Demographics and Recycling: Effects of Types of Materials

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While many studies have investigated the relationship between various demographic variables and recycling behavior, the definition of recycling behavior used has frequently limited the depth of information gained. This study tests a methodology using the actual percentage of recyclable material recycled, and relating this measure of recycling behavior to demographic variables using a multiple regression analysis. This study also looks at the differential effects of demographic variables on different recyclable materials. Results show that the methodology seems to be acceptable, and that demographics in this sample appear to have different effects on different materials.

INTRODUCTION

While recycling has long been encouraged, the level of recycling seems to has leveled off, or declined slightly on a per capita basis in the U. S. s since the year 2000 (EPA, 2011). Efforts to properly segment the market may help to increase the rate of recycling.

Segmentation of the marketplace has long been recognized as an effective means of maximizing the effect of marketing resources. Smith (1956) noted that segmentation represents a "rational and more precise adjustment of product and marketing effort," and can be used to disaggregate the marketplace into units with similar responsiveness to the marketing mix. In the area of non-profit marketing, Kotler and Roberto (1989, p. 147) point out that segmentation "enables social marketers to tailor communication and distribution more effectively to meet adopters' needs and win adoption" of a particular behavior. As costs rise for localities implementing recycling programs (Fennell, 1992), efficient use of resources to market a behavior such as recycling becomes increasingly important. Therefore, effective use of a segmentation strategy can be of critical importance to municipalities seeking to market recycling.

While a market may be segmented on a number of bases such as benefits sought, usage characteristics, and psychographics (Boyd and Walker, 1990, p. 188-203), demographics are frequently used as a basis for segmentation due to the wide availability of demographic information. Demographic information would frequently be readily available or easily obtainable by a municipality. However, as Lovelock and Weinberg (1989, p. 166-167) note, demographics must have a link to some other user characteristic, such as usage, to be an effective basis for segmentation.

While previous studies have looked at demographic variables and a single measure of recycling (i.e., Do you recycle? or Have you recycled in the past year?), limited work has been done investigating whether demographic variables are differentially related to recycling of different recyclable materials. Due to the differing characteristics that the recycling task takes on when it involves different materials, the relationship between recycling and demographic variables may differ for different materials.

In addition, recycling behavior is frequently more complex behavior than a yes or no to the question "Do you recycle?" can capture. People can recycle all recyclable waste, they can recycle only certain materials, or they can recycle differing amounts of different materials.

This study seeks to investigate the relationship between demographic variables and recycling behavior for different materials. Recycling behavior will be considered to be continuous, ranging from 0 to 100% of each recyclable material. Thus, this study will serve to extend the literature in two basic ways. The study will investigate whether multiple linear regression may be an appropriate technique for investigating the relationship between various demographic variables and recycling of different materials. If the technique is appropriate, the results may provide some insight into how demographics may be differentially related to different recyclable materials.

REVIEW OF LITERATURE ON RECYCLING AND DEMOGRAPHICS

The literature investigating the relationship of various demographic variables to recycling is quite limited, and has produced mixed results.

While McGuire (1984) and Spaccarelli, Zolk, and Jason (1989-90) found no relationship between income of neighborhoods and recycling behavior, Jacobs, Bailey, and Crews (1984) found that neighborhoods with higher housing values had consistently higher levels of participation in recycling than those with lower housing values. Vining and Ebreo (1990), in looking at individual recyclers, found recyclers had slightly higher income levels than non-recyclers.

In terms of age, Vining and Ebreo (1990) found a positive relationship between age and recycling behavior, while Folz and Hazlett (1991) found that on a city wide level, average age of residents was not related to recycling behavior. Kipperberg (2006) also found age had a positive impact on recycling behavior.

In studying the relationship between education and recycling behavior, Vining and Ebreo (1990) found no relationship between education and recycling behavior at the individual level, while Folz and Hazlett (1991) found that education level was positively related to recycling participation level for cities.

Another variable included in this study is whether the household contains children under 18. While anecdotal evidence (for example Malcolm, 1992) suggests that children can help to persuade adults to recycle, previous studies have not included the presence of children in a household as a possible variable affecting recycling, although Folz and Hazlett (1991) found that average size of household in a city was not significantly related to citywide recycling.

The presence of children in a household might affect recycling in a number of ways. Children might be persuaded to recycle and then convince parents to recycle (Malcolm, 1992), thus increasing the "environmental awareness" of the adults. Children might also be involved in fundraising activities, and persuade parents to recycle to support fundraising efforts. Hamad, Cooper, and Semb (1977) showed that incentives could dramatically affect newspaper recycling by children (with cooperation of parents.)

While existing studies of recycling and demographics are informative, none of the studies has evaluated recycling of various different materials simultaneously. However, "recycling" is a number of different activities. People can recycle newspapers, plastic containers, aluminum containers, and glass containers. Recycling of each material is somewhat different. These differences in materials may be reflected in recycling behavior and its relationship to demographic variables, and may be a variable confounding previous results.

In addition, with the exception of the Vining and Ebreo study, the studies all use grouped data rather than looking at individual behavioral relationships. Use of individual level data might be more informative as to the existence of any possible relationships between demographics and recycling behavior for various materials.

Method of measurement might also have clouded interpretation of results. Vining and Ebreo used as their measure of recycling whether or not the respondent had recycled anything in the past year. Spaccarelli, et. al., did not measure an amount of material, but simply whether any material was recycled by the participants. This definition does not discriminate between a person who does a very minimal amount of

recycling (perhaps only once a year, or perhaps only one material such as aluminum), and the person who may conscientiously recycle all recyclable materials.

Another possible confounding factor in both the McGuire study and the Folz and Hazlett study is use of only the absolute amount of materials recycled to investigate relationships of recycling behavior to income. Those with higher incomes might have more trash in general, and thus have more recyclable trash, without necessarily being more committed to recycling. This may confound the possible relationship of recycling behavior to demographic characteristics.

Thus, it would be particularly informative to look at individual level data, and have a measure of the percentage of each type of recyclable which people recycle, rather than the absolute level of material recycled. In addition, education, income level, age and whether the person has children under the age of 18 living at home tend to be related. Thus, it is necessary to look at these variables simultaneously to separate out the possible effects of one variable on the other.

The present research study seeks to overcome some of the problems with the previous research in investigating relationships between recycling of different materials and demographics.

Hypotheses

Based on the previous studies, the following hypotheses are set forth:

H1: There will be a significant positive relationship between the percentage of material recycled and income level of people.
H2: Those people with children living at home will recycle a higher percentage of recyclable materials than those without children at home.
H3: Educational levels will be positively related to percentage of materials recycled.
H4: The age of the recycler will be positively related to percentage of material recycled.

The regression equation relating behavior to the combination of demographic factors will be:

$$Beh = a + (w1)\ Income + w2\ (Children) + w3\ (Education) + w4\ (age)$$

where a is the intercept term, the w's are regression coefficients, and Beh is the percentage of materials recycled.

Due to the exploratory nature of the research into effects of different materials on recycling, no formal hypotheses will be set forth in that area.

Sampling Plan

Questionnaires were distributed to a purposive sample of subjects generated from the members of three churches and employees of a major university, all located in a large city. The sample was chosen to provide dispersion on the demographic variables of interest, and also on the amount of recycling behavior. Two churches were located at opposite ends of the city, while the third was located in the downtown area in the middle of the city. The churches were chosen because the age and income distribution of each was different from the others. The employees of the university were mainly non-faculty, with lower income levels.

Respondents mailed in their completed questionnaires in a pre-addressed, pre-stamped envelope. This enabled respondents to answer the questionnaire at their convenience, while reenforcing the belief that the researcher would be unable to identify the respondent. Questionnaires asked for respondents' percentage of recycling of newspapers, glass, aluminum, and plastic containers, as well as asking for age, education level, income, and whether the respondent had children under the age of 18 living at home. (Children living at home was a dichotomous variable.)

Each survey was accompanied by a letter requesting the cooperation of the individual. The letter asked that the person in the household most responsible for waste disposal and recycling answer the survey. The letter stressed the importance of information concerning recycling to the completion of a research project of

the researcher. It also emphasized that non-recyclers' views were just as important as recyclers. A prepaid postage envelope was included with each questionnaire. University employees were given one dollar as an incentive to respond, while church members were told that one dollar would be donated to the church for each completed questionnaire received from that church. The overall response rate was 86%, with 181 surveys being returned. This high response rate was evidence of the success of the inducement in obtaining respondents.

While the sample is not a random sample, it was conducted in order to provide a diversity of recycling behaviors and a diversity of demographic characteristics. This research is aimed at theory testing, rather than at generalizing results to a given population. Thus, use of a non-random sample is appropriate. The sampling procedures used were quite successful at producing samples with a great deal of variance in recycling behavior, as well as on the demographic variables of interest. Recycling behavior ranged from 0 to 100 percent for each material. Level of education ranged from eighth grade or less up to doctorate degree. Age ranged from 21 to 85 years of age. Income ranged from below $10,000 to above $250,000.

RESULTS AND DISCUSSION

Demographics

For the sample, average education was an undergraduate degree, average income was $39,250, and 31% of the sample had at least one child under the age of 18 living in the household. For comparison, education level for the city, as measured in the 1990 census, was not significantly different from the sample (approximately 4 years of college). The percentage of families with children under 18 in the household was 27% according to the 1990 census, again not significantly different from the sample results. The average age from the census was somewhat lower (45 years) than the lower bound of the 95% confidence level for the sample (47.5 years). The income level of $32,000 was somewhat lower than the lower bound of the 95% confidence level for the sample ($35,077).

The sample does not seem to have systematically excluded any large percentage of the population, as well as can be determined by analysis of the demographics investigated. However, the sample is somewhat older and has somewhat lower income than the city from which the sample was drawn.

Multiple Regression Analysis Diagnostics

The data gathered was analyzed using multiple linear regression analysis using ordinary least squares. There were no large correlations present which might have indicated multicollinearity. The variance inflation factors were also observed. As Myers (1986, p. 219) notes, if a particular regressor variable has a strong linear association with the remaining regressors, the variance inflation factor will be high. Myers suggests that there is reason for concern if any variance inflation factor exceeds 10. None of the variance inflation factors was greater than 10, indicating that multicollinearity was not a problem. (In fact, all variance inflation factors were below 2.)

Multiple regression is based on the assumptions that the error terms are uncorrelated, and the error variance is homogeneous. Examination of residuals indicated that these two conditions were not violated in the data samples used. Analysis of residuals also indicated that the error terms were approximately normally distributed. If the conditions of uncorrelated error terms, homogenous error variance, and no multicollinearity are met, regression is fairly robust to small violations of the normality assumption. There was no evidence in the residual and diagnostic analysis of non-normal distributions, thus it is extremely unlikely that the normality assumption was violated to the extent that the results of the regression would be affected.

Hypotheses Tests

The null hypothesis that no variables were significantly different from zero was first tested. If the F statistic associated with the regression indicated that at least one variable was significantly different from zero (i.e., if the probability of the F statistic was .05 or less), then the t test statistics associated with each demographic variable were then examined. All equations were significant at the .05 level except for the

equation for plastic, which had a probability of .053. The results from the regression for plastic will be included in the interest of completeness. T statistics with associated probabilities of .05 or less were considered as evidence that the coefficient for that particular variable was different from zero.

Hypothesis 1: Income and Recycling

Hypothesis 1 states that there will be a significant relationship between the percentage of material recycled and income level. The null hypothesis that the regression coefficient was different from zero was not rejected for any materials (p>.9) (see Exhibit 1 for complete results of the regressions for all materials and all independent variables). Thus, for this sample, there was no evidence that income level was significantly related to recycling behavior. Therefore, this result would mean that it does not appear that income will always be related to recycling. While non-random samples make generalization to other possible samples problematic, they may provide evidence for rejection of a previous finding. If income is not related to recycling in one sample, it is not possible that income is always related to recycling behavior in all samples. This is especially important in recycling, where the sample that may be targeted for recycling is not likely to be a random sample. Rather, it is more likely to be a sample chosen for some other reason, such as geographic or political reasons.

Hypothesis 2: Children and Recycling

Hypothesis 2 states that those people with children living at home will recycle a higher percentage of materials than those without children living at home.

For newspapers, the null form of Hypothesis 2 was not rejected (p=.0739). For glass, the null hypothesis was not rejected (p=.7185). For plastic, the null hypothesis was not rejected (p=.8285). For aluminum, the null hypothesis was rejected (with a coefficient of 13.9, and p=.0454), providing evidence that people with children living at home in this sample do recycle a higher percentage of aluminum than people without children living at home.

There is supporting evidence for this hypothesis only for aluminum. If the presence of children led to more recycling of all materials, this might provide evidence that the presence of children creates more of an "environmental" orientation in parents. This does not seem to be the case in this sample. [These results may indicate that the presence of children in this sample increases the likelihood that the household participates in some type of school sponsored recycling program for fundraising (which is common with aluminum), or that children may collect aluminum cans as a money making venture, but do not indicate that children tend to encourage their parents to recycle all materials.]

Hypothesis 3: Education and Recycling

Hypothesis 3 states that educational level will be positively related to recycling behavior.

The null form of Hypothesis 3 was rejected for newspapers (coefficient of 3.21, p=.0172), for glass (coefficient of 3.76, p=.0121), and for plastic (coefficient of 2.95, p=.0405), but not rejected for aluminum (p=.1301). The results provide evidence supporting the hypothesis that education is related to recycling behavior in this sample for all materials except aluminum. [One possible explanation is that because aluminum has a monetary value as a recyclable, the people in this sample may not need to be educated in the intrinsic value of recycling to engage in recycling of aluminum because of the monetary reward involved.]

Hypothesis 4: Age and Recycling Behavior

For newspapers, the null hypothesis that age was not significantly related (p=.1148) to percentage of material recycled was not rejected. For glass, the null hypothesis was rejected (coefficient=.497, p=.0077), and also for plastic (coefficient=.360, p=.0440) and aluminum (coefficient =.409, p=.0238).

These results provide evidence supporting the hypothesis that age is related to percentage of material recycled for glass, plastic and aluminum. These results agree with the Vining and Ebreo (1990) results. Researchers should try to determine if age affects recycling behavior in other samples. If so, it would be interesting and fruitful to determine why age is related to recycling behavior. Is it related to higher motivation, or more free time, or due to more thought being given to the future of the planet?

Overall, the regression equations including only the demographic factors of education, age, income, and whether the respondent had children living in the household explained less than 10 per cent of the variance in recycling behavior for the equation explaining the most variance. The percentage of variance explained was 7% for aluminum containers, 5% for glass containers, 7% for plastic containers, and 9% for newspapers.

EXHIBIT 1

Newspaper Equation

Beh = 56.8 + Ed (3.206)+ Age (.2594)+ Inc (-.0003)+ Chld (11.68)

t=2.41	t=1.59	t=0	t=1.80
p=.0172	p=.1148	p=1.0	p=.0739

R squared = .0917, adjusted R squared =.0690, F=4.04, p=.004

Glass Equation

Beh=26.06 + Ed (3.762)+ Age (.4970) + Inc (-.0001) + Chld (2.588)

t=1.88	t=2.53	t=2.70	t=0	t=.36
p=.0616	p=.0121	p=.0077	p=1.0	p=.7185

R squared= .0769, adjusted R squared = .0559, F=3.67, p=.007

Plastic Equation

Beh=32.76 + Ed (2.948) + Age (.3598) + Inc (-.0002) + Chld (1.497)

t=2.46	t=2.06	t=2.03	t=0	t=.22
p=.0150	p=.0405	p=.0440	p=1.0	p=.8285

R squared = .0513, adjusted R squared =.0298, F=2.38, p=.053

Aluminum Equation

Beh=47.92 + Ed (2.197) + Age (.4089) + Inc (-.0003) + Chld (13.91)

t=3.60	t=1.52	t=2.28	t=0	t=2.02
p=.0004	p=.1301	p=.0238	p=1.0	p=.0454

R squared =.0717, Adjusted R squared=.0501, F=3.32, p=.012

Implications of the Research

Because the sample used in this study was not a random sample, one should be wary of generalizing the results to other populations. However, the results do suggest areas for further study.

Results from the multiple regression diagnostics indicate that use of multiple regression may be a valid technique for future research into relationships between recycling behavior and various demographic variables.

This research also points out the necessity of separately evaluating the effects of demographic factors on recycling behavior toward **different** materials. Different materials may require different marketing strategies.

The results of the demographic analyses also indicate that demographic variables may not be a very efficient means of segmentation for marketing of recycling. These variables explain a very small percentage of the variation in recycling behavior. For segmentation by demographic variables to be effective, these demographics must be a good predictor of consumer response. From this study it does not appear that the recycling market can be easily segmented by demographics.

Limitations

The sample under study was a non-random sample. While this makes any generalization of the results somewhat suspect, this study can be used as an exploratory study, to suggest possible relationships of interest.

Suggestions for Future Research

Future research should explore whether the relationships found in this study are also found in random samples. If the relationships hold, community recycling programs can be designed to more efficiently market recycling. Future researchers should also seek to determine why such relationships exist. This could provide further insight into the motivations for recycling.

Future researchers should be cognizant of the possible relationships between education, age, and income. These relationships may confound results of other studies if income, age, and education are not controlled for, or included in the prediction equation.

The presence of children in a household was related to recycling for one material, aluminum, in this sample. Future researchers should study the effects in large, random samples of "children in the household" on recycling of materials, and determine whether any relationship which might exist was the result of children's attitudes affecting adult behavior, or the result of children's participation in charity drives or fundraising efforts.

Age was significantly related to recycling for almost all conditions. Future research should investigate if this relationship exists in other samples. If the relationship is found to exist in a variety of samples, then marketing efforts could be concentrated on making recycling more convenient for older people, who might be seen as having some proclivity toward recycling.

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