

**Relating Recycling: Demographics, Attitudes, Knowledge and Recycling Behavior
among UC Berkeley Students**

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ABSTRACT

Using a standardized questionnaire, I surveyed 200 students from the University of California, Berkeley to determine the relationship between demographics, attitudes, and knowledge and recycling behavior among undergraduates. In the questionnaire, participants were asked to provide demographic information, their attitudes about the environment and recycling, knowledge of proper recycling techniques and their recycling practices. Significant associations were found between recycling behavior and the demographic variables of year, race and major. Significant correlations were found between attitudes and recycling behavior, as well as a slightly higher correlation found between knowledge and recycling behavior. The correlation evidence suggests that knowledge on how to properly recycle is the most effective of the examined factors as an indicator of an individual's likelihood of recycling. The implications of study results on recycling behavior theory and recycling policy are explored, including addressing the benefit of information on factors affecting recycling behavior when developing recycling campaigns for a given population.

KEYWORDS

recycling indicators, correlations, associations, policy intervention, survey

INTRODUCTION

There is a large discrepancy between what people can recycle versus what they do recycle. About 80% of what Americans throw away is recyclable, but our recycling rate is just 28% (EPA, 2010). Also, the average person in the United States discards about 4.5 pounds of trash every day, yet recycles only 1.5 pounds of material per day (Williams, 2008). This has disturbing environmental implications. Why aren't more people recycling? How can an increase in the number of individuals recycling and the amount they recycle be achieved? As suggested in a study by Schultz, Oskamp, & Mainieri (1995) recycling practices may have a basis in individuals' demographic characteristics, attitudes and knowledge.

Many studies have considered relationships between recycling behavior and demographic variables such as age, gender, and ethnicity. One study found an increase in age to have a slightly negative correlation to recycling (Gamba & Oskamp, 1994), another found no correlation (Oskamp et al., 1991), and a third found a positive correlation (Lansana, 1992). Research on the relationship of gender to recycling behavior has typically indicated no relationship (Oskamp et al., 1991; Gamba & Oskamp 1994). However, in instances in which studies have found a relationship, they generally reveal women to be more likely to recycle (Ando & Gosselin, 2005; Oates & McDonald, 2006; Barr, 2007). Studies on race and ethnicity have generally failed to find any sort of conclusive patterns, due to interference from confounding variables (Schultz, Oskamp, & Mainieri, 1995). Ambiguous though research results have been, it is evident that demographic differences may affect recycling behavior.

Research findings have been clearer concerning the relationship of attitudes to recycling behavior, focusing on both how individuals feel about the environment and recycling. It is important to understand attitudes about recycling, because if people see no benefit to an activity they will not participate in it (Makenzie-Mohr & Smith, 1999). Studies on this relationship have examined the gap between environmental values and environmental action, sometimes referred to as the 'value-action gap' (Nixon & Saphores, 2009). This refers to the relationship between positive attitudes about the environment and acting favorably towards the environment, by, for instance, recycling. While much of the early research on recycling behavior found a significant positive relationship between pro-environmental attitudes and recycling behavior, more recent studies on the same relationship have not been able to achieve such strong results (Nixon &

Saphores, 2009). This may be accounted for by the observation that, since recycling has reached the point of being commonplace, an individual's environmental attitudes are not as important as they perhaps once were (Schultz, Oskamp & Mainieri, 1995; Bamberg, 2003).

Knowledge levels about specific recycling programs correlate with recycling rates, suggesting that recycling behaviors may be less related to knowledge in general than to knowledge about the specifics of recycling (Oskamp et al., 1991). Generally, the more information an individual has about which materials are recyclable or where they can be collected, the more likely that person is to recycle (Schultz, Oskamp & Mainieri 1995). The greatest difference between a recycler and a non-recycler is their knowledge of which items are recyclable (Vining & Ebreo 1990). In order to increase recycling, then, individuals must be informed on the subject. The literature generally supports the notion that recycling rates have a positive correlation with informational campaigns (McDonald & Ball, 1998; Scott, 1999; Thomas, 2001) underscoring the possibility that knowledge on how to recycle is positively correlated with recycling behavior. This relationship may be examined in the context of a university campus.

In 2001, the University of California, Berkeley held its first annual recycling summit, espousing the goal of promoting campus recycling through increasing access to indoor and outdoor recycling and refuse containers, campus-wide purchasing of recycled paper, and establishing a materials exchange (Recycling Summit 2001). In 2004, due to a shift in focus from recycling to other issues of sustainability, the annual recycling summit became the annual sustainability summit (Moon 2010). Since moving from a focus on recycling, progress in increasing recycling on campus has slowed. Excluding the waste diverted due to construction and demolition, UC Berkeley had one of the lowest recycling percentages of all other UC campuses for 2008-2009 (Annual Report on Sustainability Practices 2010). Unfortunately, there is an absence of research on why recycling rates are low at UC Berkeley (Moon 2010).

Objectives and Expected Findings

This study examines the relationship of demographics, attitudes, and knowledge to UC Berkeley student recycling practices. Determining how well each of these serves as an indicator of recycling behavior can be useful in deciding which recycling interventions should be used in a

given population, as well as being helpful in creating successful recycling campaigns and programs. Specifically I asked, if and how demographics, attitudes, and knowledge relate to recycling behavior among undergraduates? I expected to find that there are no differences in recycling behaviors due to demographics. I did expect to find a minor correlation between recycling behavior and environmental attitudes, however I expected that the correlation between attitudes and knowledge would be larger.

METHODS

Data Collection

I conducted 200 surveys, sampled from undergraduate students currently attending the University of California, Berkeley. To achieve a high degree of sample variance, I sampled students in lectures across a variety of disciplines. Each individual survey was administered and collected during a class meeting. I directed all students in attendance to fill out a twenty-seven-question survey, which required approximately five minutes to complete.

Survey Instrument

Each set of questions on the survey was tailored to gather specific data on the demographics, attitudes, knowledge, and recycling practices of UC Berkeley undergraduates.

Demographics

I collected information on gender, age, year, race and major. This information was collected to obtain a profile of the sampled population for comparison with the study population, and to compare responses on recycling behavior to each demographic variable.

Environmental and Recycling Attitudes

I asked questions regarding students' attitudes toward the environment, environmental behavior and recycling. I used responses in this portion of the survey to assess environmental attitudes and recycling attitudes in aggregate, as well as, each separately. I used questions about the general environment and environmental behaviors, as well as questions specific to recycling because though empirical research supports the use of general attitudinal measures (Weigel & Weigel, 1978), general attitudes may correlate to general behaviors and specific attitudes to specific behaviors (Ajzen & Fishbein, 1980). I used these responses to assess how students feel about the environment and recycling. Additionally, I compared these responses with those on recycling behavior to determine a relationship between the two.

Recycling Knowledge

I asked questions designed to determine respondent knowledge on how to properly recycle. I compiled a set of true or false questions regarding information necessary to successfully identify and dispose of recyclable materials. I identified proper recycling techniques by examining information presented on recycling websites. Asking questions based on this information allowed me to obtain a measure of student knowledge on proper recycling. I used responses to determine the existence and strength of a relationship between recycling knowledge and recycling behavior.

Recycling Behavior

I asked students about their recycling practices to obtain basic information on students' typical recycling behavior. I asked questions about specific items they recycled and how often they did so. I used these questions as a behavioral measure of student recycling.

Statistical Analysis

I tallied and categorized results from the survey into Excel spreadsheets, in which I coded categorical and text responses. I then entered and analyzed the data using the statistical software R and R commander. I analyzed the data using ANOVA, t-tests and Pearson's correlation tests, looking for statistically significant relationships.

RESULTS**Data Collection**

I sampled 200 UC Berkeley undergraduates were sampled for the survey. Only a few surveys had to be discounted due to insufficient completeness.

Demographics

The demographic profile of my sample was similar to that of the study population, except for the number of years attending UC Berkeley (Table 1). At 47%, the largest percentage of those sampled identified as Asian, 33% identified as white, 9% as Hispanic, 2% as black, and 9% as other/unknown. About 47% of respondents were male and 53% were female, with an average age of 20. The percentage of juniors in my sample population was lower than the percentage of those in the study population. 26% were first year students, 34% second year, 11% third years, and 29% fourth year. 36% of respondents had environmentally oriented majors meaning, and the remaining 64% had majors otherwise oriented.

Attitudes

Almost all (96%) of respondents expressed positive views about the environment in general, and 98% of respondents expressed positive views about recycling specifically (Table 2). A positive view included those who chose strongly agree (an average of 57%) or agree (an

average of 41%) to questions 9, 10 and 11. For the question which asked the participants primary motive for recycling, 90% chose environmental concern, 6% chose economic benefits and 4% chose societal pressures.

Table 1. Demographic Results for Sample and Study Populations.

		Sample Population	Study Population
Gender	Male	47%	47%
	Female	53%	53%
Age	Average	20	21
Year at Berkeley	Freshmen	26%	13.3%
	Sophomore	34%	16.9%
	Juniors	11%	28.5%
	Seniors	29%	41.3%
Race/Ethnicity	African-American	2%	3.5%
	Asian	47%	46%
	Hispanic	9%	11.5%
	White	33%	32%
	Other	9%	7%
Major <i>*rough estimates</i>	Environmental	36%	25%*
	Other	64%	75%*

Table 2. Attitudes about the Environment and about Recycling.

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree
Attitudes about the Environment				
6. Everyone should try to protect the environment.	58%	40%	2%	0%
7. You have a personal obligation to help protect the environment.	47%	48%	5%	0%
8. You are concerned about the amount of garbage people produce.	42%	54%	4%	0%
Attitudes about Recycling				
9. Recycling makes a difference in protecting the health of the environment.	59%	39%	2%	0%
10. You feel it is important for everyone to recycle.	55%	43%	2%	0%
11. You feel it is important for you, personally, to recycle.	57%	40%	3%	0%

Knowledge

I found that 64% of respondents indicated an ability to locate recycling bins on campus, 58% were confident in their knowledge of how to properly recycle, and 95% indicated that a

better understanding on how to properly recycle would increase their recycling frequency. Figure 1 shows the percentage of respondents who answered each question correctly. Of the true or false portion, 11% answered every question correctly while 14% answered every question incorrectly (Table 3).

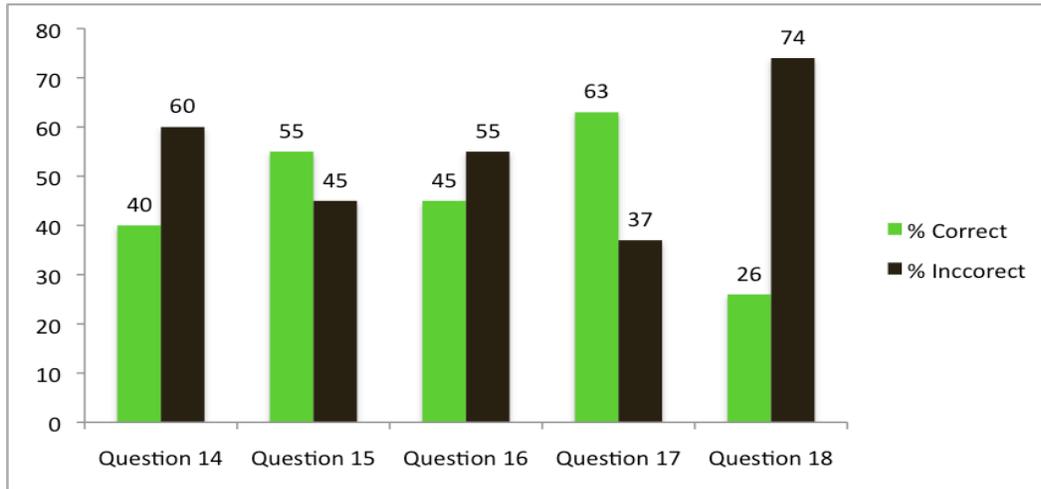


Fig. 1. Those who answered each question on proper recycling techniques correctly and incorrectly.

Table 3. Number of correctly answered questions as a percentage of the sample.

	0 correct	1 correct	2 correct	3 correct	4 correct	5 correct
% of survey respondents	14	19	21	27	8	11

Behavior

Of the sample, 36% recycled all the time, 36% most of the time, 21.5% some of the time and 6.5% did not or rarely recycled. Students indicated recycling glass the most frequently, followed by cardboard, then plastic, paper, and aluminum (Table 4). Just over half (52%) said that during this school year they had made an effort to increase the amount of waste they recycled.

Table 4. Recycling Behavior as Self-reported by Survey Respondents.

Material	All of the time	Most of the time	Some of the time	Never
Paper	32%	39%	27%	2%
Glass bottles	46%	34%	13%	7%
Plastic	33%	43%	19%	5%

Cardboard	36%	40%	20%	4%
Aluminum/Tin	32%	24%	29%	15%

Statistical Analysis

Of the two demographic variables I analyzed using t-tests, I found differences for recycling behavior between majors but not between genders. There was a highly significant difference in the amount recycled by environmental majors in comparison to other majors, with environmental majors recycling most frequently. Using ANOVA I found that there was one true difference between African-Americans and Asians in comparison to those classified as Other. No true difference was found for Whites and Hispanics as they overlapped with the other three races. ANOVA also showed a difference in recycling behavior based on years attending UC Berkeley, with juniors having been found to recycle significantly less than freshmen, sophomores and seniors.

Using a Pearson's correlations test, I found a positive relationship between recycling behavior and positive attitudes about the environment and environmental behavior. The correlation was 0.42. I also ran two more Pearson's test to test the relationship to recycling behavior. For the first I used responses about the environment in general which resulted in a correlation of 0.28 and for the second, I used responses specific to feelings about recycling, which resulted in a correlation of 0.47 (Table 5).

Using a Pearson's correlations test I found a positive correlation between knowledge about proper recycling and recycling behavior. Knowledge on how to recycle in relation to recycling behavior showed a significant correlation of 0.49 (Table 5).

Table 5. Attitudes and Knowledge Correlation to Recycling Behavior Test Results.

Factor tested	Correlation	P-value
Environmental Attitudes	0.28	5.561e-05
Recycling Attitudes	0.47	7.745e-13
Combined Attitudes	0.42	3.589e-10
Recycling Knowledge	0.49	1.656e-13

DISCUSSION

I found significant associations between of the demographic variables race, year and major and recycling behavior. Additionally, I found significant correlations between attitudes and recycling behavior, as well as knowledge and recycling behavior. These findings highlight factors that should be considered when designing recycling policy and programs. Demographic variables may be important factors to take into account in some populations, but not in others. Environmental attitudes are not as indicative of recycling behavior and are attitudes specific to recycling but a better indicator yet is knowledge of proper recycling techniques. These results can be applied to constructing effective programs to increase recycling.

Demographics and Recycling Behavior

I found significant associations between recycling behavior and race, year of enrollment and major, yet I believe the only demographic in my study population of true importance is major. Those with an environmentally oriented major oriented recycled far more than those without. Race only had two groups that truly showed differences, and I believe it would be premature to state that the individual races the category was composed of each display a significant difference. Taking this into account, in this case the ANOVA test may be insufficient evidence to claim a difference for the category denoted as Other. Recycling behavior for juniors was significantly lower than the other years but I attribute this more to having such a low percentage of juniors in my sample than to any real difference. Therefore, though my sample found associations between year, race and major, I conclude the only significant demographic variable of importance among UC Berkeley undergraduates is major.

Though major was important for my specific study population, I believe it would be injudicious to expect the same results in another population. For instance, two studies found men to be more likely to recycle (Clay, 2005; Mohai, 1992), demonstrating results contradictory to my findings of no association between gender and recycling behavior. The results of this study in comparison to others demonstrate how results concerning the associations between demographic variables and recycling behavior can vary among different populations. Due to this inconsistency, I think it would be a mistake to apply any certain demographic variables as standard indicators of recycling behavior across different populations. Population dynamics seem

too varied between different populations to expect demographic variables significant to recycling behavior in one population to be significant to recycling behavior in another.

I conclude that demographic identifiers observed singularly are insufficient to successfully predict associations with recycling behavior across different populations. Iyer and Kashyap (2007) also suggest a similar concept. Single demographic indicators are too limited in their predictive scope of recycling behavior; a more comprehensive measure will have better predictive power. In some circumstances, demographics can't adequately convey the full measure of what is truly affecting recycling behavior in a population. There may be other mitigating factors. Ida Berger (1997) found that access to recycling services mediate the influence of demographic variables on recycling behavior, hence demographics are important in so much as how they affect access to recycling.

However, this is not to say that demographic variables cannot be important to assessing recycling behavior for a specific population. Knowing the demographic characteristics of the target population may aid in choosing appropriate techniques for increasing recycling for that particular population. For example, increasing campaigning efforts in places where high-school kids like to congregate if teenagers were found to have low levels of recycling is one instance in which demographic characteristics could be used to shape execution tactics. The effectiveness of a particular recycling program may depend on the characteristics of the population for which the program is being targeted for use in. However, considering factors beyond this is imperative as it is likely that demographics are mediated in their association to recycling behavior by a multitude of factors, some more pertinent than others.

Environmental and Recycling Attitudes and Recycling Behavior

A portion of the survey was designed to explore an individual's attitudes toward environmental activism in general versus their view on recycling. Though participants consistently responded in favor of both, support for recycling was higher (Table 2). These findings suggest that, though people may not typically support environmental activism, they may support recycling as a specific form of environmental action. I suspect this has a basis in recycling having become a social norm and though people may not always actively recycle, society has positively influenced the general opinion of recycling.

Even if individuals hold favorable attitudes about the environment and recycling, they do not necessarily recycle. Although responses were consistently high across the board in support of environmental and recycling attitudes, the same high level of consistency was not reported in respondent's recycling behavior. Statistical analysis of aggregate responses for environmental and recycling attitudes determined there was a small correlation between overall attitudes and recycling behavior. The majority of participants responded in favor of both recycling and protecting the environment. Of greater interest was determining if those who hold attitudes in favor of the environment actually practice environmentally favorable behavior. This does not appear to always be so.

As the relationship between attitudes and behavior was very tenuous, I do not think attitudes are the best indicator of an individual's recycling behavior. This is consistent with many other studies exploring relationships between attitude and behavior (Iyer, 2007; Scott & Willits, 1994; Dunlap, 1991; Dunlap, 1989; Ostman & Parker, 1987). Scott (1994) found that, although students expressed support for the environment, they were not likely to engage in activities that contribute to environmental protection. Similar results were found in another study on the relation of environmental attitudes and environmentally responsible behaviors among U.S. undergraduate students, which concluded that though sympathetic towards the environment, college students did not exhibit very environmentally responsible behaviors (Thapa 1999). Yet, I did find that the correlation between recycling behavior and attitudes moved in two opposing directions when the overall attitudinal measure was separated into its two parts: pro-environmental attitudes and pro-recycling attitudes. The correlation between attitudes and recycling behavior dropped significantly when pro-environmental attitudes were compared to recycling behavior, as opposed to the correlation increase when pro-recycling attitudes were being compared (Table 5). That is, pro-environmental attitudes and recycling behavior were not highly correlated with each other. In contrast to this, the correlation of pro-recycling attitudes and recycling behavior was high. Given this, I believe that an individual's opinion on the environment is generally not a very reliable indicator of their recycling behavior, as a correlation is not really apparent unless you address the individual's attitudes about recycling specifically or in addition to their opinions on the environment.

Recycling Knowledge & Recycling Behavior

The finding that individuals generally lacked recycling knowledge suggests that some portion of the low recycling rates may be due to individual's inability to correctly identify, sort and dispose of recyclable materials. This was not unexpected. The majority of the respondents incorrectly answered more than half the recycling knowledge questions, highlighting the need for education on proper recycling methods, specifically detailing issues about what materials are recyclable and the correct way to recycle them.

There was a slightly stronger relationship between recycling knowledge and recycling behavior than observed for attitudes and recycling behavior (Table 5), confirming my expectation that knowledge would have the strongest relationship to recycling behavior. Vining & Ebreo (1990) suggest that the greatest difference between recyclers and non-recyclers is their knowledge about recyclable materials, and that recyclers possessed significantly more knowledge about recycling than non-recyclers. It seems that concrete knowledge is a necessary condition in order to facilitate actions protecting the environment (Schahn & Holzer, 1990). Perhaps people would recycle if they had the knowledge of how to properly do so. Taking into account both the findings of this and other studies (Simmons & Widmar, 1990; Vining & Ebreo, 1990), I propose that even if the direct knowledge to behavior relationship is weak, knowledge is at least a mediating factor in the practice of recycling. In this study I observed that those with negligible recycling behavior expressed almost negligible knowledge on the proper way to recycle materials. Without practical knowledge on how to properly recycle, recycling cannot occur.

I found slightly higher levels of correlation between recycling knowledge and behavior than did other studies examining this relationship. Knowledge about recycling has been found by other studies to correlate to recycling behavior, though some of the correlations have been very low (Hines et al., 1987; Sia et al., 1985; Braun 1983). However, I believe that for the most part, the low values in other studies stemmed from the abstract questions used to measure knowledge in relation to relatively concrete, specific behaviors (Hines et al., 1987; Sia et al., 1985; Braun 1983). My study differed in that I used a knowledge scale based on concrete questions specific to the behavior that I was investigating. My choice of knowledge scale could explain my higher levels of correlations.

Study Limitations

Limitations arose from the design of this study. Given that my study focused mainly on UC Berkeley students, my analysis cannot be applied to college students outside of the UC Berkeley campus. Additionally, though I made efforts to mitigate it, there may even be sampling bias limiting my analysis to other UC Berkeley students, in particular graduate students, as they were not included on the survey. The low percentage of juniors in my sample population in comparison to the percentage in the actual population of UC Berkeley may invalidate demographic and recycling behavior analysis for the year of university attendance category. Limitations also reflect my methodology, in that my analysis considered each demographic factor one by one instead of in concert, preventing a comprehensive identity of the participant being formed. Also, given the constraints of time and manpower for this study, I did not directly observe recycling behavior. This being so, information on recycling behavior had to be reported by individuals, meaning there could be discrepancies between behavior that was reported versus what behavior actually occurred. Additionally, though the experimental design for this study adequately addressed my hypothesis, my research only addresses a few of the possible relationships between demographics, attitudes and knowledge and recycling behavior.

Future Directions

As suggested by my study, identifying linkages between recycling behavior and other factors is very complicated. Yet my research has identified an avenue for future study. Though it explored demographics, attitudes and knowledge and how they each directly relate to recycling behavior, my research did not explore linkages that might possibly exist among the three. For instance, it is thought there may be some interdependence between attitudes and knowledge (Schahn 1990). Also, using the various demographics comprehensively to create a full measure of social conscience and status perhaps can more accurately depict a relationship between demographics and recycling behavior. As it was not explicitly addressed in this study design, further steps could be taken to determine any mediating factors affecting relationships between demographics, attitudes, knowledge and their relationship to recycling behavior. Finally, this study could be expanded upon to form the basis of a future study aimed at recycling among

graduate students and administration at UC Berkeley in addition to undergraduates. Furthermore, as this research was specific to UC Berkeley, the information found in this study could be explored more in depth and used to create a recycling campaign tailored to address the recycling issues specific to the UC Berkeley population.

Conclusion

The findings in this study have implications for theory on recycling behavior relationships, as well as to the composition of public policies. In order to develop effective ways to reduce waste in landfills, researchers and policy-makers need to comprehend the factors that affect recycling behavior. Determining the type of intervention necessary to create a fitting and successful program requires information on the dynamics of the population in which the program is being instituted. In this study, the correlation evidence suggests that those who have knowledge on how to properly recycle are more likely to recycle. Policy makers who aim to encourage more recycling behavior should consider implementing education programs. Rather than just educating people about the concept and encouraging behavior as many recycling programs do, these education programs need to focus on the specifics of recycling and teaching which items are recyclable and which are not.

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