A LOGISTIC REGRESSION ANALYSIS OF FACTORS AFFECTING RECYCLING BEHAVIOR IN APARTMENT COMMUNITIES

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Abstract

Apartment communities are beginning to develop recycling programs in response to recycling legislation and market pressures. Most research has examined recycling in the context of single-family housing and has not addressed the unique housing environment of apartment communities. Efforts to develop and implement recycling programs in apartment communities thus far have focused on management issues and directive recycling policies. Limited attention has been directed toward identifying factors which motivate positive recycling behavior.

A stratified sample of 46 apartment communities was surveyed to identify factors affecting recycling behavior and to develop recommendations that will assist property managers in developing effective recycling programs. A logistic regression analysis was used to identify variables that increased the probability of positive recycling behavior among apartment community residents. Recycling knowledge, education, and type of building in which the respondent resided emerged as significant variables affecting recycling behavior. Interestingly, respondent attitude toward the importance of protecting the environment was not a significant factor in this analysis. Also, respondents' gender, age, and length of residence in the apartment and region do not appear to affect positive recycling behavior. Implications of these findings for further research and application to property managers are discussed.

Introduction

Many states have implemented mandatory recycling rates to reduce the volume of the waste stream to landfills. The methods used to meet the targeted recycling rates are typically the responsibility of the local jurisdiction. Initially, mandated recycling goals

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have been relatively low and could usually be met by recycling programs focused on homeowners. As mandatory recycling rates increase over time, however, local governments will have to increase recycling programs for other waste-producing segments of the community.

Waste stream analysis, in some cases, has shown that apartment communities generate more waste per household than does single-family housing, and that a higher percentage of this waste is recyclable (Brachman, Engelbart & Duff, 1993). Consequently, apartment communities may be viewed as an efficient way to increase recycling rates in response to mandated goals, especially in communities where apartments provide a high proportion of the housing.

Property managers of apartment communities are faced with a unique set of problems regarding recycling. (The term property manager is used in this paper to represent both owners who manage their communities and managers who are employed as the owner's agent.) First, property managers have no legal method to require residents to recycle because few, if any, leases have clauses requiring recycling, and because the use of a recycling clause in the lease does not insure compliance. Also, mandatory recycling ordinances apply to the apartment owner, not to the residents. Second, the limited space available in apartments to sort and store recyclables and the lack of convenient drop-off points serve as disincentives (Johnson & Parrott, 1994). Third, most local recycling programs are designed from the perspective of municipal waste collection and do not address the peculiarities of the private or commercial waste collection systems (dumpsters) common to apartment communities. Likewise, property managers may not understand the complexities of developing a recycling program. Fourth, resident participation may be further reduced because apartment dwellers are perceived as having less financial interest in the community's future (Hyde, 1991; Loftus,1991), and they do not directly recognize the contribution of waste management costs to local taxes, since the taxes are imbedded in the rent.

Previous research on recycling has focused on technical and management issues. Technical issues have included: controlling litter, odor, and pests, and meeting fire codes (Magnuson, 1990); and color, size, shape, and location of recycling containers (Gruder-Adams, 1990; T'Kach & Schoenecker, 1990). Management issues have addressed: enforcing and monitoring participation (Gruder-Adams, 1990; Hyde, 1991; Loftus, 1991) and controlling the tendency of residents to use any available container for waste disposal (Gruder-Adams, 1990; Magnuson, 1990). (For a more complete discussion of the technical and management issues, see Parrott & Johnson, 1994).

Education, Knowledge, and Attitudes

Resident education (Gruder-Adams, 1990; Loftus, 1991; Magnuson, 1990), recycling knowledge (Hines, Hungerford & Tomera, 1986; Oskamp, Harrington, Edwards, Sherwood, Okuda, & Swanson, 1991; Parrott & Johnson, 1994), and environmental attitudes (Goldenhar & Connel, 1993; Oskamp et al., 1991; Johnson & Parrott, 1994) have been identified as variables related to environmentally responsible behavior. Pro-environment attitudes have also been found to be related to environmentally respon-

sible behavior (Newhouse, 1990; De Young, 1986; Humphrey, Bord, Hammond & Mann, 1977). Attitudinal variables have included general pro-ecological attitudes, belief in the seriousness of environmental problems, and belief in the effectiveness of recycling, among others (Oskamp et al., 1991). Interestingly, little difference has been found in the pro-environment attitudes of recyclers and non-recyclers (De Young,1989; Diamond & Loewy, 1991; Oskamp et al., 1991; Vining & Ebreo, 1990).

Hines et al. (1986) conducted a meta-analysis of 128 studies completed after 1971, which assessed variables in association with responsible environmental behavior. Their resulting model of Responsible Environmental Behavior suggests that several variables are strongly associated with environmentally responsible behavior. Among the variables identified were: positive environmental attitudes, knowledge of issues, and knowledge of action strategies. These findings are consistent with the work of Newhouse (1990) and Sia, Hungerford & Tomera (1985).

Demographics

Various demographic variables have been included in the research on environmentally responsible behavior. There is little consistency in the findings. Hyde (1991) found education to be significant with respect to environmentally responsible behavior, while Oskamp et al. (1991) found no relationship. Hines et al. (1986), in their meta-analysis of 128 studies, reported that age had a tenuous relationship with environmental behavior. The relationship between gender and environmental concern is equivocal (Goldenhar & Connel, 1993). Overall, women express greater concern about the environment (Schahn & Holzer, 1990), while males report higher levels of environmental knowledge (Gray, 1985; Parrott & Johnson, 1994; Schahn & Holzer, 1990).

Summary

Most of the studies reviewed did not include apartment communities. Reid, Luyben, Rawers & Baily (1976) examined recycling in apartment communities, but their study was limited to examining the relationship between location of recycling containers and newspaper recycling. Oskamp et al. (1991) included apartment residents in their study as a comparison to recycling rates among single-family renters and owners. Theirs appears to be the first study to specifically examine the recycling behavior of apartment residents.

Apartment Recycling Study

Virginia is a state with mandated recycling rates. The property management industry in Virginia was concerned with meeting both the mandated rates and the needs of owners and residents. The research reported here is part of a state-wide study to address recycling knowledge, attitudes, and behavior among a unique group of subjects, apartment residents. The results are intended to assist the property management industry in developing successful strategies to maximize environmentally responsible behavior among the residents.

The overall purpose of this study was to investigate the factors that are most likely to contribute to environmentally responsible behavior among apartment residents. Specifically, the hypothesis tested was: environmentally responsible behavior (recycling) is related to recycling knowledge, environmental attitude, education, gender, age, type of building, and years of residence in the apartment community and the region.

Method

A stratified sample of 46 apartment complexes in Virginia was identified. The participating apartment communities were identified with the assistance of the Virginia Tech Residential Property Management Advisory Board, an industry group supporting the undergraduate Residential Property Management degree program.

A self-reporting questionnaire was developed, pilot tested, and modified as required. The final instrument and supporting documents were distributed to the managers of the selected apartment communities. The managers were provided with instructions regarding identifying the sample, distribution of the introductory letter and survey instrument, and collection of the instrument. The managers were instructed to provide a survey instrument to every fourth apartment beginning with the n^{th} apartment, which was identified by the authors. Restrictions imposed by apartment owners and budgetary restrictions limited follow-up to one postcard.

Sample

A pilot study of 500 questionnaires was distributed to a portion of the sampling frame. The revised questionnaire was then sent to a probability sample of 2422 residents. There were 586 useable questionnaires returned; a response rate of 24.2%.

Questionnaire

The self-reporting questionnaire was comprised of several sections, four of which are reported here: residents' environmental attitude, residents' recycling knowledge, recycling behavior, and selected demographics.

Environmental attitude was established by a series of questions addressing the respondent's attitude regarding the importance of protecting: the environment, the nation's economy, and freedom of choice and free enterprise. The responses were recorded using a four-point Likert scale (range 0-12); a higher score indicated a stronger pro-environment feeling or belief. The statements used here were adapted from the National Issues Forum (Melville, 1989). This environmental attitude scale is consistent with Van Liere and Dunlap (1981), who determined that environmental concern should be studied in terms of specific issues, and that attitudes should be measured through forced-choice decisions about the environment and other social goals.

Recycling knowledge was determined by averaging the respondent's score on a nine-question true-false test (range 0-9). The questions were developed from the recycling/waste management education programs of the Virginia Cooperative Extension Service.

Recycling behavior was determined by a series of questions regarding recycling practices in the home. The question used in this analysis was "Do you recycle?" The possible responses were yes or no (no = 0, yes = 1).

Respondents completed a series of items requesting demographic information, which included the respondent's gender (male = 0, female = 1), age, education, years of residence in their apartment and years of residence in the region. Data regarding the last two items were gathered to address the findings of Hyde (1991) and Loftus (1991), who report the perception that apartment residents are less likely to participate in a community recycling program because they have less financial interest in the community's future. The type of apartment building each respondent lived in, elevator or no elevator, was known to the researchers beforehand and was included in the coding (no elevator = 0, elevator = 1).

Results

Demographics

The respondents ranged in age from 18 to 93; 51% were below the age of 35 and 18% were over 65 years of age. Female respondents represented 61% of the sample. The education level was relatively high: 17% reported holding a graduate degree, and 23% an undergraduate degree, 23% had completed some college, and 16% had completed high school. The sample fairly represents apartment dwellers in this state.

The majority of respondents (69%) lived in buildings without an elevator, usually called garden apartments; the remainder (31%) lived in buildings with an elevator (high-rise apartments). The sample was divided between long- and short-term residents; 30% had lived in their apartment less than one year and 28% had been in their apartment more than five years. However, 56% of the respondents had lived in the general area for more than five years.

Recycling Behavior

An unexpected 51% of the respondents said they recycled regularly. Those in garden apartments (57%) were more likely ($t=4.24$, $p<.001$) to recycle than those in high-rise buildings (38%). Households headed by someone over 65 years of age (44%) were less likely ($t=1.75$, $p<.05$) to recycle than households headed by a younger person (53%). Significant correlations (see Table 1) were found between age and type of building, and positive recycling behavior. Both correlations are negative, indicating that recycling behavior is associated with younger people and those who live in buildings without elevators.

Attitude

The range of possible attitude scores was 0 to 12 ($M=6.9$, $SD=1.8$); a score of 12 indicated a feeling or belief that environmental issues are more important than any other issue. The respondents as a whole were relatively pro-environment. Table 1 shows that higher attitude scores are associated with positive recycling behavior.

Table 1. Correlations

Variable		1	2	3	4	5	6
1	Age	1.00					
2	Education	-.2532**	1.00				
3	Building Type	.2978*	-.0627	1.00			
4	Recycling Behavior	-.1379**	.2243**	-.1753**			
5	Knowledge	-.1018*	.0997*	-.1199*	.1749**	1.00	
6	Attitude	-.1449**	.1999**	-.1318**	.1394**	.1839**	1.00

*p<.01 **p<.001

Knowledge

The range of possible knowledge scores was 0 to 9 (M=2.61, SD= 1.2); a score of nine indicated that the respondent answered all questions correctly (Table 2). The respondents were uninformed about recycling issues. This low level of knowledge is consistent with studies of environmental knowledge (Arcury, 1990) and recycling knowledge (Cude, 1992). Higher knowledge scores are associated with positive recycling behavior (Table 1).

Logistic Regression

Logistic regression analysis was used to estimate the probability that an individual living in an apartment community will or will not recycle. The forward stepwise variable selection method was used to select variables to be entered into the model. The likelihood-ratio test criterion was used for determining variables to be removed from the model. The analysis was conducted using recycling knowledge, education, building type, gender, age, environmental attitude, years of residence in apartment, and years living in region as the independent variables. The binary dependent variable was recycling behavior.

The Goodness of Fit chi-square value for the resulting model is 555.038. The observed significance level is .4083. The large observed significance level indicates that the observed likelihood for this model does not differ from 1 (Hosmer & Lemeshow, 1989). The value of the likelihood for a model that fits perfectly is 1.

The goodness of fit of this model may be further examined using a Classification Table (Table 3) that compares predictions to observed outcomes. Table 3 indicates that 69.18% of those respondents who recycle were correctly predicted by the model. Of the respondents who did not recycle, 56.78% were correctly classified. Overall, 63.04%

Table 2. Recycling Knowledge Percent with Correct Answer (N=586)

Statement	Sample	Re-cyclers	Elderly	High-Rise	Garden
MATERIALS: Aluminum is one of the most frequently recycled materials. (True)	81	82	81	79	82
Polypropylene is a a commonly recycled plasitic. (False)	7	8	0	6	8
Mixing colored and clear glass in a recycling container lowers the value of the glass when it is sold to a recycled glass processor. (True)	40	48	36	35	43
SYMBOLS AND TERMS:					
 and  are two symbols that are used to show that a product is recyclable. (False)	3	3	0	0	4
"Closed-loop recycling" is used to describe recycling a product back into the same product; for example, a glass bottle into another glass bottle. (True)	42	45	34	39	44
 is a symbol often used on glass bottles to show that they are recyclable. (False)	10	17	2	6	12
COST AND COMMUNITY ISSUES: Recycling is a good way for my community to earn money. (False)	11	9	2	7	12
It is often cheaper to bury trash in the landfill than to recycle it. (True)	22	23	14	17	23
Transportation cost to take materials to a processor can be a major barrier to a community recycling program. (True)	45	47	56	44	46
Average percent correct	29	29	25	26	30

Table 3. Classification Table for Recycling Behavior

Observed	Predicted No	Predicted Yes	Percent Correct
No	155	118	56.78
Yes	86	193	69.18
		Overall Correct	63.04

Table 4. Logistic Regression Analysis

Variable	B	S.E.	Significance	R	EXP(B)
Variables in the Equation					
Recycling Knowledge	2.123	.647	.001	.107	8.40
Education	.234	.049	.000	.164	1.26
Type of Building	.344	.098	.000	.117	1.41
Constant	-2.164	.366	.000		
Variables not in the Equation					
Gender	1.283*	.2574	.000		
Age	.690*	.4061	.000		
Years in Apartment	.427*	.5135	.000		
Years in Region	.307*	.5797	.000		
Attitude	1.02*	.3137	.000		

*Score statistic: tests that coefficient is O.

of the respondents were correctly classified regarding their recycling behavior. Therefore, the null hypothesis, that the observed likelihood does not differ from one, is rejected.

Table 4 contains the results of the logistic regression analysis. Only three of the independent variables remained in the model after the analysis: recycling knowledge, education, and type of building. The categorical variable of type of building was recorded for the logistic regression analysis: buildings with elevators coded 0 and buildings without elevators coded 1.

The regression coefficients (B) in logistic regression are interpreted as the change in the log odds associated with a one-unit change in the independent variable (Norusis, 1990). Therefore, when the respondent score on the recycling knowledge increases by one unit, one more correct answer in this case, the log odds of positive recycling behavior increase by 2.123. The partial correlation (R) value of .1073 between the dependent variable and recycling knowledge also indicates that as the value for recycling behavior increases so does the likelihood of the event occurring: an increase in positive recycling behavior.

It is more practical to interpret the results of logistic regression in terms of odds. Odds of an event occurring, as used here, is defined as the ratio of the probability that the event will occur to the probability that it will not. The Exp(B) value expresses the change in odds resulting from a one-unit change in the independent variable. Therefore, the Exp(B) for recycling knowledge indicates that when the value of recycling knowledge increases by one unit, the odds of positive recycling behavior occurring increase by a factor of 8.40.

As the level of education of the respondent increases by one unit, the odds of positive recycling behavior occurring increase by a factor of 1.26 [Exp(B)]. For example, the odds that respondents with a college education will recycle are 1.26 greater than the odds that a respondent with a high school education will recycle.

The interpretation of the Exp(B) value for type of building indicates that the odds that persons living in buildings without elevators will recycle are 1.41 times greater than the odds that a person living in a building with an elevator will recycle.

Discussion

The logistic regression produced both anticipated and unanticipated results. It was expected that gender, years in apartment, and years in region would not remain in the equation. The failure of age to remain in the equation was somewhat unexpected, considering the significant negative correlation between age and positive recycling behavior (See Table 1), and the significant difference in recycling rates. Also, the elderly have lower recycling rates (Parrott & Johnson, 1994), and younger families have learned more about recycling from their children (Oskamp et al., 1991). A partial explanation may lie in the distribution of the elderly between building types; 59% of the elderly respondents lived in buildings with elevators. A second logistic regression analysis was conducted using the same variables, but removing building type. The resulting equation included the variables of recycling knowledge (B=1.864, P<.001) and education (B=.2158, P< .001). Respondent's age (B=-.0076, P=.0843) did not enter the equation. There is a confounding relationship between age and building type in this study. That is, while the elderly generally recycle less, the fact that they reside in a building with an elevator is of apparently greater importance than age in determining recycling behavior.

Intuitively, environmental attitude should have emerged as a significant variable in the equation. However, this finding appears to be consistent with others. Vinning and Ebreo (1990) found that non-recyclers had pro-environment attitudes similar to recy-

clers, but that non-recyclers were more concerned about incentives for recycling rewards, and personal convenience. Also, De Young (1986) determined that recyclers tended to be motivated intrinsically and to find personal satisfaction in environmentally benficial behaviors. Further, Burn (1991) found that social influence was an important factor in motivating recycling behavior. Therefore, positive recycling behavior may be motivated more by intrinsic values and social pressure than by pro-environment attitudes.

The findings here will allow property managers developing recycling programs to allocate limited resources more effectively. As indicated here, residents of high-rise buildings are less likely to recycle, and elderly residents of these buildings are least likely to recycle. By their design, high-rise buildings contain physical barriers to recycling: lack of space to sort and store recyclables within the apartment and few convenient spaces within the building to collect, sort, and store recyclable materials. Therefore, property managers need to expend more effort in designing and implementing recycling programs in these buildings, paying particular attention to the recycling motivators of convenient drop-off points, providing adequate space to store recyclables, and not requiring residents to separate recyclable material. However, these same issues were also found to be primary recycling motivators for residents of buildings without elevators. (Johnson & Parrott, 1994).

In particular, recycling programs developed for apartment communities should be focused toward those residents with less education. Also, the major emphasis of any program should be to increase recycling knowledge for all residents, because the greatest potential for increasing positive recycling behavior comes from increased recycling knowledge. Finally, it appears that recycling programs should include a component that addresses the intrinsic and personal satisfaction values of recycling, the "good citizen" feeling, and that creates an environment that allowing the factor of social influence to emerge as a recycling motivator.

Additional research is needed to investigate further the relationship between recycling knowledge and positive recycling behavior and the influence of intrinsic motivation. While a moderate, positive relationship between behavior and knowledge has been reported (Vining & Ebro, 1990), others (Parrott & Johnson, 1994) have reported a negative relationship. A key factor may be the type of information asked about in defining recycling knowledge. Intrinsic motivators, such as personal satisfaction, have been identified as positive factors in recycling behavior (De Young, 1986, 1989), but the interaction between recycling knowledge, intrinsic motivators, and recycling behavior has yet to be examined in a single study.

Developing and implementing efficient and cost-effective recycling programs in apartment communities is an important part of an overall community recycling program. Our findings will allow property managers to identify which facets of the apartment community milieu are most responsible for improving positive recycling behavior so that they can allocate resources more effectively.

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