sessions when the experimental package was introduced whereas there was no increase in the control group. At the conclusion of the study, 90% of all homes in the experimental group and 50% of the homes in the control group had participated at least once during the 6-month program period.

Cost-Benefit Analysis

As noted in Table 3, both groups were economically self-sufficient during baseline. The higher revenues in the treatment group were due to more material collected per pickup, compared to the control group during the same period of time.

Implementation of the experimental program in the treatment group resulted in a small increase in the weekly net profit per household over the baseline period. Though more material was collected following program implementation the cost of the treatment package offset profits from the increased revenues. Weekly profits in the treatment group further increased during follow-up due to a continued high participation rate without the continuing cost of the intensive prompting program. Control group profits also increased slightly during the same period, due to more material being collected per pickup and not to increased levels of participation.

Another way to judge cost-effectiveness was to determine how long it would take to pay back the cost of the treatment package, based on weekly revenues. The total package price of $6.97 per household was derived by summing all costs specifically associated with the treatment (Table 1). Weekly collection costs were not included because these were ongoing costs exclusive of the treatment package and would continue after the package was paid off. This cost (3.32¢) was deducted from weekly household revenues (18.18¢), resulting in an adjusted weekly revenue of 14.86¢. Results indicated that it would require approximately 47 weeks at this adjusted revenue to amortize the $6.97 invested in each household. Accrued revenues following the payoff period would then be available for other program modifications or to cover deficits incurred by less successful neighborhoods.

Discussion

One limitation of this study was that the treatment package was not deployed to the second group for replication. This was considered a trade-off between the issues of replication and maintaining a long-term control group for comparative purposes. Because follow-up was a primary goal of the study it was necessary to maintain an ambient measure of the effects of community variables not under experimental control (i.e., weather, newspaper delivery disruptions, scavenging) through a control group. With the exception of the public posting procedure, each of the treatment components had been previously evaluated. In this sense this study was considered a cumulative replication of earlier investigations. Had there been sufficient time, it would have been desirable to replicate this program with more neighborhoods.

From an economic standpoint, this study was already successful during baseline because revenues exceeded costs in both groups. Implementing the experimental package further increased the amount

Table 3
Cost Benefit Analysis: Experiment 5

Costs		Revenues		Profit/ deficit
		Baseline period weekly revenues and costs (in cents)		
		Control group		
Weekly collection	3.32	1.08 lb newspaper @ 2.5¢/lb	2.70	
Program brochure (based on total cost of 17.66 distributed over the 28-week investigation)	0.63	0.13 lb aluminum @ 20¢/lb	2.60	
Total	3.95		5.30	1.35
		Treatment group		
Weekly collection	3.32	2.11 lb newspaper @ 2.5¢/lb	5.28	
Program brochure	0.63	0.15 lb aluminum @ 20¢/lb	3.00	
Total	3.95		8.28	4.33
		Intensive treatment weekly revenues and costs (in cents)		
		Control group		
Weekly collection	3.32	1.25 lb newspaper @ 2.5¢/lb	3.13	
Program brochure	0.63	0.16 lb aluminum @ 20¢/lb	3.20	
Total	3.95		6.33	2.38
		Treatment group		
Container	1.93	4.86 lb newspaper @ 2.5¢/lb	12.15	
Brochure	0.63	0.17 lb aluminum @ 20¢/lb	3.40	
Twice weekly prompting	2.64			
"We Recycle" sticker	0.22			
Sticker distribution	0.21			
Container distribution and instructions	0.86			
Collection	3.32			
Total	9.81		15.55	5.74
		Follow-up period weekly revenues and costs (in cents)		
		Control group		
Collection	3.32	1.36 lb newspaper @ 2.5¢/lb	3.4	
Brochure	0.63	0.22 lb aluminum @ 20¢/lb	4.4	
Total	3.95		7.8	3.85
		Treatment group		
Collection	3.32	4.58 lb newspaper @ 2.5¢/lb	11.45	
Brochure	0.63			
Container	1.93	0.35 lb aluminum @ 20¢/lb	7.00	
Container distribution and instructions	0.86			
Total	6.74		18.45	11.71

of material collected and the profit per household in the treatment group. Ironically, though it was difficult to bring the lower middle income neighborhood of Experiment 4 up to a cost-effective level, it was relatively easy to increase the revenues of an already profitable area. This may further substantiate the relevance of neighborhood economic levels in determining the likelihood of program participation and that more profitable areas may be required to underwrite the losses from marginal areas in a large-scale program.

GENERAL DISCUSSION

This investigation conceptualized and evaluated a municipal program under a systematic framework. By dissecting the overall recycling program into a series of subsystems it was possible to monitor and modify the program, effecting increases in participation within specific studies as great as 300%.

Successive phases of program development were related to the results of preceding investigations. This began with the evaluation of basic program sub-systems such as publicity and collection strategies, followed by analyses of procedures designed to increase participation, and culminated with a program composed of previously identified effective components. Ultimately, the final step of program development, systematic dissemination of the treatment package to the entire community, was not completed due to the end of the pilot program cycle. Based on our results, however, the county adopted a larger recycling program which was turned over to a private company. Three years later, three private firms continue to offer recycling service in the Leon County area.

Perhaps one of the most important findings was that relatively minor program differences affected rates of participation and collection. Communities beginning resource recovery programs may need more than general information if differences in each community determine the ultimate design of the recycling program. By teaching communities how to use basic behavioral evaluation procedures they may be able to develop programs that are better articulated to their specific needs. This approach would also allow municipalities the option of improving other programs through similar evaluation procedures.

The cost of each treatment was just as important as overall levels of participation. As demonstrated in Experiment 4, the program that facilitated the highest participation was not cost-effective and unlikely to be adopted at the municipal level. Actual costs and revenues are likely to vary across communities as a function of prevailing disposal costs and the strength of regional recycling markets (U.S. EPA, 1976). Indirect benefits such as energy savings, decreased pollution, and natural resource conservation are also important to consider and may make the ultimate analysis of program success dependent on how much material can be efficiently recycled, instead of ultimate profit. This is a decision best left to each community. Finally, the political impact of the program may be one of the most important variables to assess. In past program evaluation research it has been demonstrated that convincing empirical effects are often rejected for less articulated community perceptions or special interests (Campbell, 1971; Shaver & Staines, 1971; Stolz, 1981; Weiss, 1973). For example, the Assistant County Attorney prohibited the use of incentives in this program on grounds that they would violate state law and ethical standards! As a result the project evaluated more "programmatic" issues. Similar compromises are also likely to occur in other large scale settings.

The degree of experimental control provided in a setting is also important to consider. Essentially the researcher faces a trade-off between the constraints of the community environment and the demands for experimental rigor. In this investigation this compromise was noted between the county's goal to include as many neighborhoods as possible while maintaining information on individual household participation. As a result, a less stringent measure for paper collection (inches vs. pounds) was used, resulting in less accurate information about this dependent variable. This was deemed an acceptable trade-off because it allowed the program to serve more people without jeop-

ardizing other measures. Variations in paper were also more likely to be related to newspaper size instead of changes in the amount that people recycled because there were no contingencies on the quantity of material recycled or the frequency of participation (Geller et al., 1975; Luyben & Bailey, 1979).

Similar limitations were noted in several of the individual experimental designs. For example, it may have been desirable to have randomly assigned individual homes to treatment groups in Experiment 2, or to have reversed collection days between groups halfway through the study. Neither of these procedures was acceptable to the local sanitation department as they would require massive changes in ongoing services and cause confusion in the community. Similarly, Experiment 1 remained a normative evaluation because it was not possible to manipulate socioeconomic status across neighborhoods. Trade-offs were also required between the number of procedures assessed and the duration of each analysis. As a result, initial studies were designed to evaluate differential effects whereas Experiment 5 evaluated the effectiveness of a package of previously identified components over a longer period of time. Considered as a package of integrated evaluations, many of the limitations of the individual investigations are moderated by the findings of other studies within the project. In this manner the total investigation represented the integrated analysis of an ongoing community system (i.e., systems analysis) and, despite the noted limitations, it provided a stronger controlled analysis of a program of this size, or research in this area than has typically been reported. Subsequent research may be able to systematically address some of the above noted concerns.

Ultimately, the applicability of behavior analysis in the investigation of large-scale community systems is an empirical issue that will be determined as a function of repeated trials. Conceptually the analysis of community systems parallels the functional analysis of other forms of behavior in its methods of observation, measurement, and identification of controlling relations. Operationally, the task of the behavioral psychologist is to adapt this methodology to the special controlling relations of the community and large systems. Functionally, the success of this technology will depend on the degree to which it allows us to control the social systems that subsequently effect our own behavior.

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