INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

UMI

A Bell & Howell Information Company
300 North Zeeb Road, Ann Arbor MI 48106-1346 USA
313/761-4700 800/521-0600

FACTORS INFLUENCING HOUSEHOLD HAZARDOUS WASTE DISPOSAL

A Thesis in partial fulfillment of the M.Sc. Degree
Department of Psychology, Carleton University;
Collaborative Programme in Chemical and
Environmental Toxicology, Carleton University
and the University of Ottawa, Ottawa,
Ontario, Canada, 1998.

By: Roger Henri Thomas

Thesis Advisor: Dr. William M. Petrusic

National Library
of Canada

Acquisitions and
Bibliographic Services

395 Wellington Street
Ottawa ON K1A 0N4
Canada

Bibliothèque nationale
du Canada

Acquisitions et
services bibliographiques

395, rue Wellington
Ottawa ON K1A 0N4
Canada

Your file Votre référence

Our file Notre référence

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-27067-X

Canada

Thesis Acceptance Form

The undersigned recommended to the Faculty of Graduate
Studies and Research acceptance of the thesis

"FACTORS INFLUENCING HOUSEHOLD HAZARDOUS
WASTE DISPOSAL"

submitted by
ROGER H. W. THOMAS

in partial fulfillment of the requirements
for the degree of Master of Science

A handwritten signature in cursive script, appearing to read "William M. Peters", is written over a horizontal line.

Thesis Supervisor

A handwritten signature is written over a horizontal line.

Chair, Department of Psychology

Carleton University

January 15, 1998

Abstract

Household hazardous waste (HHW) is residual material generated by the use of consumer products which are toxic, inflammable, or corrosive. The purpose of this research is to determine what cognitive and demographic factors predict correct HHW disposal behaviour and discover survey participants' preferences for various disposal options. This research tests a theoretical structure comprised of six cognitive factors designed to predict correct HHW disposal using a sample of 203 residents from Ottawa-Carleton. Prediction of correct hazardous product disposal required a different logistic regression model for each of the seven HHW products evaluated. Multivariate analyses identified four key factors for predicting correct HHW disposal behaviour: perceived knowledge, willingness to travel, living in a single family dwelling with access to a vehicle, and perceived difficulty. The results also indicated participants desire for convenient means of HHW disposal. Increased participation in correct HHW disposal is unlikely without alteration in the collection infrastructure.

Acknowledgements

I should like to acknowledge the help of Professor W. M. Petrusic during the writing of this thesis. I should also like to thank the members of the thesis committee: Dr. J. T. Arnason, Dr. K. Busby, Dr. R. Dillon, and Dr. J. LeFevre for their careful reading of the document and their helpful suggestions.

I should also like to thank Ms. Ikuko Webster for statistical advice, and Ms. Lynn Giff for her efficient help.

Table of Contents

	Page
Thesis Acceptance Form	ii
Abstract	iii
Acknowledgements	iv
Table of Contents	v
List of Tables	xii
List of Illustrations	xiv
List of Appendices	xv
Chapter 1: Household Hazardous Waste	1
1.1 Household Hazardous Waste as a Societal Problem	1
1.2 Definitions of HHW	4
1.3 The Prevalence of HHW Products in the Home	5
1.4 The Quantities of HHW Generated	6
1.5 The Incorrect Disposal of HHW	7
1.5.1 Landfills and contamination by HHW	12
1.6 Control of HHW at Source as a Key HHW Management Practice	14
1.7 Control of HHW at Source Will Prevent Work-Related Injuries	15
1.8 Public Knowledge and Assessment of the HHW Problem	16

	Page
1.9 Sources of Information about HHW	17
1.10 HHW Collection Preferences	18
1.11 Preferences for Funding of HHW Programmes	19
1.12 The Importance of Proximity to the Depot in Facilitating HHW Disposal	20
1.13 The Trail Road HSW Depot and other HHW Disposal Options in the Ottawa-Carleton Region and in Ontario	21
Chapter 2: Review of the Psychological Literature on Recycling and Other Pro-environmental Behaviours	27
2.1 Behaviourist Approaches to Recycling	28
2.2 Cognitive Approaches to Recycling and Other Pro-environmental Behaviours	29
2.2.1 Altruism and pro-environmental behaviour	30
2.2.2 Perceived level of knowledge and perceived personal salience	32
2.2.3 Intrinsic motivations and recycling	33
2.2.4 Perceived personal threat of environmental problems as a predictor of pro-environmental problems	34
2.2.5 Environmental concern	37

	Page
2.3 The Six-Factor Theoretical Structure for Prediction of Correct HHW Disposal	38
Chapter 3: Hypotheses	41
3.1 Summary of Research Purpose	45
Chapter 4: Methods	46
4.1 Subjects and Sampling Technique	46
4.2 Materials - Questionnaire Contents	48
4.2.1 Demographic items	48
4.2.2 Knowledge and participation in general recycling and HHW disposal behaviours	49
4.2.3 Sources of HHW information	49
4.2.4 Psychological/attitudinal Items	50
4.2.5 Purchase and disposal of specific HHW items and knowledge of Trail Road HHW facility - the dependent variables for the main statistical analyses	51
4.2.6 Motivation: reported willingness to travel	53
4.2.7 Disposal preferences	54
4.3 Questionnaire Development	55
4.4 Procedure	56
4.5 Statistical Analyses	56

	Page
Chapter 5: Results	59
5.1 Summary Statistics for Demographic Items	59
5.2 Summary Statistics for Self-reported Knowledge and Participation in General Recycling and HHW Disposal Behaviours	64
5.3 Summary Statistics for Sources of HHW Disposal Information	65
5.4 Descriptive Statistics for Psychological Items	66
5.5 Summary Statistics for Purchase and Disposal of Products	68
5.6 Motivation: Willingness to Travel	73
5.7 Disposal Preferences, Product Information, Provincial Law	74
5.8 The Selection of Logistic Regression for Univariate and Multivariate Analysis	77
5.9 Similarities to Linear Regression, the Logistic Function, the Logistic Model, Maximum Likelihood, Odds, and the Odds Ratio	78
5.10 Logistic Regression: Guidelines for Univariate and Multivariate Analysis	80
5.11 The Disposal, Location/Day and Product Purchase Models	83

	Page
5.12 The Goodness of Fit of the Models	87
5.13 Identifying Key Variables in the Prediction of Proper vs. Improper Product Disposal	90
5.14 Multivariate Analysis, Support for the Theoretical Structure?	92
Chapter 6: Discussion	94
6.1 Key Factors in Predicting Proper HHW Disposal	94
6.1.1 The perceived level of knowledge	95
6.1.2 Motivation: willingness to travel	96
6.1.3 Single family dwelling with access to a vehicle	97
6.1.4 Perceived difficulty	98
6.2 The Performance of the Six-Factor Theoretical Structure	99
6.3 Environmental Concern	101
6.4 The Variation in the sets of Predictors Across Models	101
6.5 Hypothesized Relationships not covered by the Model Building Procedures	102
6.5.1 Recylers will also properly dispose their HHW	102

	Page
6.5.2 The influence of gender on being identified as the most knowledgeable on recycling and HHW disposal practices	103
6.5.3 The influence of gender on indicating participation in general recycling and proper HHW disposal practices	104
6.5.4 The parents of small children, recycling, and HHW disposal	105
6.6 Survey Participants' Preferences for HHW Disposal	105
6.7 The Results of the Present Resaerch and their Application to Proper HHW Disposal	108
6.8 Comparison of Recycling and HHW Disposal Behaviours	111
6.9 Suggestions for Future Research	112
Chapter 7: Conclusion	114
References	116
Appendix A: Hazardous Materials in Commercial Products (Glaub, 1993)	120
Appendix B: Household Hazardous Waste Disposal Questionnaire	122
Appendix C: Detailed Contruction of the Psychological/ Attitudinal Section of the Survey Instrument	127

	Page
Appendix D: Informed Consent Form	133
Appendix E: Household Hazardous Waste Information Sheet	134
Appendix F: Research Abstract for Survey Participants	135
Appendix G: Intercorrelations Among the Independent Variables	136
Appendix H: Logistic Regression Univariate Matrix	139
Appendix I: Proper Waste Disposal, Location/Day, and Purchase Models	149

List of Tables

	Description	Page
Table 1	Distribution of HHW Items in a Sample of 21 Homes in New Haven in 1987 (from Bass et al., 1990)	6
Table 2	Summary of HHW in Massachusetts Survey (Stanek et al., 1987)	8
Table 3	Frequency of household hazardous waste disposal (McEvoy and Rossignol, 1993)	9
Table 4	Summary of disposal methods for automotive and non-automotive HHW (McEvoy and Rossignol, 1993)	10
Table 5	HHW Collected at the HSW Depot (Ottawa-Carleton, Trail Road Landfill Site, 1994 and 1996)	23
Table 6	Respondent's Township of Residence in Ottawa-Carleton	59
Table 7	Type of Dwelling	60
Table 8	Age Distribution for Present Study Compared to Census	61
Table 9	Occupational Categories	62
Table 10	Labour and Non-Labour Force Categories for the Present Research for ages 15 +	63

	Description	Page
Table 11	Knowledge / Participation in General Recycling and HHW Disposal Behaviours	64
Table 12	Sources of HHW infomation	66
Table 13	Descriptive Statistics for Psychological Items	67
Table 14	Product Purchase and Disposal	68
Table 15	Comparison of the Households Disposing Product and Improper Product Disposal rates for the Present Research and two Prior Studies	69
Table 16	Correlation Matrix for Proper Product Disposal and Knowledge of the O-C HSW Depot Location and Day of Operation	71
Table 17	Correlation Matrix for the Purchase of Products	72
Table 18	Preference for Disposal Option	75
Table 19	Frequency of Curbside Pick-Up and Temporary Collection	76
Table 20	Proper Waste Disposal, Location/Day and Purchase Models	85
Table 21	Goodness of Fit of the Logistic Models	89
Table 22	The Prevalence of Variables Across Disposal and Location & Day Models	91

List of Illustrations

		Page
Figure 1	A Model of Altruism (Hopper & Nielsen, 1991)	31
Figure 2	Perception of Risks (Kraus & Slovic, 1988)	36
Figure 3	The Six-Factor Theoretical Structure for Predicting Recycling and Proper HHW Disposal Behaviour	40
Figure 4	Distance Willing to Travel to Dispose HHW in Kilometers	73

List of Appendices

	Page
Appendix A: Hazardous Materials in Commercial Products (Glaub, 1993)	120
Appendix B: Household Hazardous Waste Disposal Questionnaire	122
Appendix C: Detailed Contruction of the Psychological/ Attitudinal Section of the Survey Instrument	127
Appendix D: Informed Consent Form	133
Appendix E: Household Hazardous Waste Information Sheet	134
Appendix F: Research Abstract for Survey Participants	135
Appendix G: Intercorrelations Among the Independent Variables	136
Appendix H: Logistic Regression Univariate Matrix	139
Appendix I: Proper Waste Disposal, Location/Day, and Purchase Models	149

Chapter 1: Household Hazardous Waste

1.1 Household Hazardous Waste as a Societal Problem

In Canada and the United States household hazardous waste (HHW) disposal arose as a significant issue in waste management in the 1980's. Improvement in hazardous waste management in the commercial-industrial sector has allowed many provincial, state, and local governments to focus attention on unregulated household sources of hazardous waste (Scudder & Blehm, 1991). With a focus on keeping HHW out of the solid waste stream and the sanitary landfill, depots and collection programmes were set up in a relatively short time.

The need for HHW management became evident from: (1) the results of environmental monitoring at solid waste landfills; (2) the continued improvement of the detection limits of laboratory instruments; (3) the results of characterization studies of solid waste; (4) observations made in load-checking programs at solid waste landfills and transfer stations; and (5) hazardous incidents involving refuse collection workers and equipment. The increased sorting and handling of wastes in the growing number of recycling operations has placed the municipal solid waste stream under observation (Glaub, 1993).

HHW products include a range of substances that require careful disposal in order to protect environment and health.

They may include heavy metals such as arsenic (rodenticides, wood preservatives, and herbicides); thallium (insecticides and rodenticides); cadmium (household batteries and paint pigments); lithium (household batteries); and mercury and lead (in some older paints which continue to appear at HHW depots because of stockpiling). The general health effects of heavy metal poisoning by arsenic and thallium are well described in the literature (Graeff & Lovejoy, 1991). Abadin, Hibbs, and Pohl (1997) and Louekari, Uusitalo, and Pietinen (1989) have reviewed the long-term health effects of cadmium, lead, and mercury exposure.

Organic solvents are present in cleaning fluid, nail polish remover, paint thinner, and spray enamel (for a list of household items which contain organic chemical compounds known to be hazardous to man see Appendix A). Pesticides, used motor oil, and anti-freeze, if poured down drains or on to the ground may contaminate groundwater and poison wildlife. Some HHW products may harm refuse collectors or contaminate the air if incinerated improperly (Bass, Calderon, & Kahn, 1990).

Since HHW is a potential hazard to human health and the environment, and researchers find that the majority of HHW items are incorrectly disposed of (most often thrown in the garbage en route to a landfill), there is a societal problem that needs to be addressed (Geran, 1993). However, there is reason to believe that solutions to the problem may be

found. A success story in the HHW field is the recycling of lead acid batteries used in automotive and marine vehicles. There are approximately 15-20 pounds of lead and one to two gallons of sulphuric acid in each battery. In a Massachusetts 1984 survey of HHW (which was published in 1987), Stanek, Tuthill, Willis, and Moore asked respondents about the disposal of car batteries, and they found that 68% were incorrectly disposed, the majority deposited in landfills (see Table 2). By 1993, McEvoy and Rossignol found that only 14% of car batteries were incorrectly disposed (see Table 4). In Glaub's 1993 review of HHW disposal in the U.S. he stated that the majority of lead acid batteries are recycled. This success was accomplished through legal regulations, financial incentives, the concerted efforts of HHW management organisations, and the cooperation of the private sector (i.e. auto parts stores, wrecking yards, and garages).

The focus has now turned to making companies responsible for their products. This includes designing products to be easily recyclable, and making companies share in the recycling costs (Menzies, 1997). In the meantime, there remains the problem of how to dispose of large quantities of HHW that have very little salvage value, or too few facilities for recycling (e.g. household batteries).

1.2 Definitions of HHW

The Ottawa-Carleton Household Special Waste Depot uses the Environment Canada definition of HHW as: "those wastes generated in the regular household waste stream that possess corrosive, explosive, toxic, reactive or other harmful characteristics and require special considerations in their collection, handling, treatment and disposal" (Environment Canada, 1993, p. 1).

United States Federal law defines HHW as discarded materials that are ignitable, corrosive, reactive, or toxic, and those that are specifically listed hazardous wastes. The 1976 Resource, Conservation, and Recovery Act (RCRA) regulates industrial hazardous waste from the time it is manufactured to the time of its disposal (Bass et al., 1990). However, in the United States, household hazardous wastes are specifically excluded from regulation as hazardous waste under the Federal Resource Conservation and Recovery Act, and they are not covered under current U.S. Environmental Protection Agency hazardous waste disposal regulations. The reason given is that it is difficult to enforce compliance for individual households. This regulatory ambiguity has led to confusion in managing HHW in the United States, although HHW contains the same chemicals found in industrial hazardous wastes (Stanek et al., 1987).

The U.S. Environmental Protection Agency suggests that 35,000 of the 50,000 chemicals produced annually in the

United States may be harmful or potentially harmful (Bass et al., 1990). It is difficult to compile a list of HHW, however, because the chemical constituents in household products vary according to the manufacturer. For example, some drain cleaners are bases, some acids, and some are noncorrosive chlorinated solvents. Some pesticides have changed ingredients several times while retaining the same product name.

1.3 The Prevalence of HHW Products in the Home

The prevalence of HHW products in the home was studied in 1987 by using a telephone survey and two follow-up in-house surveys in New Haven, Connecticut (Bass et al., 1990). The study found a total of 1,115 HHW items in 21 homes (see Table 1). The major categories of HHW were: paint products (21%); insecticides (13.9%); cleaners (10.5%); and car products (10%). Most HHW products were found to be stored in basements and garages. According to the labels, 34% of the products were flammable; 22% were combustible; 21% were skin and eye irritants; and 27% were harmful or fatal if swallowed.

The total volume remaining in the 1,115 HHW product containers found in 21 houses was 1,827 litres. Many HHW products are often stored for long periods of time between uses or prior to their disposal. Thirty-six percent of the items found were used on a yearly basis; 17.7% on a monthly

Table 1

Distribution of HHW Items in a Sample of 21 Homes in New Haven
in 1987 (from Bass et al., 1990)

Item	Number	Percent
Cleaners	117	10.5
Polishes and Waxes	85	7.6
Disinfectants	58	5.2
Solvents	44	3.9
Paint Products	235	21.1
Ignitable Products	44	3.9
Car Products	111	10.0
Insecticides	155	13.9
Herbicides	52	4.7
Fungicides	13	1.2
Rodenticides	4	0.4
Outdated Medicines	10	0.9
Drain Openers	17	1.5
Adhesives	9	0.8
Detergents	13	1.2
Other	53	4.8
Home Repair Products	54	4.8
Wood Working Products	41	3.7
Total	1,115	100.0

basis; 11.7% on a weekly basis; and 11.6% had been used only once. Thirty-seven percent of all products were less than a year old, and 53% were from one to five years old (Bass et al., 1990).

1.4 The Quantities of HHW Generated

Significant quantities of HHW can be generated by communities even though it usually only constitutes 0.3% to 0.5% of the municipal solid waste stream (McEvoy & Rossignol, 1993). In Ottawa, Ontario, the Trail Road Waste Composition Study confirmed that the percentage of HHW in

the solid waste stream is in the 0.3% to 0.5% range. From May 1991 to May 1992 the Region's garbage was sorted into 65 categories: organic material 46.1% (approximately one third of which was yard trimmings); paper 29.7%; plastics 8.2%; miscellaneous waste 7.4%; ferrous metals 5.0%; glass 2.5%; non-ferrous metals 0.8%; and hazardous waste 0.3% (Ottawa-Carleton Environmental Services, 1993).

A small percentage of HHW in the waste stream may result in significant overall quantities generated by communities. A city with a population of 40,000 can generate approximately 43.7 metric tons of HHW each year (McEvoy & Rossignol, 1993). The City of Guelph, Ontario, calculated that the average home in Guelph and Wellington County, Ontario, uses 10-40 kg. of hazardous products each year (City of Guelph). Due to its unregulated status, HHW is a major contributor to environmental contamination (Stanek et al., 1987).

1.5 The Incorrect Disposal of HHW

Attitude surveys in the early 1980's at newly opened HHW collection sites revealed that homeowners had previously disposed of their hazardous materials in the sewer, on the ground, or in the garbage intended for landfill (Bass et al., 1990). If toxic liquids are dumped into a landfill, the liquids may percolate through the soil and contaminate an aquifer which supplies drinking water for local communities.

Similarly, pouring pesticides, herbicides, or motor oil into a sewer or backyard may contaminate homeowners' backyard wells. HHW may also react adversely with chemicals and bacteria in sewage treatment plants. Sewage sludge used as landfill or fertiliser may become contaminated (Bass et al., 1990).

A 1984 telephone survey in Massachusetts of HHW disposal methods revealed a major HHW disposal problem (see Table 2). One third of households reported they disposed of motor oil, and 57% poured it directly on the ground, into the sewer, or put it in the garbage (landfill). Although the researchers did not enquire about household batteries, 68% of the 120,000 car batteries were disposed of in landfills.

Table 2

Summary of HHW in Massachusetts Survey (Stanek et al., 1987)

Percentage of households disposing		Average quantity disposed per household	Annual amount disposed in Massachusetts	% disposed in ground, sewer, or landfill
Substance				
Oil	33%	13.2 litres	8.23 million litres	57%
Paint	11%	2.3 litres	0.45 million litres	91%
Pesticides	10%	2 cans	0.34 million litres	98%
Antifreeze	7%	18.9 litres	2.83 million litres	95%
Car Batteries	5%	1 battery	120,000 batteries	68%
Asphalt	2%	3.8 litres	0.16 million litres	100%
Gasoline / Kerosene	2%	3.8 litres	0.17 million litres	64%
Radiator flush*	1%	1 can	32,000 cans	86%
Herbicides *	1%	2 cans	44,000 cans	80%
Chemical *	1%			75%

* The number of households which reported disposal of these items was small, projections should be interpreted cautiously

Ninety-eight percent of the pesticides and 91% of the oil-based paint were disposed of improperly, nearly all of which went to landfills (Stanek et al., 1987).

Only 7% of the households disposed of antifreeze, but 18.9 litres were disposed of per household. The antifreeze was poured on the ground (54%), or into a sewer (14%), or disposed of in a landfill (27%) (Stanek et al., 1987).

In the Benton County, Oregon HHW study, McEvoy and Rossignol (1993) found that the most frequently disposed of HHW item was household batteries (83% of households), and that they were always improperly disposed of in the garbage. Used motor oil was the second most frequently disposed of HHW item, with 42% of it being incorrectly disposed. Paint was the third most frequently disposed of product; 65% of it was improperly disposed (Tables 3 and 4).

Table 3

Frequency of household hazardous waste disposal (McEvoy & Rossignol, 1993)

HHW Type	Households Disposing Waste (%)	Households Not Disposing Waste (%)	Do Not Know or Refused to Answer (%)
Household Batteries	83	17	0
Motor Oil	33	65	2
Paint/Paint Products	22	78	0
Pesticides	12	88	0
Cleaners	11	88	1
Used Antifreeze	11	86	3
Automobile Batteries	6	93	1
Wood Preservatives	6	94	0

Table 4

Summary of disposal methods for automotive and non-automotive HHW (McEvoy and Rossignol, 1993)

Disposal Method	<u>Automotive Wastes</u>		
	Antifreeze (%)	Used Motor Oil (%)	Lead-Acid Batteries (%)
Put in Garbage Can	27	15	0
Self haul to Landfill	9	6	14
Bury or Pour on the Ground	36	15	0
Store for Later Disposal	0	3	0
Burn	0	6	0
Recycle	27	55	86
HHW Collection Day	0	0	0

	<u>Non-Automotive Wastes</u>				
	Household Cleaners (%)	Paint/ Paint Product (%)	Pesticides (%)	Household batteries (%)	Wood Preservatives (%)
Put in Garbage Can	82	55	67	100	100
Self haul to Landfill	9	5	8	0	0
Bury or Pour on the Ground	0	5	0	0	0
Store for Later Disposal	9	23	25	0	0
Burn	0	0	0	0	0
Recycle	0	0	0	0	0
HHW Collection Day	0	14	0	0	0

As indicated in the above tables, oil is a major problem in HHW disposal. It is also a problem in Ontario for it is estimated that thirty million litres of used motor oil generated by do-it-yourself oil changers are dumped annually into sewers or thrown into the garbage (Ottawa-Carleton Environmental Services, Solid Waste Division, 1993).

The incorrect disposal of household batteries is another shared problem. Canadians annually throw an estimated 100 million used household batteries in the garbage, the production of which can take 50 times the amount of energy they eventually yield. When dry cell batteries are buried in the landfill, the outer casing eventually breaks down and allows the escape of heavy metals such as cadmium and lead (Ottawa-Carleton Environmental Services, Solid Waste Division, 1993).

There are at least four factors responsible for the high frequency of incorrect disposal. First, people may not consider household products to be hazardous. Second, they may believe that risks are limited to acute poisonings and injury due to skin contact. For example, respondents in a Metropolitan Seattle study rated chemical drain openers and herbicides as the highest risk products, and motor oil, car, and furniture polishes as the least hazardous. Third, many household product labels do not list all the hazardous ingredients in the product or the correct disposal methods. Fourth, householders associate storing flammable or toxic HHW materials in their homes with an increased risk of property damage and personal injury. The lack of an accessible disposal system (such as a collection day or permanent disposal site) discourages the long-term storage of some HHW until the householder has access to a correct disposal method (McEvoy & Rossignol, 1993). The research

findings for the present study would suggest that more education about product contents and specific disposal methods, as well as a more accessible community HHW programme are needed.

1.5.1 Landfills and contamination by HHW.

A large percentage of HHW ends up in the garbage en route to a landfill that in most cases is not equipped to handle it. Few landfills in the past have been constructed with the intention of containing hazardous materials. A landfill engineered with this intention requires a liner, a leachate collection system, a run-off control system, a final cover, and a long-term monitoring system. However, in a 1980 survey of the 12,627 active hazardous and non-hazardous landfills in the U.S., only 40 were equipped with liners and only 26 employed leachate treatment and control systems, although in 1981 it was estimated that 270 were being used for hazardous waste disposal (Bass et al., 1990).

The designation that a landfill is for non-hazardous waste really describes intent, and not content according to research findings. In a study of 288 landfills in California in 1988 (271 thought to be non-hazardous and 17 hazardous) hazardous waste was found in 86% of the landfills tested. Of ten organic chemicals regarded as hazardous to people or the environment, six of these were often present; benzene, methylene chloride, tetrachloro-ethylene, and

trichloroethylene were found in more than half of the waste landfills designated as nonhazardous whereas 1,1,1-trichloroethane and vinyl chloride were found in just under half of the designated nonhazardous waste sites. It was concluded by the researchers that the composition of landfill gases from hazardous and non-hazardous landfills is fairly similar (Glaub, 1993).

An EPA study of leachate from 53 municipal solid waste landfills found all ten of the target hazardous chemicals. Methylene chloride was found in the highest concentrations at the greatest number of sites (60%) (Glaub, 1993). For a table of common household products in which these ten organic chemicals are present, see Appendix A.

The Nepean landfill, which served the Ottawa-Carleton Region and has not been used since 1980, was built without a base membrane. Monitoring equipment in 1996 showed that leachate present in the shallow aquifer to the west of Moodie Drive. Leachate was also found in the deep aquifer to the northeast of the landfill and extends beneath the northwest corner of the Trail Road Landfill property. The Ottawa-Carleton Region is presently using a "engineered" landfill with regular monitoring, and in 1996 was in full compliance with leachate regulations (Ottawa-Carleton Regional Municipality, 1996).

1.6 Control of HHW at Source as a Key HHW Management Practice

The key element in controlling HHW is to reduce the amount of HHW generated by the household, and to prevent the improper disposal of those wastes that are generated. Public education is important in providing the community with information about what types of household materials are hazardous, why they are hazardous, how to use nonhazardous materials in place of products that are hazardous, and how to properly dispose of the hazardous wastes that are generated. As the public becomes more aware of HHW issues, a reduction in the amount of HHW generated by households can be expected (Glaub, 1993).

Public support for HHW source control was indicated by the 1984 Massachusetts survey of Tuthill, Stanek, Willis, & Moore (Tuthill and Stanek are colleagues and used the same survey data in two separate articles, both of which are cited in the present research). These researchers found that 77% of respondents preferred that manufacturers would develop a suitable non-hazardous product; 70% wished to pass unused hazardous materials on to a friend or neighbour; and 70% wished to buy hazardous materials in the exact quantity needed (Tuthill et al., 1987).

1.7 Control of HHW at Source Will Prevent Work-Related Injuries

The U.S. National Solid Waste Management Association has documented a number of workers injuries resulting from the presence of HHW in the solid waste stream. These injuries were due to spills, spraying (e.g., from packer trucks during compaction), fumes, fires, explosions, burns (acid, caustic, and thermal), blinding, eye irritation, respiratory problems, rashes, and nausea. As recycling operations expand there will be increased sorting and handling of waste materials, and workers will have increased exposure to hazardous wastes (Glaub, 1993).

The most common incidents involving equipment are fires in refuse collection trucks, when flammable wastes come into contact with a source of ignition, or incompatible materials mix and react. Compaction vehicles tend to liberate materials from containers, and they thereby contribute to hazardous incidents. The most serious incidents in waste processing facilities have been shredder explosions. Control of HHW will help to prevent these accidents (Glaub, 1993).

The operation of the Household Special Waste Depot for the Ottawa-Carleton Region has been accident-free since its opening in August 1992. No spills of incoming or stored materials have occurred, as well as no known incidents of chemical exposure, leaks, or fire (Ottawa-Carleton Environmental Services, Solid Waste Division, 1994, 1996).

1.8 Public Knowledge and Assessment of the HHW Problem

In 1990, 72% of Canadians aged 15 years and over believed that environmental pollution had affected their health in some way over the last 12 months. Eight percent of respondents believed that environmental pollution had "very much" affected their health; 23% "a fair amount"; and 41% "not very much." Seventeen percent of respondents thought that their health had not been affected, and 11% did not know or gave no response (Geran, 1993).

In a study in Benton County, Oregon, 75% of respondents reported that they were very concerned or somewhat concerned about the possibility of chemical pollution of surface or groundwater by HHW; 18% said that they were not too concerned; and 5% were not concerned at all. Sixty-eight percent stated that they lacked confidence in the safety of landfills; 25% were somewhat confident in the safety of chemicals in the landfill; and 5% said they were very confident. Only 49% of the subjects who had curbside pick-up of used motor oil where they lived were aware of the service, in contrast to 90% of the subjects who knew there was a general recycling service (McEvoy & Rossignol, 1993).

In a Larimer County, Colorado study by Scudder and Blehm (1991), 43% of the survey participants said they considered the general issue of hazardous waste to be a major problem. The majority of survey participants said they had high levels of concern about the amount of hazardous

waste generated by government or small businesses, but the amount generated and discarded by households was of low concern. The researchers concluded that the survey respondents did not consider themselves to be part of the overall problem of hazardous waste generation or disposal.

The Larimer County study respondents were also asked to name specific HHW items and later on in the survey to rank others as to their potential hazard. The researchers found that 20% of respondents were unable to name a single toxic product, and that another 19% could name only one; 22% could name four or more. When survey respondents were asked to rank six household products as to their potential for damaging the environment if improperly discarded, the majority were able to correctly assess the potential for environmental damage for pesticides, dishwasher soap and paints. However, the majority failed to accurately assess the potential for environmental damage from drain cleaner, motor oil or antifreeze (Scudder & Blehm, 1991).

1.9 Sources of Information about HHW

Fifty-one percent of users of the Ottawa-Carleton Trail Road Household Waste Disposal Depot in 1993 found out about the programme through the newspaper; 27% via the radio; 19% through their municipality; 17% by word of mouth; 16% by depot signs; 4% by TV; and 2% through the hotline. In 1995 the HSW Depot advertised in the Ottawa Sun, Ottawa Citizen,

and Le Droit, and on the radio on CJET, CHEZ, CKBY, CFRA, and COOL FM. They also had contracts with two advertising companies (Ottawa-Carleton Environmental Services, Solid Waste Division, 1994, 1996).

In the 1993 Benton County, Oregon study by McEvoy and Rossignol, 52% had heard or read about HHW disposal during the last year; 47% had not been exposed to HHW educational materials during the last year; and one percent could not recall. Among subjects who remembered reading or hearing about HHW disposal, 90% could recall at least one source of this information (newspapers 42%; pamphlets 21%; TV 17%; radio 13%; disposal companies 13%; schools 6%; conversations 4%; county extension service 2%; workplace 2%). When respondents were asked whom they would call for HHW disposal information, 62% said they would call the disposal company; 9% their landlord; 8% the county health department; 6% a state or federal agency; 4% county sources; and 3% Oregon State University. Since community waste disposal companies were named by 62% of the respondents as their primary source for HHW disposal information, these companies should be able to provide all the necessary information on HHW disposal and serve as a major HHW educational resource for the community.

1.10 HHW Collection Preferences

The preferred HHW disposal option varies by locale. Tuthill et al. (1987), in their Massachusetts survey, found

that their respondents preferred temporary collection sites more than the other proposed HHW disposal options. If curbside pick-up were to be offered in their community, 22% of respondents would choose weekly collection; 31% monthly; 10% four times a year; and 13% twice a year.

Of the survey respondents in Benton County, Oregon, 64% preferred access to a permanent HHW collection site, and 25% preferred home pickup. Only 13% preferred HHW collection days, with 46% of these individuals claiming that they would need a collection day once a year and 39% preferring twice a year. Forty-nine percent of subjects preferring a permanent collection site claimed that they would use it three or more times a year (McEvoy & Rossignol, 1993).

In a San Diego, California study 65% preferred free door-to-door collection. The next most popular option was a free neighbourhood collection site (Bass et al., 1990).

1.11 Preferences for Funding of HHW Programmes

When asked how HHW disposal should be funded, 47% of the participants in the Benton County, Oregon, study preferred that a fee be paid on each HHW item at the time of disposal; 31% preferred an increase in garbage disposal fees; and 22% preferred a tax on hazardous products (McEvoy & Rossignol, 1993). Fifty-nine percent of the residents in the Massachusetts survey favoured a hazardous products sales tax (Tuthill et al., 1987). Forty-two percent of survey

respondents were willing to pay up to a 5% tax, although 41% were unwilling to pay any sales tax at all. Willingness to pay the proposed tax did not vary in relation to urban/rural status, gender, educational level, voting status, or knowledge of what was hazardous. However, those under 60 or in the highest status occupations were two times more likely to be willing to pay than those 60 years and older, or those in the lowest status occupations. Seventy percent said they would approve a state law which would fine householders for the improper disposal of household hazardous wastes.

1.12 The Importance of Proximity to the Depot in Facilitating HHW Disposal

The distance to a HHW Depot appears to have a strong influence on its use. In a 1984 survey during a "clean sweep" program in Madison, Wisconsin, 60% of the programme participants drove less than 3.2 kilometers (2 miles) to the collection site; 30% drove 4.8 to 8 kilometers (3 - 5 miles); 5% drove 9.7 - 17.7 kilometers (6 - 11 miles), and 2% more than 17.7 kilometers (11 miles) (Bass et al., 1990).

In the Massachusetts survey by Tuthill et al. (1987) respondents were asked how far they would be willing to travel to drop off items at a hazardous waste collection site. There was a rapid decline in willingness to travel with increased distance from the proposed site. Seventy percent of rural residents, in comparison to 46 percent of

the urban, said that they would travel up to 8 kilometers (5 miles). Respondents said that they would use such a facility twice a year.

In Benton County, Oregon, 100% of survey respondents who preferred a permanent collection site said that they were willing to travel up to 8 kilometers (5 miles) to use the collection site, and 44% said they would travel up to 16 kilometers (10 miles). Only 10% of the subjects indicated that they would travel more than 10 miles (McEvoy & Rossignol, 1993).

1.13 The Trail Road HSW Depot and other HHW Disposal Options in the Ottawa-Carleton Region and in Ontario

The Household Special Waste (HSW) Depot for the Ottawa-Carleton region is open to the general public on Saturdays 9.00 - 17.00 hours from the middle of March through the middle of December. A Resident Registration and Survey Record is filled in by each resident who uses the HSW Depot, with the date, time, the resident's name, municipality, postal code, license plate number, and how many households are participating. The staff fill in the section of the record on the types and quantities of wastes received. The storage container number is then marked on the survey to help trace any unknown or unacceptable wastes to their original generator.

Using the registration survey records the HSW Depot

compiles annually the participation rates for each of the municipalities in the Ottawa-Carleton Region. The participation rates reveal that proximity may be a factor in disposal as there is a trend for the most distant municipalities to have the lowest participation. Realising that accessibility is a problem, there have been temporary collection events scheduled for the more distant community of Cumberland. In 1997 temporary collection events also have been scheduled for other areas of the Ottawa-Carleton Region, and they have been advertised in the local newspaper. The HHW programme is funded through the Property Tax. The Trial Road HSW Depot is registered to collect the household hazardous wastes given in Table 5.

To make their HHW programme more accessible over a very large area, the Metropolitan Toronto HHW programme operates a "toxics taxi." It averages 100 telephone calls daily for free pick-up service. The "toxics taxi" picks up HHW at all types of dwellings, including prearranged meetings by telephone at apartments and condominiums. For dwellings at ground level the hazardous waste can be left in a location arranged by telephone, such as in front of the garage. If the hazardous waste is not in its original container, the container must be relabelled for the new contents. The HHW is not to be set near the curb because of possible hazards to passers-by or curious children. Although 95% of the HHW collected is brought to the seven permanent HHW depots which

Table 5

HHW Collected at the HSW Depot (Ottawa-Carleton, Trail Road
Landfill Site, 1994 and 1996)

-
- Acid Waste
  - Alkaline Waste
  - Wastes from the use of paints, pigments, and coatings
  - Miscellaneous waste inorganic chemicals
  - Antifreeze
  - Petroleum distillates
  - Light fuels
  - Halogenated solvents
  - Halogenated pesticides and herbicides
  - Polychlorinated biphenyls (PCBs) as received in oil based paints only
  - Waste crank case oils and lubricants
  - Pharmaceuticals
  - Miscellaneous waste organic chemicals
  - Organic non-halogenated chemicals
  - Waste compressed gases, including cylinders

The following types of waste are not accepted at the HSW Depot: radioactive, pathological, PCBs, unidentifiable wastes, non residential wastes, and explosives.

---

are open on Wednesdays and Saturdays, the "toxics taxi" reaches people who would not be able or willing to drop off their waste at the permanent sites. Left-over paint is the most frequently collected item. The service is funded by the sewer fee as part of the clean water programme (Municipality of Metropolitan Toronto, 1997).

In the Ottawa-Carleton region paint constitutes the largest percentage of HHW taken to the Trail Road HSW Depot. At the Trail Road Depot, latex paint, oil-based paint and paint sludge are separately bulked in 205-litre drums. Samples from the oil-based paint are sent to a certified

laboratory for PCB analysis using the gas chromatography method. Any drum exceeding 50 ppm concentration for PCBs is stored at the RMOC PCB storage facility at 800 Greencreek Drive. Oil-based paint and stain is usually used as a supplementary fuel source. Some of the oil-based paint collected at the Trail site has been transported by licensed carrier to St. Constance, Quebec to fuel a cement kiln. Latex paint is usually sent for recycling although some of the older latex paint may be rejected due to contamination from heavy metals. In the past, mercury was used as a biocide in paint, and lead was used as a pigment (Ottawa-Carleton Environmental Services, Solid Waste Division, 1996).

An additional way of handling the large quantities of paint disposed is to send the cans of paint that are in good condition to a community-run waste exchange. Guelph, Ontario, has a Paint Plus Reuse Programme at its HHW Depot. This operates during the summer months and provides good quality household products such as paint, stains, varnishes, drywall compound, adhesives, and caulking to residents and businesses free of charge (City of Guelph).

A second big component of the HHW at the Trail Road HHW Depot is used motor oil. After the oil is bulked in drums it is sampled for PCBs before being sent for recycling (Ottawa-Carleton Environmental Services, Solid Waste Division, 1996). Re-refining used lubricating oil takes only one third

of the energy of refining it from crude oil, and the process may be repeated many times with little loss in quality (Glaub, 1993).

Used oil also can be taken to garages which participate in the Oil Recovery Programme, whereby "re-refiners" clean the oil, re-package it, and re-sell it as "recycled motor oil", or as other petroleum products (Ottawa-Carleton Environmental Services, Solid Waste Division, 1993).

In the Ottawa-Carleton Region garages which encourage the return of used oil for recycling are presently able to cover costs, but this is not the case with antifreeze, a low value item. Antifreeze that is taken to the Trail Road Depot is bulked into 205-litre drums and transported for recycling by distillation or by filtration. Recycled anti-freeze can be used in automobiles, as a de-icing solution for aircraft, or as an agent in cement production.

Mercury and silver can be recovered from used household batteries, but the processes are complicated, costly, and not widely available. When household batteries are disposed of by the Trail Road Depot they are usually sent on to a "secure" landfill site where they are often encased in lime and buried (Ottawa-Carleton Environmental Services, Solid Waste Division, 1993).

Some stores accept used "button" batteries from cameras and hearing aids for return to the manufacturer. A large appliance company has initiated a programme for used

cordless appliances which may contain cadmium (Ottawa-Carleton Environmental Services, Solid Waste Division, 1993).

Automobile batteries that are taken to Trail Road are sent to an Ottawa company, where the lead is smelted, refined, and used for new batteries. The sulphuric acid is cleaned and used for other purposes. The plastic is cleaned and reused for battery cases, and the nitrogen fumes are trapped and processed into liquid fertiliser (Ottawa-Carleton Environmental Services, Solid Waste Division, 1994).

Chapter 2: Review of the Psychological Literature on Recycling and Other Pro-Environmental Behaviours

A review of the literature reveals that research on HHW is largely descriptive, and that it focusses on the frequency of purchase, the means of disposal, and disposal preferences without trying to predict or explain why some people engage in environmentally sound disposal practices and others do not. Since the author did not find any earlier research which used a comprehensive psychological framework for the study of HHW, it was necessary to turn to the research on recycling and other pro-environmental behaviours.

A recurring research topic in the psychological literature on pro-environmental practices is whether diverse ecologically responsible behaviours such as recycling, using cold water for laundry, drying clothes on a line, turning down the thermostat, and carpooling originate from common psychological characteristics. In a study of ecologically responsible behaviours, Tracy and Oskamp (1983-84) found that six of the fifteen ecologically responsible behaviours they studied were significantly correlated with the psychological construct of reported concern for energy conservation. Five of six behaviours pertained to recycling and not buying environmentally damaging products. Survey

respondents who recycled glass containers also tended to be the same respondents who protected the environment by not purchasing aerosol containers and high-phosphate detergents (Tracy & Oskamp, 1983-84). This finding is important because it suggests there is a link between recycling behaviour and the purchase of HHW products. A central issue in HHW management is reducing pollution at the source.

2.1 Behaviourist Approaches to Recycling

Much of the research on recycling has been concerned with applied behavioural analysis oriented to expanding participation in recycling. Behaviourist researchers have concentrated on changing behaviours (without attempting to explain or change related attitudes or beliefs) by designing intervention strategies and then examining their impact on recycling behaviour (Hopper & Neilsen, 1991).

The early behaviourist research on recycling focussed on monetary and token reinforcers to initiate and sustain the desired behaviour. Reinforcement was in the form of payments at recycling centres or through reducing their garbage bills in areas where residents were charged on the basis of the weight of their garbage (Simmons & Widmar, 1990). In these studies, contests, prizes, and raffles were also shown to increase recycling behaviour. Recyclers reported monetary or other token rewards as their primary incentives. When the monetary incentives were curtailed

these extrinsically motivated recyclers stopped recycling (Oskamp et al., 1991).

Since behaviourist techniques have been relatively ineffective in predicting or encouraging long-term recycling, it is unlikely that these same techniques will predict long-term proper HHW disposal compliance.

2.2 Cognitive Approaches to Recycling and Other Pro-Environmental Behaviours

A few researchers have departed from the behaviourist tradition to suggest the importance of understanding the influence of underlying attitudes and personality characteristics in the prediction of recycling and pro-environmental behaviour. Since the cognitive approach has not been comprehensively used in household waste research, the present author reviewed the literature and attempted to synthesize a framework for proper HHW disposal. Identifying the research by focus, studies of recycling and studies of other pro-environmental behaviours using the cognitive approach can be divided into the following groups: (1) altruistic behaviour, (2) psychological barriers to engaging in pro-environmental behaviours (perceived level of knowledge and perceived personal salience), (3) intrinsic motivations, (4) perceived personal threat, and (5) environmental concern.

2.2.1 Altruism and pro-environmental behaviour.

Schwartz postulated that people are more likely to help someone in need and volunteer when their internalised structure of personal norms and values is activated, generating feelings of moral obligation to perform specific helping behaviours (Schwartz, 1977; Schwartz & Howard, 1980; Latane & Darley, 1970). There is often wide agreement about the norms that govern an altruistic behaviour, but only some individuals inconvenience themselves to act in accordance with those norms. In the case of recycling, Hopper and Nielsen (1991) argue that most people do not need to be convinced of its merits, but rather need to be persuaded to carry out the behaviour.

Schwartz argues that individuals agree with altruistic social norms in an abstract, detached way, but these norms need to be adopted at the personal level to influence behaviour and affect one's self-concept. Upholding a personal norm tends to engender feelings of satisfaction, and violating a personal norm engenders guilt. Individuals need to internalise social norms, be aware of the consequences of not upholding them, and ascribe responsibility to themselves for the consequences of not upholding these norms. Individuals must also perceive social norms as relevant to them and applicable to the situation (Schwartz, 1977; Schwartz & Howard, 1980). Hopper and Nielsen (1991) formulated a pictorial representation of

Figure 1

A Model of Altruism (Hopper & Nielsen, 1991)

Schwartz's theory of norm-activation and altruistic behaviour which is reproduced in Figure 1. In their study of recycling, Hopper and Nielsen (1991) report that their results conform well enough with Schwartz's theory to characterise recycling as a form of altruistic behaviour. However, they also report that none of their interventions (volunteer block leaders, informational brochures, and monthly prompts) affected the participants' awareness of consequences, and that this component of norm-activation is very difficult to alter.

Schwartz (1970) notes several barriers to conformity with societal norms. These are the absence of the resources and opportunities needed to conform (interpersonal skills and spatial proximity); countervailing motives (selfish interests); denial of consequences; denial of responsibility; and denying that specific moral norms legitimately apply to oneself in a situation (Schwartz, 1970). When the anticipated costs of helping were substantial, Schwartz and Howard (1980) found that personal

norms correlate with behaviour for people who tend to accept responsibility, but not for people who tend to deny it.

2.2.2 Psychological barriers: Perceived level of knowledge and preceived personal salience.

Simmons and Widmar (1990) examined two potential barriers to recycling: a perceived lack of knowledge concerning recycling, and a lack of personal salience and efficacy. These authors contend that their results are consistent with the literature on locus of control and the importance of the perceived efficacy of an action. When the personal salience factor was used as a predictor, individuals who lacked a sense of personal salience and efficacy were less likely to recycle.

They also contend their results suggest that educating the public about recycling action strategies will increase participation. When perceived lack of knowledge factor was used to predict recycling behaviour, individuals who felt confident of their knowledge engaged in recycling significantly more often than those who felt that they lacked knowledge.

Simmons and Widmar (1990) found that lack of personal salience and peceived lack of knowledge present psychological barriers to recycling even for persons with a high sense of responsible action or a high level of conservation ethic.

2.2.3 Intrinsic motivations and recycling.

De Young (1986) and De Young and Kaplan (1985-1986) contend that ecologically concerned people are not extrinsically motivated and do not seek economic advantage, but are motivated by the general satisfaction of participating in an ongoing activity and knowing they are doing something worthwhile and beneficial. De Young (1985-1986) found that intrinsic motivations, the personal satisfactions that are derived from engaging in conservation activities, were the most important reasons people gave for recycling. Oskamp et al. (1991) also found intrinsic motives to be a significant predictor of recycling behaviour.

In De Young's later 1988-1989 research he asserts that his results do not support the assumption that recyclers are fundamentally different from non-recyclers. His results suggest that respondents view recycling in a very positive light. Questionnaire respondents classified as recyclers and non-recyclers based on observed behaviour did not differ significantly in their pro-recycling attitude, extrinsic motivation, ratings of trivialness, or frugality. However, the two groups did differ in their perceived difficulty of engaging in the behaviour.

The perceived difficulty factor is evaluated in the present research, but it was not included in the main theoretical framework. It is expected to be a less powerful predictor than Simmons and Widmar's (1990) perceived lack of

knowledge factor. In essence, one perceives a task to be difficult because one does not know how to carry it out.

2.2.4 Perceived personal threat of environmental problems as a predictor of pro-environmental behaviour.

A great deal of the research on environmental attitudes and actions has focused on measures of "environmental concern": the importance placed on environmental quality, perceptions of environmental problems, knowledge about environmental issues, and general statements relating to ecological concern and interest. Baldassare and Katz (1992) examined a very specific and personal dimension of environmental concern, the extent to which individuals perceive that their own health and personal well-being are directly threatened by environmental problems, such as air and water pollution. Their concept of the personal threat of environmental problems is similar to that of perceived personal risk.

The personal threat of environmental problems and the more traditional form of environmental concern are both evaluated in the present research. However, personal threat was chosen over environmental concern for inclusion in the main theoretical framework. This is because it is expected to be a better predictor of correct HHW disposal behaviour than the more emotionally detached and diffuse measures of

environmental concern that have been generally employed.

Baldassare and Katz (1992) found that the perception of personal threat from environmental problems was a better predictor of pro-environmental practices that required personal sacrifice (i.e. limiting the amount of driving; purchasing environmentally safe products; conserving water use at home; and recycling newspapers, glass, and aluminum cans) than age, education, income, gender, political orientation, or party affiliation.

Demographic and political variables were significant predictors of the personal threat variable. Younger people, females, Democrats, and liberals were more likely to perceive environmental problems as a serious personal threat.

The perception of risk has often been studied by analyzing the discrepancies between the "subjective" perceptions of risk by lay people and the "objective" predictions of experts. The discrepancies in risk estimation by these two groups has been attributed to less factual knowledge on the part of the public and to the influence of cognitive biases or "heuristics." For example, the so-called availability heuristic refers to the tendency of overestimating the frequency of events which are more easily recalled or imagined (Eiser, Reicher, & Podpadec, 1994).

The two-axis factor space represented in Figure 2 has been replicated across groups of lay persons and experts

Figure 2

Perception of Risk (Kraus & Slovic, 1988)

judging diverse sets of hazards. The factors in this space reflect the degree to which a risk is understood and the degree to which it evokes a feeling of dread. The most important factor is "Dread Risk." The higher the hazard's score on this factor, the higher its perceived risk, the more people want to see the risk reduced, and the more they

want to see strict regulation employed to achieve the desired reduction in risk (Kraus & Slovic, 1988).

It has been suggested that when fear appeals are used as informational strategems to increase participation in a pro-environmental behaviors, the appeal should also have personal relevancethey and should also include recommended actions and emphasize how such actions might diminish a proposed threat (McCornack, 1993).

2.2.5 Environmental concern.

Concern for the environment has become widespread in western society. Pro-environmental attitudes are now socially desirable, but may not yield pro-environmental behaviour. Surveys have shown that the distributions of concern for the environment tend to be highly skewed, with 90% of the respondents falling in the highest concern category (Derksen & Gartrell, 1993).

Stern and colleagues (1985-1986) found that survey participants with high levels of environmental concern are prone to place responsibility for environmental problems at the door of industry. Typically, environmental concern is a poor predictor of whether an individual personally practices ecologically responsible behaviours. However, it appears to be a better predictor of an individual's behavioural commitment to change the environmental practices of others, such as those of industry.

2.3 The Six-Factor Theoretical Structure for the Prediction of Correct HHW Disposal

An integrated theoretical structure of psychological factors for predicting correct HHW disposal (Figure 3) is evaluated in this research. The theoretical structure was constructed from factors shown in the prior psychological research to be predictive of recycling and other pro-environmental behaviours. These are: (1) social norms and personal norms about not harming the environment; (2) awareness of the consequences of incorrect waste disposal; (3) the perception of personal threat of environmental problems; (4) ascription of responsibility to oneself or one's household for correct waste disposal; (5) sense of personal salience to rectify environmental problems; and (6) perceived level of knowledge in regards to proper waste disposal.

The Six-Factor Theoretical Structure specifies that social norms about not harming the environment (Factor 1a) need to be internalised at the personal level (Factor 1b) in order to influence correct HHW disposal behaviour. However, other factors are hypothesized to intervene and moderate the relationship between personal norms and behaviour. Individuals need to be aware of the consequences of improper hazardous waste disposal in environmental and human health terms (Factor 2), and perceive a personal threat to their well-being from such environmental contamination (Factor 3).

The next step is for individuals to ascribe responsibility to themselves, or to their households, for the proper disposal of HHW (Factor 4). They also need to feel a sense of personal salience; that their actions can help rectify environmental problems (Factor 5). Finally, individuals need to feel confident that they possess the requisite knowledge to carry out the behaviour (Factor 6). It is postulated that when all of these factors are present consistent correct HHW disposal will result.

Figure 3

The Six-Factor Theoretical Structure for Predicting Proper
HHW Disposal Behaviour

(1a), (1b), (2), and (4) - from S. H. Schwartz (1977)

(5) and (6) - from Simmons and Widmar (1990)

(3) - from Baldassare and Katz (1992)

Chapter 3: Hypotheses

It is predicted that each of the elements which comprise the six-factor theoretical structure will influence proper HHW disposal behaviour. The following hypotheses are based on the concept of an ideal HHW disposer who has: (1) internalised social norms about not harming the environment; (2) is aware of the consequences of improper HHW disposal; (3) ascribes responsibility to self for its disposal; (4) has an adequate sense of personal salience, (5) is confident regarding knowledge of HHW items and disposal practices, and (6) perceives that toxic chemicals in the environment present a personal threat to well-being.

It is predicted that the ideal HHW disposer will also be a recycler. An individual who accepts the inconvenience of storing HHW and is motivated to transport it to a HHW collection site would be expected to engage in the much more convenient behavior of curbside recycling. Recycling questions are included in the questionnaire in order to investigate whether the same individuals are engaged in both activities. If such a relationship is found, HHW researchers may be able to draw more extensively from the much larger body of recycling literature.

The ideal HHW disposer will express concern over the environment, but so will the majority of respondents. Although the environmental concern construct has been the

focus of great interest in the academic literature, it is not included in the present model because it has proven to be a weak predictor of recycling and other pro-environmental behaviors.

It is hypothesized that the "ideal" HHW disposer will often be the parent of small children. Persons who have small children would be expected to be more aware of poisons in the home and more attune to informational messages in the media pertaining to HHW and its disposal. It might also be expected that these parents would want their children to grow up in a safe environment.

It is also predicted that the ideal HHW disposer will be a female who resides in a single family dwelling, has access to a vehicle, and lives within 8km (5 miles) of a HHW repository. Baldassare and Katz (1992) discovered that females were significantly more likely to report engaging in environmental practices. Oskamp et al. (1991) found that the most important factor for predicting curbside recycling was residing in a single family dwelling house. Access to a vehicle could also be an important factor in whether an individual is able to transport HHW to the Depot or other collection location (Geran, 1993). Distance to the Depot appears to be a factor in proper HHW disposal. Tuthill et al. (1987) found that 75% of rural residents and 46% of urban residents would travel up to 5 miles (8km) to drop off HHW items at a collection site compared to roughly 90% of

both rural and urban residents who would be willing to go one mile (1.6km).

Hypotheses which pertain to factors in the model have their corresponding numbers from the model included in the subheadings below.

Social/Personal Norms (#1a & #1b)

H₁ Individuals who have internalized social norms about not harming the environment will engage in proper HHW disposal practice.

Awareness of Consequences (#2)

H₂ Individuals who are aware of the consequences of improper HHW disposal will follow the proper methods for HHW disposal.

Perception of Personal Threat of Environmental Problems (#3)

H₃ People who perceive a personal threat to their well being from toxic chemicals in the environment will properly dispose of their HHW.

Ascription of Responsibility (#4)

H₄ Individuals who ascribe responsibility to themselves for disposing of their HHW in an ecologically sound manner will follow the proper methods for HHW disposal.

Sense of Personal Salience (#5)

H₅ Individuals with a sense of personal salience will dispose of their HHW in an ecologically responsible fashion.

Perceived Level of Knowledge (#6)

H₆ Persons who are confident in their knowledge of HHW items and disposal methods will engage in proper HHW disposal practices.

Recycling and HHW Disposal

H₇ The people who indicate that they are the main household recyclers will also be those who dispose of their HHW in the appropriate manner.

Environmental Concern

H₈ An individual's level of environmental concern will be a poor predictor of the person's proper disposal of HHW.

Demographic Context

H₉ Living in a single family dwelling will be a good predictor of proper HHW disposal practices.

H₁₀ Distance to the HHW Depot will be an important factor with the majority of study subjects not willing to drive more than 8km (5 miles) to properly dispose of their HHW.

- H₁₁ Owning or having access to a vehicle will be a predictor of proper HHW disposal.
- H₁₂ Women will be disproportionately identified as most knowledgeable persons in their households concerning both recycling and HHW disposal practices.
- H₁₃ Women will be more likely to indicate general participation in both recycling and proper HHW disposal.
- H₁₄ The parents of small children will be more likely to participate in both recycling and proper HHW disposal.

3.1 Summary of Research Purpose

The purposes of this research are: (i) to ascertain which study variables are the best predictors of proper HHW disposal; (ii) to build mathematical models from these selected variables to predict the purchase and disposal of HHW products; (iii) to evaluate whether these mathematical models support the author's hypotheses and conceptualization of HHW disposal in terms of the proposed six-factor theoretical structure; and (iv) to discover survey respondents' preferences for various HHW disposal options and sources of information.

Chapter 4: Methods

The Ethics Committee of the Psychology Department of Carleton University gave permission for this study to be conducted with mall patrons in the Regional Municipality of Ottawa-Carleton. Permission was also obtained from the shopping malls prior to data collection. Participation in this study was voluntary and confidentiality was assured.

4.1 Subjects and Sampling Technique

The data for the main study was collected at six shopping malls in the Ottawa-Carleton Region from December 1996 - February 1997. Data collection was undertaken at Lincoln Heights Galleria on wednesday December 11th and thursday December 12th, Westgate Shopping Centre on friday December 20th and saturday December 21st, Pinecrest Shopping Centre saturday December 28th, Rideau Centre monday December 30th, Place d'Orleans Shopping Centre on friday January 3rd and saturday January 4th, and Carlingwood Shopping Centre on Ferbruary 1st.

The six Ottawa-Carleton shopping malls at which data was collected were those which agreed to allow this activity on their premises from the total set of shopping malls contacted. The experimenter was not able to select the days for data collection at the participating shopping malls, this was at the discretion of the mall authorities, although

the experimenter did state a preference for surveying on weekends.

A pilot study of 14 local volunteers was obtained prior to the main study. In the main study 209 individuals agreed to fill out the survey instrument from an overall sample of 435 yielding a response rate of 48%. Of the 209 questionnaires collected 6 were eliminated and 203 retained for further statistical analysis. Two of the six rejected questionnaires were incomplete, the other four were filled out by non-residents of Ottawa-Carleton. The pilot data were not combined with the main study data prior to the statistical analyses.

The sample appears to be comprised of individuals who speak English as their first language. English and French versions of the questionnaire were offered to participants, but no requests were made for the French version.

The sampling technique used was of the non-probability and "accidental" type for both the pilot and the main study. This technique does have its virtues, but one of its main limitations is that the sample is not selected in a truly random fashion and may be somewhat self-selected. Differences between the population sampled and the target population about which we would like to make inferences are potential sources of bias. Therefore, caution should be exercised in generalizing from sample results to the entire population.

4.2 Materials - Questionnaire Contents

The survey instrument used in the study was a four-page questionnaire (APPENDIX B) comprised of seven sections:

- (1) demographic items (Section 4.2.1)
- (2) knowledge and participation in general recycling and HHW disposal behaviors (Section 4.2.2)
- (3) sources of HHW information (Section 4.2.3)
- (4) psychological and attitudinal items (Section 4.2.4)
- (5) purchase and means of disposal for specific wastes; knowledge of location and day of operation of the Trail Road HSW facility (these constitute the dependent variables for the study) (Section 4.2.5)
- (6) motivation - reported willingness to travel (Section 4.2.6)
- (7) disposal preferences (Section 4.2.7)

4.2.1 Demographic items.

The first section of the questionnaire was designed to collect information about demographic characteristics which may influence the purchase of specific HHW products; their proper disposal; and knowledge of the Trail Road HHW facility. This section contains nine survey items, seven of which were obtained from the prior literature. The items inquire about the respondent's age, occupation, gender, township of residence, and type of dwelling (Oskamp et al., 1991). This section is also designed to investigate whether

the respondent has adequate backyard storage space, has access to a vehicle (Geran, 1993), if they are a parent, and if they have children 7 years of age or younger (current author, see hypotheses).

4.2.2 Knowledge and participation in general recycling and HHW disposal behaviours.

The second section was designed to examine the general relationship between reported participation in recycling and HHW disposal behaviours. Four items were included to investigate the relationship between these two tasks. Although a significant relationship is expected to be observed between the responses to these recycling and HHW items, the relationship between identifying oneself as the household "expert" (Tuthill et al., 1987) and how the specific waste products are actually dealt with is less certain. The fifth section of the survey instrument makes more in depth inquiries about this topic.

4.2.3 Sources of HHW information.

The third section of the survey was designed to determine from what informational sources survey respondents had heard or read about HHW. This section is comprised of eight survey items corresponding to different HHW informational sources noted in McEvoy and Rossignol's research (1993). Respondents could indicate more than one

source of HHW information.

4.2.4 Psychological/attitudinal items.

The fourth section of the survey was designed to gauge the respondent's endorsement of, or disagreement with, attitudes and social-psychological concepts that appear to be relevant to HHW disposal and that had previously been studied in the psychology of recycling and other pro-environmental behaviours. Personal attitudes and social-psychological orientation may influence the purchase of HHW products, their proper disposal, and acquiring knowledge regarding the Trail Road HHW facility.

This section of the survey is made up of 18 items with responses to be given on a 5-point Likert-type scale. On the 5-point scale a response of "3" represents neither agreement nor disagreement with the item. Fourteen of the items correspond to the six-factor theoretical structure so that its performance can be assessed. The remaining four items assess the two non-structure factors.

Although only two questionnaire items were used to represent each of the psychological factors in the present research, the majority of these items were obtained from prior literature where factor analyses had shown that the original items formed coherent factors. The A detailed description of the original items and the reworded versions of the psychological items is given in Appendix C.

4.2.5 Purchase and disposal of specific HHW items and knowledge of the Trail Road HHW facility - the dependent variables for the main statistical analyses.

The fifth section of the survey instrument is designed to evaluate the respondent's purchase and disposal of seven HHW products and one non-HHW product, styrofoam containers, which is recyclable (bluebox). This section of the survey is also designed to assess the respondent's knowledge of the location of the Ottawa-Carleton Household Special Waste Depot (Trail Road) and its day of operation (Saturday).

In this study there are seventeen dependent variables, all of which are dichotomous. There is a dichotomous product purchase/ product non-purchase variable for each of the seven HHW products and for styrofoam containers (8 variables). There is also a dichotomous proper disposal/ improper disposal variable for each of the seven HHW products and for styrofoam containers (8 variables). The seventeenth dependent variable is the combined variable of knowing the location and the day of operation of the Ottawa-Carleton Household Special Waste (HSW) Depot.

The selection of the seven HHW products for the survey was based on the review of the literature. The purchase and disposal of motor oil, antifreeze, paint, and pesticides have been researched by a number of authors: Stanek et al. (1987), Scudder and Blehm (1991), and McEvoy and Rosignol

(1993). The present research also used these products, but paint was divided in two categories: Latex paint and Oil-base paint. The Household Batteries item was taken from McEvoy and Rossignol (1993) and the Polishes and Waxes item was taken from Bass et al. (1990).

The one non-hazardous product included in this section, styrofoam containers, was conceived of by the author. Styrofoam containers were not accepted for curbside recycling until the advent of the "expanded" Ottawa-Carleton Blue Box Programme in the Fall of 1996. Surveying for the main study began shortly thereafter (December 1996). Since this recycling option had been available for a short time, it was thought that it would help select out the avid recyclers who pay attention to such matters and recycle as much as they can, from the intermittent recyclers and non-recyclers.

The combined variable of knowing the location of the Ottawa-Carleton HSW Depot and the day of its operation is also the author's contribution. If a respondent had actually visited this site, they should be able to provide this information. The Ottawa-Carleton HSW Depot is inconveniently located for the majority of Ottawa-Carleton residents, involving a moderate to long drive. It is neither close to shopping nor to restaurants. To visit the Trail site is a pre-planned and deliberate trip. Moreover, the day of its operation is unusual for a municipal facility. The author

believes that unless the respondent can provide this information it is unlikely that they are properly disposing of their HHW.

However, the relationship between being able to provide this information and proper HHW disposal is not perfect. A few local businesses will accept used oil and antifreeze; but products such as pesticides, polishes and waxes, paint, and household batteries are not accepted. The only place where these wastes are accepted is the Ottawa-Carleton HSW Depot. The Ottawa-Carleton HSW Depot does provide temporary collection days, but these are infrequent; and it appears that priority is given to communities most distant from the Trail site.

4.2.6 Motivation: reported willingness to travel.

The sixth section of the survey is designed to determine the respondent's level of motivation for appropriately disposing of HHW by assessing their willingness to travel, as measured in kilometers, to a HHW site. The importance of distance to the depot was discussed in the first chapter, and has been used in the prior research of Tuthill et al. (1987) and McEvoy and Rossignol (1993).

The distance that survey participants are willing to drive to properly dispose of their HHW is also indicative of whether they are actually engaging in appropriate disposal

practices. For example, if survey respondents from Britannia state that they are only willing to drive one kilometer to dispose of their HHW, then it is unlikely that they are making the trip out to the Trail Road HSW Depot, which is a much greater distance. In addition, individuals who indicate that they are only willing to drive very short distances are unlikely to be participating in temporary collection events, which could still be considerable distances from their homes.

4.2.7 Disposal preferences.

The seventh and last section of the survey instrument is designed to determine the respondents' preferences for four different means of HHW disposal, the preferred frequency of curbside collection, and the preferred frequency of temporary collection events. This section also investigates whether respondents are in favour of stores placing labels on hazardous products to provide them with information on how the product should be appropriately disposed of in the Ottawa-Carleton Region. The last item in this section inquires of respondents whether they would vote for a Provincial law which would fine householders for unsound HHW disposal practices. The survey items above were drawn from the article by Tuthill et al. (1987), except for the product information item, which is by the current author.

4.3 Questionnaire Development

The questionnaire was administered to 14 pilot study volunteers prior to the main study. Each volunteer was asked to read and sign an informed consent form (APPENDIX D) prior to administration of the survey instrument and was offered a HHW disposal information sheet upon its completion (APPENDIX E). Pilot study volunteers were also offered an abstract of the present research (APPENDIX F).

The purpose of the pilot study was to evaluate its content in terms of the clarity of the survey items. Upon completion of the survey, the pilot study respondents were asked if they had any difficulty understanding the items. Minor changes in wording were made. Pilot volunteers indicated that they were able to fill out the survey with relative ease in 10 minutes or less.

The parameter estimates for the statistical technique to be employed in the analysis of the data, logistic regression, are based on maximum likelihood estimates derived from large numbers of observations. The characteristics of the present type of data, where only a portion of the respondents purchase any given product and yet a smaller portion correctly dispose of it, do not lend themselves to reliable analysis with small numbers of subjects and the substantial number of variables in the present design. Therefore, analysis of the pilot study questionnaires was limited as to the clarity of its content.

4.4 Procedure

The data for the main study was collected at six Ottawa-Carleton shopping malls. The protocol specified by the shopping malls for surveying on their premises was uniform. The malls provided a table and chairs, or allowed the experimenter to set up his own in a designated high traffic area. This was usually close to one of the main entrances or the mall's main rotunda. The experimenter was also allowed to display two large signs (posterboard size) to encourage mall patrons to participate.

The experimenter was allowed to ask mall patrons passing close to the table whether they would be willing to fill out a survey. Those who agreed were first asked to fill out an informed consent form (APPENDIX D). Participants were then presented with the survey instrument and instructed to place it in the ballot box provided when they had completed it. Before their departure from the survey table the participants were offered a HHW information Sheet (APPENDIX E) and they were also asked if they would like an abstract of the present research proposal (APPENDIX F).

4.5 Statistical Analyses

The seventeen dependent variables used in the present research are dichotomous. Linear probability, logistic, and probit are among the models suggested for data with dichotomous dependent variables, but the logistic is the

most versatile (Pedhazur, 1997). In many fields (e.g. epidemiology) it has become the standard method of analysis in this situation (Hosmer & Lemeshow, 1989). Therefore, logistic regression was selected as the principal means of analyzing the study data.

The goal of the analysis using this method is the same as that for any statistical model building technique: to find the best-fitting and most parsimonious model to describe the relationship between a set of independent variables and a dependent variable. The principles that guide the application of linear regression are also applicable, for the most part, to logistic regression (Hosmer & Lemeshow, 1989). Like linear regression, the logistic model yields regression coefficients, predicted values, and residuals (Wright, 1995).

However, the properties of a dichotomous dependent variable render the assumptions of linear regression false. In logistic regression the population means of the Y's at each level of X are nonlinear (sigmoidal distribution), the assumption of homoscedasticity is untenable, and the errors are not normally distributed (Pedhazur, 1997). In logistic regression the value of the conditional mean (i.e. the expected Y given the value of x) is bounded (i.e. it must be greater than or equal to zero and less than or equal to 1); whereas in linear regression the conditional mean $E(Y|x)$ can potentially take on any value between positive infinity and

negative infinity. The binomial distribution, not the normal, describes the distribution of the errors upon which logistic regression analysis is based (Hosmer & Lemeshow, 1989).

Logistic regression analysis is similar to linear regression analysis in that one is interested in estimating the parameters of the regression equation. Parameter estimation in linear regression is aimed at minimizing the sum of the squared residuals. With logistic regression, the aim is to estimate those parameters which are most likely to have given rise to the sample data. The maximum likelihood (ML) estimation procedure utilizes iterative algorithms requiring the use of a computer for their application. The Statistical Package for the Social Sciences (SPSS, 1993, 1997) was used for all of the statistical analyses of the study data.

Chapter 5: Results

5.1 Summary Statistics for Demographic Items

The sample was comprised of 203 respondents, 53.3% male and 46.7% female. Sixty-two percent of the respondents reside in Ottawa and the remaining 38% in the rest of Ottawa-Carleton (primarily Gloucester and Nepean). The breakdown of respondent's township of residence is given in Table 6.

Table 6

Respondent's Township of Residence in Ottawa-Carleton

Township	Present Study (Valid%)	1991 RMOC Census
Ottawa	61.9 %	46.3 %
Gloucester	13.4 %	15.0 %
Nepean	12.9 %	15.9 %
Cumberland	3.6 %	6.0 %
Kanata	3.1 %	5.5 %
West Carleton	2.1 %	2.2 %
Rideau	1.5 %	1.7 %
Vanier	1.0 %	2.7 %
Osgoode	.5 %	2.0 %
Goulbourn	-	2.4 %
Rockcliffe	-	.3 %
	100.0 % (194 cases)	100.0 %

missing cases f=9 or 4.4% of total

The proportion of survey respondents who indicated Ottawa as their township of residence was significantly greater than that reported in the 1991 RMOC Census $\chi^2(1, N = 194) = 8.25, p < .01$. The proportions of survey respondents from Gloucester, Nepean, Cumberland, and Kanata were not significantly different ($p < .05$) from the 1991 Census. Comparisons between the present study and the Census were not made for West Carleton, Rideau, Vanier, and Osgoode because there were too few subjects from these townships to perform reliable chi-squares.

The majority of respondents live in a single family home followed in frequency by apartments/condominiums, duplexes/townhouses, and "other" types of dwellings. The study percentages are compared to those found in the 1991 RMOC Census in Table 7.

Table 7

Type of Dwelling

Dwelling Type	Present Study (Valid%)	1991 RMOC Census
Single Family	54.3 %	42.1 %
Apartments/Condo	29.1 %	33.2 %
Duplex/Townhouse	13.1 %	24.0 %
Other	3.5 %	0.6 %
	100.0 % (199 cases)	99.9 %
missing cases f=4 or 2.0% of total		

There were significantly more survey respondents in the present research who indicated that they lived in a single family dwelling $\chi^2(1, N = 199) = 12.08, p < .001$ and significantly fewer respondents who indicated they lived in duplex or townhouse $\chi^2(1, N = 199) = 13.04, p < .001$ when compared to the 1991 RMOC Census.

The mean age of the respondents was 39 years. The breakdown of the age distribution is given below in Table 8.

Age Distribution for Present Study Compared to Census

Age Range	f	Present Study (Valid %)	1991 RMOC Census
15-24 years	45	23.2 %	17.9 %
25-34 years	44	22.7 %	24.0 %
35-54 years	62	32.0 %	35.2 %
55-64 years	15	7.7 %	10.0 %
65 + years	28	14.4 %	12.9 %
	194	100.0 %	100.0 %

missing from analysis f=9 or 4.4% of total

The chi-square for the age groups shown above was not statistically significant at the $p < .05$ level, $\chi^2(4, N = 194) = 5.11, p < .30$.

Respondents were assigned to one of fourteen occupational categories. The categories are based on those used in the Ottawa-Carleton 1991 Census Review. A comparison

of the summary statistics for the present study and the 1991 census are given in Table 9. The occupational category percentages for the present study in Table 9 are for the 112 of 203 respondents who indicated some form of employment. The percentages for respondents in labour force and non-labour force categories are given in Table 10.

Table 9

Occupational Categories

Occupational Category	Present study (Valid %)	1991 RMOC Census
Manager/Aministrator & Rel Occ	19.6 %	18.7 %
Natural Sci., Engineering, & Math Occ	16.0 %	8.5 %
Social Sciences	3.6 %	3.5 %
Occupations in Religion	0.9 %	0.2 %
Teaching and Related Occupations	8.9 %	4.8 %
Medicine and Health Occupations	5.4 %	5.0 %
Art, Literature, Recreation, & Rel Occ	2.7 %	2.5 %
Clerical & Related Occ	13.4 %	20.8 %
Sales Occupations	4.5 %	8.1 %
Service Occupations	10.7 %	13.0 %
Technician	4.5 %	3.6 %
Construction Trade	1.8 %	3.7 %
Trades Other	6.3 %	5.9 %
Occupations Not Classified	1.8 %	1.8 %

based on 112 observations out of 203

Table 10

Labour and Non-Labour Force Categories for the Present
Research for ages 15 +

Category	f	Present Study	1991 RMOC Census
In Labour Force	112	55.2 %	68.0 %
Students	45	22.1 %	13.8 %
Retired	32	15.8 %	13.1 %
Others not in Workforce	11	5.4 %	5.1 %
Missing	3	1.5 %	

The present sample had significantly more individuals employed in Natural Science, Engineering, and Math Occupations $\chi^2(1, N = 112) = 8.25, p < .01$ and in Teaching and Related Occupations $\chi^2(1, N = 112) = 4.17, p < .05$ compared to the 1991 Census. Chi-square was not performed for the Social Sciences; Occupations in Religion; Art, Literature, Recreation, & Related Occupations; Technician; and Construction Trade categories because there were too few subjects for reliable analyses.

The sample had significantly fewer individuals in the labour force category $\chi^2(1, N = 200) = 13.24, p < .001$ and significantly more in the student category $\chi^2(1, N = 200) = 12.73, p < .001$ when compared to the 1991 Census.

The majority of respondents indicated that they had temporary storage at their dwelling for recyclables (82%)

and had access to a vehicle (75%). Parenthood was indicated by 40% of the respondents and 10% were parents of children seven years of age or younger.

5.2 Summary Statistics for Self-reported Knowledge and Participation in General Recycling and HHW Disposal Behaviour

The summary statistics for the survey items which inquire as to whom is most knowledgeable/main participant in the general recycling and HHW disposal practices in the respondent's household are given below in Table 11.

Table 11

Knowledge / Participation in General Recycling and HHW Disposal Behaviours

Survey Item	You		Equally Know/Do		Missing Other		
	f	Valid%	f	Valid%	f	Valid%	
Recycling Know	109	53.7%	63	31.0%	31	15.3%	0
Recycling Do	91	45.3%	85	42.3%	25	12.4%	2
HHW Know	99	49.0%	54	26.7%	54	26.7%	1
HHW Do	90	44.6%	36	17.8%	76	37.6%	1

To illustrate how Table 11 is to be read, the following illustration is supplied. In response to the first item, recycling knowledge, 109 out of 203 respondents (53.7%) identified themselves as the most knowledgeable person in their household on what can be recycled; 63 out of 203 respondents (31.0%) indicated that they equally shared this knowledge in their household; and 31 out of 203 respondents (15.3%) indicated that someone else was the most knowledgeable.

5.3 Summary Statistics for Sources of HHW Disposal Information

Survey respondents were queried as to where they had heard or read about HHW Disposal in the last year. The eight sources of HHW information used in the present survey were borrowed from McEvoy and Rossignol's 1993 article on HHW Disposal. Respondents were allowed to indicate more than one source of HHW information. Table 12 gives the summary statistics for the sources of HHW information.

When comparing the present study's percentages to those in the far column, it should be kept in mind that McEvoy and Rossignol's percentages are based on a subgroup of respondents who indicated that they had read or heard about HHW in the last year. In both studies the newspaper was the most frequently cited source of information, followed by pamphlets and flyers, and television. The majority of

Table 12

Sources of HHW information

Information Source	Frequency	Percentage of Respondents	McEvoy and Rossignol (1993)
Newspaper	102	50.2%	42%
Pamphlets or Flyers	77	37.9%	21%
Television	73	36.0%	17%
Conversation	48	23.6%	4%
Radio	47	23.2%	13%
Workplace	34	16.7%	2%
School	30	14.8%	6%
Disposal/Recycling Company	29	14.3%	13%

respondents (91.1%) had heard or read about HHW from at least one information source.

5.4 Descriptive Statistics for Psychological Items

The Psychological items in the survey were all based on a 5-point Likert scale. The descriptive statistics for these items are given in Table 13. On the 5-point scale a response of "3" indicates neither agreement nor disagreement with the survey item. The items in the table are displayed in the order in which they appear on the survey instrument. The inter-item correlations are given in Appendix G.

Table 13

Descriptive Statistics for Psychological Items

Variable	n	Mean	Mode	S.D.	Kurtosis	Skew
Social Norm 1	201	3.786	5	1.131	– .383	– .576
Social Norm 2	165	4.333	5	.906	1.668	–1.408
Personal Norm 1	201	4.483	5	1.030	4.204	–2.213
Personal Norm 2	165	4.576	5	.813	7.806	–2.594
Awareness 1	200	4.125	5	1.215	.738	–1.311
Awareness 2	202	4.050	5	1.171	.449	–1.149
Ascription 1	201	3.562	5	1.459	– .956	– .661
Ascription 2	199	4.362	5	1.096	3.081	–1.943
Salience 1	202	4.381	5	1.167	2.960	–2.015
Salience 2	202	4.366	5	1.108	3.023	–1.961
Knowledge 1	203	3.813	5	1.179	– .259	– .783
Knowledge 2	201	3.413	5	1.408	–1.182	– .341
Difficulty 1	201	3.030	3	1.435	–1.304	– .043
Difficulty 2	201	3.921	5	1.199	.011	– .967
Concern 1	201	4.463	5	.995	4.183	–2.142
Concern 2	195	4.410	5	1.023	3.712	–2.029
Personal Risk 1	200	4.120	5	1.025	.202	–1.007
Personal Risk 2	203	4.010	5	1.044	.623	–1.023

Some of the psychological items shown in Table 13 were stated in the inverse format on the survey instrument. The Awareness of Consequences, Ascription of Responsibility, Personal Salience, and Perceived Difficulty items had their

scores transposed before being included in the table.

5.5 Summary Statistics for Purchase and Disposal of Products

The survey evaluated the purchase and disposal of eight products. Seven of the products fit the description of HHW and one did not (styrofoam containers). The vast majority of respondents, 93.6 %, bought at least one of the HHW products. The summary statistics for the purchase and disposal of these products are given below in Table 14.

Table 14

Product Purchase and Disposal

Product	missing		Product Purchase		non-specific answer		Proper Disposal	
	V	Valid cases	f	\ Valid%	V	Valid cases	f	\ Valid%
Motor Oil	18	185	51	27.6%	17	34	19	55.9%
Antifreeze	20	183	50	27.3%	18	32	15	46.9%
Batteries	10	193	173	89.6%	32	141	41	29.1%
Latex Paint	23	180	115	63.9%	43	72	34	47.2%
Oilbase Paint	23	180	93	51.7%	38	55	31	56.4%
Polish & Wax	23	180	102	56.7%	12	90	26	28.9%
Pesticides	18	185	71	38.4%	20	51	26	51.0%
Styrofoam	39	164	128	78.0%	2	126	62	49.2%

To illustrate how to read Table 14 the following example is supplied. For the first product on the table, motor oil, 51 of 185 respondents or 27.6% indicated that they purchased this product. Thirty-four of the 51 respondents who indicated the purchase of motor oil gave specific answers of how they disposed of it. Nineteen of the 34 respondents who gave specific answers, or 55.9%, reported an acceptable disposal method.

In Table 15, the purchase and disposal rates for the products in the present study are compared to those found Table 15

Comparison of the Households Disposing and Improper Disposal Rates for the Present Research and Two Prior Studies

The percentages below are given in terms of households

Product	Present study		McEvoy and Rossignol (1993)		Stanek et al. (1987)	
	% dis- posing	% im- proper	% dis- posing	% im- proper	% dis- posing	% im- proper
Motor Oil	28	44	33	42	33	57
Antifreeze	27	53	11	72	7	95
Oilbase Paint	52	44	22	65	11	91
Batteries	90	71	83	100	n/a	n/a
Pesticides	38	49	12	75	10	98

the articles by Stanek et al. (1987) and McEvoy and Rossignol (1993). Not all comparisons between the products in Table 14 and the two research articles could be made, because they did not investigate exactly the same set of products. The present study was the only one to investigate the purchase and disposal of polishes & waxes and latex paints. Stanek et al. (1987) did not examine household batteries.

The proper disposal of one hazardous product by an individual was moderately to highly correlated with the proper disposal of other hazardous wastes purchased. For example, it was found that for the individuals who bought both oil and antifreeze, there was a perfect correspondence between the reported proper disposal of the one product and reported proper disposal of the other ($r=1.0$). The correlations for proper disposal of the products and the knowledge and location of the Ottawa-Carleton HSW Depot are given in Table 16.

The correlations between the proper disposal of antifreeze and the proper disposal of other hazardous products were the highest among the hazardous products overall. The correlations between the proper disposal of batteries and the other products were the lowest. Correlations for the proper disposal of the hazardous products with the proper disposal of styrofoam containers, or with knowing the location and day of operation of the

Ottawa-Carleton HSW Depot were the weakest overall.

Table 16

Correlation Matrix for Proper Product Disposal and Knowledge
of the O-C HSW Depot Location and Day of Operation

* = $p < .05$
** = $p < .001$

		Antifreeze		Latex	Polish/Wax		Pest-	Styro-
	Motor		Battery		Oilbase		icides	foam
	Oil							
Motor Oil								
Antifreeze	** 1.00 (24)							
Battery	** .79 (29)	** .93 (28)						
Latex	** .84 (25)	** .90 (21)	** .54 (61)					
Oilbase	** 1.00 (18)	** 1.00 (15)	** .60 (46)	** .86 (52)				
Polish/Wax	** .93 (27)	** 1.00 (22)	** .67 (69)	** .84 (47)	** .85 (37)			
Pesticides	** 1.00 (20)	** 1.00 (17)	** .63 (41)	** .71 (36)	** .92 (29)	** .86 (40)		
Styrofoam	.30 (20)	.30 (18)	* .26 (92)	* .30 (46)	.29 (36)	.24 (61)	* .56 (32)	
Locat/Day	* .49 (34)	* .56 (32)	* .28 (140)	* .30 (71)	* .37 (54)	* .32 (88)	* .39 (51)	* .07 (124)

The correlations for the purchase of the products were generally weak to moderate ($r < .6$) except for those between the purchase of oil and glycol ($r = .76$) and the purchase of oilbase and latex paint ($r = .76$). The correlations between the purchase of the products are given in Table 17.

Table 17

Correlation Matrix for the Purchase of Products

* =p<.05	Antifreeze		Latex	Polish/Wax			
** =p<.001	Motor Oil	Battery		Oilbase		Pest-icides	
Motor Oil							
Antifreeze	** .76 (182)						
Battery	* .17 (182)	.13 (182)					
Latex	** .40 (174)	** .34 (173)	* .15 (177)				
Oilbase	** .27 (175)	** .30 (174)	* .15 (177)	** .76 (176)			
Polish/Wax	** .37 (172)	** .33 (170)		** .33 (170)	** .37 (171)		
Pesticides	** .43 (178)	** .39 (177)		** .37 (175)	** .38 (176)	** .49 (173)	
Styrofoam				* .19 (147)	* .20 (146)	* .21 (149)	.16 (151)

5.6 Motivation: Willingness to Travel

The results for the motivational item which queried respondents as to how far they would be willing to travel to safely dispose of their HHW are represented by the decreasing cumulative frequency distribution in Figure 4.

The figure was formulated from 180 of the 203 cases (88.7% of total). The percentages in the figure are valid %. Eight of the remaining 23 cases not included in the figure

Figure 4

Distance Willing to Travel to Dispose HHW in Kilometers

had stated "no vehicle"; another 7 cases indicated that they would be willing to travel by bus, but did not state how far; and 8 cases were missing.

On the survey, respondents could circle values from 1 to 14 Km or indicate a greater distance in the blank provided. Fourteen of the respondents indicated "more" than 14km and another fifteen respondents indicated "as far as it takes". Since we know that they are willing to travel more than 14km, but not how much more, all of these subjects were conservatively assigned a distance value of 15km.

Prior to its inclusion in the logistic modelling procedures the distance variable was dichotomized into: those respondents willing to drive 9km or more and those not willing to drive 9km or more. The cutpoint was determined by the hypothesized distance of 8km (5 miles) that the majority of respondents would not be willing to travel beyond to properly dispose of their HHW. Eight kilometers, or 5 miles, was chosen as the cutpoint so that present research would be comparable to research done in the United States.

5.7 Disposal Preferences, Product Information, Provincial Law

The preference items in this section were drawn almost exclusively from the 1987 Massachusetts survey by Tuthill et al.. Survey respondents were asked to indicate their most preferred HHW disposal option selected from the four

disposal options specified in the survey. The results are given in Table 18.

In the Massachusetts survey it was found that no one particular disposal option was clearly preferred above the rest. In the present Ottawa research this is not the case. Curbside collection was clearly the most preferred option; preferred by more than half of the respondents.

Respondents in the present study were asked to indicate how often curbside pick-up should occur and how often temporary local collection events should be held. The results for these items are displayed in Table 19. Once a month was the most popular timeframe for both curbside pick-

Table 18

Preference for Disposal Option

Disposal Option	frequency	Valid% of respondents preferring Disposal Option	Tuthill et al. (1987)
Special curbside pick-up	111	54.7%	29%
Temporary local collection sites	31	15.7%	28%
Regional site open every day	31	15.7%	21%
Return to place of purchase	24	11.8%	20%
missing observations	6		

up and temporary collection. For comparison, the Massachusetts survey percentages for preferred frequency of temporary collection are supplied in the column on the far right of Table 19, and those respondents preferred monthly collection as well. Please note that the percentages supplied by Tuthill and colleagues do not add up to 100%.

The second to last item in the disposal preferences section of the present survey asked respondents if they were in favor of stores putting labels on toxic or hazardous

Table 19

Frequency of Curbside Pick-Up and Temporary Collection

	Curbside Pick-Up		Temporary Collection		
	/ Present study \		/ Present study \		/ Tuthill et al. \
Timeframe	f	Valid%	f	Valid%	(1987)
Once a year	9	4.5%	4	2.0%	3%
Twice a year	23	11.4%	17	8.5%	13%
Three times a year	10	5.0%	9	4.5%	4%
Four times a year	48	23.9%	40	20.0%	10%
Monthly	69	34.3%	73	36.5%	31%
Every two weeks	18	9.0%	16	8.0%	\
Weekly	24	11.9%	41	20.0%	22%
missing	2		3		

products with information pertaining to the proper disposal of these products in Ottawa-Carleton. The overwhelming majority (yes = 91.1%, no = 7.4% , missing = 1.5%) of respondents indicated that they would be in favor of this practice.

Respondents were queried as to whether they would vote in favor of a Provincial law which fined householders for the improper disposal of hazardous household waste. The majority of respondents indicated that they would vote in favour of the law (yes = 77.8%, no = 20.2%, missing = 2%). The percentage of respondents in the present research in favour of a HHW law was somewhat greater than the 70.2% in favour of such a law found by Tuthill and colleagues (1987) in their Massachusetts survey.

5.8 The Selection of Logistic Regression for Univariate and Multivariate Analysis

What is logistic regression and why was it chosen as the technique for analyzing the present data? Logistic regression is a mathematical modelling approach that can be used to describe or predict the influence of several independent variables on a dichotomous dependent variable (Kleinbaum, 1994). In the present study, all of the dependent variables are dichotomous in nature. Discriminant analysis can also be used to estimate the relationship among one or more predictors and a categorical dependent variable;

however, it requires assumptions that are more restrictive than those for logistic regression (Wright, 1995).

The logistic regression model is flexible; it allows the researcher to select dichotomous and continuous independent variables. It allows one to evaluate the influence of a collection of independent variables of primary interest on the dependent variable while controlling for others. These "control variables" behave like ordinary independents and may also function as predictors in the mathematical model (Kleinbaum, 1994).

5.9 Similarities to Linear Regression, the Logistic Function, the Logistic Model, Maximum Likelihood, Odds, and the Odds Ratio

Similar to linear regression, the logistic model yields regression coefficients, predicted values, and residuals. However, unlike linear regression, the relationship between the predictor and the predicted values is assumed to be nonlinear. The logistic distribution is S-shaped or sigmoidal. The logistic function, defined as $f(z) = 1 / 1 + e^{-z}$, upon which the logistic model is based provides a curve that never falls below 0 or reaches above 1. Therefore, predicted values obtained using the logistic model can always be interpreted as probabilities (Wright, 1995). To obtain the logistic model from the logistic function we write z as the linear sum of $a + B_1X_1 + B_2X_2 + \dots + B_kX_k$

where a and B_i are constant terms representing unknown parameters. In essence, z is an index that combines all of the independents (Kleinbaum, 1994). The estimated logistic coefficient for a given model variable " b_i " can be interpreted as the change in the log odds associated with a one-unit change in the independent variable while statistically adjusting for other independent variables (if any) in the equation (Norusis & SPSS Inc., 1993).

In linear regression the parameters of the model are estimated using the least-squares method; in logistic regression the parameters of the model are estimated using the maximum-likelihood method. The coefficients that make our results most "likely" are selected. Since the logistic regression model is nonlinear, an iterative algorithm is necessary for parameter estimation (Norusis & SPSS Inc., 1993).

Interpretation of logistic regression coefficients requires understanding the concept of odds. For a dichotomous variable, the odds of membership in the target group is equivalent to the probability of membership in the target group divided by the probability of membership in the "other" group. Interpreting logistic regression coefficients in terms of odds rather than simple probabilities is advantageous because the estimated change in odds is the same at all levels of the predictor, whereas the probability of membership in the target group depends on the level of

the predictor (Wright, 1995).

The odds ratio is another essential concept in logistic regression analysis. It estimates the change in the odds of membership in the target group for a one unit increase in the predictor. The odds ratio is useful because it is easier to interpret than the raw regression coefficient which represents the change in the natural logarithm of the odds ratio. An odds ratio for a predictor variable can be computed by raising e the base of the natural logarithm to the power of the predictor's regression coefficient " b_i " (Wright, 1995).

5.10 Logistic Regression: Guidelines for Univariate and Multivariate Analysis

To choose variables that result in the "best model" in the scientific context of the problem one must have: (i) a basic plan to follow to select the variables for the model and (ii) a set of methods for assessing the adequacy of the model both in terms of the individual variables in the model and the overall fit of the model. The traditional approach to statistical model building is to find the most parsimonious model that still explains the data (Hosmer & Lemshow, 1989).

Minimizing the number of variables in a resultant model tends to increase its numerical stability and generalisability. The more variables included in a model,

the greater the estimated standard errors become, and the more dependent the model becomes on the observed data. Including all scientifically relevant variables in a model may result in "overfitting" which is most commonly characterized by unrealistically large estimated coefficients and/or estimated standard errors. This effect may be exacerbated when the number of variables is large relative to the number of subjects and/or when the overall proportion responding is close to either 0 or 1 (Hosmer & Lemeshow, 1989).

The present survey data underwent a three-step process of variable selection and analysis as described by Hosmer and Lemeshow (1989) in their chapter "Model-Building Strategies and Methods for Logistic Regression."

(1) The first step in the selection process is univariate analysis of each independent variable with each dependent variable. Seventeen dependent variables were used throughout the analysis. Each of the eight waste products in the survey was split into a product non-purchaser/purchaser variable and a separate improper disposer/proper disposer variable resulting in 16 product variables. The seventeenth dependent variable was knowledge of the location and the day of operation of the Trail Road HHW facility.

At this step in the analysis, there were 22 independent variables: 3 demographic, 18 psychological, and 1 motivational item (willingness to travel). The decision was

made to treat each of the 18 psychological survey items as its own independent variable. The pairs of psychological items corresponding to the study factors tended to be weakly to moderately intercorrelated, with coefficients ranging from .21 to .69 . The inter-item correlation matrix for the 22 independent variables used in the univariate analyses is given in Appendix G.

Each of the seventeen dependent variables was individually logistically regressed on each of the 22 independent variables in turn, yielding a 17 X 22 matrix which is given in Appendix H. The likelihood ratio for the univariate logistic regression model is exactly equal to the likelihood ratio chi-square test with $k-1$ degrees of freedom. Statistical significance was set at the $p < .05$ criterion.

(2) After completion of the univariate analyses, variables were selected for the multivariate analyses. At this step, 16 independent variables were chosen for subsequent model building: 3 demographic, 12 psychological, and the motivational item. The three demographic variables: Age, Gender, and Single Family Dwelling with Vehicle were included in all of the multivariate analyses as control variables. Psychological variables which demonstrated statistically significant univariate relationships ($p < .05$) with a given dependent variable were selected as candidates for subsequent model building. The motivational item

(distance) was also selected for inclusion in model building based on a significant univariate relationship with a dependent variable.

(3) After fitting a multivariate model, the importance of each variable in the model was verified. This was primarily based on the level of significance of the Wald statistic, and the two statistics from which the Wald is calculated: the standard error and the logistic regression coefficient [the Wald = $(b / S.E.)^2$]. Variables that were retained in a model but were not significant at the $p < .05$ level were eliminated, and a new model fitted. Model variables which created unrealistically large standard errors or coefficients were also eliminated, and a new model fitted.

5.11 The Disposal, Location/Day and Product Purchase Models

The proper product disposal, location/day, and product purchase models are given in Table 20. The disposal models and location/day model are shown first with the product purchase models presented on the following page. The logistic models are presented in an abbreviated format to give the reader an overview of their composition. Forward stepwise likelihood ratio multivariate logistic regression was used in all of the analyses (In $p < .05$, Out $p > .10$).

A more detailed examination of the product disposal, location/day, and product purchase models is given in

Appendix I. The more detailed examination includes contingency tables, initial and final -2 log likelihoods, 95% confidence intervals for the odds ratios, and goodness of fit statistics.

Three goodness of fit statistics were utilized to help assess the fit of the mathematical models. Two of the goodness of fit statistics are related R^2 measures: the Cox & Snell R^2 and the Nagelkerke R^2 . Both statistics attempt to quantify the proportion of explained variation in the logistic regression model. They are similar in intent to the R^2 in a linear regression model although the variation in a logistic regression model is defined differently. The Nagelkerke is a modified version of the Cox & Snell statistic. It is modified so that it can achieve a maximum value of 1, which the Cox & Snell cannot (Norusis & SPSS Inc., 1997).

The third goodness of fit statistic is the Hosmer and Lemeshow test (1989). This statistic is essentially a chi-square measure based on the differences between the observed and estimated probabilities for cases that have been assigned to 10 groups. This statistic was not available for all of the models. It would have been calculated from too few groups due to the restricted range of observed probabilities present in some models.

Table 20

Proper Waste Disposal and Location/Day Models

Dependent	Independents	B	S.E.	p	R	O.R.
MOTOR OIL	DISTANCE	3.81	1.07	.0004	.49	45.00
GLYCOL	SINGLE w/VEHICLE	2.89	1.27	.0229	.28	17.96
	KNOWLEDGE 2	1.09	.48	.0227	.28	2.96
BATTERY	ASCRPTION 2	1.13	.42	.0065	.19	3.10
	KNOWLEDGE 2	.98	.25	.0001	.30	2.66
LATEX PAINT	KNOWLEDGE 2	1.14	.36	.0014	.30	3.12
	DIFFICULTY 1	.65	.32	.0439	.15	1.92
	PERSONAL NORM 1	.85	.36	.0184	.20	2.33
OILBASE PAINT	SINGLE w/VEHICLE	3.01	1.43	.0355	.19	20.31
	AWARENESS 2	2.06	.97	.0341	.19	7.86
	KNOWLEDGE 2	1.49	.67	.0265	.21	4.46
	DISTANCE	2.46	1.61	.0345	.19	11.71
	DIFFICULTY 1	1.05	.53	.0466	.17	2.86
POLISHES & WAXES	KNOWLEDGE 2	1.08	.39	.0060	.25	2.96
	DIFFICULTY 2	.97	.42	.0215	.19	2.64
	PERSONAL RISK 2	1.11	.45	.0149	.21	3.02
	DISTANCE	2.07	.84	.0143	.21	7.91
PESTI-CIDES	DISTANCE	4.39	1.26	.0005	.41	80.66
	KNOWLEDGE 2	1.75	.64	.0063	.30	5.79
STYRO-FOAM	KNOWLEDGE 2	.67	.20	.0010	.23	1.91
LOCATION & DAY	SINGLE w/VEHICLE	1.32	.64	.0389	.14	3.73
	DISTANCE	2.41	1.06	.0237	.17	11.10
	KNOWLEDGE 2	1.30	.44	.0035	.24	3.66

B = estimated regression coefficient

S.E. = standard error for the regression coefficient

p = level of statistical significance

R = partial correlation

O.R. = odds ratio

Table 20

Purchase Models

Dependent	Independents	B	S.E.	Sig.	R	O.R.
MOTOR	SINGLE w/VEHICLE	.93	.37	.0119	.15	2.53
OIL	KNOWLEDGE 2	.44	.20	.0256	.12	1.55
GLYCOL	SINGLE w/VEHICLE	.81	.36	.0243	.12	2.24
BATTERY	no variables in the equation except for constant					
LATEX	SINGLE w/VEHICLE	.80	.34	.0202	.13	2.22
PAINT	KNOWLEDGE 2	.47	.17	.0062	.16	1.60
OILBASE	AGE	.50	.18	.0044	.16	1.65
PAINT	SINGLE w/VEHICLE	.86	.33	.0086	.15	2.36
POLISHES	SINGLE w/VEHICLE	.74	.33	.0263	.11	2.09
& WAXES	ASCRPTION 1	-.40	.18	.0301	-.11	.67
	DIFFICULTY 2	-.37	.18	.0404	-.10	.69
PESTI-	KNOWLEDGE 2	.57	.19	.0023	.19	1.76
CIDES	DIFFICULTY 2	-.60	.18	.0011	-.21	.55
STYRO- FOAM	no variables in the equation except for constant					

B = estimated regression coefficient
 S.E. = standard error for the regression coefficient
 p = level of statistical significance
 R = partial correlation
 O.R. = odds ratio

5.12 The Goodness of Fit of the Models

The goodness of fit of the mathematical models, how effectively they describe the outcome variable, was evaluated with regards to four criteria. The first of the four criteria was the model's classification performance. This was judged in terms of both the percentage of the target group accurately classified (sensitivity) and the percentage of the "other" group accurately classified (specificity). The correct logistic model does not always yield good classification for both groups (Wright, 1995).

The second criterion for assessing the fit of a model was an examination of its histogram of estimated probabilities. Ideally, the estimated probabilities for the two groups (the target and the "other") should be very different. The more the two groups cluster at their respective ends of the plot the better the set of independent variables distinguish between the two groups (Norusis & SPSS Inc., 1997).

The third criterion for assessing the fit of a model was the value of the Nagelkerke R^2 . The Nagelkerke is a modified version of the Cox & Snell statistic which adjusts for its tendency to underestimate the proportion of explained variation in the logistic regression model due to its inability to reach a value of 1. For the purposes of this research a model with a R^2 value of approximately .1 or less will be taken as an indication of poor fit (Norusis

& SPSS Inc., 1997).

The fourth criterion is the p-value of the Hosmer and Lemeshow Goodness of Fit Chi-Square. As mentioned earlier, this statistic was not available for all of the models. The Hosmer and Lemeshow test divides the cases into 10 approximately equal groups based on the estimated probability of the event occurring (deciles of risk). The difference between the observed and expected number of events are then compared and assessed by the Chi-Square test. The Hosmer and Lemeshow can be calculated from less than 10 groups, if necessitated by a restricted range of probabilities. However, when calculated from less than 6 groups it will almost always indicate the model fits due to a loss in the sensitivity of being able to distinguish observed and expected frequencies (Hosmer & Lemeshow, 1989). The absence of this statistic for a model does not necessarily mean that the model is flawed, it may only indicate that there are too few cases to adequately perform this type of analysis. For the purposes of this research, a p-value of approximately .1 or less for the Hosmer and Lemeshow test will be taken as an indicator of poor fit.

The author's assessment of the goodness of fit of the models, using the four criteria outlined above, is given in Table 21. Models designated as having a "moderate" fit are those which meet the minimum specifications of a good fit as outlined above: a Nagelkerke R^2 above .1 , a Hosmer and

Table 21

Goodness of Fit of the Logistic Models

Purchase Models		Disposal Models/Location & Day	
Model	Fit	Model	Fit
Motor Oil	poor	Motor Oil	very good
Antifreeze	poor	Antifreeze	good
Batteries	N/A	Batteries	poor
Latex Paint	poor	Latex Paint	good
Oilbase Paint	moderate	Oilbase Paint	very good
Polishes & Waxes	moderate	Polishes & Waxes	good
Pesticides	moderate	Pesticides	very good
Styrofoam	N/A	Styrofoam	poor
		Location & Day	good

Lemeshow with a p-value above .1, and overall classification performance from 60% - 79% . Models designated as having a "good" fit are those with a Nagelkerke R^2 from .3 - .5 , a Hosmer and Lemeshow with a p-value from .3 - .6 , and overall classification performance from 80% - 84% . The models designated as having a "very good" fit are those with Nagelkerke R^2 values .6 or more, a Hosmer and Lemeshow with a p-value .7 or above, and yield an overall classification rate of 85% or better.

5.13 Identifying Key Variables in the Prediction of Proper vs. Improper Product Disposal

One of the main purposes of the present research was to identify the key independent variables (demographic and/or psychological) which predict proper waste disposal and knowledge of the correct location and day of operation of the Trail Road HHW facility.

The nine models under consideration are: proper/improper disposal of the seven hazardous wastes (motor oil, antifreeze, batteries, latex paint, oilbase paint, polishes & waxes, and pesticides); the one non-hazardous waste (styrofoam containers); and knowledge of the correct location and day for disposal of HHW at the Regional Depot. The overall collection of independent variables eligible for inclusion in model building, the independent variables which "survived" the model building procedure to be retained in at least one model, and those which were retained in one model of good fit are shown below in Table 22.

In light of results presented in Table 22, the strongest predictors of proper waste disposal across waste models (and location/day model) of good fit are: confidence in knowing where to take the waste products for appropriate disposal (Knowledge 2); willingness to travel 9km or more (Distance); living in a single-family dwelling with access to a vehicle; and not finding the storage of HHW to be a problem (Difficulty 1).

Table 22

The Prevalence of Variables Across Disposal and Location & Day Models

Candidate Variables		Retention in model	
	# of times eligible	# of times retained in a model	# of times in a model of good fit
Demographic:			
Age	-	-	-
Gender	-	-	-
Single w/Vehicle	-	3	3
Psychological:			
Social Norm 1	5	-	-
Personal Norm 1	2	1	1
Awareness 1	1	-	-
Awareness 2	7	1	1
Ascription 2	5	1	-
Salience 1	4	-	-
Salience 2	1	-	-
Knowledge 1	2	-	-
Knowledge 2	9	8	6
Difficulty 1	7	2	2
Difficulty 2	7	1	1
Risk 2	2	1	1
Willingness to Travel:			
Distance	5	5	5

Proper waste disposal is predicted across models to a lesser extent by: feeling guilty about disposing of poisonous wastes in the garbage (Personal Norm 1); disbelief that science can always provide remedial solutions to environmental problems (Awareness 2); not finding the separation of HHW from other wastes to be a nuisance (Difficulty 2); and perceiving environmental pollution to be affecting one's current health (Personal Risk 2).

5.14 Multivariate Analysis, Support for the Six-factor Theoretical Structure?

From the standpoint of building models to predict behaviour, the multivariate analyses do not appear to offer a great deal of support to the six-factor theoretical structure. It is not that these psychological factors are without influence or do not follow a meaningful univariate pattern, but more that when in competition with demographic factors such as Single Family Dwelling with Vehicle and motivational factors such as Willingness to Travel (DISTANCE) they tend to be outclassed for the positions in the models with one notable exception.

The Perceived level of knowledge (primarily represented by KNOWLEDGE 2) is the one psychological factor from the theoretical structure that was prevalent in terms of variable retention across models of good fit. The more one agrees that they know where to take their HHW, the more

likely they are to be in the target group.

Other than Perceived Level of Knowledge, the remaining five factors in the theoretical structure were less predictive. The Personal Norms factor (1b) was represented in one model of good fit by the variable PERSONAL NORM 1 (Latex Paint); the Awareness of Consequences factor was represented in one model of good fit by the variable AWARENESS 2 (for Oilbase Paint); and the Perceived Personal Threat of Environmental Problems was represented in one model of good fit by the variable PERSONAL RISK 2 (Polishes & Waxes).

The variables representing the Social Norm factor (SOCIAL NORM 1), Personal Salience factor (SALIENCE 1 & 2), and Ascription of Responsibility factor (ASCRPTION 2), were not retained in any logistic models of good fit. In summary, the study results offer little support for the current author's theoretical structure in terms of predicting behaviour. Furthermore, the results offer little support for Schwartz's norm-activation theory which is the core of the present author's theoretical structure.

Chapter 6: Discussion

Nine topics are discussed in this chapter: (1) the most parsimonious set of demographic, psychological, or motivational (willingness to travel) factors which can be used to predict proper HHW disposal behaviour as found in this research; (2) the performance of a theoretical framework of six psychological factors designed to predict HHW disposal; (3) the performance, or the hypothesized lack thereof, of the Environmental Concern Factor; (4) the variations in the sets of predictors across the product disposal models; (5) hypothesized relationships that were not covered by the model building procedures; (6) survey participants' preferences for HHW disposal; (7) the results of the present research and their practical application to proper HHW disposal; (8) the comparison of recycling and HHW disposal behaviours, and (9) suggestions for future research.

6.1 Key Factors in Predicting Proper HHW Disposal

This study identified four key factors that predict correct HHW disposal behaviour in models of good fit: confidence in knowing where to take HHW for appropriate disposal (Section 6.1.1); willingness to travel 9 kilometers or more to dispose of it (Section 6.1.2); living in a single family dwelling with access to a car (Section 6.1.3); and

not perceiving the sorting and storing HHW as difficult (Section 6.1.4).

6.1.1 The perceived level of knowledge.

The prevalence of the Perceived Level of Knowledge Factor across disposal models of good fit supports the hypothesis (H_6) that persons who are confident in their knowledge of which products constitute HHW and where these products have to be taken to properly dispose of them, will engage in proper HHW disposal practices. The hypothesis was more strongly supported for confidence in where to take HHW for disposal than for confidence in being able to distinguish between HHW and non-hazardous items.

The finding that confidence in one's knowledge influences proper HHW behavior parallels the findings of the recycling studies by Simmons and Widmar (1990) and Vining and Ebreo (1990). Simmons and Widmar found that when knowledge was used to predict recycling behaviour, individuals who felt confident in their knowledge engaged in recycling significantly more often. Vining and Ebreo (1990) also found that recyclers were significantly more confident in their knowledge of recycling than non-recyclers.

Confidence in knowing where HHW can be taken to be properly disposed of also helped to distinguish between purchasers and non-purchasers of HHW (although the models were of poor to moderate fit, see Section 5.12). For the

non-purchasing group, it may be that this information is truly irrelevant to their current disposal situation; and therefore, they do not seek it out or bother to remember it.

6.1.2 Motivation: willingness to travel.

This study found that, in agreement with the prior HHW literature, willingness to travel influences proper HHW disposal. Tuthill and colleagues (1987) found that less than half (46%) of the urban Massachusetts residents they surveyed were willing to travel five miles to drop off products at a collection site. The Ottawa-Carleton participants were somewhat more willing to travel, with two-thirds (66.6%) willing to travel 9 kilometers or more (5.6 miles).

Indicating willingness to travel 9 kilometers or more increased the odds both of properly disposing of four of the seven hazardous waste items and of knowing the location and day of operation of the Ottawa-Carleton Household Special Waste Depot. With some respondents, however, a stated willingness to travel and actual willingness to travel may differ. Proximity to the collection site was found to be important in a "clean sweep" programme for Madison, Wisconsin's where 60% of the participants drove less than 2 miles (3.2 km) to the collection site (Bass et al., 1990).

6.1.3 Single family dwelling with access to a vehicle.

Oskamp et al. (1991) and Derksen and Gartrell (1993) found that living in a single family home was their single strongest predictor of curbside recycling. In the present research, living in a single family dwelling with access to a motor vehicle was the only demographic factor that adequately predicted proper HHW disposal. Living in a single family dwelling (H_9) and having access to a vehicle (H_{11}), were individually hypothesized to be good predictors of proper HHW disposal, but when evaluated as separate variables they did not predict proper HHW disposal as well as they did in combination.

To properly dispose of HHW in Ottawa-Carleton, householders need a dwelling with enough space to store these products for a period of time, and also a means of transporting these products to a temporary or permanent collection site. The closest Ottawa-Carleton Transpo bus-stop to the permanent Trail Road site is Cedarview and Standhurd, leaving a considerable distance to be completed on foot.

The finding that Single Family Dwelling with Access to a Vehicle was the only demographic factor in the present research which adequately predicted proper HHW disposal parallels the research of Oskamp et al. (1991), who found that age, education, and political orientation did not distinguish curbside recyclers from non-recyclers. In the

present research demographic variables such as age, occupation, gender, township of residence, and parenthood either did not predict or were only very weakly predictive of the appropriate disposal of specific products in the univariate analyses.

The Single Family Dwelling with Access to a Vehicle factor was also able to distinguish between hazardous product purchasers and non-purchasers. This factor was present in five of the six purchase models (although the models were from poor to moderate fit, see Section 5.12).

6.1.4 Perceived difficulty.

The Perceived Difficulty factor was not included in the present theoretical structure because it was expected to be eclipsed by the Perceived Lack of Knowledge factor.

Individuals could perceive a task as difficult if they did not have the requisite knowledge to carry it out. Since it was used in DeYoung's 1989 recycling research with some success, two items were added to evaluate its relevance to HHW research.

Perceived Difficulty was represented in three hazardous waste models in which the Perceived Level of Knowledge factor was also present. This suggests that the Perceived Difficulty factor (which deals with the inconvenience of separating out and storing HHW), makes its own unique contribution to predicting behaviour. In DeYoung's 1989

recycling research, his Perceived Difficulty scale was the only one to be significantly related to recycler/non-recycler status.

6.2 The Performance of the Six-Factor Theoretical Structure

The multivariate model building procedure employed produced a different mathematical model for each of the hazardous wastes, with different fragments of the structure retained in each of the models. Thus, the proposed six-factor theoretical structure did not really function as an integrated structure of factors in the analyses.

The hypotheses that individuals will engage in proper HHW disposal who have internalized social norms about not harming the environment (H_1), are aware of the consequences of improper HHW disposal (H_2), and perceive a personal threat from toxic chemicals in the environment (H_3), received little support from the multivariate analyses. The factors in the structure corresponding to these hypotheses were each represented in only one disposal model of good fit.

The hypotheses that individuals who ascribe responsibility to themselves for proper HHW disposal (H_4) and have an adequate sense of personal salience (H_5) will properly dispose of the HHW received no support from the multivariate analysis. The factors in the structure corresponding to these hypotheses were not represented in

any of the mathematical models of good fit.

The multivariate models lend little support to conceptualizing HHW disposal as a form of altruistic behaviour. Three of six factors in the structure were derived from Schwartz's theory of altruism and were poorly represented across models.

The limited representation of the factors from the theoretical structure (except for Perceived Level of Knowledge) in the multivariate analyses is attributable to the fact that the respondents in general highly endorsed pro-social and pro-environmental behaviours. Respondents strongly agreed with personal and social norms about not harming the environment or others with the products they buy. They were also aware of the consequences of hazardous chemicals in the environment, ascribed responsibility to themselves for properly disposing of their HHW, felt personally salient in regards to the HHW issue, and believed that environmental problems were currently affecting their well being. The reason the remaining five factors in the theoretical structure did not perform better in distinguishing proper from improper HHW disposers is that they do not differ markedly along these normative and attitudinal dimensions.

6.3 Environmental Concern

Environmental Concern was one of the two factors evaluated in this research, but not included in the theoretical structure. It was hypothesized (H_8) that an individual's level of environmental concern would be a poor predictor of proper HHW disposal. This hypothesis is supported by the results. The Environmental Concern factor was the poorest predictor of proper HHW disposal among the psychological factors evaluated. This factor, which recognizes abuse to the environment and the earth's limited resources, was highly endorsed by the survey respondents; but it was not predictive in the univariate analyses of properly disposing of any of the waste products or knowing the location and day of operation of the Ottawa-Carleton Household Special Waste Depot.

Recent surveys have shown that the distributions of concern for the environment tend to be highly skewed, with as many as 90 percent of respondents in a given sample falling in the highest "concern" category (Derksen & Gartrell, 1993). In the present research, the percentage of respondents indicating "highest concern" was 69% and 66% for the two environmental concern survey items.

6.4 The Variation in the sets of Predictors Across Models

The variation in the sets of predictors across purchase and disposal models may be the result of participants

assigning different environmental risks to certain products. In ranking common household products as to their potential for damaging the environment, Scudder and Blehm (1991) found that the majority of survey participants correctly assessed the damage potential of pesticides and paints, but most participants incorrectly assessed the damage potential of motor oil and antifreeze. In the present research, the rates of incorrect disposal were particularly high for household batteries (71%) and polishes & waxes (72%), but lower for oilbase paints (44%), motor oil (44%), and pesticides (49%).

6.5 Hypothesized Relationships not covered by the Model

Building Procedures

Four hypothesized relationships were not covered by the multivariate analyses: persons identified as the main household recyclers will also properly dispose of their HHW (Section 6.5.1); females will be identified as the most knowledgeable on both recycling and HHW issues (Section 6.5.2); females will be more likely to indicate participation in recycling and HHW disposal (Section 6.5.3); and the parents of small children will be more likely to participate in both recycling and HHW disposal (Section 6.5.4).

6.5.1 Recylers will also properly dispose their HHW.

It was hypothesized (H_7) that the persons identified as

the main household recyclers will also be those who dispose of their HHW in the appropriate manner. This hypothesis was not supported by the results. Identifying oneself as the main household recycler, or indicating that this task was equally shared with others in the household, did not significantly increase the odds of properly disposing of any of the hazardous products or of recycling styrofoam containers in univariate analyses. However, the Chi-square for identifying oneself as both the household recycler and the main HHW disposer was significant at the $p < .00001$ level $\chi^2(1, N = 201) = 60.32$. The Chi-square for sharing equally the recycling task and the HHW disposal task was also significant at the $p < .00001$ level $\chi^2(1, N = 201) = 32.75$. Thus, in light of the relationships described above, it would appear that indicating participation in these general behaviours corresponds poorly to actual product disposal.

6.5.2 The influence of gender on being identified as the most knowledgeable on recycling and HHW disposal practices.

It was hypothesized (H_{12}) that females would be identified as the most knowledgeable persons in their households concerning both recycling and HHW disposal practices. This hypothesis was not supported by the results in terms of recycling knowledge or HHW disposal knowledge.

6.5.3 The influence of gender on indicating participation in general recycling and proper HHW disposal practices.

It was also hypothesized (H_{13}) that females would be more likely to indicate participation in general recycling and proper HHW disposal behaviours. This hypothesis was not supported by the data in terms of either recycling or HHW disposal. The relationship between gender and indicating participation in general HHW disposal was the opposite of that hypothesized. Men indicated more frequently that they were the main HHW disposers ($r=.17$, $p=.02$) in their households. However, as was the case with the general recycling item discussed above, there was little correspondence between indicating participation in the general behaviour and the actual proper disposal of specific products. Gender did not significantly increase the odds of properly disposing of any of the hazardous wastes, recycling styrofoam containers, or knowing the location and day of operation of the Trail Road facility in multivariate analyses.

Gender did increase the odds of purchasing two of the seven hazardous wastes in univariate analyses. Males were more likely to purchase polishes & waxes and pesticides.

6.5.4 The parents of small children, recycling, and HHW disposal.

It was hypothesized (H_{14}) that the parents of small children would be more likely to participate in both recycling and proper HHW disposal. This hypothesis was not supported by the data. Being the parents of children seven years of age or less did not increase the odds of properly disposing of any of the seven hazardous wastes, recycling styrofoam containers, or knowing the location and day of operation of the Trail Road HHW facility in the univariate analyses.

6.6 Survey Participants' Preferences for HHW Disposal

The survey participants' responses to the Disposal Preference items indicate that convenience is an important consideration. Curbside collection was chosen by more than half (56%) of survey respondents as their most favoured option for HHW disposal. The next preferences were for temporary collection sites (16%) and a regional site open every day (16%). The least popular option (12%) was to return residual HHW to the place of purchase. When disposal preference was employed as a univariate predictor, choosing a regional site that is open every day increased the odds of correctly identifying the Trail Road Household Special Waste Depot location and day of operation.

When queried as to how often curbside collection of HHW

should occur, the most popular response was monthly (34%), followed by four times a year (24%). The same was true for the frequency with which temporary collection events should be held, the most popular response was monthly (36.5%), followed by four times a year (20%).

One interesting trend was that when frequency of collection was used as a predictor, selecting more frequent timeframes for HHW collection (curbside collection on a monthly or weekly basis, or temporary collection on a weekly basis) decreased the odds that the participant currently properly disposed of some of the hazardous waste products. Selecting less frequent time frames for disposal, such as curbside collection four times a year, or temporary collection two or four times a year, increased the odds in univariate analyses of properly disposing of some of the waste products.

Personal convenience, therefore, appears to be an important underlying determinant of how products will be eventually disposed of. Individuals who indicated that they are willing to store their HHW for three to six months for curbside collection or temporary collection events, and those who favour driving with their waste to a regional site, are more likely to be those who are also currently properly disposing of their HHW. Those individuals who indicate that they prefer temporary collection events and curbside collection on a monthly or even more frequent basis

are not currently disposing of their HHW because it is presently not convenient enough for them. HHW products do not typically accumulate in the home at the rate recyclables do. Individuals who indicated the more frequent timeframes for collection are not likely to have stored their HHW long enough to have a realistic estimate of how often collection is actually warranted.

The vast majority of respondents (91%) were in favour of having labels on toxic products to describe proper disposal in the Ottawa-Carleton Region. When used as a predictor, being in favour of labels describing correct disposal methods on toxic products, decreased the odds in univariate analysis of currently properly disposing of two of the hazardous wastes (batteries, and polishes and waxes). It appears that some respondents who were in favor of disposal information being put on the HHW products are truly uncertain of what products are HHW, and are presently improperly disposing of them.

The majority of subjects (78%) also indicated that they would be willing to vote for a Provincial law which would fine householders for incorrect HHW disposal. When used as a predictor, this preference decreased the odds of purchasing pesticides. As shown in earlier research, respondents may assign different risks to toxic products (Scudder & Blehm, 1991; Salas, 1983).

6.7 The Results of the Present Research and their Practical Application to Proper HHW Disposal

The finding of the present research that proper and improper HHW disposers do not differ markedly along normative and attitudinal dimensions parallels that of De Young's recycling research (1988-1989), but not that of Baldassare and Katz (1992) or Hopper and Nielsen (1991). DeYoung asserts that his data did not offer support for the notion that recyclers are fundamentally different from non-recyclers. He found that respondents viewed recycling in a very positive light, and he concluded that the focus in resource recovery education programmes should not be on pro-recycling attitudes but on helping people to turn their good intentions into actual behaviour (De Young, 1988-1989).

Since 91% of the sample indicated that they had heard or read about HHW in the last year, one may question whether more information will actually lead to improved participation rates for proper product disposal. However, the content of what they have heard or read is not known. If the HHW information the respondents received focused primarily on the fact that HHW is a waste disposal problem without any specific details on how to properly dispose of these materials locally, then there is a potential for improved participation through the right type of publicity. The author has heard HHW disposal messages on television and radio which lacked concrete disposal information. Emphasis

should be put on what types of products are hazardous, how they should be stored and transported, and where they can be taken.

Studies have suggested the important part played by knowledge of action strategies. The 1981 research of Heslop, Moran, and Cousineau and the 1985-1986 research of Sia, Hungerford and Tomera revealed that perceived knowledge of action strategies predicted participation in responsible environmental behaviours (Simmons & Widmar, 1990).

Increased publicity, specific in its content to the proper disposal of HHW products, is by no means the complete answer to increasing participation rates in this behaviour. Convenience is a central issue. This was evidenced by the proportion of respondents who preferred curbside HHW collection and frequent timeframes for both curbside collection and temporary collection events. Three of the four best predictors in this study have components of convenience. The motivational item, willingness to travel, could also be interpreted as tolerance for inconvenience. Living in a single-family dwelling with access to a vehicle should make storing and transporting HHW more convenient than other types of living arrangements. Not finding the sorting and storing of HHW (Perceived Difficulty) to be a nuisance is also related to tolerance for inconvenience. In their 1993 research on recycling in Edmonton, Alberta, Derksen and Gartrell found that the most important

determinant of recycling behaviour was access to a structured, institutionalized program that makes recycling easy and convenient.

Since it is unlikely that we can alter people's tolerance for inconvenience, the only practical solution is to accomodate them. Curbside collection would probably be the ideal solution, but municipalities may balk at the expense. Temporary collection events, respondents' second most preferred choice, could be arranged at local shopping malls, fire stations, schools, or other municipal facilities on a very regular basis (e.g. the last Saturday of every month) to minimize confusion as to when these events are to occur.

A fundamental HHW disposal issue is whether taxpayers should be burdened with the entire cost of disposal of HHW products or whether local businesses which sell products which meet the description of HHW and the manufacturers of HHW products should assume at least some of the costs of collection, transportation, and disposal of residual materials. Although certain local businesses are practicing a form of product stewardship, they often do not accept all the wastes from the selection of products they sell (e.g. household batteries). One proposal is that businesses should not be allowed to sell products that they will not accept back for proper disposal, and that the original manufacturers help to subsidize the transportation and

disposal costs.

Household batteries are the most commonly purchased and one of the most improperly disposed HHW products. Battery disposal boxes could be placed in communities with the same frequency as mailboxes and emptied as required. Many studies in varied settings (housing tracts, apartment complexes, business offices, and college dorms), have all shown that providing recycling collection receptacles placed close at hand notably increased the amount of recycling (Oskamp et al., 1991).

6.8 Comparison of Recycling and HHW Disposal Behaviours

Comparisons between recycling and HHW disposal studies should take into consideration whether the products are disposed of by equivalent means. For example, depot-style HHW disposal should be compared to depot-style recycling rather than to curbside recycling. This is because depot-style waste disposal differs from curbside waste collection in two main respects: it is less convenient and it lacks a highly visible modelling stimulus.

The results from Vining and Ebreo's (1990) research on depot-style recycling are similar to the present HHW results in finding that recyclers and non-recyclers rated altruistic reasons for recycling as equally important. However, recyclers and non-recyclers differed in their rating of the importance of inconvenience. They also found that non-

recyclers were more uncertain of their knowledge about recycling.

In the research on curbside recycling, the social reasons for recycling appear to be more prominent as predictors. Oskamp et al. (1991) found that their second strongest predictor of recycling behaviour was recycling by one's friends and neighbours (a visible modelling stimulus). In Vining and Ebreo's (1990) research on depot-style recycling (where the recycling activity of significant others is less observable) social reasons were not reported as important by recyclers or non-recyclers.

6.9 Suggestions for Future Research

The findings of this study suggest that future research address the following two topics: accessibility of disposal, and specific information on how to dispose of HHW locally. First, a study could assess the relative gains to be realized through the provision of: curbside collection; convenient regularly scheduled temporary collection events; local collection receptacles (for some wastes); and the acceptance by local businesses of a more comprehensive set of HHW products (return policy).

A second focus of future research could be on how to better communicate specific and local HHW information to the public. Although 67% of students in this study reported having heard about HHW at school, the percentage could be

higher. Only 30% of workers indicated the workplace as a source of HHW information. Schools and workplaces offer excellent venues for disseminating information within a social context and for evaluating the effectiveness of that information. Schools and workplace allow for the dynamic exchange of information between an expert speaker and audience. Information should be provided on what household products are hazardous, how residuals should be stored, how they should be prepared for transportation, and exactly where and when the product residuals can be disposed of properly.

Another possibility for future research is to assess the effectiveness of dissemination of specific HHW information within the social context of the neighbourhood. The researcher could evaluate the influence of a volunteer block leader, or role model, who educates and encourages the neighbours in proper disposal of HHW. Hopper and Nielsen (1991) found that block leaders increased recycling rates more than monthly prompts by experimenters or the delivery of informational brochures. The influence of a role model and social discourse on the proper disposal of HHW is yet to be researched.

Chapter 7: Conclusion

Four key factors were identified that predict proper HHW disposal: confidence in knowing where to take these products (Perceived Level of Knowledge); living in a single family dwelling with a vehicle; willingness to travel 9km or more to dispose of HHW; and the perception that the sorting and storage of HHW is not difficult (Perceived Difficulty).

The logistic regression model-building procedure used in this study produced a unique disposal model for each of the seven hazardous wastes, which suggests that respondents assign different risks to products. Proper and improper HHW disposers were not found to differ markedly in their endorsement of personal and social norms, their awareness of consequences, ascription of responsibility, their sense of personal salience, or in their perceived personal threat of environmental problems. Therefore, the theoretical structure of psychological factors which was designed to predict proper HHW disposal received little support from the multivariate analyses.

Residing in a single family dwelling with access to a vehicle was the only demographic factor that adequately predicted HHW disposal. Age and Gender did not distinguish improper from proper disposers in the main analyses. In the univariate analyses improper and proper HHW disposers were also not well distinguished by their township of residence,

occupation, or parental status.

The Environmental Concern factor was completely non-predictive as hypothesized. Its performance was poor in both univariate and multivariate analyses.

Survey respondents indicated that they prefer convenient means of HHW disposal with more than half (55%) preferring curbside collection. Respondents also preferred collection to be frequent, on a monthly basis for both curbside collection and temporary collection events. The importance of convenience should not be underestimated. Three of the four factors that were found to predict proper HHW disposal (single family dwelling with access to a vehicle, willingness to travel, and perceived difficulty) have elements of convenience.

Major gains in HHW correct disposal participation rates will require modifications in the current waste collection and disposal infrastructure to make HHW disposal more convenient for the general public. Increased convenience should be accompanied by HHW information specific in its disposal content. If HHW disposal were to become a curbside practice, the effects of observing neighbours and friends properly disposing of their HHW on a regular basis could yield even larger gains in participation.

References

- Abadin, H. G., Hibbs, B. F., & Pohl, H. R. (1997). Breast-feeding exposure of infants to cadmium, lead, and mercury: a public health viewpoint. Toxicology and Industrial Health, 13(4), 495-517.
- Baldassare, M., & Katz, C. (1992). The personal threat of environmental problems as predictor of environmental practices. Environment and Behavior, 24(5), 602-616.
- Bass, E. S., Calderon, R. L., & Khan, M. E. (1990). Household hazardous waste: A review of public attitudes and disposal problems. Journal of Environmental Health, 52(6), 358-361.
- City of Guelph. Household hazardous waste: Your guide to safe and proper disposal of hazardous waste in the home. Guelph, Ontario: Author.
- Derksen, L., & Gartrell, J. (1993). The social context of recycling. American Sociological Review, 58, 434-442.
- De Young, R. (1985-86). Encouraging environmentally appropriate behavior: The role of intrinsic motivation. Journal of Environmental Systems, 15(4), 281-292.
- De Young, R. (1986). Some psychological aspects of recycling: The structure of conservation satisfactions. Environment and Behavior, 18(4), 425-449.
- De Young, R. (1988-89). Exploring the difference between recyclers and non-recyclers: The role of information. Journal of Environmental Systems, 18(4), 341-351.
- De Young, R., & Kaplan, S. (1985-86). Conservation behavior and the structure of satisfactions. Journal of Environmental Systems, 15(3), 233-242.
- Eiser, J. R., Reicher, S. D., & Podpadec, T. J. (1994). Awareness of bad news, environmental attitudes, and subjective estimates of coastal pollution. Risk Analysis, 14(6), 945-948.
- Environmental Canada. (1993). Household hazardous waste management policies and practices in OCED countries (pp. 1). Hull, Quebec: Author

- Geran, L. (Spring, 1993). Environmental practices of Canadian households. Canadian Social Trends, Statistics Canada, 17-20.
- Glaub, J. C. (1993). Household hazardous wastes. In H. F. Lund (Ed.), The McGraw-Hill recycling handbook (pp. 21.1-21.31). New York: McGraw-Hill.
- Graef, J. W., & Lovejoy, F. H. (1991). Heavy metal poisoning. In Harrison's principles of internal medicine (12th ed., Vol. 2, pp. 2182-2187). New York: McGraw-Hill.
- Heslop, L., Moran, L., & Cousineau, A. (1981). Consciousness in energy conservation behavior: An exploratory study. Journal of Consumer Research, 8(3), 299-305.
- Hopper, J. R., & Neilsen, J. Mc. (1991). Recycling as altruistic behavior: Normative and behavioral strategies to expand participation in a community recycling program. Environment and Behavior, 23(2), 195-220.
- Hosmer, D. W., & Lemeshow, S. (1989). Applied Logistic Regression. New York: John Wiley & Sons.
- Kleinbaum, D. G. (1994). Logistic regression: a self-learning text. New York: Springer-Verlag.
- Kraus, N. N., & Slovic, P. (1988). Taxonomic analysis of perceived risk: Modelling individual and group perceptions within homogeneous hazard domains. Risk Analysis, 8(3), 435-455.
- Latane, B., & Darley J. M. (1970). The unresponsive bystander: Why doesn't he help?. New York: Appleton-Century-Crofts.
- Louekari, K., Uusitalo, U., & Pietinen, O. P. (1989). Variation and modifying factors of the exposure to lead and cadmium based on an epidemiological study. Science and the Total Environment, 84, 1-12.
- McCornack, P. (1993). The psychology of recycling. In H. F. Lund (Ed.), The McGraw-Hill recycling handbook (pp. 10.1-10.14). New York: McGraw-Hill.
- McEvoy, J. W., & Rossignol, A. M. (1993). Household hazardous waste disposal in Benton County, Oregon. Journal of Environmental Health, 56(3), 11-15.

- Menzies, D. (1987, September). Waste blues: Curbside recycling reassessed. Financial Post Magazine, pp. 36-38, 40, 42, 45, 47, 49-50, 52.
- Municipality of Metropolitan Toronto, Department of Works. (1997). Household Hazardous Waste Program - 1996. Toronto, Ontario: Author.
- Norusis, M.J. & SPSS Inc. (1993). SPSS for Windows Base System User's Guide Release 6.0. Chicago: SPSS Inc.
- Norusis, M.J. & SPSS Inc. (1997). SPSS Professional Statistics 7.5. Chicago: SPSS Inc.
- Oskamp, S., Harrington, M. J., Edwards, T. C., Sherwood, D. L., Okuda, S. M., & Swanson, D. C. (1991). Factors influencing household recycling behavior. Environment and Behavior, 23(4), 494-519.
- Ottawa-Carleton Environmental Services. (1993). All about the Trail Road landfill site. Ottawa, Ontario: Author
- Ottawa-Carleton Environmental Services, Solid Waste Division. (1993). Facts about household recycling. Ottawa-Carleton Regional Municipality, Ontario: Author.
- Ottawa-Carleton Environmental Services, Solid Waste Division. (1994). Trail Road Landfill Site Household Special Waste Depot 1994 annual report. Ottawa-Carleton Regional Municipality, Ontario: Author.
- Ottawa-Carleton Environmental Services, Solid Waste Division. (1996). Trail Road Landfill Site Household Special Waste Depot 1996 annual report. Ottawa-Carleton Regional Municipality, Ontario: Author.
- Ottawa-Carleton Regional Municipality (1996). Trail Road and Nepean Landfill sites 1996 monitoring and operating report. Ottawa-Carleton Regional Municipality, Ontario: Author
- Pedhazur, E. J. (1997). Multiple regression in behavioral research explanation and prediction. Orlando: Harcourt Brace College Publishers.
- Salas, A. (1983). Residential hazardous/toxic waste survey. Albuquerque, NM: Department of Health and Energy.
- Schwartz, S. H. (1970). Moral decision making and behavior. In J. Macauley & L. Berkowitz, (Eds.), Altruism and helping behavior (pp. 127-141). New York: Academic Press.

- Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz. (Ed.). Advances in Experimental Social Psychology (Vol. 10, pp. 221-279). New York: Academic Press.
- Schwartz, S. H., & Howard, J. A. (1980). Explanations of the moderating effect of responsibility denial on the personal norm-behavior relationship. Social Psychology Quarterly, 43(4), 441-446.
- Scudder, K., & Blehm, K. D. (1991). Household hazardous waste: Assessing public attitudes and awareness. Journal of Environmental Health, 53(6), 18-21.
- Sia, A., Hungerford, H., & Tomera, A. (1985-86). Selected predictors of responsible environmental behavior. Journal of Environmental Education, 17(2), 31-40.
- Simmons, D., & Widmar, R. (1990). Motivations and barriers to recycling: Toward a strategy for public education. Journal of Environmental Education, 22, 13-18.
- Stanek, E. J. III, Tuthill, R. W., Willis, C., & Moore, G. S. (1987). Household hazardous waste in Massachusetts. Archives of Environmental Health, 42(2), 83-86.
- Statistics Canada, Household Surveys Division. (1995). Households and the environment 1994. Ottawa, Ontario: Minister of Industry, Science and Technology.
- Stern, P. C., Dietz, T., & Black, J. S. (1985-86). Support for environmental protection: The role of moral norms. Population and Environment, 8(3&4), 204-222.
- Tracy, A. P., & Oskamp, S. (1983-84). Relationships among ecologically responsible behaviors. Journal of Environmental Systems, 13(2), 115-126.
- Tuthill, R. W., Stanek, E. J., III., Willis, C., & Moore, G. S. (1987). Degree of public support for household hazardous waste control alternatives. American Journal of Public Health, 77(3), 304-306.
- Vining, J., & Ebreo, A. (1990). What makes a recycler? A comparison of recyclers and nonrecyclers. Environment and Behavior, 22(1), 55-73.
- Wright, R. E. (1995). Logistic Regression. In L. G. Grimm & P. R. Yarnold (Eds.), Reading and understanding multivariate statistics. (pp. 217-244) Washington, D.C.: American Psychological Association.

Appendix A

Hazardous Materials in Commercial Products
(Glaub, 1993)

Chemical	Potential products containing chemical
Benzene	Dry cleaning fluids, fumigants, gasoline, insecticides, motor oil, paint brush cleaner, paint remover, rubber cement, solvents (various), spot remover
Carbon Tetrachloride	Degreasers, dry cleaning fluids, drying agents, fire extinguishers, fumigants, laquers, propellants, refrigerants, solvents (various)
Chloroform	Anaesthetics, fluorocarbon refrigerants, fumigants, laquers, propellants, refrigerants, solvents (various)
1,2-Dichloro-ethane	Degreasers, finish removers, fumigants, gasoline, paint remover, penetrating agents, scouring compounds, soaps, solvents (various), wetting agents
Ethylene Dibromide	Fire extinguishers, fumigants, gasoline, solvents (various), waterproofing preparations
Methylene Chloride	Aerosol propellant, degreasers, dewaxers, fumigants, furniture refinishers, hair spray, oven cleaner, paint, paint brush cleaner, paint remover, septic tank cleaner, shoe cleaner, shoe polish, solvents (various), spot removers, wood putty
Tetrachloro-ethylene	Degreasers, dry cleaning fluids, drying agents, heat transfer medium, paint remover, spot removers, vermifuges

Hazardous Materials in Commercial Products
(continued)

Chemical	Potential products containing chemical
Toluene	Adhesives, dry cleaning fluids, dyes, gasoline, motor oil, paint, paint remover, perfumes, pharmaceuticals, solvents (various), spot removers, wood putty
1,1,1-Trichloro-ethane	Aerosol propellant, degreasers, drain opener, furniture polish, oven cleaner, paint remover, pesticides, rug cleaner, septic tank cleaner, shoe dye, shoe polish, solvents (various), spot removers, upholstery cleaner
Trichloro-ethylene	Adhesives, degreasers, dry cleaning fluids, dyes, fumigants, fur cleaner, paint, pharmaceuticals, shoe cleaner, shoe polish, solvents (various)
Vinyl Chloride	Adhesives for plastics, intermediate in polymer production
Xylene	Caulking compounds, dyes, gasoline, insecticides, motor oil, paint, paint remover, rubber cement, shoe dye, solvents (various)

Appendix B

Household Hazardous Waste Disposal Questionnaire

Definition: Household Hazardous Waste is defined as those wastes generated in the regular household waste stream that possess corrosive, explosive, toxic, reactive or other harmful characteristics and require special considerations in their collection, handling, treatment and disposal.

Age_____ Occupation_____

Gender: ☐ Male   ☐ Female

In which township or city do you reside? (e.g., Nepean) _____

What type of dwelling do you live in? Checkmark one of the below:

☐ Single family dwelling   ☐ Duplex   ☐ Apartment   ☐ Other

Does your dwelling have a backyard, shed, or place where you can temporarily store recyclables?   ☐ YES   ☐ NO

Do you own or have access to a vehicle?   ☐ YES   ☐ NO

Are you a parent?   ☐ YES   ☐ NO

Do you have children who are 7 years of age or younger?   ☐ YES   ☐ NO

Who is the most knowledgeable person in your household in regard to what items should be recycled?

☐ You   ☐ Spouse   ☐ Equally knowledgeable   ☐ Other   ☐ Nobody knows

Who does most of the household recycling?

☐ You   ☐ Spouse   ☐ Equally share task   ☐ Other   ☐ Nobody recycles

Who is the most knowledgeable person in your household in regard to which items are hazardous waste?

☐ You   ☐ Spouse   ☐ Equally knowledgeable   ☐ Other   ☐ Nobody knows

Who does most of the disposal of household hazardous waste at your residence?

☐ You ☐ Spouse ☐ Equally share task ☐ Other ☐ Nobody

If you have heard or read about household hazardous disposal in the last year please indicate the source(s) of this information below:

☐ newspaper ☐ TV ☐ radio ☐ pamphlets or flyers ☐ school
☐ conversation ☐ workplace ☐ disposal or recycling company

For each statement please circle the number you most agree with:

	STRONGLY DISAGREE			STRONGLY AGREE	
	 V			 V	
My friends would expect me to properly dispose of my household hazardous products when I am finished with them	1	2	3	4	5
I would expect my neighbours to properly dispose of their household hazardous waste	1	2	3	4	5
If I know an item is poisonous, I feel guilty disposing of it in the garbage	1	2	3	4	5
I have an obligation not to harm others or the environment with the products I buy	1	2	3	4	5
We have always had chemicals in our food and water; people who worry about danger from chemicals are making a big fuss over nothing	1	2	3	4	5
Science will find a way to clean our water before anyone is hurt by chemical waste in it	1	2	3	4	5
The government should take care of its own hazardous waste problem before asking me to take care of my small amount	1	2	3	4	5

	STRONGLY DISAGREE			STRONGLY AGREE	
	↓ V			↓ V	
Most landfills are constructed in such a fashion that it should not matter what I dispose of in my garbage; it will be safely contained	1	2	3	4	5
If one considers the magnitude of the hazardous waste problem, one more container of used motor oil disposed of in the garbage really doesn't matter	1	2	3	4	5
Since industry will just keep on polluting it is a waste of time to sort out my few items of hazardous waste	1	2	3	4	5
I can recognize most household hazardous waste items in order to separate them from the regular garbage	1	2	3	4	5
I know where to take my household hazardous waste items for appropriate disposal and reclamation	1	2	3	4	5
It is a problem to find a place to store household hazardous waste at my residence	1	2	3	4	5
It is a big nuisance to separate out the household hazardous waste items from the other waste	1	2	3	4	5
Humanity is severely abusing the environment	1	2	3	4	5
The earth is like a spaceship with only limited room and resources	1	2	3	4	5
I am worried that there may be far more pollution present in my immediate environment than I am able to perceive	1	2	3	4	5
I feel that environmental problems, such as air and water pollution, are affecting my health and well-being today	1	2	3	4	5

At present how do you dispose of either the used product or the residuals from any of the following household items? If you check "Collection Point or Depot," please give the location.

Product not purchased	Down the drain	On Ground	In Garbage	Blue Box	Disposal at Collection Point or Depot (give location)
Used motor oil	_____	_____	_____	_____	_____
Used Antifreeze	_____	_____	_____	_____	_____
Household batteries	_____	_____	_____	_____	_____
Latex Paint	_____	_____	_____	_____	_____
Oil-based Paint	_____	_____	_____	_____	_____
Polishes & waxes	_____	_____	_____	_____	_____
Styrofoam containers	_____	_____	_____	_____	_____
Pesticides	_____	_____	_____	_____	_____

On what road is the main household-hazardous-waste depot for the Ottawa-Carleton Region located? Checkmark one.

_Merivale _St. Laurent _Trail Road _Innes Road _I do not know

In the Ottawa-Carleton Region on which day(s) does the main depot accept household hazardous waste? Please checkmark.

_Mon. _Tues. _Wed. _Thurs. _Fri. _Sat. _Sun. _I do not know

How far would you be willing to travel to safely dispose of your household hazardous waste items? Please circle one of the below.

1km   2km   3km   4km   5km   6km   7km   8km   9km   10km
 11km   12km   13km   14km   other _____

Please checkmark the one Household Hazardous Waste disposal option you most prefer. Read all of the options before making your choice.

Bringing your household hazardous waste to a temporary local collection site ☐ preference

Returning leftover hazardous waste or empty containers to the place of purchase like you do with soda bottles ☐ preference

Bringing your household hazardous waste to a regional site that is open every day ☐ preference

Having special curbside pick-up of household hazardous waste ☐ preference

If curbside collection of household hazardous waste were available in your community how often should it be collected? Please circle one of the below:

Once a year	Twice a year	Three times a year	Four times a year	Monthly	Every two weeks	Weekly

If your community had special days on which you could bring your household hazardous waste items to a designated location for collection, how often should they occur? Please circle one of the below:

Once a year	Twice a year	Three times a year	Four times a year	Monthly	Every two weeks	Weekly

I would favor local stores putting a label on toxic or hazardous products to inform me about proper disposal of these items in the Ottawa-Carleton region.

☐ YES ☐ NO

If you had a chance to vote on a Provincial law which fined householders for the improper disposal of household hazardous waste, would you vote in favor of it?

☐ YES ☐ NO

Appendix C

Detailed Contruction of the Psychological/Attitudinal Section of the Survey Instrument

In general, the psychological/attitudinal items from related environmental field were easily adapted to HHW. In a few instances, there wasn't an original item, but the text of the article provided ideas for questionnaire items. In either case, the original author is cited for that item. The questionniare items and their origins are explored below.

The first factor in the theoretical structure is made up of two components: Social Norms (#1a) and Personal Norms (#1b). Each of the components was represented on the survey by two items. The remaining five factors in the theoretical structure: Awareness of Consequences (#2), Ascription of Responsibility (#3), Personal Salience (#4), Perceived Level of Knowledge (#5), and the Perception of Personal Threat of Environmental Problems (#6) were each represented on the questionnaire by two items.

The two psychological factors not included in the theoretical structure: the "Environmental Concern" factor, and De Young's "Perceived Difficulty" factor were also represented on survey by two items each.

Social and Personal Norms

The Social Norm scale and the Personal Norm scale are each comprised of one questionnaire item. Both items were

derived from Hopper and Neilsen's 1991 article. The original and modified items are given below.

Social Norms

original item - Friends expect recycling

modified item - My friends would expect me to properly dispose of my household hazardous products when I am finished with them

original item - Expect neighbors to recycle

modified item - I would expect my neighbours to properly dispose of their household hazardous waste

Personal Norms

original item - How much does it bother you to throw away motor oil?

modified item - If I know an item is poisonous, I feel guilty disposing of it in the garbage

original item - How much personal obligation do you feel to recycle cans?

modified item - I have an obligation not to harm others or the environment with the products I buy

---

Awareness of Consequences

The Awareness of Consequences Scale is comprised of two items. Both items were drawn from Stern et al.'s 1985-86 research article and added to the present questionnaire unchanged. The items were originally used to study subject's beliefs about people or organizations that produce or regulate hazardous substances, but also appear to be well suited to the present area of inquiry. The original items are given below.

Awareness of Consequences

We have always had chemicals in our food and water; people who worry about danger from chemicals are making a big fuss over nothing.

Science will find a way to clean our water before anyone is hurt by chemical waste in it.

Ascription of Responsibility

The Ascription of Responsibility scale is made up of two items. The first item was derived from the text of Scudder and Blehm's 1991 article and the second item is by the current author. Scudder and Blehm originally placed this item under the Motivation factor heading, but the item also appears to lend itself well to the measurement of AR. The two ascription of responsibility items are given below.

Ascription of Responsibility

The government should take care of its own hazardous waste problem before asking me to take care of my small amount.

Most landfills are constructed in such a fashion that it should not matter what I dispose of in my garbage; it will be safely contained.

Personal Salience

The Sense of Personal Salience scale contains two items. One item was derived from an item found in Simmons and Widmar's 1990 article on recycling. The second item is by the current author. The original and modified versions of the first item and the second item by the current author are given

below.

Sense of Personal Salience

original item - I really don't produce enough waste to make recycling worthwhile

modified item - If one considers the magnitude of the hazardous waste problem, one more container of used motor oil disposed of in the garbage really doesn't matter

Since industry will just keep on polluting it is a waste of time to sort out my few items of hazardous waste.

Perceived Lack of Knowledge

The Perceived Lack of Knowledge scale is comprised of two items. Both items were derived from items found in Simmons and Widmar's 1990 article on recycling. The original and modified versions of the items are given below.

Perceived Lack of Knowledge

original item - I am not sure what can be recycled

modified item - I can recognize most household hazardous waste items in order to separate them from the regular garbage

original item - I am not sure how to recycle my household goods

modified item - I know where to take my household hazardous waste items for appropriate disposal and reclamation

---

Perceived Difficulty

The Perceived Difficulty scale contains two items. Both items were formulated from items found in De Young's 1989

article on recycling. The Perceived Difficulty scale was included in the present questionnaire to see if it is essentially the analogue of the Lack of Knowledge factor and scale. The perceived lack of knowledge should be inextricably linked with an individual perceiving a task as difficult. This factor is not part of the current theoretical structure. The original and modified items are given below.

Perceived Difficulty

original item - A problem with recycling is finding a place to put the stuff.

modified item - It is a problem to find a place to store household hazardous waste at my residence

original item - It's a big nuisance to keep everything separated for recycling

modified item - It is a big nuisance to separate out the household hazardous waste items from the other waste

---

Environmental Concern

The Environmental Concern scale is made up of two items. Both items were borrowed unaltered from Stern et al.'s 1985-86 publication for inclusion in the present questionnaire. The "general" Environmental Concern scale is included to demonstrate this diffuse concept's lack of behavioural predictive power. Although the environmental concern factor may have questionable predictive power in terms of whether an individual engages in specific pro-environmental behaviours, there is some evidence that high levels of environmental

concern may be a behavior enhancer for those already participating in pro-environmental behaviours. This factor is not part of the theoretical structure. The two environmental concern items are given below.

Environmental Concern

Humanity is severely abusing the environment

The earth is like a spaceship with only limited room and resources

---

The Personal Threat of Environmental Problems

The Personal Threat of Environmental Problems scale is made up of two items. The first item was derived from Eiser et al.'s 1994 article on beach pollution. The second item was derived and taken from Baldassare and Katz's 1992 publication. These items were added with minor modification. The original and modified versions of the items are given below.

Personal Threat of Environmental Problems

original item - I'm worried there may be far more pollution here than I can tell

modified item - I am worried that there may be far more pollution present in my immediate environment than I am able to perceive

original item - How serious a threat do you think environmental problems, such as air and water pollution, are to your well-being and health today?

modified item - I feel that environmental problems, such as air and water pollution, are affecting my health and well-being today

---

Appendix D

Informed Consent Form

The purpose of this form is to insure that you understand the purpose of this study and the nature of your involvement if you wish to participate.

Present Study: Household Hazardous Waste Disposal Behavior

Research Personnel: Roger H. Thomas (Principal Investigator, Dr. W. Petrusic (Faculty Sponsor Psychology) and Dr. Wyndham (Faculty Sponsor Toxicology). If you should wish speak with any of the individuals above please call 820-9924 during business hours (9-5) weekdays (Mon-Fri). If you have any ethical concerns about this study, please contact Dr. Lise Paquet (Chair, Department of Psychology Ethics Committee) or Dr. W. Jones (Chair, Department of Psychology, 520-2600, Ext. 2648).

Purpose: The purpose of this study to investigate how cognitive, socio-structural, and demographic factors influence household hazardous waste (HHW) disposal behavior.

Task Requirements: Completion of a anonymous four page HHW questionnaire

Duration: Approximately 7-10 minutes

Potential Risk/Discomfort: There are no potential physical or psychological risks associated with this study.

Anonymity/Confidentiality: The survey is completely anonymous (name and adress are not requested). After completing the survey instrument the participant deposits it into a ballot box.

Right to Withdraw: You have the right to withdraw form this survey at any time.

I have read the above description of the Household Hazardous Waste Disposal Behavior study and understand the conditions of my participation. My signature indicates that I agree to participate in this experiment.

Participant's Name: _____

Participant's Signature: _____

Researcher's Name: Roger H. Thomas

Researcher's Signature: _____

Date: _____

Appendix E

Household Hazardous Waste Information Sheet

Household Hazardous Waste (HHW) is residential refuse that is potentially dangerous and should not be put in a garbage can or blue box for regular collection. It is waste that is ignitable, corrosive, or toxic. Most landfills are not designed to contain hazardous waste. Household hazardous waste should not be poured down the drain, or poured on the ground, because it often ends up in rivers and lakes, contaminating drinking water and harming plants and wildlife.

The following are products that fall under the HHW classification and should be taken to the Ottawa-Carleton Household Special Waste Depot:

-paint	-turpentine	-brake fluid
-aerosol containers	-fire extinguishers	-pool chemicals
-insecticides	-stains	-wood preservatives
-barbeque starter	-oven cleaners	-disinfectants
-herbicides	-fungicides	-furniture stripper
-gasoline	-batteries	-propane tanks
-window cleaners	-antifreeze	-oils
-prescription drugs		

The Ottawa-Carleton Household Special Waste Depot is open on Saturdays from 9:00 a.m. to 5:00 p.m. (closed mid-December to mid-March) and is located at the Trail Road Landfill Site on Moodie Drive South of Fallowfield Road. Used motor oil and antifreeze may also be taken to local businesses willing to accept such wastes. When transporting your HHW to the Household Special Waste Depot, it should be stored in clearly labeled tightly sealed containers and carried in the trunk of the car. HHW products should never be mixed together.

What does the Depot do with your HHW? Products like paints, gasoline, oils, and antifreeze are sent away to be processed for reuse. Propane tanks and some types of batteries are being recycled. Some of the waste is transported to government-approved landfill sites specifically designed to contain such wastes.

The ideal situation is to produce very little, or no HHW. Purchase only the amount of a given chemical, or paint, that you are really going to use. If there is leftover, try to find someone who can use it up. For example, leftover paint may be donated to a community group or a neighbor who can use it. Another way to reduce the amount of HHW is to find safe alternatives for potentially hazardous products. For example, you can purchase rechargeable batteries, or use a vinegar-and-water solution to clean windows.

Thank you for your participation.

Appendix F

Research Abstract for Survey Participants

The purpose of the current proposal is to investigate how cognitive and demographic factors influence household hazardous waste (HHW) disposal behaviour. Household hazardous waste is defined as the residual material generated from the purchase and use of consumer products which are toxic, inflammable, or corrosive in nature. To protect the environment such products should be taken to a designated local municipal HHW disposal facility, or to a private business willing to accept such waste items for reprocessing; HHW materials are not to be discarded in the garbage or placed in the blue box.

Many municipalities have instituted HHW disposal programs, but the diminutive body of extant HHW literature has repeatedly indicated that less than 10% of the general public participates in such programs. This research intends to identify the factors which predict participation or non-participation in HHW disposal programs. This research also tries to determine survey respondent's HHW disposal preferences and sources of HHW information. This knowledge should be useful in the formulation of informational and educational campaigns and in ascertaining what structural modifications need to be made in existing HHW collection systems to improve their efficacy.

Review of psychological literature has revealed the influence of six key cognitive factors on participation in "ecologically responsible" behaviours: Social/Personal Norms, Awareness of Consequences, Ascription of Responsibility, Perceived Lack of Knowledge, Sense of Personal Salience, and Perceived Personal Threat of Environmental Problems (Perceived Risk). The review of the literature did not reveal any predictive or explanatory psychological models of HHW disposal behaviour. Therefore, in the current proposal, these factors have been brought together into a testable theoretical psychological structure designed to predict correct HHW disposal behaviour.

The influence of demographic and motivational factors on HHW disposal behavior is also to be assessed. The demographic variables of interest in the present study are: Age, Gender, Young Children in the Home, Access to a Vehicle, and Type of Dwelling. The motivational factor is survey respondents' Willingness to Travel to properly dispose of their HHW.

Appendix G

Intercorrelations Among the Independent Variables

	Single w/ Vehicle		\	Willing to Travel	Social Norms		Personal Norms	
	Age	Gender			#1	#2	#1	#2
* =p<.05								
** =p<.001								
Age								
Gender	.16*							
Single w/ Vehicle	.19	.05						
Willing to Travel	.01	-.02	.16*					
/ #1	.26**	-.07	.23*	.05				
Social Norm\ #2	.07	-.18*	.22*	.19*	.41**			
/ #1	.00	-.18*	.04	.09	.24*	.32**		
Personal Norm\ #2	-.01	-.03**	.01	.13*	.13	.44**	.43**	
/ #1	-.17*	-.27**	-.05	.15	-.01	.29**	.13**	.34*
Awareness \ #2	-.05**	-.09	.05	.14	.06*	.06	.20**	.14*
/ #1	-.29*	-.10*	.02	.11	.16	.11*	.27**	.22**
Ascription \ #2	-.15*	.20*	.01	.12	.14	.24*	.28*	.27**
/ #1	-.13*	-.23*	-.10	.09	.00	.19*	.22*	.36*
Salience \ #2	-.21	-.09	-.13	.12	.10*	.26	.20	.21
/ #1	.13**	.10	.03	-.08	.16*	.09*	.08	-.04
Knowledge \ #2	.29	.10	.10*	.03*	.18	.18*	.04	.01
/ #1	.05	.07	.22*	.24*	.03	.03*	-.01	.03*
Difficulty \ #2	.10	-.12*	.03	.24	.16*	.16**	.14*	.23**
/ #1	-.07	-.16*	-.11	.08	.18*	.35**	.21*	.38*
Concern \ #2	-.04	-.18*	-.06	-.03	.17	.30**	.22*	.24**
/ #1	-.01	-.18	-.05	-.05	.14	.27*	.22	.37*
Personal Risk\ #2	-.01	-.12	-.01	.02	.08	.19	.02	.23

Intercorrelations Among the Independent Variables

	Awareness		Ascription		Salience		Knowledge	
	#1	#2	#1	#2	#1	#2	#1	#2
Age								
Gender								
Single w/ Vehicle								
Willing to Travel								
/ #1								
Social Norm\ #2								
/ #1								
Personal Norm\ #2								
/ #1								
Awareness * \ #2	.23							
* / #1	.21	.30						
Ascription ** \ #2	.37	.25	.28					
** / #1	.48	.32	.33	.62				
Salience ** \ #2	.31	.16	.38	.54	.61			
* / #1	-.12	-.08	-.06	.04	-.02	-.01		
Knowledge ** \ #2	-.11	-.06	-.07	-.03	-.05	-.06	.38	
* / #1	.16	.18	.04	.02	.13	.00	.04	.06
Difficulty ** \ #2	.30	.33	.19	.23	.28	.36	.12	.10
** / #1	.33	.13	.18	.20	.18	.12	.03	-.03
Concern * \ #2	.22	.07	.10	.24	.13	.14	.09	.02
** / #1	.26	.24	.15	.20	.15	.09	.02	-.04
Personal * Risk\ #2	.23	.15	.13	.10	.16	.09	-.01	.05

Intercorrelations Among the Independent Variables

	Difficulty		Concern		Personal Risk	
	#1 /	\ #2	#1 /	\ #2	#1 /	\ #2
Age						
Gender						
Single w/ Vehicle						
Willing to Travel						
/ #1						
Social Norm\ #2						
/ #1						
Personal Norm\ #2						
/ #1						
Awareness \ #2						
/ #1						
Ascription \ #2						
/ #1						
Salience \ #2						
/ #1						
Knowledge \ #2						
/ #1						
Difficulty \ #2	* .21					
/ #1	.00	.05				
Concern \ #2	-.07	.04	** .69			
/ #1	.09	.04	.50	** .56		
Personal Risk\ #2	-.04	.06	.31	.29	** .44	

Appendix H

The Logistic Regression Univariate Matrix

The following matrix is the aforementioned 17 x 22 univariate matrix spread over eight pages. Significant univariate logistic regressions are given in boldface type. Significant univariate logistic regressions in which the independent variable was later retained in a multivariate model are presented in very dark boldface type (bold with shadow). The first number in the cell is the significance level of the Wald statistic. The second number in the cell is point value (the middle of the 95% confidence interval) for the odds ratio. Please note that all of the values in the matrix are univariate values, even those for variables in very bold face type which are indicated to be retained in some model. These values change when the variable is entered with others in the regression equation. The adjusted values are those given in the table of the mathematical models (Table 20).

Univariate relationships which were not significant within the context of logistic regression were given as simple correlations. Correlations which were significant at the $p < .05$ level (two-tailed) are denoted by an asterix to the lower left of the correlation coefficient. First to be displayed are the univariate statistics for disposal of the seven hazardous products, disposal of styrofoam containers, and location and day of operation of the Trail HSW facility. The the odds ratios are configured so that a larger odds ratios indicate

increased likelihood of membership in the target who properly dispose of these products; or know the correct location and day of operation of the O-C HSW Depot.

Next to be displayed are the univariate statistics for purchase of the seven hazardous products and styrofoam containers. The odd-ratios were configured so that a larger odds ratio indicates increased likelihood of purchasing the product.

Logistic Regression Univariate Matrix
(Correct Hazardous Product Disposal)

	MOTOR OIL	GLYCOL	BATTERY	LATEX PAINT	OILBASE PAINT	POLISH & WAX
AGE	+ .0396 2.2292	+ .0442 2.3438	+ .0341 1.5320	.18	+ .0385 1.9957	.18
GENDER	.02	.11	.02	-.04	-.08	.03
SINGLE w/ VEHICLE	+ .0199 8.4999	+ .0121 17.9998	+ .0108 2.7518	+ .0499 2.6822	+ .0211 3.8500	+ .0108 4.1981
DISTANCE	+ .0006 30.0000	+ .0235 13.4999	.10	+ .0089 3.9531	+ .0015 7.2857	+ .0085 4.9655
SOCIAL NORM 1	.17	.31	.15	+ .0155 1.8351	+ .0065 2.3086	.14
SOCIAL NORM 2	.10	.29	.11	.20	+ E .0356 1.8757	.13
PERSONAL NORM 1	.43 *	.30	.13	+ .0353 2.0793	+ .0391 3.0421	.10
PERSONAL NORM 2	.35	.25	.13	.08	.06	.06
AWARENESS 1	.12	.07	.16	.09	.15	.19
AWARENESS 2	+ E .0089 4.2362	+ .0480 3.0451	+ .0014 2.7098	+ .0318 1.9420	+ .0067 2.8527	+ .0174 2.1670
ASCRPTION 1	.22	.17	.01	.01	.08	.19

Logistic Regression Univariate Matrix
(Correct Hazardous Product Disposal)

	MOTOR OIL	GLYCOL	BATTERY	LATEX PAINT	OILBASE PAINT	POLISH & WAX
ASCRPTION 2	.22	.32	⁺ .0057 3.0734	⁺ .0393 2.1205	⁺ .0230 2.5582	⁺ .0443 1.9962
SALIENCE 1	⁺ E .0499 2.1108	.36 *	⁺ .0354 1.9744	.20	.26	⁺ .0266 2.3826
SALIENCE 2	.04	.22	.11	.21	.18	⁺ .0315 2.3219
KNOWLEDGE 1	.12	.17	.14	⁺ .0231 1.7235	.27 *	.14
KNOWLEDGE 2	⁺ E .0121 2.6838	⁺ .0063 3.1783	⁺ .0001 2.4868	⁺ .0003 3.0842	⁺ .0007 3.2018	⁺ .0040 1.8292
DIFFICULTY 1	⁺ E .0129 3.8252	⁺ E .0116 3.4745	⁺ .0175 1.6170	⁺ .0067 2.0284	⁺ .0004 3.4223	⁺ E .0301 1.7953
DIFFICULTY 2	⁺ E .0145 2.9579	⁺ .0432 2.7534	⁺ .0086 1.8764	⁺ .0248 1.8968	⁺ .0047 2.3967	⁺ .0109 2.0765
CONCERN 1	-.11	-.21	.06	-.04	.05	.01
CONCERN 2	-.35 *	-.32	.02	.04	.07	-.13
RISK 1	.30	.04	.15	.02	.17	.15
RISK 2	.12	.06	⁺ .0232 1.6826	.06	.03	⁺ .0303 1.7981

Logistic Regression Univariate Matrix
(Correct Hazardous Product Disposal, Styrofoam Recycling,
Location & Day)

	PESTI- CIDES		STYRO- FOAM		LOCATION & DAY	
AGE	.23		⁺ .0471 1.4834		⁺ .0368 1.6070	
GENDER	-.16		-.11		.11	
SINGLE w/ VEHICLE	⁺ .0093 5.0000		.17		⁺ .0161 4.0701	
DISTANCE	⁺ .0002 17.9376		.14		⁺ .0093 5.0000	
SOCIAL NORM 1	⁺ .0301 1.9981		⁺ .0121 1.6137		⁺ .0140 2.1419	
SOCIAL NORM 2	.21		.07		.03	
PERSONAL NORM 1	.29 *		.01		.10	
PERSONAL NORM 2	.11		-.01		.03	
AWARENESS 1	⁺ .0467 1.7419		.06		-.07	
AWARENESS 2	⁺ .0238 2.2129		.16		.07	
ASCRPTION 1	.16		-.02		.04	

Logistic Regression Univariate Matrix
(Correct Hazardous Product Disposal, Styrofoam Recycling,
Location & Day)

	PESTI- CIDES		STYRO- FOAM		LOCATION & DAY	
ASCRPTION 2	+ .0044 3.1337		-.10		.02	
SALIENCE 1	+ .0422 1.8815		-.10		.03	
SALIENCE 2	.28 *		-.01		.07	
KNOWLEDGE 1	.18		.00		+ .0099 2.5481	
KNOWLEDGE 2	+ .0078 2.7363		+ .0007 1.9127		+ .0012 3.4499	
DIFFICULTY 1	.26		.10		+ .0211 1.8401	
DIFFICULTY 2	+ .0036 2.7354		.16		.12	
CONCERN 1	-.02		-.04		-.10	
CONCERN 2	-.08		-.10		-.12	
RISK 1	-.02		-.01		.03	
RISK 2	-.13		-.04		-.00	

Logistic Regression Univariate Matrix
(Product Purchase)

	MOTOR OIL	GLYCOL	BATTERY	LATEX PAINT	OILBASE PAINT	POLISH & WAX
AGE	.11	.01	-.13	.15 *	⁺ .0108 1.5149	⁺ .0301 1.4250
GENDER	.10	-.01	-.11	.02	-.06	⁺ .0490 1.8304
SINGLE w/ VEHICLE	⁺ .0036 2.8331	⁺ .0269 2.1754	-.01	⁺ .0046 2.5609	⁺ .0015 2.7343	⁺ .0162 2.1289
DISTANCE	-.02	.06	.04	.04	.05	-.05
SOCIAL NORM 1	.06	-.06	-.13	.06	.12	.10
SOCIAL NORM 2	.15	⁺ .0206 1.8002	.03	.11	.13	-.04
PERSONAL NORM 1	.01	.06	.02	.10	.15 *	-.01
PERSONAL NORM 2	.10	.15	-.05	.05	-.03	-.10
AWARENESS 1	-.11	-.01	.05	-.06	-.03	-.10
AWARENESS 2	-.02	-.04	-.00	.05	.01	-.09
ASCRPTION 1	-.02	.02	.08	.04	-.05	⁻ .0318 .6676

Logistic Regression Univariate Matrix
(Product Purchase)

	MOTOR OIL	GLYCOL	BATTERY	LATEX PAINT	OILBASE PAINT	POLISH & WAX
ASCRPTION 2	-.15	-.07	-.12	-.03	-.02	-.10
SALIENCE 1	⁻ .0206 .6977	-.12	-.03	-.02	-.05	⁻ .0227 .6597
SALIENCE 2	-.08	-.00	.03	-.01	-.06	-.11
KNOWLEDGE 1	-.04	⁺ .0459 .7190	-.05	-.06	-.08	-.04
KNOWLEDGE 2	⁺ .0184 1.5350	.10	-.09	⁺ .0043 1.5822	.14	.10
DIFFICULTY 1	.08	.07	-.00	-.01	.03	-.09
DIFFICULTY 2	-.14	-.09	-.04	-.05	-.05	⁻ .0191 .6777
CONCERN 1	-.07	.02	-.07	-.09	-.03	-.06
CONCERN 2	-.07	.01	-.05	-.06	.06	.01
RISK 1	.04	.01	.00	-.03	.03	-.07
RISK 2	.10	.05	.14	.11	.06	-.03

Logistic Regression Univariate Matrix
(Product Purchase)

	PESTI- CIDES		STYRO- FOAM			
AGE	+ .0368 1.6070		-.03			
GENDER	+ .0187 2.0877		.06			
SINGLE w/ VEHICLE	.14		.08			
DISTANCE	-.02		.09			
SOCIAL NORM 1	-.04		-.10			
SOCIAL NORM 2	-.06		-.06			
PERSONAL NORM 1	-.12		.15			
PERSONAL NORM 2	- E .0162 .0052		-.08			
AWARENESS 1	- .0052 .6450		.05			
AWARENESS 2	-.12		-.04			
ASCRPTION 1	-.12		-.02			

Logistic Regression Univariate Matrix
(Product Purchase)

	PESTI- CIDES		STYRO- FOAM			
ASCRPTION 2	- .0025 .5817		-.06			
SALIENCE 1	- .0164 .6674		-.07			
SALIENCE 2	- .0268 .6947		-.02			
KNOWLEDGE 1	-.01		-.03			
KNOWLEDGE 2	+ .0020 1.6622		-.03			
DIFFICULTY 1	-.02		.10			
DIFFICULTY 2	- .0033 .6302		-.02			
CONCERN 1	-.12		.10			
CONCERN 2	-.08		.05			
RISK 1	-.09		-.11			
RISK 2	.12		-.13			

Appendix I

Proper Waste Disposal, Location/Day, and Purchase ModelsProper Waste Disposal Models**MOTOR OIL**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
DISTANCE	3.81	1.07	.0004	.49	45.00	5.5 - 368

# of cases in analysis: 31

initial -2LL 42.68		Predicted			
-2LL 23.80		0 1			

Observed	0	12	2	86%	
	1	2	15	88%	

		Overall		87%	

Cox & Snell R^2 : .456
 Nagelkerke R^2 : .610
 Hosmer and Lemeshow: N/A

GLYCOL

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
SINGLE w/VEHICLE	2.89	1.27	.0229	.28	17.96	1.5 - 216
KNOWLEDGE 2	1.09	.48	.0227	.28	2.96	1.2 - 7.5

# of cases in analysis: 30

initial -2LL 41.59		Predicted			
-2LL 26.70		0 1			

Observed	0	13	2	87%	
	1	3	12	80%	

		Overall		83%	

Cox & Snell R^2 : .391
 Nagelkerke R^2 : .522
 Hosmer and Lemeshow: N/A

Proper Waste Disposal Models**BATTERY**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
ASCRPTION 2	1.13	.42	.0065	.19	3.10	1.4 - 1.7
KNOWLEDGE 2	.98	.25	.0001	.30	2.66	1.6 - 4.3

# of cases in analysis: 123

initial -2LL 152.10
 -2LL 122.11

	Predicted		
	0	1	
Observed	0	81	4
	1	18	20
Overall			82%

Cox & Snell R^2 : .216
 Nagelkerke R^2 : .305
 Hosmer and Lemeshow: $p=.1023$

LATEX PAINT

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
KNOWLEDGE 2	1.14	.36	.0014	.30	3.12	1.6 - 6.3
DIFFICULTY 1	.65	.32	.0439	.15	1.92	1.0 - 3.6
PERSONAL NORM 1	.85	.36	.0184	.20	2.33	1.2 - 4.7

# of cases in analysis: 65

	Predicted		
	0	1	
Observed	0	28	6
	1	5	26
Overall			83%

Cox & Snell R^2 : .336
 Nagelkerke R^2 : .448
 Hosmer and Lemeshow: $p=.3483$

Proper Waste Disposal Models**OILBASE PAINT**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
SINGLE w/VEHICLE	3.01	1.43	.0355	.19	20.31	1.2 - 336
AWARENESS 2	2.06	.97	.0341	.19	7.86	1.2 - 53
KNOWLEDGE 2	1.49	.67	.0265	.21	4.46	1.2 - 17
DISTANCE	2.46	1.61	.0345	.19	11.71	1.2 - 115
DIFFICULTY 1	1.05	.53	.0466	.17	2.86	1.0 - 8.0

# of cases in analysis: 50

		Predicted		
		0	1	
initial -2LL	68.99			
-2LL	23.90			
Observed	0	21	2	91%
	1	1	26	96%
Overall				94%

Cox & Snell R^2 : .594Nagelkerke R^2 : .794Hosmer and Lemeshow: $p=.7552$ **POLISHES & WAXES**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
KNOWLEDGE 2	1.08	.39	.0060	.25	2.96	1.4 - 6.4
DIFFICULTY 2	.97	.42	.0215	.19	2.64	1.2 - 6.0
PERSONAL RISK 2	1.11	.45	.0149	.21	3.02	1.2 - 7.4
DISTANCE	2.07	.84	.0143	.21	7.91	1.5 - 41

# of cases in analysis: 75

		Predicted		
		0	1	
initial -2LL	90.77			
-2LL	58.66			
Observed	0	46	7	87%
	1	8	14	64%
Overall				80%

Cox & Snell R^2 : .348Nagelkerke R^2 : .496Hosmer and Lemeshow: $p=.8052$

Proper Waste Disposal Models**PESTICIDES**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
DISTANCE 4	4.39	1.26	.0005	.41	80.66	6.9 - 948
KNOWLEDGE 2	1.75	.64	.0063	.30	5.79	1.6 - 20

# of cases in analysis: 43

		Predicted		
		0	1	
initial -2LL	59.59			
-2LL	28.89			
Observed	0	21	1	95%
	1	4	17	81%
Overall				88%

Cox & Snell R^2 : .510
 Nagelkerke R^2 : .681
 Hosmer and Lemeshow: N/A

STYROFOAM

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
KNOWLEDGE 2	.67	.20	.0010	.23	1.91	1.3 - 2.8

# of cases in analysis: 118

		Predicted		
		0	1	
initial -2LL	163.58			
-2LL	151.77			
Observed	0	40	19	68%
	1	24	35	59%
Overall				64%

Cox & Snell R^2 : .095
 Nagelkerke R^2 : .175
 Hosmer and Lemeshow: N/A

Location & Day Model**LOCATION & DAY**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
SINGLE w/VEHICLE	1.32	.64	.0389	.14	3.73	1.1 - 13
DISTANCE	2.41	1.06	.0237	.17	11.10	1.4 - 89
KNOWLEDGE 2	1.30	.44	.0035	.24	3.66	1.5 - 8.7

# of cases in analysis: 166

initial -2LL 109.67
 -2LL 82.60

		Predicted		
		0	1	
Observed	0	149	0	100%
	1	17	0	0%
Overall				90%

Cox & Snell R^2 : .151
 Nagelkerke R^2 : .311
 Hosmer and Lemeshow: $p=.3758$

Purchase Models**MOTOR OIL**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.	
SINGLE w/VEHICLE	.93	.37	.0119	.15	2.53	1.2	- 5.2
KNOWLEDGE 2	.44	.20	.0256	.12	1.55	1.1	- 2.3

# of cases in analysis: 168

initial -2LL 199.16 -2LL 185.70		Predicted			
		0	1		
Observed	0	121	0	100%	
	1	47	0	0%	
				Overall	72%

Cox & Snell R^2 : .077
 Nagelkerke R^2 : .111
 Hosmer and Lemeshow: N/A

GLYCOL

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.	
SINGLE w/VEHICLE	.81	.36	.0243	.12	2.24	1.1	- 4.5

# of cases in analysis: 169

initial -2LL 197.87 -2LL 192.61		Predicted			
		0	1		
Observed	0	123	0	100%	
	1	46	0	00%	
				Overall	73%

Cox & Snell R^2 : .031
 Nagelkerke R^2 : .044
 Hosmer and Lemeshow: N/A

Purchase Models**BATTERY**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.

---

no variables in the equation except for constant

# of cases in analysis: 177

		Predicted		
		0	1	
initial	-2LL	120.69		
	-2LL	120.69		
Observed	0	0	19	0%
	1	0	158	100%
				Overall 89%

Cox & Snell R^2 : /
 Nagelkerke R^2 : /
 Hosmer and Lemeshow: /

LATEX PAINT

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.

SINGLE w/VEHICLE	.80	.34	.0202	.13	2.22	1.1 - 4.3
KNOWLEDGE 2	.47	.17	.0062	.16	1.60	1.1 - 2.2

# of cases in analysis: 166

		Predicted		
		0	1	
initial	-2LL	214.83		
	-2LL	200.17		
Observed	0	13	45	22%
	1	13	95	88%
				Overall 65%

Cox & Snell R^2 : .084
 Nagelkerke R^2 : .116
 Hosmer and Lemeshow: N/A

Purchase Models**OILBASE PAINT**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
AGE	.50	.18	.0044	.16	1.65	1.2 - 2.3
SINGLE w/VEHICLE	.86	.33	.0086	.15	2.36	1.2 - 4.5

# of cases in analysis: 168

initial -2LL 232.68		Predicted		
-2LL 214.54		0 1		
Observed	0	55	26	68%
	1	32	55	63%
Overall				65%

Cox & Snell R^2 : .102
 Nagelkerke R^2 : .137
 Hosmer and Lemeshow: $p=.4092$

POLISHES & WAXES

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
SINGLE w/VEHICLE	.74	.33	.0263	.11	2.09	1.1 - 4.0
ASCRPTION 1	-.40	.18	.0301	-.11	.67	.5 - 1.0
DIFFICULTY 2	-.37	.18	.0404	-.10	.69	.5 - 1.0

# of cases in analysis: 163

initial -2LL 223.25		Predicted		
-2LL 207.55		0 1		
Observed	0	37	34	52%
	1	25	67	73%
Overall				64%

Cox & Snell R^2 : .092
 Nagelkerke R^2 : .123
 Hosmer and Lemeshow: $p=.1945$

Purchase Models**PESTICIDES**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.
KNOWLEDGE 2	.57	.19	.0023	.19	1.76	1.4 - 2.1
DIFFICULTY 2	-.60	.18	.0011	-.21	.55	.4 - .9

# of cases in analysis: 151

initial -2LL 203.73

-2LL 183.78

		Predicted		
		0	1	
Observed	0	73	17	81%
	1	35	26	43%
Overall				66%

Cox & Snell R^2 : .139Nagelkerke R^2 : .187Hosmer and Lemeshow: $p=.1539$ **STYROFOAM**

Independents	B	S.E.	Sig.	R	O.R.	95% C.I.

no variables in the equation except for constant

# of cases in analysis: 153

initial -2LL 156.93

-2LL 156.93

		Predicted		
		0	1	
Observed	0	0	32	0%
	1	0	121	100%
Overall				79%

Cox & Snell R^2 : /Nagelkerke R^2 : /

Hosmer and Lemeshow: /

IMAGE EVALUATION TEST TARGET (QA-3)

APPLIED IMAGE, Inc.
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989

© 1993, Applied Image, Inc., All Rights Reserved