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Linking recycling behavior to waste management planning: A case study of office workers in Taiwan

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Abstract

In recent years, planners have become increasingly involved in issues related to solid waste and the need to develop comprehensive waste management programs. Policy options have been suggested for reducing consumption—an important mechanism for addressing the solid waste disposal problem. These options range from educational programs which encourage individuals and organizations to voluntarily minimize consumer waste to regulations that mandate waste reduction behavior, including recycling, resource reduction, and re-use. In deciding among policy options, planners need to understand those factors that are likely to influence these behaviors in different settings. Although there is a growing body of research covering factors which influence household recycling, determinants of recycling in the workplace are largely unknown.

In this paper, a model displaying factors that may contribute to recycling behavior in the office is presented. Components of the model are then analyzed using data from questionnaires administered to 1788 office workers in 32 organizations in the Taipei metropolitan area. The role of prior recycling experience at home and the organizational and physical context of workplaces in determining office recycling rates are analyzed, as are relationships between environmental attitudes and motivations and recycling practices. Finally, policy options (i.e. educational programs, financial incentives, establishing social norms) for conserving resources through waste management are discussed in light of the findings.

Introduction

Prior to the 1992 Earth Summit in Brazil, a New York Times article suggested that homo sapiens rivals the movement of continents, volcanic eruptions, asteroid impacts, and ice ages as an agent of global change (Stevens, 1992). The forces of population growth together with industrialization and urbanization have been accompanied by emissions of substances such as carbon dioxide and sulfur into the atmosphere, the seeping of toxic wastes into our soils and water bodies, and the consumption of land for urban development. Similarly, the burning of fossil fuels and forests have been releasing heat-trapping carbon dioxide faster than it can be absorbed by oceans and plants.

While few of these global environmental problems resulting from human activity are currently being addressed by urban and regional planners, many are indirectly linked to some of the challenges planners throughout the world are facing today. In this paper, we briefly discuss linkages between the disposal of solid wastes, an issue of growing importance to planners dealing with municipal landfill, and recycling. Solid waste disposal is also a global problem, although it is most pronounced in industrialized countries such as the United States where the amount of municipal solid waste per capita is greater than in any other nation (US Environmental Protection Agency, 1990). We next review the literature covering the effects of environmental attitudes on behavior and

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more specifically, determinants of recycling behavior. A model is then presented suggesting relationships between natural resource depletion, product consumption and disposal, solid waste reduction, and the potential role of policy, planning, and design. Finally, an empirical study examining elements of the model is presented. Specifically, the study considers the extent to which attitudes and motivations together with selected intervention strategies (e.g. recycling programs) are associated with recycling. Determinants of individual and organizational recycling behavior in the context of office environments in Taiwan are examined.

Linking solid waste disposal and recycling

In recent years, the disposal of solid waste, including paper products, has attracted public attention as disposal costs have increased and landfill capacity and location have become hotly debated political issues. The problem is expected to intensify in the future. Current estimates are that 80% of the existing permitted landfills in the US will reach capacity and close within 20 years (US Congress, Office of Technology Assessment, 1989).

Similarly, solid waste resource reduction as a means of minimizing the amount of waste returning to the environment has become a common activity in many communities and households in the US and elsewhere. Indeed, Brussalis and Heumann (1991) have identified several options for consideration by planners and policy makers in their efforts to reduce and better manage the flow of solid waste at the community level. These options taken together constitute elements of a comprehensive waste management plan and warrant the attention of urban and regional planners. Two key elements of the plan are the encouragement of consumers to engage in source reduction activities by establishing recycling programs and the creation of educational/awareness programs aimed at the individual and the corporate consumer.

Recycling programs can affect consumptive as well as recycling behaviors which ultimately impact on both natural resource utilization and the landfill problem. For community recycling programs to be successful, ease of access is a key requirement and has typically been achieved through regular curbside pick-ups and/or conveniently located drop-off centers. The planning of a successful educational/awareness program requires an understanding of consumers themselves, including their waste disposal practices, their environmental attitudes, and relationships between the two.

Environmental attitudes as determinants of behavior

Most researchers are in agreement that relationships exist between environmental attitudes and behaviors associated with the environment. Yet there is little understanding of those factors that are most likely to contribute to environmentally appropriate behaviors. This lack of understanding is not attributable to the paucity of research on the subject. In fact, there has been much research covering environmental attitudes and behavior over the past 20 years (e.g. Constantini and Hanf, 1972; Sharma et al., 1975; Ajzen and Fishbein, 1980; Van Liere and Dunlap, 1980; Heberlein, 1981; Oskamp, 1983; Hines et al., 1986–1987; Vining and Ebreo, 1990; Oskamp et al., 1991). In part, the literature on attitude consistency may help in understanding our inability to establish clear links between environmental attitudes and environmentally appropriate behavior.

According to several attitude theorists, there is a tendency toward consistency in our cognitive structure. For instance, Festinger (1957) suggests that attitude inconsistency is seen as an active force which individuals try to reduce or avoid. However, substantial inconsistencies sometimes exist in spite of this tendency (e.g. LaPiere, 1934; Wicker, 1969). However, when

all other factors stay the same, most researchers believe that a person's cognitive structure tends toward consistency (Heberlein, 1981).

The evidence of attitude–behavior inconsistency has generated various reactions. One reaction involves retrospection of conceptual and methodological issues that might clarify relations between attitudes and behavior. This represents an important change in the focus of research—a change from studying whether or not attitudes are related to behavior to studying the conditions under which attitudes and behavior co-vary. Weigel (1985) identifies three types of issues worthy of consideration:
(1) methodological issues in previous attitude–behavior studies that could have overstated the attitude–behavior inconsistencies observed;
(2) the other-variable issue that, when functioning, could counteract and diminish the impact of attitudes on behavior;
(3) the behavioral criterion issue.

Obviously, relationships between attitudes and behavior are more complicated than generally have been recognized. Nonetheless, substantial relationships can be found when two necessary conditions are met in conducting the research (Weigel, 1985). First, a high-quality attitude measure must be employed. Evidence of internal consistency of the attitude measure should be supplied by the researchers. It is also desirable that evidence of the test–retest reliability and validity of the measure, derived from independent samples, should be provided.

The second condition is that the behavioral criterion should reflect an action domain of comparable breadth to the attitude domain under study. If the attitude measure focuses on the subject's evaluation of a given behavior, then observations of the subject's exhibition or non-exhibition of that behavior represent a legitimate criterion measure. However, if the attitude measure focuses on the subject's evaluation of an object, then only multiple observations of heterogeneous behaviors with respect to that object constitute an appropriate criterion. For example, if we want to understand relationships between workers' attitudes toward office recycling and what they do, we need to measure several types of recycling behavior in office environments, rather than rely on a single behavioral measure.

Understanding factors influencing recycling behavior

Numerous studies have examined conservation behavior, including household recycling and its socio-psychological determinants. For example, general environmental attitudes have played a large part in studies of conservation behavior (Heberlein, 1981; Weigel, 1985) with most investigators agreeing that positive attitudes, including the importance of a specific behavior can be useful predictors of that behavior.

It has also been shown that selected motivations are likely to predict conservation practices. Whereas some studies have reported modest correlations between economic incentives and conservation behavior (Hines et al., 1986–1987), others note that monetary rewards are highly successful in reinforcing behaviors such as energy conservation (e.g. Winett and Neale, 1979). According to some researchers however, monetary incentives only have a temporary effect—conservation behavior returns to baseline levels after the rewards are withdrawn (Jacobs and Bailey, 1982–1983; De Young, 1986; Katzev and Johnson, 1987). These somewhat contradictory findings suggest the need for further research to clarify the importance of economic incentives and motivations in contributing to desirable conservation behavior such as recycling.

Whereas most studies of recycling behavior have focused on the household or solid waste resource reduction in residential settings, we know of no such studies that have occurred in the context of office environments. Our point of departure, therefore, is to understand attitudes and motivations as possible determi-

nants of recycling in this non-residential setting where vast amounts of paper and other products are used in both developed and newly industrialized countries. Similarly, we want to understand the connection between office recycling, recycling practices at home, and the organizational and environmental context of the office worker. Although the extent to which these factors are managed is debatable, it is clear that the amount of recycling (and product reduction and re-use) that takes place in offices can have a significant impact on landfills.

A framework within which the research was conducted is shown in Fig. 1 and was developed as part of a broader investigation of linkages between resource depletion (i.e. deforestation), the production of paper products and their consumption in the office environment, and efforts to minimize paper disposal through waste management programs involving source reduction, re-use, and recycling (Lee, 1992). By source reduction, we mean decreasing product consumption, increasing product durability, and using fewer resources in product production and packaging. Re-use involves both direct consumer re-use of products (e.g. writing on the back side of paper) and composting, whereas recycling includes source separation recycling (e.g. newspapers) and indirect re-use of products (e.g. use of returnable containers). The model shows that imported waste paper and forests are sources of paper products which can either be used in offices (i.e. office paper) or elsewhere. The re-use and recycling of office paper is shown to impact on the amount of paper that is incinerated and eventually disposed of. Finally, the model shows how various interventions (i.e. policies, plans, and designs) can potentially alter recycling practices through changes in individual attitudes and motivations and the organizational/physical context within which individuals operate.

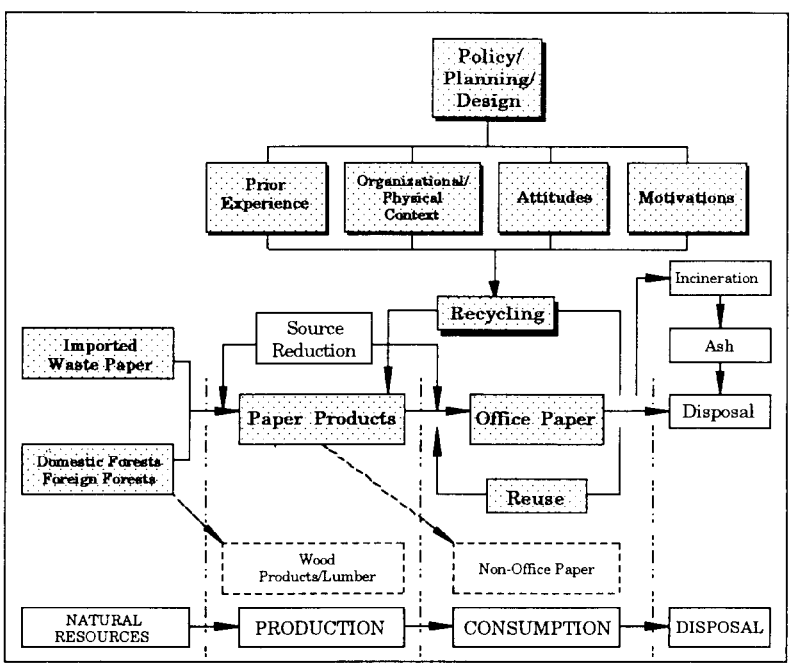

Fig. 1. Framework for linking natural resources, solid waste souirce reduction and selected points of intervention.

The Taiwanese case study

Relationships shown in the upper portion of Fig. 1 and highlighted in Fig. 2 are examined using data from a 1991 survey of office organizations and their workers. The survey was conducted in Taipei, the capital of Taiwan—a country characterized by rapid industrialization, rising living standards, the depletion of natural resources, and a myriad of environmental problems, not unnoticed by the resident population.

Thirty-two organizations in the Taipei metropolitan area were identified and divided into two groups—those having recycling programs ($n=15$) and those without programs ($n=17$). Self-administered questionnaires were distributed to all workers in organizations employing fewer than 30 people; for organizations employing 30 or more people, a probability sample of workers was selected and given questionnaires. A total of 1788 questionnaires was returned, representing a response rate of 89.4%.

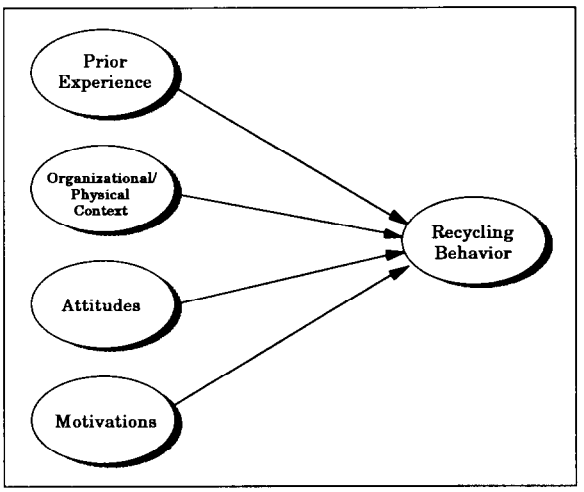

Fig. 2. Factors predicting recycling behavior in offices.

Table 1
Demographic characteristics of Taiwanese respondents

Item	Descriptive statistics
Sex	Male (49.8%), Female (50.2%) ($n=1788$)
Age	Under 30 (36.0%), 30–39 (41.8%), 40–49 (13.5%), 50–59 (5.7%), over 60 (3.0%) $n=1788$)
Education	Primary school (0.1%), Junior high school (0.9%), Senior high school or vocational school (14.5%), Junior college (22.7%), University (44.9%), Graduate school or above (16.9%) ($n=1774$)
Job	Managerial (14.0%), Professional (26.7%), Researcher (2.7%), Secretary (6.2%), clerk (40.9%), Janitor (1.9%), Temporary personnel and others (7.6%) ($n=1747$)

Male and female respondents were equally represented in the sample. About one in three respondents (36%) was under 30 years of age, four in ten were in their 30s, one in seven was in his/her 40s, and 9% of the respondents were 50 years of age or older. Approximately three in five had at least one university degree, whereas one in six had no more than a high school degree. One out of seven workers (14.0%) was in a managerial position, one quarter were professional workers, two in five were clerks, and 6.2% were secretaries (see Table 1).

Measuring key concepts

The questionnaire contained several questions designed to measure each of the concepts shown in Fig. 2. Whereas office recycling is depicted by 'recycling behavior' in the model, household recycling is viewed as an antecedent and therefore is shown as 'prior experience'[1]. In order to study the influence of the physical setting on office recycling, questions about the office layout, depicted as 'physical context', were asked, whereas 'organizational context' refers to the presence or absence of a recycling program in the organization. Finally, questions were included to measure workers' attitudes and motivations with respect to recy-

[1]Whereas office recycling was initiated in the private sector and in governmental offices in the 1990s, household recycling has been widely practiced in Taiwan since World War II. Furthermore, respondents in the study reported a long history of recycling at home. Household recycling is therefore used as a measure of 'prior experience' in the model.

cling. A more detailed discussion of each of these concepts follows.

Office and household recycling

Respondents were asked to report the extent to which they recycled several products in the office and at home. These products included newspapers, aluminum cans, glass containers, plastic bottles, and computer/office paper. Questions about re-using paper, double-sided copying, encouraging co-workers to recycle, and using one's own cup as opposed to a paper cup were also asked.

As shown in the first part of Table 2, household recycling of three main products is widely practiced among the sample of Taiwanese office workers. Four in five said they recycle newspapers at home, whereas glass containers were recycled by somewhat less than half (45%) of the Taiwan respondents, and a third indicated that they recycle aluminum cans.

Household recycling is not new to Taiwan. The practice was widely encouraged following World War II when the government recognized that natural resources were in short supply. Residents recycled and re-used the few consumer products available to them. This long history of household recycling was substantiated by survey respondents.

Approximately the same sequencing of waste materials that was recycled at home was recycled in the office (see Table 2). About nine in ten office workers indicated that they recycle computer/office paper at work, a third said they recycle glass containers, while a somewhat smaller proportion (29%) recycle aluminum cans[2].

As a first step in examining relationships between office recycling and home recycling (prior experience), indices were developed reflecting the degree to which people in the sample engaged in both activities. Using the respondent's answers to eight questions about the extent to which they recycled and re-used office materials, an office recycling index (ORI) was created with individual scores ranging from 0 to 16. Similarly, a household recycling index (HRI) was created using the same procedure. Based on the distribution of index scores for office and home recycling, respondents were grouped into three categories to characterize their household and office recy-

Table 2
Percentage of Taiwanese respondents who recycle at home and at work

	Percentage
Household recycling[1] ($n=1788$)	
Newspapers	82
Glass containers	45
Aluminum cans	35
Office recycling[2] ($n=1788$)	
Computer and office paper	89
Glass containers	34
Aluminum cans	29
Office recycling index (ORI)[3] ($n=1788$)	
Frequent recyclers	16.3
Occasional recyclers	66.2
Infrequent recyclers	17.5
Household recycling index (HRI)[4] ($n=1788$)	
Frequent recyclers	64.0
Occasional recyclers	26.9
Infrequent recyclers	9.1

[1]The question was "And how often do you do the following AT HOME?" The three response categories were: regularly, occasionally, and never. Data reported here cover the regularly and occasionally response.

[2]The question was "Here are some questions about recycling and the re-use of things found around offices. Please indicate how often do you do the following while at work". The three response categories were: regularly, occasionally, and never. Data reported here combine the regularly and occasionally responses.

[3]The office recycling index covers the degree to which various products are recycled and reused. Questions deal with the recycling of newspaper, aluminum cans, glass containers, PET bottles, computer/office paper, the re-use of paper, double-sided copying, and using one's own cup as opposed to a paper cup.

[4]The household recycling index covers the degree to which newspapers, paper/paperboard, aluminum cans, glass containers, PET bottles are recycled, and paper is re-used.

[2]Prior to 1980, people sold their old newspapers, scrap metal, etc. to collectors, but not their used glass bottles or aluminum cans. Today, households save all these used materials and bring them to recycling centers, not for economic reasons but for environmental reasons. In office settings where computer and office paper is widely used, workers are more likely to recycle paper than other materials.

cling practices. These were frequent recyclers, occasional recyclers, and infrequent recyclers.

As shown in the third part of Table 2, about one in six Taiwanese (16.3%) were classified as frequent recyclers at work, two-thirds recycled occasionally, and nearly one in five were classified as infrequent recyclers. In the home setting, two-thirds (64%) were frequent recyclers, a quarter (26.9%) were occasional recyclers, and less than one in ten were infrequent recyclers. These data suggest that the Taiwanese office worker is more actively involved in household recycling than in recycling at work.

Office layout

Two questions pertaining to the layout of the office were included in the questionnaire. Respondents were asked to indicate whether they agreed or disagreed with the following statements using a five-point Likert scale ranging from strongly agree to strongly disagree: "The arrangement of my work place makes it easy for me to recycle," and "It is convenient for me to recycle at work" (see upper panel of Table 3).

When asked about the arrangement of their work place for ease of recycling, about half of the respondents agreed, whereas only one in six (15.6%) disagreed. Similarly, approximately half of the respondents agreed that it was convenient for them to recycle at work and one in five disagreed.

Environmental attitudes

Eight agree–disagree items were used to measure general environmental attitudes and attitudes toward recycling (see middle panel of Table 3). When asked if there was too little concern for environmental issues among coworkers, more than half (53.9%) of the respondents agreed, whereas nine out of ten felt that people at work should make every effort to recycle paper and use the unused side of paper for notes. Almost all respondents (96.9%) agreed that "Recycling seems like the right thing to do" and a similar proportion felt that "Recycling should be an essential part of our way of life."

Motivations to recycle

Several items were included to tape peoples' motives vis-a-vis recycling (see lower panel of Table 3). In general, economic incentives to recycling were not considered important. Only two in ten respondents felt that money would induce them to recycle, and fewer (13.3%) agreed that recycling at work was worthwhile only if they were paid to do so. A slightly higher proportion (22.1%) agreed that recycling only benefitted people in the recycling business while one in ten felt that recycling was a trivial activity.

Findings

In this section, the key concepts of prior experience, availability of recycling program, office layout, and environmental attitudes and motivations are examined vis-a-vis office recycling practices.

The influence of prior recycling experience

Since one purpose of the study was to explore relationships between household and office recycling and test the hypothesis that frequent recyclers at home would most likely recycle at work, a number of ANOVA analyses were performed for different sub-groups of the sample. As shown in Fig. 3, a clear relationship exists between household recycling and recycling at work among Taiwanese office workers ($F_{2,1751} = 387.8$, $P < 0.0001$). Those who actively recycle at home were much more likely to actively recycle at work than their coworkers whose household recycling was limited.

The influence of recycling programs

To what extent do the recycling practices of office workers differ between those in organizations which have sponsored recycling programs and those in organizations where such

Table 3
Statements used in measuring predictor variables

Predictor variable	Statement[1]	Abbreviation
Office layout		
	The arrangement of my work place makes it easy for me to recycle	Arrangement
	It is convenient for me to recycle at work	Convenient
Attitudes	There is too little concern for environmental issues among my co-workers	Little
	People at work should make every effort to recycle paper	Efforts
	People at work should make every effort to use the unused side of paper for notes	Unused
	Recycling seems like the right thing to do	Right
	Recycling should be an essential part of our way of life	Essence
	More information about the value of recycling should be available at my work place	Infoval
	More information about how to recycle should be available at my work place	Infohow
	There is little information about recycling at my place of work	Infolitt
Motivations	Need money incentive for me to recycle	Money
	Recycling at work is worthwhile only if I get paid to do so	Paid
	Recycling only benefits people in the recycling business	Benefit
	Recycling is a trivial activity for which some folks have time	Trivial

[1]The stem question read: "Please indicate to what extent the following statements are true for you". All questions scored on a five-point Likert scale ranging from strongly agree to strongly disagree.

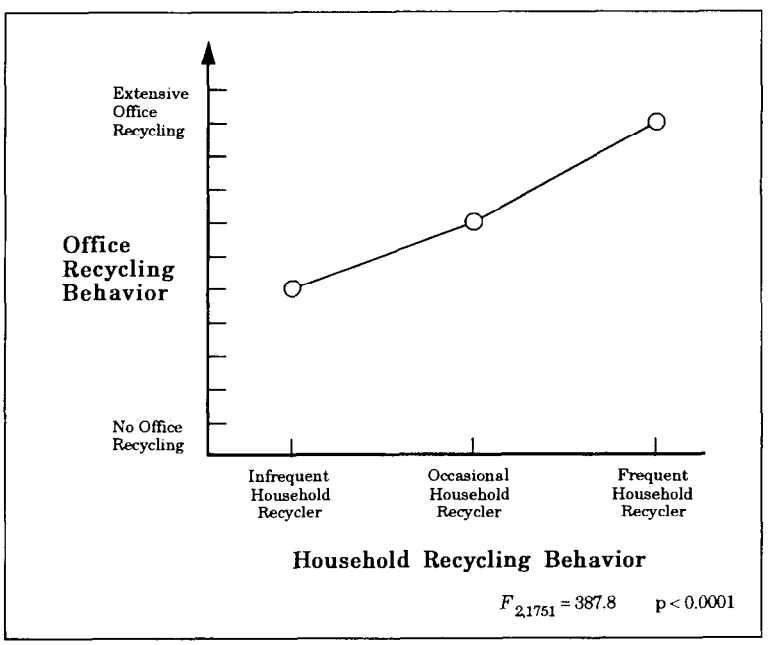

Fig. 3. Relationship between recycling at work and at home.

Table 4
Office recycling among different Taiwanese organizations (figures given are percentages)

		Infrequent office recyclers	Occasional office recyclers	Frequent office recyclers
All	(n=1788)	12	66	22
Program (n=953)	Government (n=305)	16	65	19
	Non-government (n=648)	7	60	33
No program (n=835)	Government (n=383)	17	68	15
	Non-government (n=452)	9	75	16

programs do not exist? Is there a difference in office recycling among employees in governmental and private sector organizations having programs? In order to answer these questions, several analyses were conducted and are summarized in Table 4.

The existence of recycling programs has a definite bearing on employee recycling behavior. Workers in organizations with programs tended to be more active recyclers than those in organizations without programs. Whereas the differences in the proportions of frequent recyclers among governmental organizations without programs was in the correct direction (19% vs. 15%), it was not statistically significant. However, the difference in the proportions of frequent recyclers in non-governmental organizations with and without programs was statistically significant (33% vs. 16%, $P<0.05$).

The table also shows that, among workers in organizations having programs, those working in the private sector (non-government) were more active recyclers than workers in the governmental organizations. A third of the workers in private sector offices were classified as frequent recyclers, whereas only 19% of the workers in governmental organizations were frequent recyclers ($P<0.05$).

In Taiwan, when private office organizations launch a recycling program, it is usually initiated by employees, whereas in governmental organizations the program is imposed by management, reflecting a top-down approach. In the private sector, organizations usually have created an atmosphere whereby workers can initiate various employee-run activities. In the private organizations studied, recycling programs were established in this manner and consequently, workers were more committed to the programs and more willing than those in governmental organizations to participate in recycling (Lee, 1992).

The influence of the office layout

Whereas employees can be encouraged to recycle waste materials through the establishment of 'company-sponsored' programs, recycling can also be facilitated through the design and management of the physical setting. That is, the physical environment and the way it is organized and managed can encourage or impede the recycling of waste products. At the same time, the manner in which recycled products are collected and stored can affect the appearance and functioning of individual workstations and the overall office setting.

Data from the Taiwan study enabled us to explore relationships between the physical context or arrangement of offices and the recycling practices of the workers who occupy them. We suspected that, in addition to organizational directives and established recycling programs, office recycling could be promoted

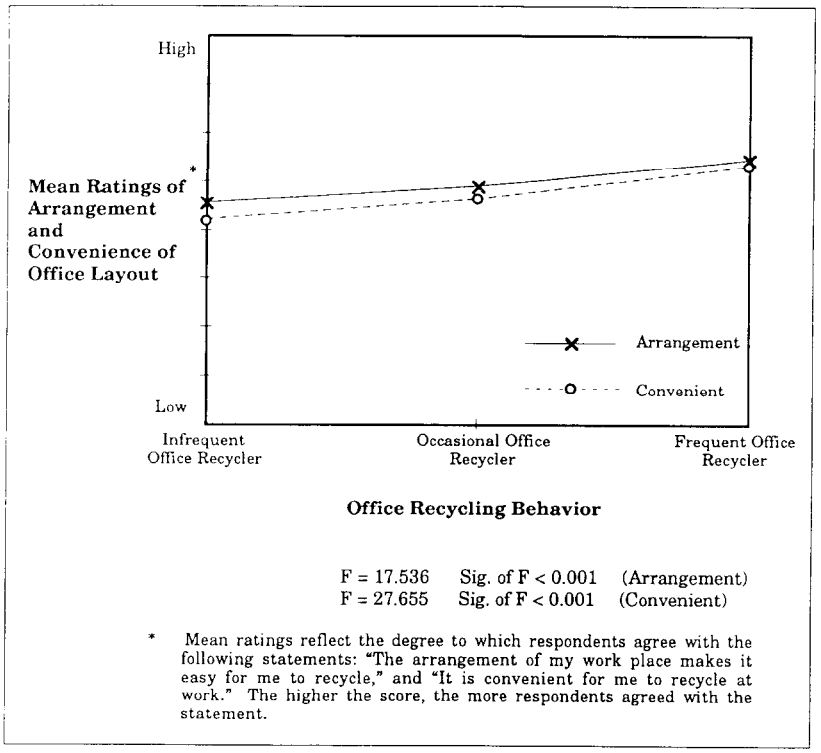

Fig. 4. Relationship between office recycling and office layout.

Table 5
Relationships between office recycling and selected predictor variables

Predictor variable	Infrequent office recyclers		Occasional office recyclers		Frequent office recyclers		F
	Mean	SD	Mean	SD	Mean	SD	
Attitude[1]							
Efforts	4.02	0.72	4.34	0.62	4.55	0.60	47.51**
Right	4.29	0.60	4.53	0.58	4.70	0.48	37.16**
Inofoval	4.22	0.60	4.36	0.57	4.48	0.57	14.61**
Essence	4.16	0.55	4.38	0.58	4.62	0.53	48.87**
Unused	3.90	0.73	4.34	0.64	4.57	0.62	71.83**
Infohow	4.15	0.58	4.36	0.62	4.40	0.69	11.15**
Little	2.81	0.88	3.14	0.99	3.54	0.99	42.65**
Infolitt	2.31	0.86	2.66	1.07	3.35	1.11	84.54**
Motivations							
Money	2.23	0.82	2.04	0.78	1.88	0.80	13.55**
Benefit	2.29	0.88	2.19	0.90	2.00	0.97	8.36**
Trivial	1.98	0.80	1.79	0.74	1.66	0.80	12.38**
Paid	2.11	0.81	1.86	0.71	1.67	0.79	22.68**

[1]See Table 3 for full text of questionnaire items. All questions scored on a five-point Likert scale ranging from strongly disagree (1) to strongly agree (5).
**$P<0.001$.

by both the arrangement of the individual workspace and the placement of stations/bins designed to receive waste materials. Our observations within the organizations did indeed reveal a wide variety of physical arrangements with respect to the placement of collection stations vis-a-vis the office workers. Although these arrangements were not systematically measured and classified, we were able to determine if workers felt the physical setting was supportive of or impeded their recycling. Specifically, workers were asked to indicate whether they agreed with two statements: "The arrangement of my work space makes it easy for me to recycle" and "It is convenient for me to recycle at work".

As shown in Fig. 4, there are modest but significant relationships between the workers' responses to the two items and the frequency with which they recycle. Workers classified as frequent recyclers were more likely than infrequent recyclers to say the arrangement of their office supported their recycling. Similarly, frequent recyclers were more likely to report that recycling at their work was convenient than those classified as infrequent recyclers.

The influence of attitudes and motivations

Table 5 shows the results of ANOVA analyses covering relationships between attitudinal and motivational variables on the one hand, and frequency of office recycling on the other.

Eight attitudinal predictors and four motivational predictors were significantly related to frequency of recycling. As expected, the attitudinal predictors were positively related to frequency of recycling, whereas the motivational predictors were negatively related. Those who felt that economic incentives and monetary rewards were unimportant tended to be more active recyclers than others.

Summary

Correlational analysis of the Taiwan data confirms several of the relationships shown in Fig. 2. Prior experience in terms of recycling at home, the availability of recycling programs at work, the arrangement of the workspace, and selected environmental attitudes and motivations are all associated with the amount and type of office recycling engaged in by office workers. However, subsequent analysis using LISREL indicates that there are more complex underlying factors associated with recycling in the Taiwan office (Lee, 1992). For example, the amount and nature of information about recycling conveyed by organizations (i.e. organizational commitment) is more important to individual recycling behavior than simply knowing whether or not a recycling program exists for the organization. Similarly, office layout, as measured in the Taiwan study, has no impact on an individual's recycling behavior when other influencing factors are taken into consideration. At the same time, a general measure of household recycling has virtually no impact on paper source reduction at work, whereas the latter is strongly associated with paper recycling within the household. These anomalies suggest further inquiries are warranted, not only in Taiwan but in other industrialized countries, where solid waste source reduction and solid waste disposal are salient.

Nonetheless, the Taiwan study suggests numerous possibilities for planners and others dealing with waste management planning. In the area of environmental education, programs can be implemented to not only challenge pre-existing negative environmental attitudes but to encourage individual and organizational recycling. The fact that economic incentives were not a prerequisite for office recycling among Taiwan office workers suggests that providing people with procedural information about environmentally appropriate behavior may be more effective in encouraging that behavior than monetary rewards.

With regard to the organizational and physical context of the workspace, encouraging office workers to recycle can be accomplished through establishing information-rich recy-

cling programs. Similarly, the physical setting within which the organization operates can be designed to facilitate active recycling. For example, an organization's commitment to recycling can be demonstrated, in part, by programming for conveniently located recycling stations when planning and designing offices. That is, facility managers can work closely with architects, office designers, and furniture designers to create the appropriate physical context that enables workers to easily engage in recycling practices.

At a global level, this paper has suggested linkages between the disposal of solid waste and the problem of municipal landfills while discussing the role of policy, planning, and design in solid waste reduction. It has also presented findings from an empirical study which examined worker attitudes and motivations associated with office recycling in Taiwan. The findings suggest that waste management planning requires an understanding of recycling behavior and its antecedents, including the attitudes of consumers and the physical and organizational context within which they operate.

References

Ajzen, I. and Fishbein, M., 1980. Understanding Attitudes and Predicting Social Behavior. Prentice-Hall, Englewood Cliffs, NJ.

Brussalis, C.W. and Heumann, L.F., 1991. Solid waste source reduction: A local and regional planning strategy. Plann. Public Policy, 15: 1–4.

Constantini, E. and Hanf, K., 1972. Environmental concern and Lake Tahoe: A study of elite perceptions, backgrounds, and attitudes. Environ. Behav., 4: 209–242.

De Young, R., 1986. Some psychological aspects of recycling: The structure of conservation satisfactions. Environ. Behav., 18: 435–449.

Festinger, L., 1957. A Theory of Cognitive Dissonance. Stanford University Press, Stanford, CA.

Heberlein, T.A., 1981. Environmental attitudes. Z. Umweltpolitik, 2: 241–270.

Hines, J.M., Hungerford, H.R. and Tomera, A.N., 1986–1987. Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. J. Environ. Educ., 18: 18.

Jacobs, H.E. and Bailey, J.S., 1982–1983. Evaluating participation in a residential recycling program. J. Environ. Syst., 12:141–152.

Katzev, R.D. and Johnson, T., 1987. Social Influences. Westview Press, Boulder, CO.

LaPiere, R.T., 1934. Attitudes versus actions. Soc. Forces, 13: 230–237.

Lee, Y.-J., 1992. Determinants of individual recycling behavior in office environments: A case study in Taiwan. Ph.D. Dissertation, University of Michigan, Ann Arbor. (Unpublished.)

Oskamp, S., 1983. Psychology's role in the conserving society. Pop. Environ., 255–293.

Oskamp, S., Harrington, M.J., Edwards, T.C., Sherwood, D.L., Okuda, S.M. and Swanson, D.C., 1991. Factors influencing household recycling behavior. Environ. Behav., 23: 494–519.

Sharma, N.C., Kivlin, J.E. and Flegel, F.C., 1975. Environmental pollution: Is there enough concern to lead to action? Environ. Behav., 7: 455–471.

Stevens, W.K., 1992. Humanity confronts its handiwork: An altered planet. The New York Times, 5 May 1992.

US Environmental Protection Agency, 1990. Characterization of municipal solid waste in the United States: 1990 update. Executive summary. EPA/530-SW-90-042A, Office of Solid Waste, US EPA, Washington DC.

US Congress, Office of Technology Assessment, 1989. Facing America's trash: What next for municipal solid waste. OTA-O424, US Government Printing Office, Washington DC.

Van Liere, K.D. and Dunlap, R.E., 1980. The social bases of environmental concern: A review of hypotheses, explanations and empirical evidence. Public Opinion Q., 44:181–197.

Vining, J. and Ebreo, A., 1990. What makes a recycler? A comparison of recyclers and nonrecyclers. Environ. Behav., 22: 55–73.

Weigel, R.H., 1985. Ecological attitudes and actions. In: D.B. Gray (Editor), Ecological Beliefs and Behaviors: Assessment and Change. Greenwood Press, Westport, CT, pp. 57–85

Wicker, A.W., 1969. Attitudes versus actions: The relationship of verbal and overt behavioral responses to attitude objects. J. Soc. Issues, 25: 41–78.

Winett, R.A. and Neale, M.S., 1979. Psychological framework for energy conservation in buildings: Strategies, outcomes, directions. Energy Buildings, 2:101–116.