

EFFECTS OF EDUCATIONAL AND FEEDBACK INTERVENTIONS ON RECYCLING KNOWLEDGE, ATTITUDES, BELIEFS, AND BEHAVIORS*

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ABSTRACT

The relative effects of education and feedback strategies on knowledge, attitudes, beliefs, and behaviors regarding waste recycling were studied. Baseline and follow-up data were gathered from 1,619 university students. Using a quasi-experimental design, eight dormitories were randomly assigned to one of four experimental groups. No statistically significant group differences were discovered in terms of students' attitudes or beliefs about recycling, however, the feedback groups reported higher levels of recycling behavior than did the education or control groups ($F = 12.8 (1, 3,325), p < .001$). Implications for designing and evaluating intervention programs aimed at increasing waste recycling behavior are discussed.

Until recently, the two most widely accepted approaches for helping to alleviate the solid waste crisis were either technological/engineering or economically based [1]. Specifically, technological or engineering strategies involve the development of devices for preventing or remedying an acknowledged environmental problem while economic approaches focus on monetary incentives in an attempt to

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dissuade environmentally-unsound practices. It is now recognized that although the technological and economic approaches might be necessary, they are not sufficient for solving America's current waste crisis. Behavioral solutions must also become an integral part of energy conservation and solid waste management [1-4]. Targeting consumers' convenience- and throwaway-oriented attitudes and behaviors is imperative to prevent further environmental destruction.

Over the past twenty years, a number of behavioral scientists have conducted studies examining individuals' environmentally-related attitudes and behaviors. Behaviorally-focused intervention strategies include a variety of techniques that can be broadly categorized as antecedent and consequence strategies [5, 6]. Antecedent techniques include, for example, verbal or written messages and/or awareness or education sessions. When used alone, these techniques typically have not been very successful in motivating inconvenient or time consuming resource recovery behaviors. For example, Witmer and Geller [7] found that prompting techniques (fliers describing the importance of recycling as well as prompting recycling behavior) were less effective than either a raffle contingency or a contest contingency [8].

Some success stories, however, have been reported. For example, Vining and Ebreo found that recycling behavior increased after a community-based recycling education program [9]. Burn and Oskamp discovered that when they provided households with either a persuasive communication alone, public commitment alone (i.e., signing a card pledging support for the community recycling program), a combination of both strategies, or no intervention, households in the three treatment groups recycled more than those in the control groups [10]. Contrary to expectations, however, there were no between-group differences in recycling behavior [10]. Finally, Jacobs et al. compared the behavioral and cost effectiveness of newspaper ads, brochures, bumper stickers, recycling containers, and weekly collections [11]. The authors reported that although intensive prompting that included brochures, ads, and bumper stickers produced the highest levels of participation in recycling, providing citizens with recycling collection containers was more cost-effective [11].

Consequence strategies such as raffles, prizes, and individual and group feedback have reportedly been much more successful than antecedent strategies in promoting recycling behavior [12]. As previously mentioned, raffles have been shown to increase recycling behavior more than prompts (fliers) alone [7], and newspaper recycling was greater when consequence strategies (prizes) were combined with fliers than when fliers were combined with convenient containers [13].

Wang and Katzev compared the relative effectiveness of the provision of discount coupons (consequence strategy), group commitment (i.e., a group of individuals was asked to make a collective commitment to recycle), and individual commitment (i.e., individuals were asked to participate in a recycling effort) – both antecedent strategies – on paper recycling in college dormitories. Each of the three interventions promoted greater short-term recycling behavior

compared to the control group; however, when the reinforcers were removed, only the group receiving individual commitment continued to recycle more than the control group. Similarly, other previous research indicates that it is difficult to provide meaningful incentives to increase recycling [10], and that once the contingencies are removed the desired behavior ceases [15, 16].

In general, feedback as a consequence strategy used either alone or in combination with antecedents or with other response contingent reinforcements, has had mixed results in terms of its effectiveness in modifying behavior [17, 18]. Most of the community studies using feedback as a behavior change strategy were applied to energy conservation or mass-transit use. Mishima and Katzev, however, provided feedback about recycling behavior to university students by posting signs next to recycling barrels in the mailroom [19]. After implementing the intervention, recycling increased by 76.7 percent compared to baseline levels. Unfortunately, the internal validity of the findings is questionable due to the lack of a comparison group. In the present study, feedback was presumed to be a particularly effective strategy for facilitating newspaper recycling because of the competitive nature of a rigorous academic program (e.g., taking exams and receiving grades) and the highly dense networks created in dormitory settings.

To date, there has not been a large scale, pretest-posttest quasi-experimental study to examine the differential impact of education/information (antecedent strategy) and public feedback (consequence strategy) on attitudes, beliefs, and behaviors regarding newspaper recycling. The present study attempted to fill this gap by evaluating the effectiveness of two types of behaviorally-focused interventions (education and feedback) on first-year university students' knowledge, beliefs, attitudes, intentions, and recycling behaviors. Specifically, the hypotheses tested were:

1. Being exposed to either the feedback and/or educational interventions would result in more pro-environmental knowledge, attitudes, beliefs, rated importance, and stronger intentions to participate in recycling in the future than having no exposure to the interventions (control group); and
2. Recycling behavior would be greater for individuals exposed to the feedback intervention (alone or in a combination with education) than for individuals in the education only or control groups.

METHOD

Participants and Procedure

To assess the effectiveness of the interventions, a pre-post test, quasi-experimental design was employed. Baseline and follow-up data were gathered from first-year students residing in residence halls at the University of Michigan. Baseline questionnaires were completed by 3,706 students (80%

return rate). Of the 3,706 students completing the baseline questionnaire, 1,619 (35%) also returned the follow-up questionnaire.

To obtain baseline data, questionnaires were administered to students attending the 1989 summer orientation program. Approximately five months after the baseline measures were gathered, follow-up questionnaires were distributed. To avoid attenuated results, a shorter time span between measurement periods is recommended for future research. Due to arrangements made with the University Housing Department and logistic considerations, however, a shorter time span was not possible. Using the campus mail system, all 4,682 students were sent a letter explaining the study, a questionnaire, and a return envelope. Students were asked to place their completed questionnaires either in boxes at the residence hall or in the campus mail. Students who completed and returned the questionnaire within two weeks were eligible to enter a random drawing to win one of two \$50 prizes. A second mailing including another letter and questionnaire went to those students who did not return the follow-up questionnaire within two weeks but who had completed the baseline questionnaire.

Interventions

Eight residence halls were matched on size and randomly assigned to one of four groups (two halls per group) (see Table 1):

1. Education plus feedback;
2. Feedback posters alone;
3. Education posters alone; or
4. Control group.

Although the residence hall was the unit of randomization, the individual student was the unit of analysis. The experimental interventions, conducted over a five-month period, were of two types:

1. Educational information about the advantages and importance of recycling; and
2. Behavioral feedback (individual and aggregate levels).

Educational Intervention

A series of five "Recycling Myth of the Month" educational posters were developed (size – 7" × 17"). The posters were primarily based on the knowledge questions asked in the baseline and follow-up surveys, thereby providing an assessment of potential knowledge gain due to exposure to the intervention. The poster topics included:

1. The garbage crisis in general;
2. The environmental impact of paper recycling;
3. Product packaging;

4. Energy savings from using recycled materials rather than raw materials; and
5. Decreased air and water pollution resulting from using recycled materials rather than the raw materials.

Feedback Intervention

The feedback intervention, also a poster (size – 11" × 16"), provided two types of information. First, using a bar graph where one additional bar was added monthly, students could see how much newspaper, on a pounds per student basis, had been recycled in their residence hall during the previous month. This strategy provided intra-group feedback. The poster also provided inter-group feedback by displaying ranks of the eight residence halls in terms of overall recyclables collected during the previous month.

The posters were displayed on the inside of the door of waste/recycling closets located on each of the residence hall floors. The closets contained large containers into which the students placed their trash, newspapers, and cardboard boxes for daily custodial pick-up. These closets provided the only way for students to remove trash from their rooms and therefore were most likely used by a great percentage of the students in the hall. Thus, poster placement in the waste/recycling closets, rather than on an overly crowded hall bulletin board, allowed for high levels of exposure to the poster(s). Also, students from other dorms were less likely to be exposed to the poster thereby reducing possible contamination across experimental conditions. Random spot checks conducted during the month showed that overall, the posters were not being vandalized or removed from the closet doors. There were two instances when posters had been removed or defaced, but this was not indicative of a consistent pattern across the residence halls.

Questionnaire Development

As recommended by Ajzen and Fishbein, exploratory data were gathered as the first step in the questionnaire development [20]. A telephone survey conducted with fifty randomly selected students from the 1988-89 freshman class of the university from which the final sample was selected provided information used to develop the final recycling questionnaire. As suggested in the attitude-behavior literature, all questions were worded to focus specifically on paper and paper-product recycling in the residence hall (the behavior of interest), rather than on recycling in general. (Copies of the questionnaires may be obtained from the first author.) Pretesting and reliability assessment was performed with three independent samples of adolescents. One group of twenty-five high school seniors completed two questionnaires, two weeks apart, providing test-retest data. A second group of thirty-nine high school seniors was used to test the revised pretest questionnaire. Cronbach alpha coefficients remained stable across the two surveyed groups and ranged in value from .73 to .90. The test-retest reliability

coefficients ranged in value from .46 to .73. Questionnaires were also administered to an independent sample of 116 first-year university students attending a smaller university in a nearby city. The smaller university group was comparable to the sample used in the study in terms of demographics (age, sex, political leanings). Comparisons of the means and standard deviations of the questionnaire items revealed no statistically significant differences between the samples from the two universities.

Measures

The principle dependent variable in our study was students' self-reported newspaper recycling behavior. Although an objective indicator of actual individual recycling behavior would have been a preferable outcome measure, the size of the present study population ($N = 4,682$) made retrieval of this type of data very difficult. An attempt was made to use pounds of newspaper recycled per residence hall as an objective recycling measure. Results of this analysis showed no statistically significant differences in the quantity of recycled newspapers across experimental groups ($F(4,7) = .338$). We are concerned that the power of this analysis was low, however, because there were only six observations (monthly totals) per dormitory or twelve per experiment condition.

The major constructs outlined in the theory of reasoned action were also measured, including attitudes and beliefs regarding recycling and intentions to participate in recycling [20]. Additionally, rated importance of recycling (compared to other social problems) and knowledge about recycling were measured. For each construct, an operationalization, number of representative items, scale format, and response chosen are presented below.

- **Self-Reported Recycling Behavior:** "How often did you place your already-read newspapers in the designated recycling areas?" (1 item, 7-point Likert scale; *never to always*).
- **Newspaper Recycling Experience:** "How often does your family recycle newspapers?" (1 item, 7-point Likert scale; *never to always*).
- **Behavioral Intent:** "How certain are you that you'll become involved in the residence hall recycling program?" "How involved do you think you'll become in the residence hall recycling program?" (2 items, 7-point Likert scale; *very uncertain to very certain, very uninvolved to very involved*).
- **Attitudes:** Feelings about whether participating in the recycling program is *good/bad, wise/foolish, harmful/beneficial, important/unimportant, wrong/right* (5 items, 7-point semantic differential scale).
- **Beliefs:** "How likely is it that your participating in recycling in the dorm will/won't . . . (a list of twelve possible consequences, i.e., preserve the environment, take more time than it's worth, increase pollution)?" (12 items, 7-point Likert scale; *very unlikely to very likely*).

- **Importance of Recycling:** "Compared to other social issues (e.g., drug abuse, crime), how important do you believe recycling is?" (1 item, 7-point Likert scale; *very unimportant to very important*).
- **Knowledge:** The knowledge questions about the solid waste crisis, included: a) Recycling leads to the marketing of _____ quality products; b) For every \$10 we spend on food, the packaging costs _____; c) Recycling the total print run of the Sunday New York Times saves about _____ trees; d) Making products from recycled materials rather than raw materials requires _____ energy; e) On average, a U.S. citizen throws away _____ pounds of garbage every day. (5 items, *Multiple choice format*).

To determine the degree of exposure to the intervention(s), random telephone calls were made to sixty-five students in the experimental groups. Students were asked: a) if they had observed the educational and/or feedback posters; b) the location of the observed posters; and c) to provide any details they remembered about the posters.

To estimate the amount of newspapers entering each residence hall, the number of student newspaper subscriptions was obtained. This figure was used to address the possibility that recycling behavior would be higher in those residence halls with higher subscription rates.

RESULTS

To examine potential selection bias, analyses comparing students completing only the baseline survey with those completing both surveys were conducted. Students completing both surveys were more likely to be: female ($t(1,3563) = 7.49, p < .001$), and liberal ($t(1,3469) = -3.54, p < .001$), and to have more positive attitudes ($t(1,3609) = -8.20, p < .001$), social norms ($t(1,3655) = -2.45, p < .014$), and intentions ($t(1,3676) = -7.13, p < .001$) regarding recycling than students who completed only the baseline survey.

Descriptive statistics for each scale/variable are depicted in Table 2. The mean age of the sample was eighteen years old and approximately one-half of the sample was male (52%). Also, the sample tended to be slightly more conservative than liberal. Overall, recycling attitudes, beliefs, and intentions reflected a general pro-environmental bias, although only a limited amount of previous experience with recycling was reported.

To address each hypothesis, a two-step analysis of variance (ANOVA) procedure was applied. First, baseline variables were analyzed to determine whether differences in attitudes, beliefs, and recycling experiences existed prior to intervention exposure. No significant group differences at baseline were discovered. Posttest data were then analyzed using a one-way analysis of variance and an *a priori* Scheffe' multiple comparison procedure to see if there were any observable differences across experimental groups [21]. This, rather than analyzing simple

Table 1. Schematic of Study Design:
Assignment of Residence Halls to Experimental Conditions

Group	Baseline Survey	Educational Intervention	Feedback Intervention	Follow-Up Survey
Feedback + Education	+	+	+	+
Feedback only	+	0	+	+
Education only	+	+	0	+
Control	+	0	0	+

Note: + = received the component of the study; 0 = did not receive the component of the study. Assignment to groups was random, each group includes two residence halls.

Table 2. Means and Standard Deviations of Major Study Variables

	Mean	SD
Age (years)	17.7	(0.52)
Political Leanings ^a	4.3	(1.50)
Prior Recycling Experience ^b	3.4	(1.40)
Rated Importance of Recycling ^c	3.4	(2.30)
Recycling Attitudes ^d	6.0	(0.91)
Recycling Beliefs ^e	5.1	(0.88)
Recycling Intentions ^f	4.3	(1.27)

Note: Response anchors –

^a 1 = more conservative, 7 = more liberal.

^b 1 = never, 7 = always.

^c 1 = very unimportant, 7 = very important.

^d 1-7 = semantic differential (see measures section).

^e 1 = very unlikely, 7 = very likely (see measures section).

^f 1 = very uncertain/very uninvolved, 7 = very certain/very involved.

change scores (follow-up minus pretest scores), is a preferred method for determining change in variables of interest [22].

The data in Table 3 reveal that no statistically significant group differences in terms of students' beliefs, intentions, rated importance of and knowledge about recycling at follow-up were discovered. Therefore, the first hypothesis that proposed a differential change in specific variables from baseline to follow-up across experimental groups was not supported.

Table 3. Multiple Comparisons across Experimental Groups in Post-Intervention Beliefs, Attitudes, Intentions, Rated Importance, and Knowledge

Dependent Variable	Group				F	p Value
	A	B	C	D		
Beliefs	5.4 (.85)	5.4 (.87)	5.4 (.90)	5.3 (.91)	1.91	.13
Attitudes	6.3 (.80)	6.3 (.71)	6.3 (.77)	6.2 (.80)	2.29	.08
Intentions	4.0 (1.4)	3.9 (1.4)	3.9 (1.4)	3.9 (1.4)	.80	.50
Importance	3.8 (1.3)	3.9 (1.4)	3.8 (1.4)	3.7 (1.4)	.95	.42
Knowledge	2.4 (.99)	2.3 (.96)	2.4 (1.0)	2.2 (1.0)	1.20	.31

Note: Group A = feedback plus education; Group B = feedback; Group C = education; and Group D = control. Due to the unequal sample sizes across the experimental groups, a harmonic mean cell size was used for the analyses. Values are means and (standard deviations).

Results reported in Table 4 indicate that the second hypothesis was supported. There was a statistically significant difference ($p < .001$) between both the feedback group and the feedback plus education group compared to the education-only and control groups in terms of self-reported newspaper recycling behavior.

Qualitative data obtained from the random telephone calls made to students in the experimental groups substantiated the results obtained from testing the second hypothesis. That is, students receiving the feedback alone and feedback plus education interventions remembered seeing the posters to a much greater degree than students in the education-only residence halls. Also, in the feedback plus education groups, students recalled the feedback poster more readily than the education poster.

DISCUSSION

The results generated from testing the first hypothesis supported findings from previous research that indicate that environmentally-related attitudes and beliefs are not necessarily accurate predictors of behavior [23]. The relationship between

Table 4. Multiple Comparisons of Self-Reported Recycling Behavior across Experimental Groups

	Group				F	p Value
	Feedback + Education	Feedback	Education	Control		
Self-Reported Recycling Behavior	<u>5.8^a</u> (1.6)	<u>5.8^a</u> (1.5)	5.2 (1.8)	5.4 (1.8)	12.80	.001

Note: Due to the unequal sample sizes across the experimental groups, a harmonic mean cell size was used for the analyses. Values are means and (standard deviations).

^aGroups with underlined values were found to be statistically significantly different in self-reported recycling behavior than the other two groups, but not different from each other.

attitudes and behavior is integral to the theory of reasoned action, whereby intentions mediate the relationship between psychological variables and actual behavior [20]. Perhaps because of the current salience of environmental issues, students held positive attitudes and beliefs about recycling prior to the intervention. This pro-environmental stance among adolescents, reported earlier by Dunlap [24] and Arbuthnot [25], was also observed in the present sample.

Results indicated that only in the feedback plus education and feedback alone groups were students' recycling beliefs and attitudes reflected in their self-reported behavior. This finding is similar to that reported in the behavior modification literature and in prior studies on recycling behavior suggesting that providing a person with feedback on their behavior will increase the frequency of the desired behavior [19, 26]. As suggested earlier, feedback may be particularly effective with this sample of college students. Motivated students who have been accepted to a top university are likely to be responsive to feedback regarding their behavioral performance, given the emphasis on grades, test scores, and ranking among classmates. Of course, the concern among those interested in changing behaviors is that the desired behavior will cease once the feedback is removed [15, 16]. This issue could be addressed in a follow-up study examining the relationship between students' stated intentions to participate in paper recycling once leaving the residence hall and their subsequent recycling behavior.

Of concern was the fact that higher self-reported recycling behavior might simply reflect the amount of newspaper being brought into particular residence halls. That is, students receiving more newspapers would have had a greater opportunity to recycle and would therefore be more likely to record a higher behavior score. This issue was addressed by determining the number of newspaper subscriptions in each of the residence halls. The group with the largest number of

newspaper subscriptions was the education only group (351 subscriptions), followed by the control group (338 subscriptions). The education plus feedback and the feedback alone groups had subscription rates of 267 and 212, respectively. Although these values are obviously approximations of newspaper input (because it was impossible to determine how many newspapers were being brought into the residence halls from other sources), it does not appear that the amount of available newspaper necessarily influenced self-reported recycling behavior.

This study has a number of limitations. First, the unit of assignment to the experimental group was the residence hall while the unit of analysis was the student. This presents a problem because it is difficult to tease out the particular treatment effects from what could be called the residence hall effect [27]. Attempts were made to control for additional recycling-education efforts and to make them consistent across each residence hall. However, as is typical for most quasi-experimental studies, complete control of each condition was not always possible. Also, posters are a fairly weak intervention strategy. The impact on self-reported behavior may be more dramatic when used in conjunction with a stronger intervention (e.g., university-wide endorsement via a broad-based media campaign, contests between dorm floors, use of a buddy system).

Finally, the generalizability of the findings is of concern. Not only is this a relatively homogeneous group of adolescents, residence hall residents are also a captive audience. A comparative study with a different sample population, using the same interventions and measuring actual rather than self-reported behavior is needed to determine more explicitly the effectiveness of the interventions.

A generally accepted notion among behavioral scientists is that it is important to apply well-established theoretical frameworks to guide applied intervention research. In doing so, not only is it possible to evaluate the effectiveness of the intervention in a more systematic manner, it also leads to the advancement of theory. The underlying theory for the study reported here was the theory of reasoned action [20]. This theory posits that attitudes and beliefs influence behavior indirectly, and that only intentions to behave directly effect behavior. The educational intervention in this study was specifically developed to influence beliefs about the consequences of recycling. Results indicated, however, that as shown in previous studies, providing information alone did not result in differential changes in beliefs nor in significant behavior change. The feedback intervention, however, did have a small but statistically significant effect on self-reported behavior. Although the differences were small, the findings do begin to provide a picture of how we might be more successful at changing environmentally-related behavior among individuals at this stage in their life. Thus, it may be efficient to focus on the intention-behavior linkage when developing interventions because the present findings suggest that other important variables (e.g., feedback) moderate the relationship between intentions and behaviors that are not included in the TRA. For example, developing interventions that decrease behavioral barriers so behavioral intentions can more easily result in behavior change may be

more important than simply trying to change beliefs. Further research should be conducted to explore additional variables and the types of interventions that could be implemented to enhance recycling behavior.

Technological, economic, and behavioral approaches to alleviating the solid waste crisis have all been proposed. It is reasonable to suggest that none of these approaches alone will provide the ultimate solution to our solid waste crisis. Quite likely, a program combining all three approaches will come closest to promoting a healthy environment. Technology should be used to make recycling more convenient and economic disincentives should be used to discourage *not* participating in recycling. At the same time, environmental responsibility needs to be encouraged and individuals need to learn how to act accordingly and habitually through interventions that include a feedback component.

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