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DEVELOPING A TENTATIVE MODEL OF DISPOSAL DECISIONS*

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ABSTRACT

Concern over problems of resource depletion, environmental damage, and the ever-increasing costs of disposing of solid wastes has led to a search for new approaches to managing these wastes. One way of reducing the rate at which the wastes are first generated might be to extend the lifetimes of durable products. To assist policy-makers in understanding how the lifetimes are determined, an exploratory study has examined factors influencing consumers' decisions to dispose of certain small electrical appliances. Selected findings of a household survey are presented here, focusing on 1) the frequency distribution of disposal choices and the reasons given for disposal, and 2) variables associated with particular disposal options. A tentative model of the process leading from consumer purchase to consumer disposal is proposed.

INTRODUCTION

Concern over problems of resource depletion and environmental damage, as well as over the ever-increasing costs of disposing of solid wastes, has led to a search for new approaches to managing these wastes. Rather than simply taking the waste stream as a given, and attempting either to recover resources from it or to

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assimilate it as harmlessly as possible into the environment, attention is increasingly being given to the feasibility of altering the processes that lead to its generation, an approach known as "waste reduction." One possibility under consideration is that of extending the lifetimes of durable products, in the hope of slowing both the generation of discards and the demand for replacements.[1] Although it has been shown that the manufacture, use, and disposal of more durable products could, under some circumstances, entail a higher rather than lower intensity of materials and energy use [6], nevertheless, the extension of product lifetimes seems likely in many cases to offer resource and environmental benefits.

Assuming that policy-makers might wish to extend the lifetimes of durable products, it is important for them to understand the key factors that determine these lifetimes. There would be little point, for example, in simply persuading manufacturers to make physically more durable products if physical durability were not a major factor affecting disposal decisions (that is, if consumers were to dispose of products regardless of their functional state).

Until recently, hardly any empirical research had been conducted in this area. A limited amount of information on particular disposition decisions for durable products had been obtained from surveys of consumers' reasons for making replacement purchases [7, 8] but to these authors' knowledge, only one study had been aimed specifically at examining disposition behavior [9]. In this last study, the authors developed a three-part taxonomy of possible disposal options (i.e., keep the product, permanently dispose of it, or temporarily dispose of it) which they found useful in categorizing the behavior revealed in an exploratory survey concerning the disposition of several consumer products; they then suggested important directions for future research, including the gathering of additional descriptive information, a search for explanations of why certain patterns exist, and efforts to predict and change disposition behavior. However, before publication of this work, a more extensive though still exploratory investigation had begun, sponsored by the National Science Foundation (NSF) and entitled "Factors Affecting Product Lifetime: A Study in Support of Policy Development for Waste Reduction."

The NSF-sponsored project included:

1. a survey of consumers to obtain information about their acquisition and disposal of a selected set of products;
2. in-depth interviews with firms engaged in the manufacture and distribution of the same set of products; and
3. a limited investigation of second-hand markets (on the grounds that these markets provide an opportunity for the transfer of products from owners

[1] Other examples of waste reduction include 1) the use of less material per unit of product, 2) the substitution of reuseable products for single-use "disposable" products, and an increase in the number of times that items are reused, and 3) a reduction in the number of units of product consumed per household per year [1-5].

who no longer use them to prospective new users who may thereby extend their lifetimes).

The present paper reports on selected findings from the consumer survey, focusing on:

1. the frequency distribution of disposal choices and the reasons given for disposal, and
2. variables associated with particular disposal options.

A tentative model of the process leading from consumer purchase to consumer disposal is proposed.

PROCEDURE EMPLOYED IN CONSUMER SURVEY

Sampling Frame

A stratified random sample of 3,291 residents of the City of Santa Monica, California, were contacted by telephone and administered a screening questionnaire to identify those who had disposed of one of the selected appliances within the past twelve months. Of those who were thus identified, 311 agreed to and successfully completed in-home interviews conducted by professional interviewers.

Product Mix

The products chosen for inclusion in the study were a variety of small electrical appliances. One of the reasons for this choice was that typically these particular products, while relatively inexpensive to purchase, are rather expensive to repair; thus consumers may be quick to discard them as soon as they break down (for whatever reason). If products are classified on a spectrum from "durable" to "non-durable," it may be that these appliances (in the consumers' perception) are moving toward the "non-durable" end of the spectrum. This being so, they symbolize a trend that is contrary to the notion of waste reduction.

The specific product list for the study was designed to include appliances characterized by rapid technological innovation (e.g., toaster ovens), those for which stylistic innovation is rapid (e.g., hair dryers), those that could be considered "fads" (e.g., electric toothbrushes), and those considered relatively "stable" (e.g., vacuum cleaners). Product selection was also guided to some extent by focus group discussions, suggestions from the project's industrial consultant, etc. An initial list of fourteen appliances was originally intended to be narrowed down early in the study so that just a few "representative" products could be examined in depth; with a smaller number of products, the sample size for each would be larger and product-specific results would therefore have

greater statistical significance. However, an early finding (from a pre-test of the screening instrument) was that the frequencies with which individual products had been disposed of were too low to narrow the list and still acquire a sufficiently large sample overall (within the time and resource constraints of the project) to support quantitative analysis.[2] Thus all of the products included in the initial list were retained for examination in the full survey. The list included toasters, toaster ovens, blenders, coffee-makers, can openers, frypans/skillets, irons, blow hairdryers, bonnet hairdryers, vacuum cleaners, radios, black and white televisions, electric toothbrushes, and mixers.

Dependent Variable

A verbal report of disposal choice served as the dependent variable. "Dispose" in this context included: throw away, store (with no definite intention to reuse), donate to charity, sell, give to a friend or relative, and trade-in. It may be noted that the options throw away and store can be considered more likely to signify the end of a product's useful lifetime than the other four options, although some stored items may of course subsequently be reused, while the lifetimes of products donated, sold, given away, or traded-in may not always be extended by their new owners.

Independent Variables

Among the independent variables considered potentially significant were socioeconomic variables (consumers' education, income, ethnicity, sex, and age), characteristics of the products (type, price, years of use, functional state when discarded) and perceptions/sentiments of the consumers (years of expected use, satisfaction with length of actual use). These variables were all explored in the household interviews.

Data Analysis

Relationships between the variables were examined by means of simple statistical techniques, largely cross-tabulations. Associations were sought with a significance level of 0.05 (i.e., 95% confidence) or better.

RESULTS

Choice of Disposal Options and Reasons for Disposal

Table 1 gives the frequency distribution of the disposal options, as recorded in the completed interviews. It is apparent that the options thrown away and stored were chosen most often.

[2] Of those who responded to the telephone screener, 33 per cent had disposed of one of the selected appliances within the previous twelve months.

Table 1. Disposal Option Frequency Distribution

Option	*Per cent*
Stored	41
Thrown Away	21
Given Away	18
Donated	11
Sold	7
Traded-in	2

Note: Total number of respondents = 311.

Table 2 groups the responses to an open-ended question regarding the circumstances leading to the disposal decision. The most important reasons given for disposing of products were:

1. that the product was broken;
2. that a new product was preferred; and
3. that the respondent had no use for the product.

Table 2. Circumstances Which Led to Disposal Decision

Reason	*Per cent giving reason*	
A. Product inoperative:	40	
not working—no attempt to repair		27
repair cost too high		9
misused and consequently inoperative		3
can't get repair parts		1
B. New product preferred:	26	
had or bought a replacement		10
obtained technically improved model		8
given a replacement		4
very old—not working as well as new ones		4
C. No use for product:	25	
lifestyle change and no longer need		8
don't like the product and/or way it functions		8
never any need for product		6
inconvenient to use (no space in kitchen, etc.)		3
D. Other:	9	
friend or relative needed		5
moving or will move soon		3
unclear		1

Note: Total number of respondents = 303.

Table 3. Circumstances Which Led to Disposal Decision and Choice of Disposal Option

I. Disposal option by circumstance which led to disposal

Reason for disposal of product	*Disposal Option (Per cent)*			
	Stored	*Thrown away*	*Other*[a]	*n*
Preferred new product	39	12	49	79
Product inoperative	39	42	19	127
No use for product	53	3	44	81
Other	17	0	83	8

II. Circumstance which led to disposal by disposal option

Disposal option	*Reason for Disposal (Per cent)*				
	Preferred new product	*Product broken*	*No use for product*	*Other*	*n*
Stored	24	39	34	3	124
Thrown away	14	83	3	0	64
Other	33	20	30	17	107

[a] "Other" disposal options included donate, sell, give-away, trade-in.

Table 3 compares the circumstances which led to disposal with the disposal option chosen by each respondent. Many people who had no use for their products chose to store them. Those who preferred a new product were most likely to choose one of the "other" disposal options (i.e., donate, sell, give-away, trade-in). Those whose products were broken were least likely to choose one of these other options. Most respondents who threw products away (83%) did so because the product had broken down. Almost all of the others who threw items away did so because they had replaced the old product with a new one.

The data support the proposition that people usually throw products away because they no longer function. It is interesting that not all of those whose products were broken at the time of disposal (54% of the sample) gave this as their most important reason for disposing, which suggests that the possibility of having their products repaired might not even have been considered. The data also imply that people disposing of products that they no longer use (or never used) typically choose to store them. It may be that these products are in particularly good condition (due to little or no prior use) and so their owners are reluctant to part with them.

Table 4. Reasons for Choice of Disposal Option

	Per cent	*Total n responding for each disposal option*
Stored		128
Possible future use	35	
Couldn't decide what to do, nice	23	
Will repair in future	15	
Thrown away		65
Damaged beyond repair	29	
Not worth repairing	29	
Easiest option available	11	
Given away		56
Friend, relative needed one	39	
Still works—not used now	30	
Nice to do	16	
Sold		34
Need the money	24	
Still useful—saleable	24	
Garage sales fun	10	
Donated		22
So others can use	35	
Support volunteer organizations	30	
Too much trouble to repair	18	
Traded-in		6
To get a price cut	43	
Still worth something	29	
Wanted new one	29	

Respondents were asked to give the reasons for their particular choices of disposal option. The responses most frequently given are shown in Table 4.

Variables Associated With Disposal Behavior

No direct association was found to exist between the socioeconomic variables and the disposal choice. However, as discussed below, significant age differences were found in the years of product use, a variable that did differ significantly with disposal option.

The variables that appeared to exhibit the most significant associations with disposal option were:

1. product type;
2. product price;
3. functional state of the product when discarded; and
4. consumer satisfaction with length of use.

Table 5. Disposal Option By Product Type

	Per cent of products			
Appliance	*Thrown Away*	*Stored*	*Other*	*n*
Toaster	29	26	45	35
Toaster oven	0	36	64	11
Mixer	19	33	48	21
Can opener	30	46	24	33
Coffee maker	32	50	36	16
Blender	17	56	27	23
Skillet	10	40	50	10
Blow dryer	42	42	16	41
Bonnet hairdryer	19	57	23	21
Elec. Toothbrush	20	40	40	5
Vacuum cleaner	0	32	67	29
Iron	32	38	30	16
Television (B & W)	7	35	59	34
Radio	13	62	25	16
All products	21	41	38	311

Note: Significance = .0036.

Some variation was also found among the disposal options for the variables years of use and years of expected use.

Product type and disposal option–Table 5 shows the relationship between product type and disposal option. It is apparent that the products most often thrown away were blow dryers, irons, and coffee makers; the products most often stored were radios, bonnet hairdryers, and blenders; and the products most often disposed of by donating, selling, giving away, or trading-in were vacuum cleaners, toaster ovens, and televisions.

Product price and disposal option–Table 6 shows the distribution of disposal options by product price, where this was known.[3] About two-thirds of the

[3] Note that, of the 311 respondents interviewed, 184 (59%) claimed to have known the price of the product they had disposed of. It is possible that whether or not a respondent knew the product price may have influenced disposal option choice; thus conclusions based on price cannot necessarily be applied to the entire sample. Furthermore, the product prices may not be strictly comparable since 1) the respondents had to rely on memory, and the accuracy of their responses may well have depended on the different lengths of time that had lapsed since their products had been acquired, and 2) the prices of small electrical appliances have been changing over the past few years as the result of two influences, namely technological developments (which have tended to lower the prices) and inflation (which has tended to raise them).

Table 6. Product Price By Disposal Option

	Per cent costing		
Disposal Option	*Under $30*	*$30 and Over*	*n*
Thrown away	88	12	42
Stored	70	30	70
Other	49	51	72

Note: Significance ⩽ .001.

sample, 70 per cent of the stored items and 88 per cent of those thrown away, had cost under $30. Forty-nine per cent of the items disposed of in one of the other ways had cost under $30. The data appear to indicate that expensive items were generally not thrown away, while inexpensive items were disposed of in any manner. They do not explain why only certain inexpensive items were thrown away.

Functional state and disposal option–The apparent association between price and the disposal option thrown away might be explained by one or more of the other factors associated with disposal option. Table 7 shows the relationship between the variable disposal option and functional state when discarded. This table follows a similar pattern to that of disposal choice by price. Products thrown away needed repair (when disposed of) 95 per cent of the time. Stored items needed repair less often (about the same per cent as that for all the products combined), and the other options needed repair the least often.

The repair factor seems to almost completely explain the association between purchase price and disposal option for products thrown away. Table 8 compares price and functional state when discarded. Only one product (for which price was known) was thrown away without needing repair. All of the products

Table 7. Functional State of Discarded Products, By Disposal Option

	Per cent of products		
Disposal Option	*Needing Repair*	*Not Needing Repair*	*n*
Thrown away	95	5	65
Stored	53	47	128
Other	32	68	115

Note: Significance ⩽ .001.

Table 8. Functional State of Discarded Products, By Price and Disposal Option

	Thrown away		*Stored*		*Other*	
Price	*R*[a]	*NR*	*R*	*NR*	*R*	*NR*
Under $30	97	3	59	41	27	73
$30 and over	100	0	52	48	43	57
n	41	1	40	30	25	46

[a] R = per cent of products that needed repairs when discarded; NR = per cent of products that did not need repair.

costing $30 and over, and 97 per cent of the products under $30, were thrown away in need of repair. This indicates that the correlation between low price and the disposal option thrown away can be explained by the repair factor. It appears that products were thrown away because they needed repair, not because they were inexpensive. However, one might expect the inexpensive items to break down more readily than items costing $30 or more.

The repair variable is less helpful in explaining why items were stored or disposed of in one of the other four ways. Table 8 reveals that more than half of the products stored, in both price categories, needed repair. While the percentage of items in need of repair was lower than for items thrown away, non-functioning products still accounted for a majority of stored items. Why were these products stored rather than thrown away? The repair variable does not answer this question.

Fewer than half of the products in the "other" disposal category were non-functioning when discarded. Interestingly, in this category, fewer of the less expensive items needed repair than the items costing $30 or more. It appears that the more expensive items, though in need of repair 43 per cent of the time, were still of sufficient value to someone to be donated, sold, given away, or traded-in.

Years of use and disposal option—The variable years of use may partially explain why some items needing repair were thrown away and others were stored. The mean years of use for products thrown away had a probability of varying significantly from the mean years of use for all products 95 per cent of the time (see Table 9). The mean years of use for all products was 6.59 years; the mean for thrown away products was 4.68 years. In contrast, the mean years of use for stored and "other" products was slightly higher than the mean for all products but did not differ from it significantly. This information suggests that thrown away items were generally inexpensive products that had broken down after a few years of use. The years of use factor may have distinguished

Table 9. Mean Years of Product Use, By Disposal Option

Disposal option	*Mean years of use*	*n*
Thrown away	4.68	63
Stored	7.15	123
Other	7.04	113
All	6.59	299
Confidence interval	(5.87-7.31)	

Note: Confidence level = .05; Standard deviation = 6.33.

inexpensive, non-functioning, thrown away items from the same category of stored items. Items that had broken down after the consumer had used the product for a satisfactory length of time might have been stored most often than thrown away.

Price, years of use, and disposal option—A significant association between price and years of use seems logical since price might have affected the rate of disfunction; in turn, broken products might have been discarded. The data appear to support this assumption. Table 10 shows that 79 per cent of the products used from zero to three years cost under $30, 62 per cent of the products used from four to six years had cost under $30, and 52 per cent of the products used for more than six years had cost under $30. This suggests that the number of years a product was used increased as price increased. There could be at least two explanations for this, namely:

1. more expensive items might not have broken down as quickly as inexpensive items and might, therefore, have been used longer; and/or
2. less expensive items might have been discarded more quickly than expensive items regardless of their functional state because they represented a smaller consumer investment.

Table 11 shows the mean years of product use for different price ranges and different disposal options. Price had no effect on the years of use of thrown away products; inexpensive items lasted an average of 4.62 years, and more expensive items lasted an average of 4.40 years. However, stored items that had cost $30 and over differed significantly from the less expensive items as to mean years of use. Since the more expensive stored items lasted an average of 10.71 years, it appears that years of use might have played a role in the decision to store or throw away. Possibly, owners were more likely to store rather than throw away products that had given "good service" (i.e., when they had given

Table 10. Product Price By Years of Use

	Per cent costing		
Years of Use	*Under $30*	*$30 and Over*	*n*
0-3	79	21	75
4-6	62	38	42
Over 6	52	48	63
All products	66	34	180

Note: Significance = 0.0045

many years of use). Products in the "other" category did not differ significantly by price as to mean years of use, but were used longer than products thrown away.

Years of use and consumer satisfaction–How many years of use were considered satisfactory by consumers? It may be reasoned that satisfaction with the years of use would depend on how long a consumer expected the product to last. Eighty per cent of the consumers were satisfied with the years of product use. Products generally did last the number of years expected. Table 12 compares the mean years of expected use and the mean years of actual use for each disposal option category. The table indicates that in only 5 per cent of the cases would one expect to find significant deviations in the mean value for years of use and years of expected use.

Since the years of actual use generally met expectations for each of the disposal option categories, one might expect equal consumer satisfaction among disposal options as to years of use. However, Table 12 shows that there was

Table 11. Years of Use By Price and Disposal Option

	Mean years of use for products			
Disposal Option	*Under $30*	*$30 and Over*		*n*
Thrown away	4.62	4.40	No significant difference	42
Stored	6.23	10.71	Significant variation at .05 confidence level	68
Other	5.41	7.42	No significant difference	70

Note: Confidence intervals at .05 confidence level = 5.84-9.40; Standard deviation = 7.47.

Table 12. Years of Expected Use and Years of Actual Use, By Disposal Option

Disposal option	*Mean years of expected use*	*Mean years of actual use*	*n*	*Standard deviation*[a]
Thrown away	5.17	4.68	52	3.43
Stored	6.37	7.15	87	5.13
Other	8.04	7.04	78	6.18

[a] Confidence levels indicate no significant deviation in years of use and years of expected use 95 per cent of the time.

significant variation among disposal options as to consumer satisfaction (43% of the dissatisfied respondents threw away products). People who threw items away were less satisfied than others. Table 14 shows that years of use was important to satisfaction. The mean years of product use was 2.91 years for those who were dissatisfied, but 7.71 years for those who were satisfied.

One might conclude that while years of use is important to consumer satisfaction, such satisfaction is not necessarily determined by whether years of use equals years of expected use.

It was found that years of use and expected years of use varied significantly with the age of respondents. Table 15 shows that 56 per cent of the post-retirement age respondents had products which were over six years old when discarded, and 55 per cent of the young adults used products for three years or less. Expected years of use followed a similar pattern; 42 per cent of the young adults expected products to last three years or less, while 49 per cent of the post-retirement respondents expected products to last more than six years.

It is possible that years of expected use (as recorded in the survey) was influenced by years of actual use. One might also infer from Table 14 that consumers were likely to be dissatisfied with products that lasted about three years or less.

Table 13. Per cent Satisfied With Years of Use, By Disposal Option

	Per cent who were		
Disposal Option	*Satisfied*	*Not Satisfied*	*n*
Thrown away	58	42	65
Stored	84	16	127
Other	86	14	113
All	79	21	305

Note: Significance $\leq .001$.

Table 14. Years of Use and Satisfaction With Years of Use

Satisfied	*Mean years of use*	*n*
Yes	7.71	241
No	2.91	58
Mean	6.59	299
Confidence Interval	(5.98-7.33)	

Note: Confidence level = .05; Standard deviation = 6.33.

TENTATIVE MODEL OF PROCESS LEADING FROM PURCHASE TO DISPOSAL

It seems possible that product type and perhaps product price are the original independent variables since they are established prior to the other variables (being determined at the point of purchase). The findings suggest that the other variables might help to explain the association of product type and price to disposal option. Figure 1 shows the possible sequential order and relationships of these variables.

This figure suggests that product type (1) influences the price paid for the product (2). The price in turn influences how long the consumer expects to use the product (2 to 3) and how many years the consumer actually uses the product (2 to 5). Price also influences the functional state of the product at the time of disposal, given the years of product use (2 to 5 to 4).

Functional state and years of use might influence each other. For example, the product might be inexpensive, and break down quickly, and this might result in its disposal after a few years of use (4 to 5). Alternatively, the product might need repair as the result of many years of use (5 to 4). It seems that the years the product has been used, and whether it needs repair (in light of the years of

Table 15. Years of Use By Age of Respondents

	Per cent of products used			
Age of Respondents	*0-3 yrs*	*4-6 yrs*	*Over 6 yrs*	*n*
Young adults (18-24 years)	55	38	7	42
Adults (25-64 years)	43	23	34	201
Post-retirement (65 years and older)	26	18	56	50

Note: Significance $\leq$ .001.

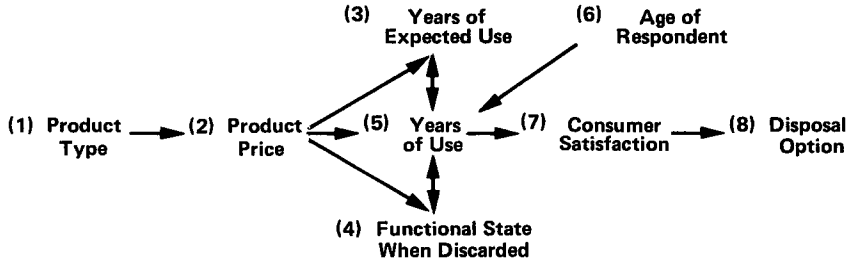

Figure 1. Variables leading to disposal option.

use), have an influence on consumer satisfaction (4 and 5 to 7). Consumer satisfaction then influences disposal option (7 to 8). It has been shown that years of expected use (at acquisition) may influence years of use, but also vice versa. Years of expected use may be a reflection of the years of actual use (3 to 5 and 5 to 3).

Even if the schematic has validity (and the evidence at this stage is really insufficient to be conclusive), it is likely to be an extremly simplified version of the actual process leading from consumer purchase to consumer disposal. Other factors might be expected to influence the variables outlined above: for example, the frequency of product use is probably significant in this regard, but unfortunately reliable use data proved difficult to obtain in the survey. The research team recognized in advance the difficulty of obtaining reliable data on the amount of use given to a product prior to its disposal, but were unable to develop a satisfactory method of measurement. The questionnaire included questions about both frequency and time of use in the hope that respondents might be able to make reasonable estimates of one or the other (if not both). For example, it is perhaps easier to remember the number of times (rather than the length of time) that a toaster is used in a week, while the opposite might be true of an iron. However, because of problems of comparing the amount of use for different products, and other difficulties, the information collected proved to be of little value.

CONCLUSIONS

Among those concerned about problems of resource depletion and environmental damage, there are some who feel that these problems will ultimately force upon us fundamental shifts in our present materialistic lifestyles. The "throw-away" mentality that so many of us seem to possess (at least in the U.S. and Western Europe) will have to be changed. With this in mind, a study has examined factors that influence consumers in their decisions to dispose of certain products. The study was exploratory, and its use of a relatively small

survey sample (in a limited geographical area) means that its findings can be generalized only with caution. Nevertheless, a start has now been made at increasing our knowledge in a hitherto largely neglected area, one that hopefully will attract more attention in the future.

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