MULTI-FAMILY RECYCLING:

A STUDY ON INCREASING PARTICIPATION

AND DECREASING CONTAMINATION

Master's Project
University of Michigan
School of Natural Resources
May 13, 1992

Project Advisor: Dr. Raymond De Young

Graduate Students: Sally Boerschig
Sarah Carney
Anne Dillenbeck
Mark Elster
Susan Horst
Brad Kleiner
Bruce Thomson

ACKNOWLEDGEMENTS

We wish to express our deep appreciation for the support and contributions of numerous people and organizations:

To our advisor, Raymond De Young, for his invaluable assistance and guidance which has made this project a truly useful and educational experience.

To Nancy Stone of the Ann Arbor Department of Solid Waste for her unflagging enthusiasm and attention to detail.

To Tom McMurtrie of the Ann Arbor Department of Solid Waste for his excellent work in coordinating the multi-family recycling program.

To the drivers at Recycle Ann Arbor, without whose generous assistance in data collection we could not have completed this study.

To Rebecca Kanner and the other helpful folks at the Ecology Center of Ann Arbor for their willing contributions of time, effort and expertise with the volunteer recycling coordinators.

To Gary Fowler for his most constructive advice and assistance with our data analysis.

To our families and friends for their constant support and encouragement.

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I. INTRODUCTION

Increasingly visible signs of ecological stress point to a worldwide crisis of maladaptive human behavior. Pollution of our air, soil, and waterways, and over consumption of resources are concerns of international importance. Central to this complex of environmental problems is the production and disposal of solid waste.

In the United States, it is estimated that the amount of solid waste generated annually will reach 216 million tons by the year 2000, almost 4.4 pounds per person per day (U.S. EPA, 1988). This figure, a 10 percent increase over estimated 1988 levels, represents a double-edged problem: valuable resources are lost in the waste stream and options for disposal of this waste are dwindling. While existing landfills are reaching capacity, new landfills are increasingly difficult to site because of stringent environmental regulations and public opposition. The development of other waste management strategies, such as waste-to-energy facilities, faces similar problems.

Excessive consumption and misuse of resources are relatively new phenomena in our national history. This century has included two periods of diligent resource conservation which were both brought about by cost and scarcity: the Depression and World War II. As anyone who lived during these eras will verify, conservation and recycling of waste materials were once national habits. Our nation once lived by an ethic of thrift and frugality.

More recent times have witnessed a need to return to this earlier ethic of frugality and conservation. Fortunately, there has also been a coinciding realization that this ethic need not be synonymous with deprivation; having less does not necessarily make life worse. Recycling has become a feasible means of reducing resource waste and saving landfill space. Support for recycling has grown as government officials, researchers, and concerned citizens recognize that changes in human behavior may help to solve ever more frequently occurring waste management problems.

Despite its endorsement by large numbers of people, recycling is still not commonplace in the United States. Where programs do exist, they are generally focused on weekly or monthly curbside pick-up programs for single-family residences. The provision of convenient recycling opportunities to multi-family dwellings is a relatively recent and rare development. This is true despite the fact that 27% of Americans live in apartments (Wood, 1991).

A. RECYCLING IN ANN ARBOR

Ann Arbor first began recycling with a number of drop-off sites in 1970. The program, which has remained voluntary, is contracted by the City of Ann Arbor with Recycle Ann Arbor, a subsidiary of the non-profit Ecology Center of Ann Arbor. In 1982, Recycle Ann Arbor began to provide the City with monthly curbside service to single-family residences in Ann Arbor. The program was upgraded to weekly service in May of 1991 and has proven highly successful. The City Solid Waste Department estimates participation in the single-family program to be at 60-70%. During the period from July 1990 to June 1991, 31% of the total waste stream was recovered (City of Ann Arbor, 1991). This figure represents the recovery of curbside collected household materials, yard waste, white goods, and drop-off station materials. Single-family residences receive a pair of stackable plastic crates for newspapers and containers and a biannual newsletter published by the City Solid Waste Department. They also receive a notice at the curbside when recyclables are improperly prepared. A great part of the success of the single-family residence program has been attributed to the volunteer coordinator program, through which residents are encouraged in their recycling efforts by a volunteer coordinator from their neighborhood.

A small portion of a $28 million Environmental Bond, passed in April 1990 for the City's solid waste programs, went to expanding Ann Arbor's recycling program to include the 22,000 multi-family dwellings in the city[1]. Waste from multi-family dwellings comprises 29% of the total waste stream for the city, the portion from the City's 20,000 single-family residences is estimated at 42% , and commercial entities make up the remaining waste stream (City of Ann Arbor, 1992). The multi-family dwelling program is being phased in over a one year period that began in April 1991. Although tenant participation is voluntary, it is mandatory for landlords to provide tenants with the opportunity to recycle. This requires that all landlords in Ann Arbor join the City program in order to retain the ability to offer rental properties for lease. In the program, one or more pairs of 105 gallon curbcarts for newspaper and mixed containers are shared by all the residents of each apartment complex. The curbcarts are emptied weekly by Recycle Ann Arbor. The City has set a goal of recovering 28% of the waste from multi-family dwellings by 1995 (City of Ann Arbor, 1990).

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[1]In general this report uses the terms single-family residence program or single-family residences and multi-family dwelling program or multi-family dwellings. Multi-family dwellings include: houses converted into apartments; small garden apartments; large complexes, some comprised of many smaller buildings; and high rise apartment buildings. For the sake of simplicity and familiarity, a multi-family dwelling will be considered the same as an apartment complex, apartment complexes consisting of one or more apartment buildings, and apartment buildings consisting of apartment units.

As multi-family dwelling programs are just now starting up around the country, little is known about what will make these programs successful. Educational and promotional strategies for multi-family dwelling programs are often merely adaptations of strategies used in single-family residence programs, despite significant differences between the two types of living environments and possible differences in demographic characteristics of the residents. A number of constraints exist which make the operation of multi-family dwelling programs more problematic than single-family residence programs. Some logistical difficulties include: the lack of space in and around apartments to store recyclables; the lifestyle of apartment dwellers, who tend to be single, young, and mobile; the high turnover rate of tenants; and the unwillingness of owners and managers to bother with recycling (Benton and Fox, 1990). Low participation rates and contamination of the common collection site are frequent problems (Magnuson, 1990). In Ann Arbor's curbside single-family residence program, drivers of recycling collection vehicles can reject improperly prepared materials or non-recyclables and leave an explanation behind that directly informs the recycler of the problem. In a multi-family dwelling program where users share curbcarts, there is no direct link to the people depositing the materials.

B. PURPOSE OF THE STUDY

Because of problems reported in the handful of multi-family dwelling programs existing around the country, the City of Ann Arbor Solid Waste Department wanted to choose educational strategies with the greatest probability for success. With the assistance of a group of graduate students at the University of Michigan School of Natural Resources, an experiment was designed and implemented along with the City's multi-family dwelling program. The purpose of this study was to assist the City of Ann Arbor in arriving at an educational and informational strategy or combination of strategies that would most successfully increase recycling rates and decrease contamination in the multi-family dwelling recycling program. The goal of the survey aspect of this study was to examine the psychological measures related to recycling, and to examine the ways these measures differ between the pre-test period (prior to the program's initiation) and post-test period. The strategies were chosen based on conservation behavior literature and the experiences of other cities with multi-family dwelling programs. In particular, the City wished to test the effectiveness of the volunteer coordinator program in multi-family dwellings. Although the volunteer coordinators seem to be effective in Ann Arbor's single-family residence program, this strategy has never been rigorously

evaluated. The City was interested in learning if the multi-family dwelling volunteer coordinator program's annual cost of $40,000 - $50,000, including materials (Stone, 1992), would be justified.

II. LITERATURE REVIEW

Much of the research on the psychology of recycling behavior has been conducted on recyclers in single-family residences. The majority of this research has been conducted by behaviorists who emphasize the use of positive reinforcement strategies (Burn, 1991). As Geller (1989a) has argued, punishment and negative reinforcement may be perceived as threats by potential recyclers and may actually bring about behavior contrary to that which is desired, due to psychological reactance (Bem, 1970). Studies using positive reinforcement via incentives (e.g., lotteries, tickets, coupons) have been able to elicit increased recycling behavior quickly and reliably (Diamond and Loewy, 1991; Jacobs and Bailey, 1982-1983) but these changes tend to be short-lived and decline after the incentive is removed (Cook and Berrenberg, 1981; Wang and Katzev, 1990). Stern and Oskamp (1987) found a 10-15% increase in recycling behavior due to positive reinforcement strategies but this number declined after the incentive was removed, illustrating the lack of durability of the treatment. Pardini and Katzev (1983-1984) attribute this decline to the "over justification effect." This is the tendency for external rewards to reduce other forms of motivation because individuals come to believe that the reason they are performing an activity is solely for the extrinsic reward (Lepper and Greene, 1978). When the reward is removed, so is the reason for the behavior. In addition to this effect, incentive programs can be difficult to implement and administer and may not be cost-effective (Jacobs and Bailey, 1982-1983).

Because rewards/extrinsic motivation techniques have been shown to be relatively ineffective motives for recycling (De Young, 1985-1986), and not durable over time, other methods of eliciting increased recycling behavior are called for. The behavior strategies specifically examined in this research were:

- volunteer coordinators (also referred to as block leaders in the literature),
- written commitment,
- specific feedback, and
- general feedback.

A. STATUS OF EXISTING MULTI-FAMILY DWELLING RECYCLING PROGRAMS

A small number of cities have implemented pilot and full-scale multi-family dwelling recycling programs. Clearwater, Florida has used a variety of public education strategies (i.e., presentations, flyers, newsletters, inserts) which have combined to make this aspect of Clearwater's recycling program one of its most successful ventures (Wood, 1991). Melbourne, Florida also plans to use ongoing educational efforts via direct mail and apartment newsletters to increase participation in their program (Zarillo, 1990).

Programs in Prince George's County, Maryland and St. Paul, Minnesota both point toward the usefulness of some form of volunteer coordinator when used in conjunction with other educational techniques. In the Prince George's County program, a residential recycling committee comprised of building residents used "friendly harassment" techniques in combination with wide distribution of procedural information to help improve participation in the program (Hyde, 1990).

St. Paul uses "resident environmentalists" to distribute information and to report and help solve problems. This strategy, in tandem with other educational strategies, has resulted in dramatic improvements (T'Kach and Schoenecker, 1990). The St. Paul program also provided monthly and yearly feedback to building residents and management. They greatly appreciated this feedback and felt it to be a contributing factor to the program's success (T'Kach and Schoenecker, 1990).

While almost all of these multi-family dwelling programs report increased recycling behavior over baseline amounts, there is little statistical evidence gauging the effectiveness of each strategy, either alone or in combination with others. Anecdotal evidence from trade journal articles seems to suggest that volunteer coordinators, usually in the form of an on-site manager, work well (Benton and Fox, 1990; Hyde, 1991). Feedback also seems to be effective (ANJEC, 1988; Rhode Island Department of Environmental Management, [no date given]; Hyde, 1991). It bears repeating that the studies mentioned here provide anecdotal evidence for the effectiveness of the various strategies. This current study of the Ann Arbor multi-family dwelling recycling program is unique because the strategies were systematically investigated. An experimental research design was employed with strategies being applied to the multi-family dwelling program under strict controls and the results subjected to statistical analyses (see chapter III and IV).

B. VOLUNTEER COORDINATORS

Volunteer coordinators have been viewed as playing three equally important roles in recycling programs: 1) setting a norm or modeling desired social behavior; 2) acting as a prompt or a reminder to recycle; and, 3) serving as a source of information on correct recycling techniques. Humans want to be perceived as fitting into the group, tribe, neighborhood, or whatever level of social aggregate to which they belong. Actions seen as being socially "wrong" can lead to a sense of embarrassment or even humiliation and can make individuals reticent to participate in future socially desirable behaviors. Volunteer coordinators can be artificially introduced into existing social networks in order to take an active role in illustrating and creating recycling norms and behaviors (Hopper and Nielsen, 1991). Burn (1991) proposes that volunteer coordinators make recycling behavior salient and highlight a social norm. Hopper and Nielsen (1991) looked at recycling as altruistic behavior and felt that if altruistic behavior is normative behavior and norms emerge out of social interactions, then volunteer coordinators may initiate a social process beyond simple levels of interpersonal contact to tap the means by which norms are shaped. Cook and Berrenberg (1981) view this type of intervention as a "social incentive" to recycling.

De Young (1988-1989) has shown that many non-recyclers have pro-recycling attitudes but simply do not have enough procedural information to carry out the desired action. In the volunteer coordinator approach, individuals who are in a capacity to disseminate information to their neighbors on recycling behavior are recruited to serve as a face-to-face contact (Nielsen and Ellington, 1983). Burn (1991) also points out that volunteer coordinators serve an important role in providing information about how to correctly participate in the desired behavior and about the consequences of the behavior. They may also serve as prompts to participate in the desired behavior. Local sources of information may be more familiar and hence more believable to an individual. Therefore, individuals may be more likely to adopt the behavior of the volunteer coordinators. This phenomena, known as attribution, is a tool that can be used to cognitively simplify a complex environment (Miller, 1985).

Although there has been considerable research in settings that employ volunteer coordinators, Burn (1991) nonetheless feels that a volunteer coordinator strategy can be described as a "black box." He argues that these studies involve situations where the observed effect may be caused by a variety of unknown or unmeasured causes. Because volunteer coordinators may be causing an observed effect due to an interaction with an unknown variable, this study sought to control the influence of the volunteer coordinator in order to

determine which strategies may be actually producing the improved recycling behavior and if there is any interaction between the strategies.

C. COMMITMENT

Commitment has been shown to be an effective means of eliciting recycling behavior. A commitment, usually phrased as agreeing to participate in a recycling program for a fixed period of time, may be requested in a written or verbal format. Pardini and Katzev (1983-1984) showed that recycling behavior is increased via commitment, as did Burn and Oskamp (1986). Commitment may work because of the individual's desire to be consistent. Public commitment to a course of action may cause an individual to feel inconsistency or dissonance if they do not follow through. Individuals may act to reduce dissonance by performing the action to which they have committed (Zimbardo and Ebbesen, 1969). In addition, inconsistency is viewed as a socially undesirable trait and may motivate individuals to act to reduce it (Cialdini et al., 1990). Geller (1989b) felt that commitment works because it has the potential to elicit some personal reason to participate, which may include intrinsic motivation, which, in turn, is more likely to cause the desired behavior to continue after the commitment period is over. This is illustrated in Katzev and Pardini's 1987-1988 study where they examined recycling behavior for three weeks after the five week commitment period ended. The results showed that commitment strategies produced more lasting changes in behavior than positive incentives such as prizes, tokens or monetary rewards. Wang and Katzev (1990) showed that for four weeks after the commitment period ended, recycling behavior continued at a high rate. Pardini and Katzev (1983-1984) felt that this mild form of external inducement was able to maintain conservation behavior better than strong forms (e.g., penalties, monetary incentives) because the commitment leads to trying the behavior. The theory is that commitment causes the individual to find their own intrinsic motivation and/or reason for recycling, thereby eliminating any over justification effect. Over justification is the tendency for external rewards to reduce all other forms of motivation because individuals come to believe that the reason they are performing an activity is solely for the extrinsic reward. When the reward is removed, so is the reason for the behavior.

D. FEEDBACK

Specific and general feedback both provide evidence of, and information about, the utility and effectiveness of a behavior. This information can also give participants a sense of accomplishment and ownership and the feeling that they are making a difference. Specific feedback gives an individual information on his or her personal behavior and how it may relate to the behavior of other individuals. General feedback gives an individual information on the behavior of the social aggregation that he or she belongs to. Social learning theory (Zimbardo and Ebbesen, 1969) sees most behavior as leading to consequences which feed back to the behavior; if the consequences are positive, the behavior is likely to recur. Making the consequences of their actions salient to recyclers by direct feedback may thus result in a continuation of the behavior.

Cook and Berrenberg (1981) view feedback as providing rewards for actions and motivation for the individual. Feedback provides information on progress, particularly when the conservation behavior involves negative costs (Seligman, et al., 1981). Feedback can fulfill a need for information that may be the crucial difference in influencing recycling behavior (De Young, 1988-1989).

E. ATTITUDES AND OTHER CONSTRUCTS RELATED TO RECYCLING

Attitudes have played a large role in the study of conservation behavior (Thurstone, 1931; Hendee, 1972). Many recycling studies have attempted to gauge attitudes as indicators and/or predictors of recycling behavior (De Young, 1985-1986, 1988-1989, 1990; Vining and Ebrero, 1990). However, most studies have shown only weak correlations between attitude and behavior. While not highly correlated, having pro-recycling attitudes does increase the likelihood of eliciting the desired conservation behavior (McGuiness, et al., 1977). Weigel and Newman (1976) found evidence that environmental attitudes can predict broad patterns of environmentally desirable behaviors.

Despite what would seem to be a commonsense assumption that behavior can be predicted from attitudes, in general psychological research has been unable to establish a causal link between attitude and behavior (see Fishbein, 1967 for a review). Rokeach (1968) defines an attitude as an organization of beliefs around an object where the object may be abstract or concrete. He assumes that all attitudes have a behavioral component because the beliefs

underlying the attitude "describe, evaluate, or advocate" predispositions which will lead to a response. An attitude is thus also a "predisposition to respond." Citing the lack of dependence of behavior upon attitude, he notes that behavior is determined by a number of attitudes and situational conditions, and hypothesizes that behavior can be formulated as an interaction between the attitude toward the object and the attitude toward the situational conditions of the behavior. Azjen and Fishbein (1980) state that attitude measures should focus on the attitudes toward the behavior related to the attitude object, not necessarily toward the attitude object itself. Thus, for a better understanding of the motivations underlying the behavior, researchers of recycling behavior and attitudes may want to examine the attitude people hold towards *doing recycling*, and not on recycling itself. Generally speaking, attitudes toward a behavior may be defined as a function of two kinds of beliefs: behavioral beliefs, that is, what an individual believes about the behavior; and normative beliefs, that is, what an individual believes others think about the behavior (Azjen and Fishbein, 1980).

Weigel (1985) suggests that research examine the conditions under which attitudes and behavior interact. Other variables may function to counteract and obscure the impact of attitudes and behavior, including external events as well as an individual's perceptions. Attitude-behavior consistency in an individual may be enhanced by increased familiarity, direct experience, social norms, expectations of public disclosure of the behavior, attitude certainty, and the salience of the attitude (Weigel, 1985).

Weigel and Amsterdam (1976) found that "behavior relevant information is a necessary catalyst for behavior/attitude consistency." In other words, a positive attitude toward a behavior may not result in the behavior unless it is accompanied by a specific procedural knowledge about enacting the behavior. This knowledge is reflected in recycling studies which found that lack of procedural information (not knowing how to recycle) is one reason that people do not recycle (De Young, 1988-1989). Vining and Ebrero (1990) found that the major difference between recyclers and non-recyclers was their level of procedural knowledge.

F. DWELLING SIZE/DENSITY

1. Information Processing Perspective

Humans, as information processors, seek and prefer to be able to make sense out of their environment in a way that requires the least amount of energy and use of directed attention. Humans perform better in environments that are "legible" and can be "made sense of."

Legibility serves as a kind of reassurance, an indication that the information yet to come will be manageable (Kaplan and Kaplan, 1982). One way of achieving this goal is to limit the scale of the environment with which one interacts. If an environment is smaller in scale, it may be more legible, easier to make sense of, and thus more preferred.

Dealing with a non-preferred environment can be stressful (Kaplan and Kaplan, 1982). Such an environment may have too much uncertainty and complexity, and this can drastically limit our ability to predict what will happen next (Kaplan and Kaplan, 1982). Stea (1969) talks about how humans, who have a limited capacity for information storage, manipulation, and retrieval, are stressed by having to interact with a large and complex world. Hence certain simplifications need to take place, such as creating a simplified prototype of one's environment. An example of this strategy are the mental maps of the environment that we create. These prototypes necessarily leave out features of the environment but still contain enough information to allow us to recognize, predict, evaluate and act without all the information being available (Kaplan and Kaplan, 1982). Therefore, from a purely information-processing standpoint, smaller units of aggregation (i.e., small apartment complexes) may allow for easier information processing with regard to recycling and may lead to increased recycling behavior.

2. Social Perspective

Apartment complex size may also be a factor influencing recycling behavior due to the presence or absence of a sense of community, which influences the degree to which an individual feels anonymous and/or involved in a socially desirable behavior. The size and density of a residence and the area surrounding it have been shown to create feelings of anonymity and isolation among occupants. McCarthy and Saegert's 1978 study of hi-rise and low-rise low-income housing projects showed that with an increasing number of social contacts, a resident's interaction capacity may be exceeded, leading to "social overload." (This can also be a type of information overload, hindering human's ability to process information.) This can lead to a decrease in social activity, a greater sense of powerlessness in affecting decisions, and a trend toward lower membership in voluntary clubs and organizations. Wirth (1938) suggested that growth in the size and density of urban centers may lead to structural differentiation (i.e., increases in complexity and heterogeneity). This structural differentiation produces different patterns of social interaction, including greater anonymity in densely populated areas. Freedman (1975) also felt that high density may serve to intensify the effects of social isolation and anonymity.

These conditions can then lead to the creation of norms of non-involvement, or worse, they can destroy norms that usually maintain socially acceptable behavior. Zimbardo (1969) felt that anonymity encouraged vandalism of public and private property and led to an entirely different set of norms controlling behavior in public places. He felt that the individual misses out on participation in social networks which can help foster individual identity and responsiveness to group norms. The huge Pruitt-Igoe public housing complex had to be torn down due to its design which inhibited the creation of the informal networks crucial to coping in such a crowded environment (Yancey, 1971). Sherrod and Cohen (1976) described high density environments as uncontrollable. They lack the "sense of community" which is critical for human beings living together (Denman, 1970). Without this sense of community, there is no sense of social commitment to fellow citizens and this lack will lead to crime, poverty and disorder (Denman, 1970). In a large, heterogeneous situation, an individual can be subjected to deindividuation (Sadalla, 1978), which is characterized by lessened awareness of the self and decreased concern about the evaluations of others. In short, individual behavior and the environment can be viewed in terms of a set of interlocking relationships where social systems are influenced by the physical nature of the built environment (Davis, 1978). Hence, low rates of participation in recycling programs may be caused, in part, by norms of non-involvement and anonymity.

The relationship between size of a community and the level of personal involvement has also been documented in educational settings. Students at smaller schools felt a sense of community and were more satisfied and involved when compared to students at larger schools (Barker and Gump, 1964). These students lived under greater day-to-day attraction, obligation, and external pressure to take part in the various behavior settings of the school than students in large schools. Their responses to questions in the study also reflected more feelings of responsibility. This effect may play itself out in small complexes where increased external pressure to recycle may be exerted on individuals due to the nature of the smaller community.

III. METHODOLOGY

A. GOALS

The goals of this study were as follows:

1. To evaluate the effectiveness of volunteer coordinators, commitment, and feedback, both specific and general, in improving the recycling behavior of program participants.

2. To document the effect that these interventions had upon attitudes and other constructs related to recycling.

B. HYPOTHESES

The initial hypotheses concerning these goals were as follows:

1. Participation of volunteer coordinators, by setting norms for recycling behavior and providing procedural information, will increase the amount recycled and decrease contamination in the multi-family dwelling recycling program.

2. Making a written commitment to participate in recycling will cause residents to increase recycling and decrease contamination in the multi-family dwelling recycling program.

3. General and specific feedback will fulfill a need for information, thereby increasing recycling and decreasing contamination in the multi-family dwelling recycling program.

4. Strategies used in this study would cause pro-recycling attitudes to increase and the perceived barriers to recycling to decrease.

C. THE SETTING

Research was conducted on a sub-group of participants in a new recycling program for multi-family dwellings in the city of Ann Arbor, Michigan. Multi-family dwellings were brought into the program monthly from August 1991 to April 1992.

The program provides convenient collection to multi-family dwellings by providing interior collection containers (10 gallon totes) to each residence. The totes are color coded with 105 gallon curbcarts, usually located close to trash dumpsters. Individuals place their collected recyclables into their totes and then transfer them to the curbcarts at their leisure. The curbcarts are emptied weekly by Recycle Ann Arbor.

The curbcarts are provided in pairs; one holds newspaper and cardboard and the other holds commingled containers, including glass, plastic (milk jugs and plastic laundry bottles only), aluminum and steel cans. Michigan has a ten cent deposit law which captures many beverage containers. Curbcarts are located so that generally, no more than 25 apartment units shared a curbcart.

Although some demographic characteristics of Ann Arbor are given here for comparison with other studies, these characteristics were not considered as variables when program participants were assigned to strategy groups. This choice was made to ensure proper randomization of the sample. The population of Ann Arbor, Michigan in 1990 was 109,592. There are approximately 22,000 apartment units and 20,000 single-family homes in the city. Eighty percent of the population is white, 12% are African-American, 3% are Asian, 5% are other. The median age of the City's residents is 27.3 years, compared with the national median age of 32.9 years. Per capita income in Ann Arbor in 1987 was $14,684; the national per capita income was $11,923. Ninety-one percent of all people living in Ann Arbor have graduated from high school; this figure is the second highest in the state of Michigan. The median number of years of school completed (1980 figures) is 16.4 years, compared to the national median of 12.5 years of schooling (U.S. Census Bureau, 1992).

D. THE SAMPLE

The focus of this study is the recycling behavior of apartment dwellers, and behavior change as seen in the recyclables collected. However, the actual unit of analysis consisted of neither individuals nor apartment complexes, but rather curbcarts, which could be used to measure actual amounts of materials recycled (see subsection F). Hence, apartment complexes

that signed up for the opportunity to recycle in September and October of 1991 (the second and third month of sign-up) had their curbcarts randomly assigned into eight cells representing the different combinations of strategies to be received. A total of 98 apartment complexes were included in the study with 157 newspaper curbcarts and 151 container curbcarts assigned to the eight cells as shown in Table 1.[2]

Table 1.
Distribution of curbcart sample among strategies[3]

Newspaper Curbcarts

	Control	Pledge	Postcard[4]	Newsletter[5]
Volunteer Coordinator	15	20	20	20
No Volunteer Coordinator	21	16	22	23

Container Curbcarts

	Control	Pledge	Postcard	Newsletter
Volunteer Coordinator	15	20	20	19
No Volunteer Coordinator	21	16	22	18

[2]Some complexes were given extra newspaper curbcarts.

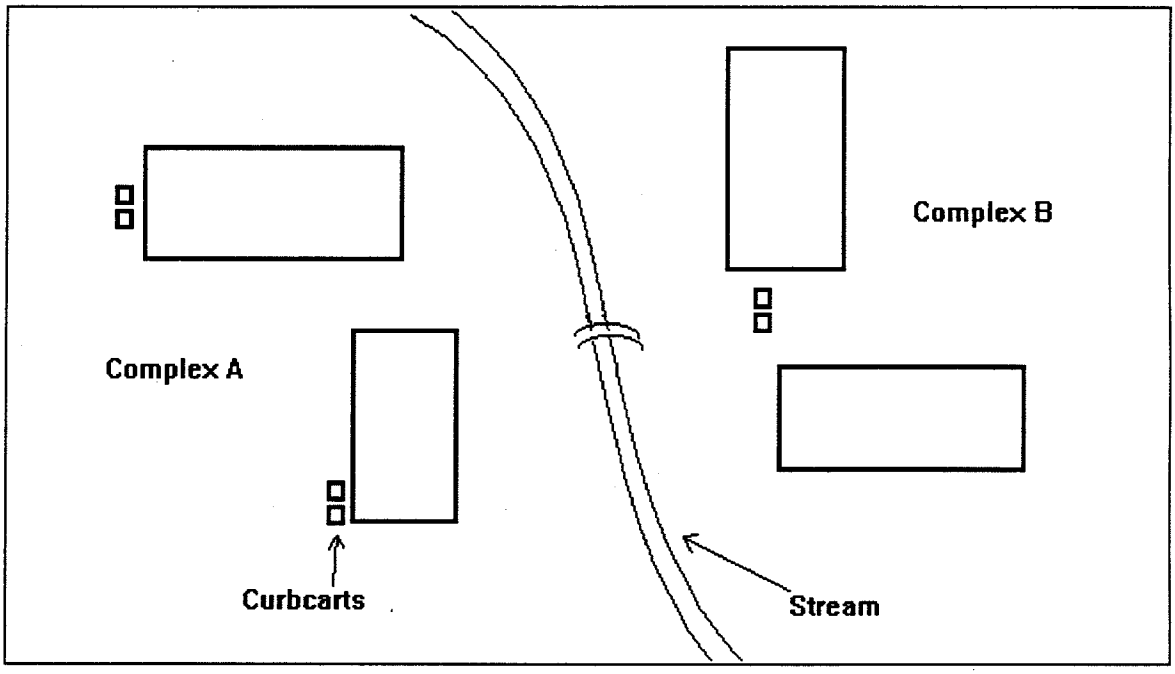
[3]The term "strategy" refers to any of the interventions (i.e., volunteer coordinator, pledge, postcard or newletter) or a combination of the interventions. The term "treatment" (used later in this document) does not include the volunteer coordinator intervention and refers only to the pledge, postcard and newsletter interventions.

[4]Postcards were sent to provide specific feedback.

[5]Newsletters were sent to provide general feedback.

In most cases, larger complexes with more than one set of curbcarts had all of their curbcarts placed in one cell. This was done to avoid a situation where residents of the same apartment complex might receive strategies different from their neighbors and become aware that they were being tested, thus threatening the internal validity of this study. However, some very large complexes had so many curbcarts that they might have overloaded a cell, leading to a situation where one apartment complex might skew the data specific to a particular combination of strategies. These very large complexes were divided into "Complex A" and "Complex B" by whatever existing natural or built barrier seemed to best inhibit interaction between any one area of a complex and another (see Figure A). The divided sections of the complex were treated as two complexes and randomized as in all other cases.

Figure A.
Division of a large complex by a natural barrier



E. APARTMENT COMPLEX SIZE

Apartment complexes varied greatly in size. The sample included many types of multi-family dwellings, including houses converted into small apartments, small and medium garden apartments, large complexes (some comprised of many smaller individual buildings) and high-rise apartment buildings. The apartment complexes were divided into four size categories as shown in Table 2.

Table 2.
Complex size categories

Size	Number of Apartment Units
Small	10 or less
Medium	11-30
Large	31 - 99
Very large	100 or more

F. MEASURES

Recycling behavior of residents was quantified by measuring amounts of material recycled and by assigning ordinal values to the level of contamination found in recyclables. Since the recycling program collects newspaper and containers separately, four measurement variables were created -- newspaper weight, container weight, contamination of newspaper, and contamination of containers. Data corresponding to the four measurement variables were collected weekly by the Recycle Ann Arbor drivers on their collection routes. Drivers made direct observations of curbcarts[6] located in apartment complexes that were part of the study.

[6] These curbcarts were flagged on the outside. This was noticeable and some participants asked about it. Participants who asked were told that it was an aid for internal quality control.

1. Amount of Material Recycled

The drivers measured the volume of newspapers and containers in each curbcart with the aid of 39 inch long adhesive measuring tapes that had been placed inside each of the curbcarts (see Appendix A). Inch intervals were marked in bold numbers, and drivers were asked to record the first number that they could see above the recyclables. This method of measurement was pre-tested and then carefully explained to all of the drivers to ensure consistent measurements. The data collection form was designed with driver input (see Appendix A). Volume readings were converted to pounds for ease of comparison with other studies. The conversion assumed: a 105 gallon curbcart = .52 cubic yards; 220 pounds of containers per cubic yard; and 500 pounds of newspapers per cubic yard (Apotheker, 1991).

The final unit of measure, pounds per unit per week, was calculated by dividing the weight of the curbcart each week by the total number of apartment units using that curbcart. In some large complexes, it was impossible to tell how many units used each curbcart because of the layout of the buildings or the location of the curbcarts for that complex. In this situation, the weights of all of the curbcarts were added and then divided by the total number of units designated to all of the curbcarts.

2. Level of Contamination

To facilitate the separation of commingled recyclables after collection, drivers routinely removed as much contamination from curbcarts as possible before loading material into the trucks. The drivers were asked to rank the level of contamination found in each curbcart by estimating the amount of time it took them to remove the contamination. The scale used is shown in Table 3.

Table 3.
Definition of contamination level

Contamination Level	Time Needed to Decontaminate
0 -- perfect	0 seconds
1 -- a little extra work	30 seconds - 1 minute
2 -- average amount of extra work	1 - 2 minutes
3 -- lots of extra time	2 - 5 minutes
4 -- unacceptable for whatever reason	-- --

Drivers were also asked to record the *types* of contamination found in curbcarts. This was done with the aid of a coding system that the drivers were accustomed to using in the single-family residence program (see Appendix A). Although information concerning types of contamination was gathered for all curbcarts in the study, it was only used in two of the strategies. It was directly used to create specific feedback (postcards) and indirectly used for general feedback (newsletters). The type of contamination was not factored into any of the measurement variables nor was it separately analyzed.

G. STRATEGIES

1. Matrix of Intervention Strategies

Figure B shows the experimental design used for both the curbcart data and the survey analysis. This design allows one to test the interactive effects of the volunteer coordinator with the other treatments -- pledge, postcard, and newsletter.

Figure B.
Matrix of strategies -- experimental design

	Control	Pledge	Postcard	Newsletter
Volunteer Coordinator	Cell 1	Cell 3	Cell 5	Cell 7
No Volunteer Coordinator	Cell 2	Cell 4	Cell 6	Cell 8

2. Volunteer Coordinator

Ann Arbor has been using volunteer coordinators to encourage recycling in single-family homes for the last 10 years and was interested in knowing whether volunteer coordinators would help increase recycling and/or reduce contamination in the multi-family dwelling program. The units using the curbcarts assigned to the top row of Figure B (Cells 1, 3, 5 and 7) were serviced by a volunteer coordinator. The units using the curbcarts assigned to the lower row (Cells 2, 4, 6 and 8) had no volunteer coordinator. The left most column (Cells 1 and 2) allowed for testing the effectiveness of the volunteer coordinator in isolation as no other strategy was involved. The other three columns (Cells 3 and 4; 5 and 6; and 7 and 8) allowed for testing the effectiveness of each strategy alone and in combination with the volunteer coordinators. The bottom row also allowed for testing the unique effectiveness of the pledge, postcard and newsletter (Cells 4, 6 and 8) by individually comparing them with Cell 2.

On the premise that the volunteer coordinator program for single-family residences is successful, a volunteer coordinator program was designed for multi-family dwellings, mimicking the former as closely as possible. The guidelines for recruiting volunteer coordinators were: someone who lived in the building for which they were responsible; someone who was not part of the building's management; and, no more than 20 individual apartments per volunteer coordinator.

Volunteer coordinators were recruited through flyers posted in apartment buildings, through connections with the single-family block coordinator program, and through door-to-door contact. Most were recruited by this latter method. It was explained that coordinators

would be asked to pass out information in their building three to four times per year and that the entire commitment would be for approximately ten hours per year. Spending more than this amount of time and being more involved was encouraged but not required. A total of 120 volunteer coordinators were recruited to assist the residents who used the 75 newspaper curbcarts and the 74 container curbcarts in this part of the study.

The volunteer coordinators were asked to pass out brochures and make personal contacts with neighbors within the first weeks of their volunteering. Volunteer coordinators in cell 3 (combined strategies of volunteer coordinator and pledge, see Figure B) received packets containing enough pledges to solicit written commitments from residents of units which the former had agreed to serve. During the holiday season, a flyer was sent concerning holiday waste, with a request that they post it in their building. Refer to Appendix B to see copies of the items sent to volunteer coordinators and distributed to residents.

During recruitment, many people were enthusiastic about recycling but reluctant to take on the responsibility of being the volunteer coordinator. People did want to discuss the recycling program and voice their complaints (e.g., they did not receive the necessary procedural information, the totes did not fit in their limited space).

3. Control

A control was maintained for both the volunteer coordinator and non-volunteer coordinator groups (cells 1 and 2 in Figure B). The control received the baseline educational material that the city sent to all multi-family dwellings over the months of the study. This included procedural information provided with the totes, graphically displayed procedural information inside the curbcarts, a promotional brochure in the mail (or from their volunteer coordinator if in Cell 1), and the City's semi-annual newsletter on recycling called *The Waste Watcher*. Along with this information, the control and all participants may have received information about recycling in newspapers, television, magazines, the radio, from their children, or other sources. See Appendix C for examples of the information sent to everyone in the multi-family dwelling recycling program.

4. Commitment - Pledge

This strategy is best described as a *written commitment*. The word *pledge* is used to denote the actual document signed by program participants who made written commitments (cells 3 and 4 in Figure B). The pledge was administered by face-to-face contact in which individuals were asked to make a commitment to recycle for a period of two months. If they

were unsure about making a commitment, the card was left with them to sign later, if they so desired. If two attempts failed to find residents at home, the pledge was left on the doorknob. The pledge was administered to 528 apartments units using the 36 newspaper curbcarts and 36 container curbcarts in this part of the study. Volunteer coordinators contacted residents (in 238 apartment units) using the 20 newspaper curbcarts and 20 container curbcarts in this part of the study. Those without volunteer coordinators were contacted by the researchers. Volunteer coordinators were sent enough pledges to give one to each apartment unit that they had agreed to serve. Instructions explaining exactly how to implement the pledge were included. Refer to Appendix D to see copies of this information.

The pledge was printed on the top and bottom of the card with a perforation in between. The top of the card was to be kept by the resident making the pledge as a reminder of the commitment and the bottom was to be signed and sent back to the City (postage-paid). The pledge states:

> "As part of the City of Ann Arbor's Opportunity to Recycle, I and my household will participate in the weekly recycling curbcart collection for at least the next two months. We will recycle glass bottles and jars, tin and aluminum cans, plastic milk jugs, plastic #2 detergent bottles, and newspapers; preparing these items according to the directions that the City has provided."

5. Feedback

Two types of feedback were tested: specific and general. Specific feedback is information supplied to each resident in an apartment complex indicating their complex's contribution to the amount of recyclables collected and the level of contamination recorded at the curbcart. General feedback provides similar information to each resident in an apartment complex but gives information on the City's entire multi-family dwelling recycling program. As implemented in this study, these two treatments are parallel except for the fact that the medium used to provide general feedback contained more general information about recycling.

(a.) Specific Feedback - Postcard

Postcards were used to provide specific feedback to apartment complexes (cells 5 and 6 in Figure B). They were mailed first class every two weeks to program participants. The postcards provided cumulative, biweekly averages (written and displayed graphically) of the amount of material recycled in the resident's complex. Information concerning specific contamination problems found in each complex's curbcarts was also included. If no

contamination problems had been found, an encouraging comment was written on the postcard. Printed on the back of each postcard was a graphical representation explaining how to recycle properly. Refer to Appendix E for examples of the postcards.

(b.) General Feedback - Newsletter

Newsletters were used to provide general feedback to apartment complexes (cells 7 and 8 in Figure B). They were mailed first class every two weeks to program participants. Cumulative, biweekly averages (written and displayed graphically) of the amount of material recycled in *the entire multi-family dwelling program* were prominently featured in this one page newsletter, entitled the *Three Minute Recycler*. The newsletter contained feedback on contamination which also pertained to the entire multi-family dwelling program. Feedback on contamination appeared as a separate section highlighting the previous period's most frequently occurring contamination problems. The same graphical instructions as those used on the postcards were also reproduced on the back of each newsletter. Refer to Appendix F for examples of the newsletter. In addition each newsletter included:

- a simple fact about waste generation in the United States or the impacts of recycling, accompanied by a graphic

- a short section dealing with some aspect of recycling of specific interest to apartment dwellers

H. SURVEY

To understand the effects of the strategies on individual attitudes and knowledge about recycling, pre-tested survey instruments were administered prior to and following the intervention period. Most questions used a five-point Likert scale (Oppenheim, 1966), which allows measurement of the direction of response and intensity (Weisberg and Bowen, 1977). It also provided a uniform frame of reference for respondents and made data coding more efficient. A few open-ended questions and "fill in the blank" questions were included in both surveys. Questions were developed using as a guide other surveys of recycling attitudes and knowledge (De Young, 1988-1989; De Young, 1990).

The two page pre-test survey instrument (see Appendix G) consisted of 31 statements about recycling. Participants were offered a range of responses from "strongly agree" to "strongly disagree" on a five-point Likert scale; they were also give the option of responding with "no opinion." Questions were designed to measure the following psychological measures: perceived barriers to recycling, procedural knowledge, social norms, intrinsic motivation, psychological reactance, attitude toward recycling issues, and altruism as a motivation to recycle. Satisfaction variables for various activities were also tested. Demographic measures were included (i.e., occupation, household size and age, length of residence in Ann Arbor, and previous recycling experience).

The post-test survey instrument contained the same items as those used on the pre-test survey (with the exception of the demographic measures) with additional questions testing the delivery of strategies to the individual apartments (see Appendix H). Participants were provided a space to write their complex name or address if they desired. This allowed for analysis by complex size in a latter part of this study.

I. TIMELINE

Figure C illustrates the timeline for the implementation of the strategies and the administration of the surveys used in this study.

Figure C.
Project timeline

	October/91				November/91				December/91				January/92				February/92			
Pre-Test Survey	x																			
Pledge		x																		
Postcard		x			x				x				x							
Newsletter		x			x				x				x							
Vol. Coordinator		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
Data Collection		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x			
Post-Test Survey																				x

IV. RESULTS

A. INTRODUCTION

Data discussed in this section include the pre-test survey, the four curbcart measurements (container weight, container contamination, newspaper weight, and newspaper contamination) and the post-test survey. Unless otherwise indicated, all findings are statistically significant at $p < .05$.

B. PRE-TEST SURVEY RESULTS

On the pre-test survey instrument, participants were asked a series of opinion, satisfaction, and behavior questions that were associated with recycling and conservation behavior. A total of 1140 survey instruments were returned out of the 3585 distributed, for a response rate of 32%. Tables 4-6 show the results of a factor analysis for all opinion, satisfaction and behavior questions. Factor analysis is a statistical test that dimensionalizes the items to reflect how they cluster in the mind of the respondent. The researchers then gave a name to each cluster to describe what we perceived all items in the cluster to have in common. These same factors were used on the post-test survey; the corresponding alphas[7] are given for both the pre-test and the post-test survey.[8]

The 31 opinion questions aggregated as three variables as shown in Table 4 to yield a Perceived Barriers variable, a Need For Information variable, and a Pro-Recycling Attitude variable. A higher mean for the Perceived Barriers indicates a higher degree of problems or barriers associated with recycling. A higher mean for Need For Information indicates a greater desire for information about recycling and its impact on the environment. A higher mean for Pro-Recycling Attitude indicates a more positive attitude toward recycling and waste reduction.

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[7]The alpha is Cronbach's coefficient of internal consistency. It reflects the degree to which a collection of items "hang together."

[8]The factor clusters from the pre-test survey were used for the post-test survey. Cronbach's alpha was calculated to verify the clusters on the post-test survey.

Table 4.

Results of factor analysis for 31 opinion questions[9]

Item	Pre-Test Factor Loading
Pro-Recycling Attitude Scale	
Recycling is a very good idea.	.68
My recycling will make a difference for the environment in the long run.	.67
Recycling makes sense economically.	.61
We urgently need to conserve resources for the future.	.76
Our society would benefit from recycling more.	.82
I feel a strong sense of duty to recycle.	.62
Recycling saves valuable resources.	.74
Recycling is an excellent way of investing in the future.	.79
Everybody who can recycle should do so.	.78
I believe recycling is the right thing to do.	.82
Conserving resources seems like a natural thing to do.	.57
Since I pay taxes I shouldn't have to recycle .	-.49
I want to be part of a community that recycles.	.72
It's definitely worth the trouble to recycle.	.71
I'd like to think our society is learning to recycle more.	.70
I get very good feelings from recycling.	.67
My community can make a big difference by recycling.	.75
Pre-test Cronbach's alpha= 0.95 Post-test Cronbach's alpha= 0.95	
Pre-test mean correlation= 0.54 Post-test mean correlation= 0.52	
Perceived Barriers to Recycling Scale	
Recycling causes messiness around the house.	.56
The requirements about preparing recyclables are very confusing.	.50
I need much more room in my house to store recyclables.	.63
Recycling takes much too much time.	.68
It is very bothersome to separate recyclables from my trash.	.73
I don't see why the City can't separate the trash instead of making us do it.	.50
Pre-test Cronbach's alpha= 0.79 Post-test Cronbach's alpha= 0.81	
Pre-test mean correlation= 0.39 Post-test mean correlation= 0.42	
Desire for More Information	
I'd like to know how much energy recycling saves.	.60
I'd like to know more about the process of recycling.	.65
I wish I knew if my recycling was truly helping the environment.	.50
I would like to know how much I'm recycling each month.	.44
Pre-test Cronbach's alpha= 0.65 Post-test Cronbach's alpha= 0.69	
Pre-test mean correlation= 0.32 Post-test mean correlation= 0.36	

[9]Participants were asked to indicate the extent to which they agree or disagree with a series of statements on a scale of one to five. X=no opinion; 1=strongly disagree....5=strongly agree.

The 15 satisfaction questions aggregated as two variables as shown in Table 5 to yield a Satisfaction From Frugality variable and a Satisfaction From Participation variable. A higher mean for Satisfaction From Frugality indicates a greater degree of satisfaction or enjoyment from activities that are frugal in nature. A higher mean for Satisfaction From Participation indicates a greater degree of satisfaction or enjoyment from participating in activities that have positive consequences.

Table 5.
Results of factor analysis for 15 satisfaction questions[10]

Items	Pre-Test Factor Loading
Satisfaction From Participation[11]	
Helping make sense out of the world.	.67
Doing things that help bring order to this crazy world.	.70
Taking actions which can help change the world.	.72
Influencing how society solves problems.	.72
Finding my place in the natural scheme of things.	.67
Doing things that will matter in the long run.	.57
Pre-test Cronbach's alpha= 0.89	
Pre-test mean correlation= 0.58	
Satisfaction From Frugality	
Keeping something running long past its normal life.	.65
Finding ways to use things over and over.	.74
Repairing rather than throwing things away.	.66
Finding ways of doing things that don't rely on others.	.42
Saving things I may need some day.	.48
Pre-test Cronbach's alpha= 0.80 Post-test Cronbach's alpha= 0.80	
Pre-test mean correlation= 0.45 Post-test mean correlation= 0.44	

The eight self-reported behavior questions aggregated as two variables as shown in Table 6 to yield a Recycling Curbcart Items and Recycling Non-Curbcart Items. Recycling Curbcart Items refers to the self-reported frequency of recycling items which Recycle Ann Arbor picks

[10]Participants were asked to indicate how much satisfaction they received from a list of activities on a scale of one to five. 1=none at all...3=some...5=a very great deal.

[11]These questions were not asked on the post-test survey.

up weekly in the curbcarts.[12] The curbcart items include: plastic milk jugs, #2 plastic laundry detergent bottles, glass containers, metal cans, newsprint, and cardboard. Recycling Non-Curbcart Items refers to the self-reported frequency of recycling items which Recycle Ann Arbor does not currently collect in the curbside recycling collection program. The non-curbcart items include: used motor oil, household batteries, office paper, and computer paper. These self-reported behaviors are different from the pounds per unit per week that will be discussed in the curbcart data analysis. The survey measure of recycling behavior is of the frequency (how *often* one recycled), as compared to an actual amount, (how *much* one recycled) as illustrated by the curbcart data. They also differ in that the researchers cannot be sure that the self-reported behavior on the survey is accurate, whereas the curbcart data was measured by the researchers.

Table 6.
Results of factor analysis for eight self-reported behavior questions[13]

Item	Pre-Test Factor Loading
Recycling Curbcart Items	
Milk jugs	.85
Glass containers	.86
Metal cans	.74
Newsprint	.77
Cardboard	.66
Pre-test Cronbach's alpha= .86	Post-test Cronbach's alpha= .84
Pre-test mean correlation= .55	Post-test mean correlation= .51
Recycling Non-Curbcart Items	
Used motor oil	.78
Household batteries	.44
Office paper/computer paper	.36
Pre-test Cronbach's alpha= .51	Post-test Cronbach's alpha= .60
Pre-test mean correlation= .26	Post-test mean correlation= .34

[12]Prior to the initiation of this study, multi-family dwellings were not serviced by the City with curbcarts. Any recycling done in the multi-family residences had to be done at the resident's initiative by taking the materials to the drop-off center.

[13]Participants were asked to indicate how often they recycle a series of items. X=do not use; 1=not at all...5=always.

In addition to the opinion, satisfaction and behavior questions, the pre-test survey also contained a bank of demographic questions. Table 7 shows the results of these demographic questions.

Table 7.
Demographic data

Residents per household

	Mean	SD
People per household	1.82	0.94
Children per household	0.21	0.59

Employment status

Employment	% responding
Employed	52
Student	35
Retired	6
Homemaker	3
Not Employed	2
Other	1

Length of residence in Ann Arbor

Years	% responding
< 1	17
1 to 2	19
3 to 5	28
6 to 10	13
> 10	23
Other	1

Respondents who had recycled previously 61%

Analyses were run on the seven factors and the demographic variables to contrast the survey respondents among the different strategies. The results show that there were no significant differences among the participants of the different strategies with respect to Need For Information, Satisfaction From Frugality, Satisfaction From Participation, Recycling Non-Curbcart Items, or the demographic variables.

There were significant differences with regard to Recycling Curbcart Items, Perceived Barriers, and Pro-Recycling Attitude, but no discernible pattern emerged. Table 8 shows the significant pair-wise differences among the responses from the different strategies for Recycling Curbcart Items as revealed by the Tukey HSD comparison test.[14] In general, respondents who were to receive the pledge with no volunteer coordinator and the respondents who were to receive a postcard with a volunteer coordinator reported higher recycling rates of milk jugs, glass, cans, and newspaper than selected other strategies. However, these data illustrate no discernible pattern of one strategy being significantly different from all other strategies.

In addition, for Perceived Barriers, respondents who were to receive the newsletter with a volunteer coordinator had significantly lower barriers ($p < .05$) than those respondents who were to receive the postcard with a volunteer coordinator (in Table 8, G > E). Respondents who were to receive the postcard with no volunteer coordinator had significantly higher Pro-Recycling Attitudes ($p < .05$) than respondents who were to receive the newsletter with a volunteer coordinator (in Table 8, F > G). Again, there is no discernible statistical pattern.

[14]The Tukey HSD multiple comparison test compares each cell with every other cell as designated by the grouping variables. In this case, the grouping variables are treatment and volunteer. Thus we have eight cells to compare.

Table 8.
Significant differences on Recycling Curbcart Items from the pre-test survey

	Control	Pledge	Postcard	Newsletter
Volunteer Coordinator	A	C	E	G
No Volunteer Coordinator	B	D	F	H

Tukey HSD comparison results indicating cells scoring significantly higher than other cells at $p < .05$.

D > A	E > A
D > F	E > B
D > G	E > F
D > H	E > G
	E > H

Overall, the pre-test survey data tend to confirm that participants were randomly distributed across the eight strategies. With 1140 (31%) of the participants responding, baseline data revealed no discernible patterns in statistical significance among the eight strategies with respect to attitude, satisfaction, perceived barriers, need for information, or behavior. Appendix G details the grand mean results for individual questions asked on the pre-test survey.

C.-CURBCART DATA RESULTS

This section presents the results of various statistical procedures designed to test this study's hypotheses concerning the effect of various strategies on recycling behavior. Although the data did not support the hypotheses *as stated*, a coherent effect can be seen with a modification of these hypotheses. In general, complex size tended to be the biggest factor in predicting recycling behavior, with desired behavior (i.e., more recycling with less

contamination) corresponding to the smaller complexes. When treatment did have an effect it was in mid-sized complexes and it concerned contamination in container recyclables only.

The average amount recycled by the residents of Ann Arbor's multi-family dwelling program over the sixteen week data collection period was found to be 2.79 pounds of containers per unit per week and 9.15 pounds of newspapers per unit per week. Thus, the total average amount of the waste stream recycled was 11.94 pounds per unit per week. Appendix I compares the amount recycled from the Ann Arbor multi-family dwelling program to amounts recycled in programs of other cities.

T-tests performed on all four measurement variables -- container contamination, newspaper contamination, container weight, and newspaper weight -- to determine the effectiveness of volunteer coordinators revealed no significant differences between the behavior of the participants with volunteer coordinators and those without volunteer coordinators. Since volunteer coordinators did not show a significant difference for any of the four measurement variables, the volunteer coordinator treatment was not considered as a focus for further testing of the behavior data.

Upon initial investigation, use of the pledge strategy appeared to result in significantly better behavior than other strategies or the control on some measurement variables. Table 9 gives the mean scores that showed significant differences between treatment groups revealed by a Tukey HSD multiple comparison test. This test suggests that the pledge was more effective than the control on the container contamination measure ($p < .05$) and on the newspaper weight measure ($p < .05$). The pledge was more effective than the postcard on the container weight measure ($p < .05$) and the newspaper weight measure ($p < .01$). The pledge again appeared more effective than the newsletter on the newspaper weight measure ($p < .07$).

Table 9.
Significant differences among treatments

Treatments	Measurement Variables	Scores	Significance
Pledge / Control	Container Contamination	0.77 / 1.16	($p < .05$)
Pledge / Control	Newspaper Weight	12.37 / 8.28	($p < .05$)
Pledge / Postcard	Container Weight	3.78 / 2.18	($p < .05$)
Pledge / Postcard	Newspaper Weight	12.37 / 7.28	($p < .01$)
Pledge / Newsletter	Newspaper Weight	12.37 / 8.78	($p < .07$)

However, when a two-way analysis of variance (ANOVA) with a covariant was used, with treatment and volunteer coordinator as independent variables and the number of units in each complex as a covariant, much of the difference previously thought to exist between treatments was controlled by the covariant. Table10 shows the results from a two-way analysis of variance with the effects of the treatment and volunteer coordinator controlled by the number of units in each complex. Only the covariant, number of units, proves significant for the measurement variables newspaper weight ($F = 45.49$; $df = 1, 148$; $p < .001$), newspaper contamination ($F = 17.18$; $df = 1, 148$; $p < .001$), and container weight ($F = 24.70$; $df = 1, 142$; $p < .001$). However, for the container contamination variable, the treatment ($F = 3.14$; $df = 3, 142$; $p < .03$) and the interaction between treatment and volunteer coordinator ($F = 2.72$; $df = 3, 142$; $p < .05$) proved significant in addition to the number of units ($F = 10.87$; $df = 1, 142$; $p = .001$). These findings show that the number of units in each complex controls the variance in recycling behavior that previously appeared to exist between groups receiving different treatments.

Table 10.
Results from two-way analysis of variance with a covariant:
Effect of treatment and volunteer coordinator on recycling behavior while controlling for the number of units in each complex

Measurement Variable	Treatment	Volunteer Coordinator	Interaction	Number of Units
Newspaper	df=3, 148	df=1, 148	df=3, 148	df=1, 148
Weight	F=1.55	F=0.06	F=0.38	F=45.49
	n.s.	n.s.	n.s.	$p < .001$
Newspaper	df=3, 148	df=1, 148	df=3, 148	df=1, 148
Contamination	F=0.12	F=0.50	F=1.13	F=17.18
	n.s.	n.s.	n.s.	$p < .001$
Container	df=3, 142	df=1, 142	df=3, 142	df=1, 142
Weight	F=1.41	F=2.19	F=0.30	F=24.70
	n.s.	n.s.	n.s.	$p < .001$
Container	df=3, 142	df=1, 142	df=3, 142	df=1, 142
Contamination	F=3.14	F=0.59	F=2.72	F=10.87
	$p < .03$	n.s.	$p < .05$	p=.001

For further analyses, measurement data was broken into groups that corresponded to the four different complex sizes so that complex size could be used as an independent variable along with the four remaining strategies (volunteer coordinators were not included in this analysis, having been previously discounted as a successful strategy). This allowed further testing of the significance of the number of units in each complex in predicting recycling behavior. The four groups of complex sizes were formed based on the number of units in each complex, with small complexes having up to 10 units, medium complexes having 11 to 30

units, large complexes having 31 to 99 units, and very large complexes having 100 or more units.

Tables 11-14 show the mean scores for pounds per unit per week and mean contamination levels of containers and newspapers grouped by complex size and the four treatments -- control, pledge, postcard, and newsletter. A two-way analysis of variance shows that complex size was a predictor of pounds of recyclables per unit and contamination level of recyclables, with smaller complexes generally doing better. While complex size was significant for newspaper weight, ($F = 24.02$; $df = 3, 141$; $p < .001$; Table 11), it appeared only as a trend for newspaper contamination ($F = 2.51$; $df = 3, 141$; $p < .07$; Table 12). Complex size also predicted container weight ($F = 17.36$; $df = 3, 135$; $p < .001$; Table 13) and container contamination ($F = 3.19$; $df = 3, 135$; $p < .05$; Table 14). Although none of the individual treatment groups were significant predictors of behavior for any of the measurement variables, the interactive effect between complex size and treatment appeared as a trend for container contamination ($F = 1.80$; $df = 9, 135$; $p < .08$; Table 14).

Table 11.
Mean newspaper pounds per unit per week grouped by treatment and complex size

Complex Size	Treatment							
	Control		Pledge		Postcard		Newsletter	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Small	12.51	3.41	18.18	12.92	15.98	5.85	15.17	5.85
Medium	8.09	0.99	8.60	2.31	11.05	2.51	12.28	4.15
Large	6.95	2.77	4.56	2.31	7.18	0.98	8.73	0.30
Very Large	7.03	1.36	6.78	1.24	5.05	2.37	5.27	1.70

Two-way ANOVA Results

	df	F	p<
Complex Size	3, 141	24.02	0.001
Treatment	3, 141	0.39	n.s.
Interaction	9, 141	1.22	n.s.

Table 12.
Mean newspaper contamination levels grouped by treatment and complex size

Complex Size	Treatment							
	Control		Pledge		Postcard		Newsletter	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Small	0.18	0.19	0.21	0.23	0.09	0.09	0.24	0.28
Medium	0.23	0.15	0.31	0.25	0.18	0.06	0.25	0.25
Large	0.44	0.38	0.17	0.20	0.27	0.10	0.21	0.02
Very Large	0.43	0.35	0.29	0.26	0.64	0.80	0.56	0.83

Two-way ANOVA Results

	df	F	p<
Complex Size	3, 141	2.51	0.07
Treatment	3, 141	0.11	n.s.
Interaction	9, 141	0.46	n.s.

Table 13.
Mean container pounds per unit per week grouped by treatment and complex size

Complex Size	Treatment							
	Control		Pledge		Postcard		Newsletter	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Small	4.11	1.87	5.53	3.99	4.57	0.73	5.99	5.15
Medium	2.71	0.09	2.73	0.94	2.69	0.55	3.44	1.51
Large	2.30	0.70	1.21	0.46	2.35	0.66	3.03	0.11
Very Large	1.82	0.42	2.13	0.76	1.59	0.68	1.87	0.40

Two-way ANOVA Results

	df	F	p<
Complex Size	3, 135	17.36	0.001
Treatment	3, 135	0.75	n.s.
Interaction	9, 135	0.56	n.s.

Table 14.

Mean container contamination levels grouped by treatment and complex size

Complex Size	Treatment							
	Control		Pledge		Postcard		Newsletter	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Small	0.73	0.52	0.59	0.46	0.50	0.15	0.91	0.88
Medium	1.21	0.18	0.85	0.56	0.47	0.18	0.74	0.36
Large	1.57	0.62	0.84	0.28	0.92	0.32	0.58	0.03
Very Large	0.96	0.48	1.09	0.42	1.20	0.73	1.01	0.50

Two-way ANOVA Results

	df	F	p<
Complex Size	3, 135	3.19	0.05
Treatment	3, 135	1.67	n.s.
Interaction	9, 135	1.80	0.08

Since the individual treatments did not prove to be significant predictors of behavior when performing a two-way analysis of variance with treatment and complex size as independent variables, the three treatment groups were combined to allow for further analysis of any treatment versus the control. The treatment group in the following analyses represents a combination of the three strategies: pledge, postcard, and newsletter; thus representing the effects of delivering any treatment versus no treatment. This grouping is hereafter referred to as the "combined strategy." The results of these analyses are conveyed in four tables, each table giving means for one of the measurement variables and highlighting the significant findings of a two-way analysis of variance and a Tukey HSD comparison.

Table 15 compares mean pounds of newspapers recycled in the control group with mean pounds in the combined treatment group for each complex size category. A two-way analysis of variance procedure again showed that complex size was a significant predictor of pounds of

newspapers recycled per unit ($F = 16.29$; $df = 3, 149$; $p < .001$) with higher mean weights correlated with smaller complexes. A Tukey HSD comparison of newspaper weight grouped by complex size and combined treatment versus the control confirms that small complexes recycled significantly more. The small control group recycled better than the very large combined treatment group ($p < .01$). The small combined treatment group recycled better than the medium combined treatment, the large control, the large combined treatment, the very large control and the very large combined treatment groups ($P < .001$). The medium combined treatment group recycled better than the very large combined treatment group ($p < .02$).

Table 15.
Newspaper weight means (pounds per unit per week) grouped by complex size: Control versus Combined Treatment

Complex Size	Control		Combined Treatment	
	Mean	SD	Mean	SD
Small	12.51 $_{a*}$	3.41	16.85 $_{b,c,d,e,f}$	10.03
Medium	8.09	0.99	10.17 $_{b,g}$	3.24
Large	6.95 $_{c}$	2.77	6.61 $_{d}$	2.04
Very Large	7.03 $_{e}$	1.36	5.33 $_{a,f,g}$	2.04

Two-way ANOVA results

	df	F	p<
Complex Size	3, 149	16.29	0.001
Combined Treatment	1, 149	0.76	n.s.
Interaction	3, 149	1.95	n.s.

*Tukey HSD comparison results:
Means sharing the same subscript are significantly different at p<: a,g = .02; c,d,e,f = .001.

Table 16 shows mean levels of contamination in newspapers recycled. Testing, however, revealed no significant differences between control and combined treatment groups for any of the complex size categories. This result was not completely unexpected since the preparation of the newspaper recycling stream is relatively simple compared to the container stream. Therefore, there is a low chance that contamination will be present, which in turn results in little variance in the contamination levels for this stream of recyclables.

Table 16.
Newspaper contamination means grouped by complex size: Control versus Combined Treatment

Complex Size	Control		Combined Treatment	
	Mean	SD	Mean	SD
Small	0.18	0.19	0.21	0.23
Medium	0.23	0.15	0.26	0.22
Large	0.44	0.38	0.23	0.13
Very Large	0.43	0.35	0.57	0.77

Two-way ANOVA results

	df	F	p
Complex Size	3, 149	2.08	n.s.
Combined Treatment	1, 149	0.00	n.s.
Interaction	3, 149	0.63	n.s.

Tukey HSD comparison results:
No significant differences.

Table 17 compares the mean pounds of containers recycled by the control group with the mean pounds recycled by the combined treatment group for each complex size category. A two-way analysis of variance again shows that complex size is a significant predictor of pounds of containers recycled ($F = 13.01$; $df = 3, 143$; $p < .001$). Tukey HSD comparison results

confirm that small complexes recycled more containers on a per unit basis. The small control group recycled better than the very large combined treatment group ($p < .05$). The small combined treatment group recycled better than the medium combined treatment, the large control, the large combined treatment, the very large control and the very large combined treatment groups ($p < .001$).

Table 17.
Container weight means (pounds per unit per week) grouped by complex size: Control versus Combined Treatment

Complex Size	Control		Combined Treatment	
	Mean	SD	Mean	SD
Small	4.11 $_{a*}$	1.87	5.51 $_{b,c,d,e,f}$	3.98
Medium	2.71	0.09	2.92 $_{b}$	1.06
Large	2.30 $_{c}$	0.70	2.10 $_{d}$	0.85
Very Large	1.82 $_{e}$	0.42	1.76 $_{a,f}$	0.61

Two-way ANOVA results.

	df	F	p<
Complex Size	3, 143	13.01	0.001
Combined Treatment	1, 143	0.49	n.s.
Interaction	3, 143	0.91	n.s.

*Tukey HSD comparison results:
Means sharing the same subscript are significantly different at p<: a = .05; b,c,d,e,f = .001

Table 18 compares the mean levels of contamination in containers recycled by the control group and by the combined treatment group for each size category. Again, complex size was a significant predictor of container contamination ($F = 3.76$; $df = 3, 143$; $p < .02$). However, unlike the newspaper stream, the container stream includes many more materials which require