FACTORS AFFECTING ENVIRONMENTAL BEHAVIOUR OF HOUSE INHABITANTS IN CANADA

by

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ABSTRACT

The present study examined environmental behaviour of house inhabitants in Canada. An environmental psychology approach was followed. Over one thousand completed questionnaires were collected through a mail survey. Results indicated adoption levels for environmental housing behaviours were, in general, satisfactory. However, a large variation in adoption levels among behaviours was observed with waste management behaviours having the highest percentages of adoption and water conservation behaviours having the lowest.

Numerous variables were found to have an effect on behaviour although this was at most of a moderate level magnitude. Variables measured at a level specific to a given behaviour were exerting the highest influence on behaviour. A theoretical model was formulated to explain environmental housing behaviour. The model was considered to be effective in capturing the main factors that affect behaviour at a general level, despite certain limitations in its generalisability. It can be of use to either researchers or policy makers concerned with environmental housing behaviour.

Although current behaviour adoption levels are not regarded as low, a number of suggestions to further increase adoption were proposed to deal with increasing environmental pressures. These recommendations included employing variables that may affect one's ability and motivation to process a persuasive message and implementing approaches that utilise a given behaviour's relative advantage, compatibility, trialability, complexity, and observability.

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1. INTRODUCTION

The study of human behaviour can assist in understanding and dealing with many contemporary problems and issues. This study can be approached by social psychology, which is defined as the scientific field that studies the ways social (i.e., related to how other people influence one's thoughts, feelings, and actions) and cognitive (i.e., related to how one's thoughts, emotions, memories, and motivations influence one's perceptions and actions) processes affect how people understand, influence, and relate to others (Smith and Mackie, 2000).

Ajzen (2005) states that much of the work in social psychology has been based on hypothetical characteristics of people, such as personal values and attitudes, that cannot be observed directly and are, therefore, assessed by measurable signs, such as a person's verbal or non verbal behaviour. This approach can be useful in accurately explaining and predicting behaviour, provided that individuals exhibit consistency in their beliefs, feelings, and actions. However, this is a rather simplistic view of reality. Instead, people may act in ways that contradict their stated disposition as their engagement in a particular behaviour may depend on the characteristics of the situation they face.

Although social psychology is of limited assistance in explaining human behaviour on a particular occasion, it can have a valuable contribution in revealing general patterns of human action. An individual's characteristics, such as personal values and attitudes, can encapsulate that person's behavioural disposition. Thus, social psychology can uncover the general laws governing human behaviour (Ajzen, 2005).

A current issue, where human behaviour plays an important role, is the condition of the natural environment around the world. The natural environment has been experiencing increasing pressures due to human activities over the last decades (MA, 2005; Oskamp, 2000), which can be partly attributed to the impact of buildings (Roodman and Lenssen, 1995). In Canada, the residential sector is of particular interest since it accounted for over 200,000 annual average housing starts in the last ten years (CMHC,

2009). One way to reduce the impact from houses on the natural environment is through implementation of environmental housing practices to improve a building's performance in areas such as energy efficiency, water efficiency, material resource efficiency, and/or impact on ecosystems. However, in spite of the existence of such practices, ultimately it is up to individuals whether they will adopt those practices or not.

Behaviour of humans related to the natural environment is examined by the field of environmental psychology, which can be defined as the study of transactions between humans and their physical and social environment (Cassidy, 1997). Environmental psychology draws a large part of its methodology from social psychology and it bases its approach on concepts such as personal values, beliefs, and attitudes (Stern and Dietz, 1994).

The present study utilised an environmental psychology approach and was undertaken to enhance understanding of the role of human behaviour related to minimising environmental housing impacts, given the limited availability of existing studies that address this issue in Canada. It attempted to ascertain the current situation regarding the adoption of environmental behaviours of house inhabitants in Canada to reveal potentially problematic areas (i.e., a low adoption level for a specific behaviour or a group of behaviours). In addition, the study identified factors that are significant predictors of these behaviours and by combining them (with the aid of relevant theories) it developed a conceptual framework that can depict the general patterns that characterise environmental housing behaviour. This was considered to be of use given that existing environmental behaviour models do not specialise in housing issues. Finally, using existing theoretical concepts, the study formulated a number of recommendations that can be applied to enhance adoption of environmental housing behaviours among the general public.

A mail survey was employed to collect data from Canadian households and it was conducted between June and July 2007. The organisation for the remainder of this report is as follows. Chapter 2 presents a literature review that covers the increasing awareness of environmental issues and the associated impact

of buildings, environmental behaviour and the factors that may affect it, popular theoretical models to explain environmental behaviour, ways to promote environmental practices by achieving behavioural change, the particular problem that the present study sought to address, and the study's objectives. Chapter 3 describes the methodology followed for primary data collection including information on the population of the study, survey design, and data analysis. Chapter 4 presents results from descriptive statistics, reliability and validity considerations, and results from logistic regression analysis, partial correlation analysis, and cross-tabulation analysis. Chapter 5 offers a commentary on measured adoption levels of environmental housing behaviours, individual factors that may influence behaviour, and the theoretical model developed to explain environmental housing behaviour, and presents likely ways to promote adoption of behaviours. Finally, chapter 6 provides concluding remarks including the study's limitations and recommendations for future research.

2. LITERATURE REVIEW

This chapter begins with a brief presentation of the current state of man-made environmental problems and the corresponding contribution of buildings, which is substantial. Given that solutions to minimise impacts of buildings on the environment are available but to be implemented require appropriate human behaviour, the chapter continues with a description of factors that can influence human behaviour. These factors can be broadly grouped into four categories: (1) internal factors (mostly psychological constructs, such as personal values and attitudes), (2) individual factors (i.e., socio-economic and demographic factors), (3) external factors e.g., existence of campaigns aimed at minimising environmental impacts by adopting a certain behaviour), and (4) prior experiences with a specific behaviour. Subsequently, theoretical models that bring these factors together to explain environmental behaviour are presented. The chapter includes a presentation of popular theories that can be used to enhance adoption of environmentally friendly housing practices and ends with a statement of the specific problem addressed by this study and the objectives pursued.

2.1. Increasing environmental awareness and impact of buildings on the natural environment

People are becoming increasingly aware of the impacts of human growth and development on the natural environment. Within the last 40 years, the world population has doubled to 6 billion people (MA, 2005). This led to an increasing use of natural resources and unprecedented (and sometimes irreversible) changes in structure and function of ecosystems (Cofaigh et al., 1996; MA, 2005). Ecosystem degradation, which can be considered as a loss of assets for a country, can also harm human well-being. Environmental problems can worsen the economic situation for certain groups of people and increase the occurrence of nonlinear changes (e.g., the emergence of epidemics or regional climate change) (MA, 2005).

In certain cases, the environmental situation has improved but important problems still exist that need to be addressed in the coming years to slow down and reverse the degradation of ecosystems (MA, 2005).

Among other sources that can contribute to environmental degradation (e.g., manufacturing and automobiles), the construction and use of buildings can heavily affect the natural environment.

2.1.1. Impact of buildings on the natural environment

The impact of buildings on the natural environment is considerable. Roodman and Lenssen (1995) estimate that they use 40 % of the world's energy and material flows, 16% of its fresh water removal, and 25% of its wood harvest. During operation, buildings are responsible for 36% of total energy use, 65% of electricity consumption, and 30% of greenhouse-gas emissions in the U.S. (Foster et al., 2004).

Environmental impacts of buildings may result from building material production and transportation, energy consumption (during construction, use, and demolition of buildings), pollution (caused by emissions from burning fuel), toxic material emissions (that harm occupant health), and depletion of non-renewable resources (Cofaigh et al., 1996; Smith et al., 1997). Among different categories of buildings, the residential sector is of importance since between 1999 and 2008 there were 201,352 annual average housing starts in Canada (CMHC, 2009) and 1,645,110 in the U.S. (NAHB, 2009). Numerous environmental housing practices exist to mitigate the abovementioned impacts, as presented in the following sections.

2.1.2. Environmental buildings

A universally accepted definition of the term environmental (or green) building has not been yet established (Cole, 2000a; Oliver, 2008). However, the term, in general, refers to buildings that incorporate improvements over conventional structures on issues such as energy efficiency, water efficiency, material resource efficiency, indoor environmental quality, and impact on ecosystems during the phases of building design, construction, operation, and removal or re-use (Cole, 2000a; McGraw-Hill Construction, 2008). Currently, there are efforts underway to draft an International Green Construction Code through the International Code Council (ICC, 2009). It is being designed to integrate with other accepted international codes.

Important developments regarding the evolution of the green building movement are briefly summarised below (McGraw-Hill Construction, 2008). In 1970, the U.S. introduced the first legal requirements to produce environmental impact statements for buildings. The 1973 oil crisis assisted in enhancing awareness of energy efficiency issues in many parts of the world while in 1979 California introduced the first standards to promote energy efficiency in state office buildings. In 1988, an influential voluntary energy efficiency standard for buildings (i.e., Passive House) was developed and implemented in European countries. In the 1990s, industry associations and consortiums related to green building were established (e.g., the Committee on the Environment created by the American Institute of Architects). During that decade, the first environmental performance assessment systems of buildings (see section 2.1.3. for more information) were introduced to set voluntary criteria for reducing environmental impacts of buildings. After the year 2000, increasing concerns related to climate change led to a higher degree of environmental building initiatives and collaboration among governmental and nongovernmental organizations (NGOs) around the world. A move from voluntary green building practices to national building code requirements is currently observed (Bowyer et al., 2010).

The importance of green building is growing all over the world driven by factors such as perceptions that green building presents a "correct" course of action regarding construction, corporate commitments to environmental practices, market and client demands, environmental regulations, the fact that green buildings benefit human health and wellbeing, or attempts to reduce annual energy consumption and costs (McGraw-Hill Construction, 2008; Oliver, 2008). It is estimated that globally more than 10% of current construction follows environmental guidelines while by 2013, green buildings will account for more than 60% of projects undertaken by the majority of construction companies. The residential sector (i.e., the focus of the present study) was ranked third in terms of green building activity behind the office and government sectors in 2008. However, it is expected to exceed the government sector by 2013 (McGraw-Hill Construction, 2008).

However, certain obstacles may interfere with and delay the expansion of environmental buildings. Important barriers (according to construction firms) include the high initial expenditures required (whether perceived or actual), inadequate public awareness about green buildings and the benefits they provide throughout their lifetimes, and the lack of appropriately educated/trained environmental construction professionals (McGraw-Hill Construction, 2008; Oliver, 2008).

Construction of green buildings is facilitated by the existence of environmental performance assessment systems for buildings. These systems provided an identification of essential environmental housing practices that were examined in the present study.

2.1.3. Identification of environmental housing practices

Environmental performance assessment systems for buildings[1] can be a starting point to identify housing practices that reduce environmental impacts. These systems can assist in explaining the relationships between technical solutions implemented and performance achieved although more research is recommended in this area to establish the objectivity of environmental performance assessment systems (Crawley and Aho, 1999).

Environmental performance assessment systems set criteria for minimizing environmental impacts of buildings during construction, operation, and demolition. These systems need to include both global and regional criteria. Global criteria can be determined by international agreements or scientific findings. Criteria of regional importance are necessary to ensure optimization of practices to local conditions (e.g., climate, materials, and social issues) (Todd and Geissler, 1999).

Three current environmental performance assessment systems of buildings were used in this study. These systems are:

[1] This literature review addressed the situation of environmental performance assessment systems of buildings in 2005. These systems were used to develop the questionnaire at that time. Although there have been numerous substantive changes in the field of environmental assessment for housing, they are not relevant to this work.

- Leadership in Energy and Environmental Design[2] (LEED) (USGBC, 2005)
- Building Research Establishment Environmental Assessment Method (BREEAM) (BREEAM, 2005)
- National Association of Home Builders (NAHB) Green Home Building Guidelines (NAHB, 2005)

However, BREEAM standards did not apply to residential buildings at the time (2005) the information was first collected from their website. Criteria included in these three systems are presented in Appendix A.

Common issues in all the above assessment systems and guidelines include: site management, energy efficiency, water efficiency, environmentally sound materials use, and indoor environmental quality (which includes issues such as lighting, ventilation, or psychological well-being). The focus of this research is on the behaviour of house inhabitants to reduce environmental impacts. Three of these issues (energy efficiency, water efficiency, and environmentally sound materials use related to household practices) are useful in identifying specific environmental housing practices that can be controlled by house inhabitants and help reduce impacts on the natural environment. Site management has the potential to minimize environmental impacts but it is generally not controlled by house inhabitants while indoor environmental quality affects the health of the residents and not the health of ecosystems.

Implementation of the various practices mentioned above can minimize environmental impacts. However, the behaviour of house inhabitants plays an important role in efficiently implementing such practices and is not straightforward to understand (Abreu et al., 2008). This aspect of the environmental impact of residential buildings (i.e., human behaviour) was the key driving force of this thesis. In addition, the majority of houses already exist and their environmental impacts are not affected by environmental

[2] The specific version used in this research was LEED for Homes Version 1.4 (USGBC, 2005).

design and construction of new structures. The focus of this work was the environmental behaviour of current house inhabitants and a review of the broader field of environmental concern and behaviour is required to provide a foundation for exploring the factors that affect behaviour of humans in their residences.

2.2. Environmental behaviour and its determinants

Environmental issues have become increasingly important since the 1960s (Prakash, 2002). Phillips (1999) reports that 87% of adults in the U.S.A. are concerned about the condition of the environment. A 1995 public opinion poll found that 75% of people in the United States of America said they were environmentalists (Mackoy et al., 1995) while a more recent Harris Interactive poll (2009) reports that 46% of people from that country felt environmental conservation was more important to them on a personal level than it was a few years ago and 47% found it to be no more or less important..

Fortunately, people can adopt various actions/behaviours to help translate environmental concern into practice that effectively reduces problems both with the indoor and outdoor environment. According to Parker and McDonough (1999) an environmental behaviour is "an action that can occur as a result of a person's environmental attitudes". However, research has shown that environmental concern and behaviour are affected not only by attitudes (or personal values), but also by other internal variables (e.g. knowledge and experience of environmental conditions), individual variables (e.g., demographics), external or contextual variables (e.g., objective environmental conditions), prior experiences with the behaviour, and interactions among these factors (Blake, 2001; Corraliza and Berenguer, 2000; Schultz et al., 1995; Tanner et al., 2004).

Environmental behaviours can be categorized into high-cost (e.g., installing solar panels) and low-cost behaviours (e.g., turning off the lights when people leave a room) (Gatersleben et al., 2002; Tanner et al., 2004). High-cost behaviours are those requiring high resource commitments from house inhabitants while low-cost behaviours involve low resource commitments. Internal variables (such as attitudes and beliefs)

seem to influence mostly low-cost behaviours while individual variables (such as household size and income) are more related to high-cost behaviours (Gatersleben et al., 2002).

However, there is a gap between consumers' concern and observed behaviour regarding environmental issues. People may express an interest in protecting the environment but they do not necessarily engage in environmentally friendly practices (Do Valle et al., 2005; Gagnon Thompson and Barton, 1994; Nordlund and Garvill, 2002; Prakash, 2002; Smith and Haugtvedt, 1995). For example, often people believe that environmentally friendly products offer consumers benefits (e.g., a cleaner environment) provided to all of the people irrespective of their particular pro-environmental actions. However, although such benefits are desirable, consumers are usually not willing to pay premiums for them (Prakash, 2002). Moreover, people who engage in one type of environmental behaviour do not necessarily engage in another (Schultz et al., 1995). To assist in understanding environmental behaviour, the following subsections present more information regarding variables that may affect it.

2.2.1. Internal characteristics affecting behaviour

Internal variables are usually assessed by self-reporting. They include the knowledge and experience of environmental issues, personal values, and attitudes.

2.2.1.1. Knowledge and experience of environmental conditions

Blake (2001) states that substantial knowledge of environmental conditions and problems is more likely to result in environmental behaviour. Knowledge of environmental issues and practices can affect environmental concern by leading to beliefs that engaging in a certain behaviour is not inconvenient and that individual actions can be effective (Do Valle et al., 2005). Schultz et al. (1995) report that when people possess more pertinent information they are more likely to engage in recycling. The actual experience of environmental conditions can also influence environmental concern (Kals et al., 1999).

2.2.1.2. Personal values

Personal values (or held values) are abstract ideals that include the modes of behaviour (e.g., hard work) one uses to achieve his/her life goals which are also known as instrumental values, desirable end-states of existence (e.g., freedom) which are also known as terminal values, and qualities (e.g., landscape beauty) that can be desirable (Brown, 1984; Rokeach, 1968). People form preference relationships about objects, which express the relative importance of these objects based on their held values. The relative importance of a certain object can be called the assigned value to that object. Assigned values are determined by perceptions about the specific object under evaluation, held values, and the evaluation context (Brown, 1984). This context depends on factors such as the evaluating person's internal state (i.e., physical and emotional factors), the evaluating person's external situation (e.g., financial situation, available time, and condition of the environment), the social situation where the evaluation takes place (e.g., whether others are aware of the evaluation), the constituency of the evaluation (i.e., whether individuals represent themselves or a group when making the evaluation), the mode of the evaluation (i.e., verbal statement or action), the scale of the evaluation (i.e., ordinal or interval), and the measure of the evaluation (e.g., such measures can be time commitment, willingness to pay, or opinion related to an object) (Brown, 1984). Assigned values are comparable to attitudes, which are described in more detail in the next section.

Personal values form at an early stage of the socialization process; they are rather stable throughout an individual's life, they are deeper (and more stable) than attitudes, and can shape attitudes and behaviour (Axelrod, 1994; Do Valle et al., 2005; Hoyer and MacInnis, 2004, Poortinga et al., 2004; Stern and Dietz, 1994). Do Valle et al. (2005) report that personal values can determine general (as distinct from specific) attitudes. A general attitude refers to a worldview while a specific attitude is related to a particular object (e.g., electric cars). People tend to purchase and use products and services in a way that is in agreement with their personal values (Hoyer and MacInnis, 2004). For example, conservative people tend to dress accordingly.

Two axes can be used to portray general types of personal values. One axis ranges from self-transcendence to self-enhancement and the other ranges from conservatism (or traditionalism) to openness to change (Schultz and Zelezny, 1998; Nordlund and Garvill, 2002). Self-transcendence values refer to values that serve the welfare of other people and self-enhancement values refer to values that serve self-interests (Schultz and Zelezny, 1998). Research has mostly assessed the effect of the self-transcendence and self-enhancement values on environmental concern (rather than the effect of conservatism or openness to change values).

Another way to categorise personal values is between materialist and post materialist values with research showing that post-materialist values can lead to pro-environmental actions (Blake, 2001). This distinction refers to priorities given to either materialist (e.g., maintain a strong economy) or post materialist (e.g., progress toward a more humane society) goals (Blake, 2001).

Personal norms (beliefs about what is right or wrong with respect to an individual's behaviour) and social norms (beliefs about whether an individual's family, neighbours, friends, and colleagues think he or she should engage in pro-environmental behaviours) may also influence environmental action with social norms having the potential to influence personal norms (Do Valle et al., 2005). The next section presents attitudes which can be shaped by one's personal values.

2.2.1.3. Attitudes

An attitude can be defined as a synoptic evaluation of a psychological object (e.g., a person or an issue) (Ajzen, 2001). This evaluation can be favourable (for example, an object can be evaluated as good, likeable, pleasant, and so on), unfavourable, or even neutral (Petty and Cacioppo, 1986). Although the tendency to create evaluations about psychological objects is present in all individuals, it varies so that some people tend to evaluate more than others (Ajzen, 2001). Attitudes are, in general, acquired (learned) later in life although they may have a hereditary component (Rokeach, 1968).

Understanding one's attitude about a psychological object can be complicated because it is possible for people to have more than one attitude about a given object. This happens in situations when an attitude changes and the new attitude does not completely replace the old attitude. In this case, one may hold two different attitudes for one object at the same time. One of these attitudes is implicit with the other being explicit (Ajzen, 2001).

Attitudes are relatively stable over time and they predispose one to act (Rokeach, 1968). The influence they exert on behaviour is one factor that explains the interest in studying attitudes (Ajzen, 2001; Perloff, 1993). Fazio and Roskos-Ewoldsen (2005) found that the five conditions presented below contribute to the link between attitudes and behaviour. These conditions partly explain the discrepancies between stated environmental concern and observed behaviour which is mentioned in a number of studies (e.g., Do Valle et al., 2005; Gagnon Thompson and Barton, 1994; Nordlund and Garvill, 2002; Prakash, 2002; Smith and Haugtvedt, 1995):

- Attitudes better predict behaviour when they are measured at the same level of specificity as behaviour (e.g., measuring generalised attitudes to predict generalised behaviours).
- People who tend to be guided by their feelings when making decisions instead of being guided by external (situational) factors and signals, tend to exhibit more attitude-behaviour consistency. This concept relates to the personality dimension of self-monitoring according to which people may be either high self-monitors (i.e., they monitor the impression they make on others and adjust their behaviour accordingly) or low self-monitors (i.e., they do not pay particular attention to what others expect of them but instead decide based on how they feel and what they believe).
- Social norms, which are beliefs about how one is to behave according to other people's expectations, may prevent attitudes from influencing behaviour.
- When a decision has to be reached rather fast, time pressure assists in making people act according to their attitudes. This happens because there is no time to carefully examine all relevant information and, therefore, people tend to use their existing attitudes to decide.

- Attitudes that have greater accessibility (i.e., they come easily to one's mind) tend to better predict behaviour. When attitudes are generated by direct experience with the psychological object, they are generally more accessible (and, therefore, better at predicting behaviour) compared to attitudes generated by indirect experience (e.g., from a friend's description of a psychological object).

Attitudes can exist and be measured at a general or specific level. As mentioned in the previous section, general attitudes are worldviews (for example, attitudes about the environment in general that are not related to any particular environmental behaviour) while specific attitudes are those evaluating a particular psychological object (for example, recycling). Comparing measurements of two psychological constructs made at different levels of specificity can lead to weak correlations between those constructs (Ajzen, 2005).

Gagnon Thompson and Barton (1994) state that self-transcendence values (presented in the previous section) are related to ecocentric attitudes (i.e., assigning a value to nature for its own sake) while self-enhancement values are quite similar to anthropocentric attitudes (i.e., assigning a value to nature because of the benefits it provides to human beings) and they found an association of ecocentric attitudes with pro-environmental behaviour (both self-reported and observed). However, studies showed that anthropocentric attitudes may not necessarily result in pro-environmental behaviour (Gagnon Thompson and Barton, 1994; Schultz et al, 2000). This categorization between ecocentric and anthropocentric attitudes results from the basic distinction of environmental ethics into human-centered and not human-centered approaches (Elliot, 1995). Individuals with either of the two types of attitudes may express an interest in protecting the environment but for different reasons. People holding self-enhancement values or anthropocentric attitudes want to protect the environment because this can result in a higher quality of life for themselves or for other human beings. People with self-transcendent values or ecocentric attitudes on the other hand see an intrinsic (and terminal) value in nature.

The distinction between anthropocentric and ecocentric attitudes may depend on the evaluation's context (Brown, 1984). Accordingly, more ecocentric attitudes may be expressed in case people feel they represent the whole society or the entire planet when they evaluate the natural environment while more anthropocentric attitudes may be expressed in case people feel they represent only themselves.

2.2.2. Individual variables

Socio-economic and demographic factors (commonly assessed by self-reports) are included in this category and these can vary between individuals living in a particular area. Certain researchers (Blake, 2001; Ewert and Baker, 2001) found that demographic factors do affect environmental concern and action while others (Do Valle et al., 2005) report an unclear or poor relation to environmental behaviour.

A person's economic situation can play a role in environmental actions. For example, income appears to have a positive correlation with recycling behaviour (Schultz et al., 1995). However, Tanner et al. (2004) found no association between income (or social status) and environmental behaviour related to food purchasing although they mention that money becomes more important in high-cost behaviours.

Gender has also been found to influence behaviour. Existing studies show that women have more concern about the environment compared to men (Blake, 2001) although gender was not found to be a predictor of recycling (Schultz et al., 1995).

Schultz et al. (1995) state that the relationship between age and recycling is unclear while they suggest that high levels of education might be positively correlated to recycling. Ewert and Baker (2001) report a relationship between academic major and environmental beliefs and attitudes. They found that business administration and forestry students had higher anthropocentric and lower pro-environmental scores. Another finding from this study was that female and older students had higher levels of environmental concern.

Household size (i.e., number of people in the house) and the residential environment (i.e., urban vs. rural) was found to be associated with environmental behaviours related to food purchasing (Tanner et al., 2004). However, residential environment did not influence environmental concern in another study (Ewert and Baker, 2001). Environmental values are more likely to lead to behaviour for individuals involved in environmental organizations (Smith and Haugtvedt, 1995).

2.2.3. External variables

This category includes characteristics that generally apply equally to all people living in a particular geographical region and can have an effect on environmental behaviour. External factors include building regulations, influence from other people, or the existence of campaigns to promote environmental behaviour. These factors are normally uncontrollable by individuals (Tanner et al., 2004).

Environmental behaviour may be facilitated or inhibited by external factors. In this way, different geographical regions create different contexts that affect environmental behaviours. Environmental concern and behaviour were found to vary depending on the objectively measured quality of local environmental conditions (Blake, 2001).

Existence of communication strategies may have an effect on environmental action (Do Valle et al., 2005). These are promotional campaigns, mostly run by governmental organizations, with the goal of enhancing environmental behaviour. Do Valle et al. (2005) report that the specific communication strategy they examined (which was publicized through television, radio, newspapers, magazines, and billboards) influenced specific environmental knowledge but not people's beliefs. Smith and Haugtvedt (1995) state that the effectiveness of promotional strategies in changing people's behaviour depends on the reasons (utilitarian vs. normative) individuals may hold their environmental values. For example, people who want to achieve social acceptance may not be persuaded by arguments that focus on the scientifically proven importance of a certain environmental behaviour. These people would more easily change their behaviour if others were doing the same.

Certain external factors have been manipulated by studies carried out by Schultz et al. (1995) and were found to be successful in promoting recycling behaviour. These factors include:

- Promotional campaigns (where information concerning environmental behaviour is presented to people)
- Commitment (where people express their commitment to a certain behaviour by signing a pledge)
- Normative influence (where a few people initiate a certain behaviour and then try to convince other members of their community to follow)
- Removal of barriers to pro-environmental behaviour (i.e., reducing inconvenience)
- Goal-setting by communities to motivate individuals to act
- Informing people of a consequence (such as a reward or a punishment) of a particular behaviour

Regarding two of the abovementioned external factors (i.e., normative influence and feedback), Hamid and Cheng (1995) found that normative influence only had a small effect on predicting antipollution behavioural intentions while Schultz et al. (1995) mention that providing people with feedback concerning their behaviour led to a decrease in energy and water consumption by 10%-15%. Prior experiences with a specific behaviour may also influence it as the next section discusses.

2.2.4. Prior behavioural experience

Prior experiences with a particular behaviour are described separately from other factors that affect behaviour because they cannot be included in any of the aforementioned categories. Results are mixed. According to Ajzen (1991), prior experiences with a specific behaviour (either personal or from relatives and acquaintances) influence an individual's perceived level of difficulty of performing that behaviour in the future. Successful experiences with a given behaviour provide validation that the individual can efficiently perform a given behaviour and enhance beliefs of control over the behaviour while unsuccessful experiences have the opposite effect (Bandura, 1991).

Barr (2007) found only a minor effect of prior experience with recycling on performing that behaviour. However, Hamid and Cheng (1995) report that prior antipollution behaviour could predict both future behavioural intentions and behaviour.

2.2.5. Interactions among factors

Except for evaluating the effect each individual factor may have on behaviour, it is also important to consider the interactions among these factors on environmental behaviour (Corraliza and Berenguer, 2000; Schultz et al., 1995). An interaction is present when the effect of a predictor variable on the outcome varies depending on the values of another variable (called moderator variable) (Jaccard, 2001). For example, when studying adoption of environmental behaviour, if environmental concern (or generalised attitudes about the natural environment) interacts with one's financial condition (i.e., income level) and assuming a positive relationship between concern and adoption of environmental behaviour, although people may engage more in environmental behaviour as concern becomes greater, the enhancement in behavioural engagement will be greater for people with a high income. In this example, environmental concern is the dependent variable, financial condition is the moderator variable, and adoption of environmental behaviour is the outcome variable.

Joireman et al. (2001) report a significant interaction between one's value orientation (i.e., self-enhancement vs. self-transcendence) and perceived consequences for the biosphere (i.e., a measure of generalised environmental attitudes) on environmental behaviour intentions. Specifically, they found that people with self-enhancement value orientations exhibited a stronger relationship between generalised environmental attitudes and behaviour intentions. In another study, Meinhold and Malkus (2005) discovered that knowledge level of environmental issues interacted with generalised attitudes on behaviour with those subjects scoring high on environmental knowledge demonstrating a stronger relationship between attitudes and behaviour. Finally, Zelezny et al. (2000) suggest testing for interactions between age and gender on environmental behaviour.

Corraliza and Berenguer (2000) studied interactions from a different perspective. They found that when consistency between internal and external (or contextual) variables is high, then internal variables are more likely to predict behaviour. High consistency occurs in two situations: either when both internal and external variables facilitate the behaviour or when both internal and external variables are unfavourable towards a particular behaviour.

After providing a description of the different categories of factors that influence behaviour, the following section deals with theoretical models that combine these factors to explain behaviour. Two popular environmental behaviour models are presented.

2.3. Environmental behaviour models

The various factors that affect environmental behaviour can be linked together in rather complicated ways that different studies have attempted to disentangle with varying degrees of success (e.g., Barr, 2007; Do Valle et al., 2005; Gatersleben et al., 2002; Hallin, 1995; Oskamp et al., 1991; Poortinga et al., 2004; Schultz and Zelezny, 1998). Two popular theoretical models that attempt to understand and predict environmental behaviour are described in the following sections. These include the theory of planned behaviour (Ajzen, 1991) and the causal model of environmental concern (Stern et al., 1995).

2.3.1. The theory of planned behaviour

A prominent way to systematise the ways human behaviour determinants produce their effect on behaviour and one of the foundations for developing an environmental behaviour model for this study has been the theory of planned behaviour (Ajzen, 1991). This theory was created to explain and predict human behaviour and it is an extension of the theory of reasoned action (Fishbein and Ajzen, 1975). The more recent description of the theory of planned behaviour (Ajzen, 1991) was used in this study instead of the original version (Ajzen, 1985). This theory is well accepted in the field of environmental behaviour and has received empirical support (Do Valle et al., 2005; Oreg and Katz-Gerro, 2006; Taylor and Todd,

1995, 1997) although certain researchers have found it somewhat inadequate to fully explain behaviour (Boldero, 1995; Cheung et al. 1999; Sparks and Shepherd, 1992).

The theory of planned behaviour (Ajzen, 1991) posits that performing a particular behaviour depends on the presence of intentions (or motivation) and perceived behavioural control (i.e., confidence in one's ability to perform the behaviour). Ajzen (1991) states that intentions are determined by specific attitudes towards the behaviour, subjective or social norms (i.e., influence from other people with respect to performing a given behaviour), and perceived behavioural control (Figure 1). Perceived behavioural control reflects personal judgements (beliefs) about one's ability to perform a behaviour and is specific to a particular behaviour (i.e., it is not a general predisposition that is unchanged across behaviours and situations). Perceived behavioural control depends on personal beliefs about the availability of resources and opportunities and the existence of obstacles to perform a given behaviour. Such beliefs are formed by past experience with the behaviour, relevant external information, experiences of friends and relatives, and other factors (Ajzen, 1991). The addition of perceived behavioural control is what distinguishes the theory of planned behaviour (Ajzen, 1991) from the theory of reasoned action (Fishbein and Ajzen, 1975).

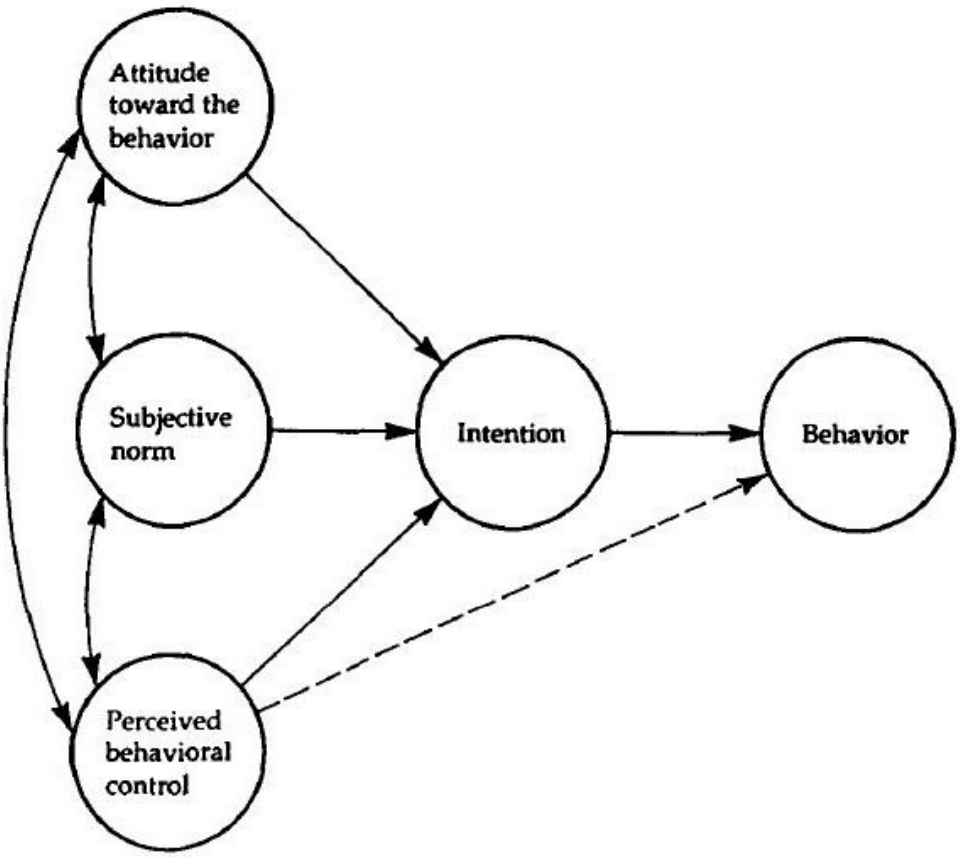

Figure 1. The theory of planned behaviour (source: Ajzen, 1991)

However, the theory of planned behaviour (Ajzen, 1991) does not directly address the issue of one's actual (as distinct from perceived) control to perform a specific behaviour. External factors and events may interfere and modify intentions or perceived behavioural control to the extent that it becomes unfeasible to predict behaviour based on intentions and perceived behavioural control alone. In this case, a substantial discrepancy may exist between perceived and actual behavioural control (Ajzen, 1991). Contrary to what the theory of planned behaviour states, Hamid and Cheng (1995) report that perceived behavioural control was not a predictor of behavioural intentions.

Another area of relative weakness of the theory of planned behaviour (Ajzen, 1991) is that it focuses excessively on intentions. Indeed, it is problematic to measure intentions for past actions (Do Valle et al., 2005). Such an approach (i.e., to measure intentions) would be more suitable for a longitudinal study where intentions are measured at one point in time and behaviours are measured at a subsequent point in

time. Furthermore, the theory does not take into account other factors that have been known to affect behaviour, such as personal values (Cameron et al., 1998; Grob, 1995; Karp, 1996; Schultz and Zelezny, 1998; Van Vugt et al., 1995), general attitudes (as distinct from specific ones) (Corral-Verdugo et al., 2008; Grob, 1995; Heberlein and Black, 1976), and demographics (Barr, 2007; Gatersleben et al., 2002; Hallin, 1995; Oskamp et al., 1991; Poortinga et al., 2004; Tanner et al., 2004).

The next section presents the causal model of environmental concern (Stern et al., 1995). This model addresses environmental behaviour from a different perspective by encompassing psychological constructs that may precede specific attitudes and shape them (in contrast to the theory of planned behaviour).

2.3.2. The causal model of environmental concern

The causal model of environmental concern (Stern et al., 1995) not only describes attitudes and behaviour relations, but also incorporates theories of attitude formation. It states that position in the social structure shapes one's psychological characteristics (i.e., personal values and attitudes) and, subsequently, behaviour (Figure 2). The main direction of causation is from top to bottom although the model does not include causal arrows. The reverse direction is also possible. For example, behaviour feedback may have an effect on future attitudes. Factors near the top are, in general, more uncontrollable by the individual. Despite the fact that non-adjacent factors can affect each other directly, causation is stronger between adjacent factors.

New information is filtered through personal values and general attitudes so that the more this information is in line with these two constructs the higher the likelihood that the information will influence specific attitudes. Personal values are considered antecedents of attitudes because they are formed earlier in one's life (i.e., from one's family environment), they are more general concepts than attitudes, and they are considered more stable throughout one's life (Stern et al., 1995).

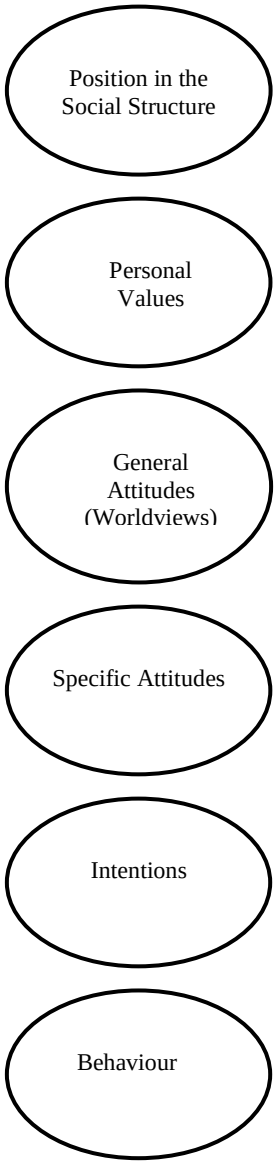

Figure 2. The causal model of environmental concern (adapted from Stern et al., 1995)

Heberlein and Black (1976) suggest that models that predict behaviour should include general attitudes (which are included in the causal model of environmental concern but not in the theory of planned behaviour). They state that although specific attitudes are better at predicting[3] a given behaviour than general attitudes, both types of attitudes have to be included in a model that predicts behaviour to show the links among the different types of attitudes and behaviour in more detail and to render the model

[3] Empirically they result in higher correlations.

applicable to a variety of behaviours. Empirical support for the causal model of environmental concern has been reported (Do Valle et al., 2005; Stern et al., 1995).

2.4. Promotion of environmental practices and behavioural change

Up to this point, this chapter has dealt with ways to systematise and understand human behaviour. However, to effectively implement such an understanding to achieve behavioural change and increase adoption of environmental practices, consideration of relevant theories is important. The theories described in the present section include the elaboration likelihood model (Petty and Cacioppo, 1986) and the theory of diffusion of innovations (Rogers, 1995).

According to relevant literature (and as described earlier in this chapter), two central concepts in understanding and possibly manipulating human behaviour are personal values and attitudes. Attempting to change behaviour by changing one's personal values, although promising, is considered to involve an enormous undertaking given the enduring nature of values compared to attitudes (Reardon, 1991). For this reason, a popular persuasion theory (i.e., the elaboration likelihood model) where the concept of attitude is a vital component was considered for this project. This theory is largely based on the fact that attitudes are associated with behaviour and, consequently, changes in one's attitudes are expected to produce changes in one's behaviours (Gass and Seiter, 2004). To complement that theory, concepts from Rogers' diffusion of innovations theory (1995) were also employed in addressing the issue of enhancing adoption of environmental housing practices.

2.4.1. The elaboration likelihood model

The theory of the elaboration likelihood model (ELM) describes the principal ways in which persuasion is affected by a variety of factors (Petty and Cacioppo, 1986). A brief presentation of this theory is given below.

According to the ELM, there are two ways through which persuasion can take place (Petty and Cacioppo, 1986). One is through peripheral processing and the other is through central processing. During peripheral processing, the individual does not carefully process a persuasive message's contents but instead bases his/her evaluation of the message on superficial signs, such as simple heuristics (e.g., expensive items are of better quality), contextual factors (e.g., surrounding atmosphere), or message characteristics unrelated to its content (e.g., number of arguments given, irrespective of the quality of those arguments). Peripheral processing occurs when either motivation or ability to process information is obstructed. However, central processing takes place when both motivation and ability are present to a high degree. During central processing, the persuasive message receiver scrutinises (elaborates on) the message's contents and the facts presented before forming any judgments.

A factor that contributes to the occurrence of central processing (as distinct from peripheral processing) is personal involvement with the issue the message communicates (Petty and Cacioppo, 1986; 1990). This may happen when the message issue is linked to constructs related to one's self (e.g., personal values) and/or people or objects important to that person. Personal involvement results in a higher level of motivation to process information. Another factor affecting one's motivation to process a message's information can be whether one feels personally responsible about assessing an issue (as distinct from feeling that he/she shares responsibility with other people) (Petty and Cacioppo, 1986).

Factors affecting one's ability to process information from a message can be the presence of distractions that may prevent one from thinking, the complexity of the message, and prior knowledge about the issue (Petty and Cacioppo, 1986). Regarding prior knowledge, when one receives a persuasive message that is consistent with one's attitudes (that were formed based on prior knowledge) about the message's issue, he/she will tend to process the message in a supporting way while if the message is inconsistent with one's attitudes, he/she will provide opposing arguments.

In a situation where moderate elaboration occurs (for example, when motivation to process information is high but ability is low), information processing may be performed through a mixing of the two ways (i.e., central and peripheral) (Petty and Cacioppo, 1986).

The two different ways of processing a persuasive message can result in different types of attitudes. Attitudes formed after elaborate information processing tend to be more resistant to change, longer-lasting, and better at predicting and guiding behaviour (Boninger et al., 1995; Petty and Cacioppo, 1986).

2.4.2. The theory of diffusion of innovations

The theory of diffusion of innovations (Rogers, 1995) attempts to explain how new concepts spread over time within a social system and describes the factors that influence the speed of adoption of these concepts. Rogers (1995) defines diffusion as "the process by which an innovation is communicated through certain channels over time among the members of a social system" and offers four principal elements of the diffusion process:

- The innovation
- Communication channels
- The element of time
- The social system where the innovation is diffused

The innovation can be a physical object, a practice, or an idea that is perceived as new by units of adoption (e.g., an individual or an organisation). Perceptions that something is new may vary between countries and within countries (Chigona and Licker, 2008). In many situations, an innovation consists of a hardware component (i.e., the physical object) and a software one (i.e., relevant knowledge about the physical object). There are five characteristics of innovations (Rogers, 1995) that may influence their rate of adoption:

- Relative advantage (i.e., perceptions about the degree to which a new concept is better in terms of factors such as cost, convenience, pleasure, or prestige)
- Compatibility (i.e., perceptions about the degree to which a new concept is consistent with personal values, needs, and prior experiences of adopter units)
- Complexity (i.e., perceptions about the degree to which a new concept is difficult to comprehend and use)
- Trialability (i.e., the degree to which units of adoption can experiment with a new concept on a trial basis)
- Observability (i.e., the degree to which a new concept's results can be seen)

Innovations that are perceived as having a relative advantage over older concepts, are compatible with adopters' needs, values, and experiences, are not complex, are trialable, and have visible results tend to be adopted faster (Rogers, 1995).

Communication channels are the instruments through which information related to an innovation is exchanged between units of adoption that are knowledgeable about this innovation and units of adoption that are not knowledgeable about it. Mass media communication channels (e.g., television or newspapers) are efficient in rapidly informing potential adopters about the existence of an innovation. However, interpersonal channels (i.e., face-to-face exchange) are more effective in facilitating persuasion (Rogers, 1995). Communication among individuals from a distance (e.g., by telephone or audio-conferencing) can be effective at both raising awareness about an innovation and persuading people to adopt it (Mark and Poltrock, 2001). During interpersonal communication, the scientific merits of an innovation mostly play a role at the early stages of adoption. At later stages, people tend to become influenced by the relevant experiences of people similar to them in terms of attributes such as personal values, education, or social status (Rogers, 1995).

The element of time is involved in the temporal phases through which a unit of adoption passes to reach a decision about a new concept. This decision making process starts from the point in time when some first knowledge about an innovation is acquired and is followed by the formation of a favourable or unfavourable attitude toward the innovation. It continues with reaching a decision to adopt or to reject the innovation and finally involves the implementation of the innovation and the confirmation that the innovation is indeed worthy. There can be exceptions to the abovementioned sequence (Rogers, 1995).

Time is also involved in the rate of adoption of an innovation. Members of a social system can be classified according to the degree to which they are early (or late) to adopt an innovation relative to other members of that social system. As many as five such adopter categories have been suggested (Rogers, 1995). These are in descending order of degree of innovation adoption: innovators, early adopters, early majority, late majority, and laggards. An S-shaped curve describes the relationship between the number of individuals in a social system adopting an innovation (specifically, the cumulative frequency of adopters) and time (Figure 3). The curve's slope is expected to vary among different innovations and different social systems.

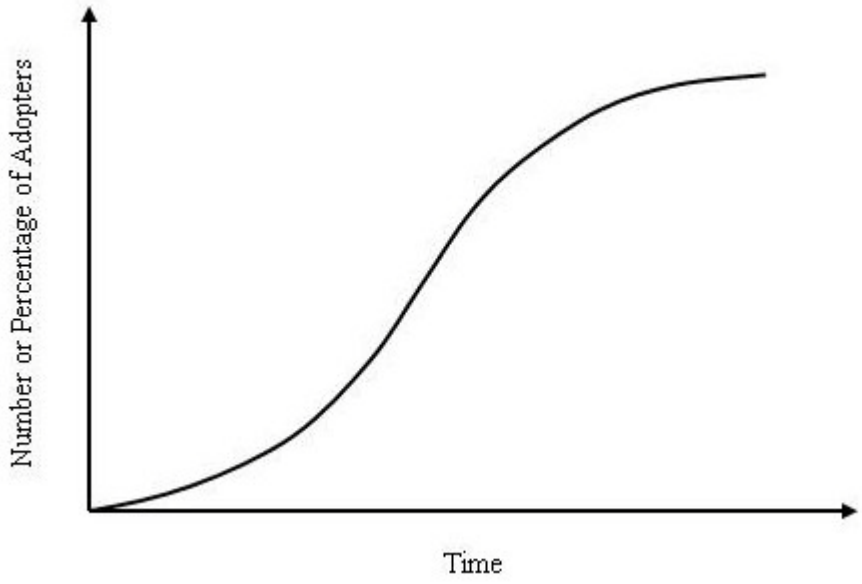

Figure 3. Relationship between number or percentage of adopters and time (adapted from Rogers, 1995)

Diffusion of innovations happens within a social system which is composed of members (individuals or groups of individuals) that attempt to achieve a common purpose by collectively approaching existing problems and issues. Diffusion of innovations is influenced by a system's social structure, social norms (i.e., influence from other people within the system), and the roles of opinion leaders (i.e., members of a social system that exert substantial influence over the attitudes and behaviours of other system members) and change agents (i.e., professionals who represent a change agency that is external to the social system). Change agents may utilize opinion leaders to facilitate diffusion (Rogers, 1995).

The theory of diffusion of innovations has been applied to a variety of products, services, and processes, such as food items and cooking utensils (Ostlund, 1974), communal computing facilities (Chigona and Licker, 2008), instructional computer use by the faculty members of a college (Sahin and Thompson, 2006), and energy-conserving processes and products for houses (Darley and Beniger, 1981).

2.5. Problem statement and objectives

As explained earlier in this chapter, the environmental impacts of buildings around the world are a cause for concern. The current situation in Canada is challenging and various issues exist. For example, the country is under increasing pressure to reduce its energy consumption and the residential sector is of importance as it accounts for approximately 20% of the end-use energy consumption (Fung et al., 2001). Regarding water issues, although Canada was ranked second best (with Italy being the best) in terms of its water quality among the leading industrialized countries (i.e., Canada, France, Germany, Italy, Japan, Russia, the United Kingdom, and the United States) (Environment Canada, 2009a), issues such as urban and suburban development or household behaviour are among the factors that are currently putting pressure to the freshwater quality (Environment Canada, 2009b).

Another example of environmental challenges for Canada is the fact that household solid waste across Canada reached 12 million tonnes or 383 kg per capita in 2002, which amounts to 4.9% more per capita than in 2000 (Statistics Canada, 2005). In terms of land pollution, tens of thousands of contaminated sites have been identified across Canada (Environment Canada, 2009c).

Minimising housing impacts on the environment requires the co-operation of residents who have to adopt appropriate practices. However, individuals may act in seemingly irrational ways and they do not always adopt the most suitable behaviours to reduce impacts from their housing activities (Abreu et al., 2008). Even people who feel concerned about the environment may not take appropriate actions to protect it (Do Valle et al., 2005; Gagnon Thompson and Barton, 1994; Nordlund and Garvill, 2002; Prakash, 2002; Smith and Haugtvedt, 1995). Therefore, understanding human behaviour in the context of environmental housing activities is necessary to efficiently implement existing solutions that can minimise environmental impacts.

The existing literature related to human behaviour and environmental housing has focused generally on either recycling, which is a single behaviour (e.g., Boldero, 1995; Cheung et al., 1999; Do Valle et al.,

2005; Gamba and Oskamp, 1994; Guerin et al., 2001; Knussen and Yule, 2008; Oskamp et al., 1991; Schultz et al., 1995; Vining and Ebreo, 1992) or groups of related behaviours, such as those leading to energy conservation (e.g., Brandon and Lewis, 1999; Darley and Beniger, 1981; McMakin et al., 2002; Poortinga et al., 2004), behaviours leading to water conservation (e.g., Corral-Verdugo et al., 2008; Domene and Saurí, 2006), behaviours leading to improved waste management (e.g., Barr, 2007; Taylor and Todd, 1995), and behaviours leading to the reduced use of toxic household products (e.g., Werner, 2003). There are insufficient studies that evaluate the overall impacts of domestic practices with the exception (in Canada) of the Households and the Environment Survey that assesses all the main categories of environmental housing behaviours (including energy conservation, water conservation, waste management, and use of toxic materials) (Statistics Canada, 2009a). This survey is conducted biennially and although it is relatively thorough, it does not assess certain important behaviours (e.g., washing laundry in cold water) and does not, in general, examine factors (such as personal values or perceptions of familiarity with and importance of behaviours) that may affect adoption of behaviours.

The existing theoretical models to explain environmental behaviour that were presented earlier were developed to either describe environmental behaviour in general (such as the causal model of environmental concern from Stern et al., 1995) or more broadly understand human behaviour (such as the theory of planned behaviour from Ajzen, 1991). Although these models can be applied to housing practices, they are not specific to them. Therefore, a theoretical model developed and validated using data from housing behaviours could be more relevant in illuminating characteristics regarding that particular important area.

To address the current situation, the present study was conducted and it attempted to deal with the issue in a holistic way. Initially, a broad understanding of the current situation regarding the adoption of environmental housing behaviours in Canada was pursued. This focused on the main areas of environmental housing behaviour, namely: energy conservation, water conservation, waste management and reduction, and use and reduction of toxic materials. Subsequently, the study identified determinants

of environmental behaviour that were later combined together in a theoretical model to provide insights about how they work collectively. Finally, it suggested appropriate ways to increase adoption of environmental housing behaviours to the general public so as to utilise findings.

Specifically, there were four objectives for the present study. These are given below:

1. To ascertain the current situation regarding the adoption of environmental housing behaviours in Canada by house inhabitants.
2. To identify the internal, individual, and external factors that are significant predictors of environmental behaviours of house inhabitants related to environmental housing practices. This includes possible interactions between factors.
3. To develop a theoretical model to explain environmental behaviour of house inhabitants based on existing related models. The new model would be specific to housing practices in contrast to existing models that are generic about environmental behaviour.
4. To propose suitable methods for enhancing the adoption of environmental housing behaviours to the general public.

Results from the present study could better enable policy makers in deciding on the best available courses of action to mitigate housing impacts. Findings could also assist researchers in understanding the main drivers of human behaviour in relation to environmental housing practices and in identifying efficient ways to enhance adoption of these practices. Moreover, it is hoped that the general public could benefit by acquiring a cleaner and more healthful environment.

2.6. Summary

This chapter presented why and how human behaviour needs to be studied to reduce environmental housing impacts. The importance of the Canadian residential sector as a source of environmental degradation was presented. In addition, various characteristics of environmental behaviour as well as

theoretical models that attempt to explain it or can be used to enhance adoption of environmental practices were introduced. The importance of human behaviour and the insufficient level of current knowledge regarding environmental housing practices led to the present study. Its main objectives are to ascertain the current adoption levels of environmental housing behaviours in Canada, to identify factors that are significant predictors of environmental housing behaviours, to develop a theoretical model to explain environmental behaviour of house inhabitants, and to suggest methods for enhancing adoption of environmental housing behaviours among the general public. The specific methodologies employed to meet the study's objectives are presented in the following chapter.

3. METHODOLOGY

To fulfill the study's objectives, an extensive literature review was first conducted. Based on that understanding, a questionnaire was developed to collect primary data from house inhabitants from all Canadian Provinces and Territories. Subsequently, these data were analysed with various methods to provide an understanding of environmental behaviour of house inhabitants in Canada.

This chapter begins with a description of the population under investigation by this study followed by a presentation of the questionnaire and cover letters used to collect data. Information on the approval obtained by the Behavioural Research Ethics Board of The University of British Columbia to proceed with data collection is provided.

Data analysis follows with reliability and validity considerations for scales used in the questionnaire as well as the procedure employed to develop an environmental behaviour model based on existing relevant theories. The chapter ends with a presentation of the techniques used in this study; logistic regression, partial correlation, and cross-tabulation. Specifically, logistic regression was employed to identify predictor variables for environmental behaviours and to validate the environmental behaviour model that was developed. Partial correlation analysis enabled a better understanding of the links among the factors in the environmental behaviour model while the cross-tabulation analysis (between predictor variables and outcome behaviours in the environmental behaviour model) assisted in evaluating the importance of interventions to enhance adoption of environmental behaviours by modifying predictor variables.

3.1. Population of the study

The study aimed to understand environmental behaviour of Canadians relative to housing practices. A random sample of 5,000 Canadians 19 years or older from all Provinces and Territories was considered appropriate to provide the required data. The sample of 5,000 addresses was the largest possible based on considerations of expected response rates and funding limitations.

A surplus was included in the initial address purchase in case of unacceptably low response rates after the first 5,000 subjects had been contacted. Consequently, 10,180 addresses of Canadians 19 years or older were purchased from a commercial provider. From these addresses, 5,000 were randomly selected for contact. Care was taken to approximate the actual population distribution per Province or Territory in the sample. Table 1 shows the distribution of respondents per Province or Territory.

Table 1. Number of people contacted per Province or Territory

Province or Territory	Number of people contacted	Percentage of surveys mailed	Actual percentage in 2007*
Alberta	668	13.4%	10.7%
British Columbia	655	13.1%	13.1%
Manitoba	178	3.6%	3.6%
New Brunswick	91	1.8%	2.3%
Newfoundland and Labrador	66	1.3%	1.5%
Nova Scotia	148	3.0%	2.8%
Northwest Territories	21	0.4%	0.1%
Nunavut	2	<0.1%	0.1%
Ontario	1,848	37.0%	38.9%
Prince Edward Island	18	0.4%	0.4%
Quebec	1,122	22.4%	23.3%
Saskatchewan	158	3.2%	3.0%
Yukon	25	0.5%	0.1%
Total	5,000	100.0%	100.0%

* Source: Statistics Canada, 2009b.

The list of all these 10,180 addresses/households was the sample frame, which represented the population of the survey (Dillman, 2000). The next section offers information on the design of the survey.

3.2. Design of the survey

The principles of the Tailored Design Method (Dillman, 2000) for conducting surveys were followed as much as possible. The following sections present information on the questionnaire and cover letters used for the mail survey as well as the approval obtained by the Behavioural Research Ethics Board of The University of British Columbia to proceed with data collection.

3.2.1. Questionnaire

Considerable efforts were made to create the best possible questionnaire to collect required information to achieve the study's objectives although it is stated that no questionnaire can ever be flawless (Rea and Parker, 1997). There were numerous iterations during the development of the questionnaire. Before the design was finalised, acknowledged experts in survey design from The University of British Columbia, as well as colleagues, reviewed the questionnaire to improve issues such as individual question content and wording, questionnaire structure relevant to the study's objectives, minimisation of respondents' burden, formatting and layout, and flow between sections or questions.

After the English version of the questionnaire was completed (Appendix B), the questionnaire was translated into French language for use in the Province of Quebec by a team of two researchers that were native speakers of French. The French version of the questionnaire and the three cover letters (described in the next section) are available upon request from the researcher.

The questionnaire was divided into six sections. These are presented below:

1. **Section A:** This section collected information about variables hypothesised to be predictors of environmental behaviours. These could be either internal (e.g., personal values) or external (e.g., awareness of media environmental campaigns) factors. There were three standardised scales (all of them commonly accepted in the study of environmental behaviour) used in this section including:

    1. The Brief Inventory of Values scale (question A9) to measure self-transcendence, self-enhancement, conservation, and openness to change values (Stern et al., 1998)
    2. The Postmaterialism Index scale (question A10) to measure post materialist and materialist values (Blake, 2001)

3. The New Environmental Paradigm (NEP) scale (question A11) to identify generalised environmental attitudes (Dunlap and Van Liere, 1978)

2. **Sections B, C, D, and E:** These sections focused on individual behaviours identified as having the potential to reduce housing impacts on the environment mostly by examination of environmental assessment systems for buildings. These four sections were designed to uncover information about familiarity with specific behaviours, attitudes identifiable with these behaviours (as assessed by their perceived personal importance), and whether respondents had adopted the behaviours or not. These sections differed in the category of respondents they addressed and the individual behaviours measured were modified accordingly. Section B addressed house owners, section C addressed house renters, section D addressed people having renovated their house within the past twelve months from the time of the survey, and section E addressed people having either built or purchased a house within the past twelve months from the time of the survey. Thus, some respondents could fill in more than one section but no more than three sections. Familiarity with and perceived personal importance of specific behaviours were included as potential predictors of environmental behaviours.

   The environmental behaviours in sections B, C, D, and E belonged to four broad categories: energy efficiency, water efficiency, minimizing waste materials, and protecting surrounding ecosystems (mostly by reducing use of toxic materials). These categories were also used in parts of section A.

3. **Section F:** This section contained the demographic questions. They were included in the questionnaire to both provide profiling information for the survey participants and test whether they were associated with environmental behaviours. There was a question in section F attempting to identify the usefulness of various methods (e.g., through magazines or radio programs) for finding information about green building/housing practices. This knowledge could

assist in suggesting suitable ways for the diffusion of green housing practices among the general public.

As recommended by Dillman (2000) and Fink (1995), the questionnaire was written in a simplified language to render it easily understandable by respondents and avoid item non-response. Its size did not exceed eight pages for the English version and ten pages for the French version and respondents did not have to complete all of the pages. There was only one open-ended question included in the questionnaire because this type of questions can be difficult for respondents to interpret and it is recommended to minimise their use (Czaja and Blair, 1996). Certain questions (e.g., those in sections C, D, and E) gathered information that was not directly relevant to this study's specific objectives and was not used in data analyses. Cover letters accompanying the questionnaire are described in the section below.

3.2.2. Cover letters

Three cover letters (Appendix C) were prepared to accompany the questionnaire with one for each of the three mailings. Cover letters used The University of British Columbia letterhead and emphasized the importance of the study in terms of minimising housing environmental impacts. Since there was no identifiable information on the questionnaire, the first cover letter requested the participants' name and address in case they required a free summary of the results.

The first cover letter included information on the title of the project, the research organization (The University of British Columbia), the selection process for subjects (5,000 people across Canada), the voluntary nature of the study, instructions for participating in the survey, a confidentiality commitment, and ways to contact the researchers.

The second cover letter acted as a reminder and it thanked subjects who had already participated in the survey while encouraging non-respondents to participate by stressing the importance of collecting

opinions from a sample that would accurately reflect Canadian households. It also offered instructions on how to receive a replacement questionnaire copy in case it was needed.

The third and final cover letter also acted as a reminder and thanked those subjects who had already participated in the survey while encouraging non-respondents to participate. It informed subjects that a replacement questionnaire copy was included in case it was needed. Prior to the first mailing, approval from the Behavioural Research Ethics Board of The University of British Columbia was obtained.

3.2.3. Approval from Behavioural Research Ethics Board

A Certificate of Approval of the project was issued by the Behavioural Research Ethics Board of The University of British Columbia on May 22, 2007 (Appendix D). The Certificate stated that the application for ethical review and the documents submitted (English and French questionnaires and cover letters) had been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects. The next section describes the methodology of the data analysis.

3.3. Data analysis

Once primary data were collected from the mail survey, they were analysed using both descriptive and inferential statistics. The kind of data (i.e., data on a ratio, ordinal, or nominal scale) and the study's objectives guided the selection of the most suitable analyses. Microsoft Office Excel 2003, SPSS Statistics GradPack 17.0 for Windows, and Dev-C++ Version 4.9.9.2 (Integrated Development Environment for the C++ Programming Language) were the software applications used to perform the statistical analyses.

The section below deals with issues pertaining to reliability and validity. The remainder of the chapter presents the development of a model to explain environmental behaviour as well as the techniques of logistic regression, partial correlation, and cross-tabulations that were used during data analysis.

3.3.1. Reliability and validity considerations

The following sections discuss reliability and validity considerations for the three standardised scales used as well as for the specific attitudes scale included in section B of the questionnaire. The standardised scales are:

- The Brief Inventory of Values scale (question A9. of the questionnaire) (Stern et al., 1998)
- The Postmaterialism Index scale (question A10. of the questionnaire) (Blake, 2001)
- The New Environmental Paradigm (NEP) scale (question A11. of the questionnaire) (Dunlap and Van Liere, 1978)

Assessment of reliability and validity is important as it provides evidence of quality of a study's results (Seale, 2004). Presentation of these issues starts with internal consistency reliability.

3.3.1.1. Internal consistency reliability

Reliability of a research measurement tool refers to its potential to produce consistent results every time it is used on the same population (Seale, 2004). In the case of using standardised tests, it is important to assess the reliability of scores they provide every time they are used even though they have been already tested for reliability by the researchers who first created them. This is because reliability depends not only on the scale used, but also on the sample of respondents that use the scale (Caruso, 2000; Dawis, 1987; Yin and Fan, 2000).

A commonly assessed form of reliability that can be calculated from cross-sectional data (the approach followed in this study) is internal consistency reliability (Streiner, 2003; Yin and Fan, 2000). This depends on the extent to which various items of a measurement tool (e.g., a psychological standardised scale) are related and whether all of these items measure an underlying common dimension that is not directly observable (i.e., the unidimensionality of a scale) (Hulin et al., 2001).

Hulin et al. (2001) recommend a two step approach to assess internal consistency reliability which starts with a factor analysis to reveal the number of underlying common dimensions in the scale followed by an estimation of Cronbach's coefficient alpha. Although Cronbach's coefficient alpha (Cronbach, 1951) is a popular measure of internal consistency, it alone cannot show the number of underlying dimensions but rather only illustrate the extent to which various items of a scale are related (Hulin et al., 2001).

There are no absolute statistical criteria for determining a minimum acceptable value for alpha and different researchers recommend different values. In general, alpha values above 0.8 are considered good while values above 0.7 are acceptable (Gliem and Gliem, 2003). However, for scales measuring psychological constructs even values below 0.7 can be accepted (Field, 2005).

3.3.1.2. Convergent and discriminant validity

The operating performance of a research measurement tool can be assessed against suitable and established indicators (criteria). This is known as criterion validity (Seale, 2004). Two aspects of criterion validity (Hojat et al., 2001) were examined in this study: convergent and discriminant validity. Support for presence of convergent validity is provided when different measurement tools of the same construct produce similar results while support for presence of discriminant validity is provided when different measurement tools of different constructs produce dissimilar results (Betz and Gwilliam, 2002; Pitoniak et al., 2002).

Campbell and Fiske (1959) developed a systematic approach (called the multitrait-multimethod matrix) to identify evidence for convergent and discriminant validity based on analysis of correlations of test scores. A requirement of this approach is to employ more than one method and measure more than one trait. Subsequently, a table is created with the correlations of scores of traits measured by different methods. Correlations between scores of a single trait measured by two different methods are called monotrait-heteromethod correlations. Correlations between scores of two different traits measured by two different methods are called heterotrait-heteromethod correlations. Correlations between scores of two different

traits measured with a single method are called heterotrait-monomethod correlations. To identify evidence for convergent and discriminant validity Campbell and Fiske (1959) offer four criteria the first of which provides evidence for convergent validity while the other three provide evidence for discriminant validity. The criteria are presented below:

1. Monotrait-heteromethod correlations must be significantly different from zero and large enough to justify further analyses of validity.
2. Each monotrait-heteromethod correlation should be higher than the heterotrait-heteromethod correlations in its row and column.
3. Monotrait-heteromethod correlations should be higher than heterotrait-monomethod correlations.
4. Heterotrait-monomethod and heterotrait-heteromethod correlations should have the same pattern.

Scores obtained from two standardised scales each measuring two traits were used to employ the multitrait-multimethod matrix approach so as to identify evidence for convergent and discriminant validity. The traits used were self-transcendence and self-enhancement values from the Brief Inventory of Values scale (Stern et al., 1998) and post materialist and materialist values from the Postmaterialism Index scale (Blake, 2001). It was assumed that the traits self-transcendence values and post materialist values are similar to a considerable extent as they are both related to environmental protection and social justice issues while self-enhancement values and materialist values were assumed to be rather similar since they are related to economic prosperity (Blake, 2001; Inglehart, 1995; Inglehart and Abramson, 1999; Schwartz, 1994; Stern et al., 1998).

3.3.2. Development of an environmental behaviour model

A theoretical model to explain environmental behaviour of house inhabitants was developed based on existing related models. Development proceeded in three steps:

1. Development of a theoretical model (presented in section 3.3.2.1.) based primarily on the theory of planned behaviour (Ajzen, 1991) and the causal model of environmental concern (Stern et al., 1995).
2. Development of an operational model (presented in section 3.3.2.2.) based on the theoretical model. The operational model would be able to accept as inputs data collected from the survey (since the theoretical model included variables taken from the source models that were not measured in the present study).
3. Development of a parsimonious model (presented in sections 4.4.5. and 4.5.) by applying the results of a logistic regression analysis to the operational model followed by an inclusion into the model of results from a partial correlation analysis using survey data.

The next section describes the formulation of the theoretical environmental behaviour model. Links to relevant supporting literature are provided.

3.3.2.1. Development of a theoretical environmental behaviour model

A model to understand and predict environmental behaviour was hypothesised (Figure 4) based predominantly on inputs from the theory of planned behaviour (Ajzen, 1991) and the causal model of environmental concern (Stern et al., 1995). Care was taken to create a model that encompasses, in an as concise as possible way, the main forces that shape behaviour. A description of the theoretical model and its links with existing literature follows.

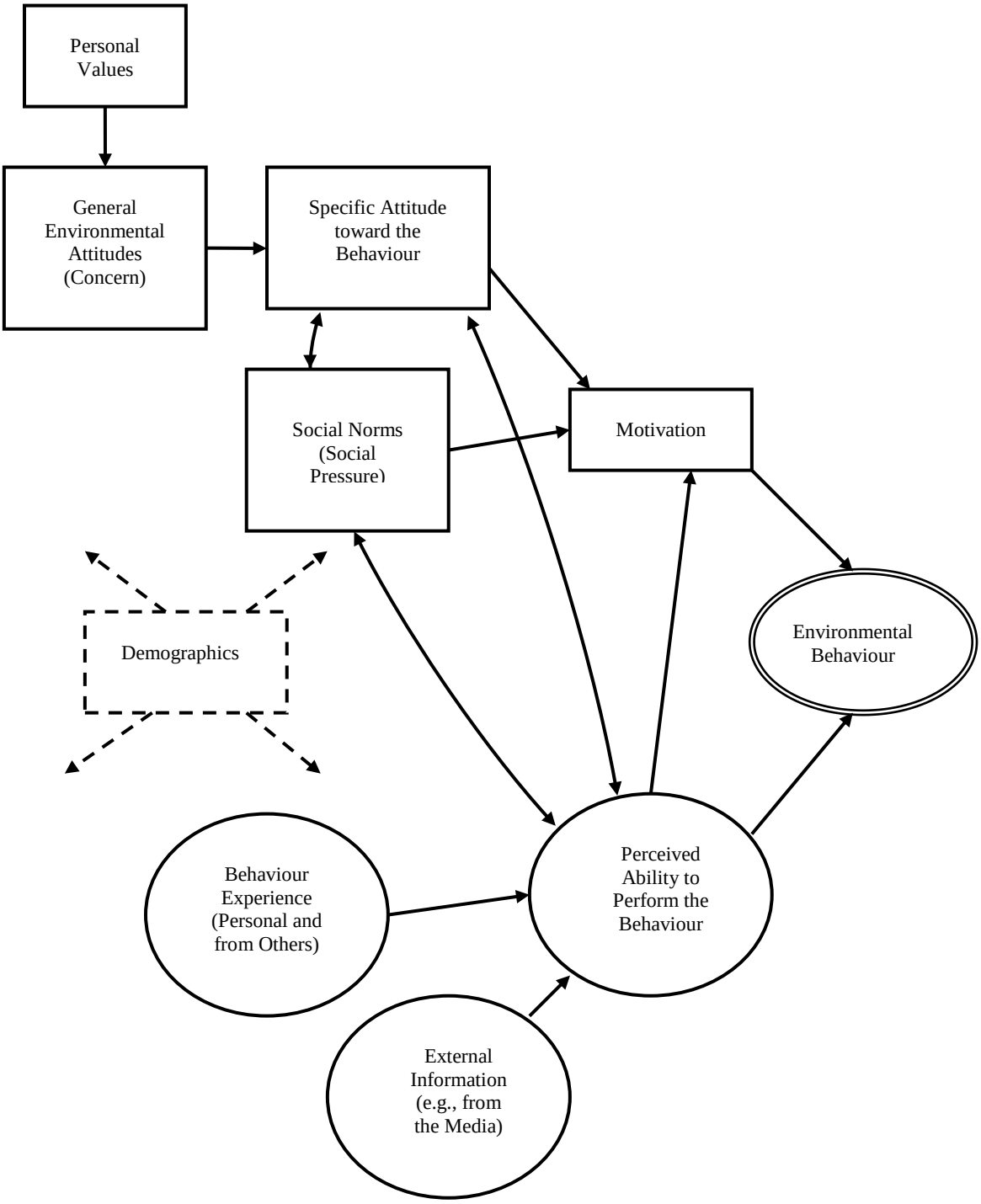

Figure 4. Theoretical model to explain environmental behaviour (developed using inputs primarily from Ajzen, 1991 and Stern et al., 1995)

Note: Factors in single-lined rectangles belong to the motivation path and factors in single-lined ovals belong to the ability path. Demographics are in a dashed-lined rectangle and behaviour in a double-lined oval.

To reach behaviour, this model suggests two main paths that are based on the theory of planned behaviour (Ajzen, 1991) and the causal model of environmental concern (Stern et al., 1995). While based on the literature (see Table 2), the paths also seem to be intuitively logical. One path is through motivation (or intention) (using rectangles in Figure 4) and the other is through ability (using ovals in Figure 4) to perform the behaviour (i.e., how much one is willing and able to perform the behaviour).

Table 2. Supporting literature for variables included in the environmental behaviour model

Model variable	Supporting literature
Personal values	Cameron et al., 1998; Grob, 1995; Karp, 1996; Schultz and Zelezny, 1998; Stern et al., 1995; Van Vugt et al., 1995
General Environmental Attitudes (Concern)	Corral-Verdugo et al., 2008; Grob, 1995; Heberlein and Black, 1976; Stern et al., 1995
Specific attitude toward the behaviour	Dietz and Stern, 1995; Stern et al., 1995; Vining and Ebreo, 1992
Social Norms (Social Pressure)	Ajzen, 1991; Do Valle et al., 2005; Barr, 2007; Vining and Ebreo, 1992
Motivation	Ajzen, 1991; Barr, 2007; Boldero, 1995; Sheppard et al., 1988; Stern et al., 1995; Taylor and Todd, 1997;
Perceived Ability to Perform the Behaviour	Ajzen, 1991; Bandura, 1982; 1991; Bandura et al., 1977
Behaviour Experience (Personal and from Others)	Ajzen, 1991; Bandura, 1991
External Information (e.g., from the Media)	Ajzen, 1991; Do Valle et al., 2005
Demographics	Barr, 2007; Gatersleben et al., 2002; Hallin, 1995; Klineberg et al., 1998; Oskamp et al., 1991; Poortinga et al., 2004; Schultz et al., 1995; Stern, 2000; Tanner et al., 2004

Note: The studies mentioned in the above table do not constitute an exhaustive but rather an indicative list.

Starting with the motivation path, **personal values** and **general attitudes**, that are absent in the theory of planned behaviour (Ajzen, 1991), were incorporated in the model as suggested by Stern et al. (1995). Associations between values or attitudes and **environmental behaviour** are also commonly reported in the literature (Barr, 2007; Blake, 2001; Cameron et l., 1998; Corral-Verdugo et al., 2008; Do Valle et al., 2005; Gagnon Thompson and Barton, 1994; Grob, 1995; Heberlein and Black, 1976; Karp, 1996; Poortinga et al., 2004; Schultz and Zelezny, 1998; Van Vugt et al., 1995).

Personal values are measured at a general level (i.e., not specific to a given behaviour) and they are supposed to shape worldviews or general attitudes (Do Valle et al., 2005; Poortinga et al., 2004; Stern et al., 1995). Of particular interest for this model are general attitudes related to the natural environment. In this study, general environmental attitudes are treated as largely synonymous to environmental concern. At an operational level (e.g., in a questionnaire), essential characteristics of environmental concern can be measured (Poortinga et al., 2004; Stern et al., 1995; Van Liere and Dunlap, 1981) by use of the New Environmental Paradigm scale (Dunlap and Van Liere, 1978), which assesses general environmental attitudes. Environmental concern is a potential precursor of environmental behaviour (Barr, 2007; Corral-Verdugo et al., 2008; Schultz et al., 1995) and it has been linked to demographic factors (e.g., age, gender, income, education, and political ideology) (Blake, 2001; Klineberg et al., 1998) that are included in the model.

Position in the social structure, another aspect of the causal model of environmental concern (Stern et al., 1995) that comes before personal values, is not explicitly included as a factor in the model but rather derived indirectly from **demographics**. The next factor in the "motivation path" after personal values and general attitudes is one's **specific attitude toward a given behaviour**. Vining and Ebreo (1992) report links between specific attitude and recycling behaviour. As described in the section about causal model of environmental concern, personal values and general attitudes can affect formation of specific attitudes (Stern et al., 1995). In addition, to explain the link between one's general predisposition and specific attitudes or behaviours, Dietz and Stern (1995) and Stern et al. (1995) state that in many instances of decision making people tend to ignore specific details of the issue at hand and instead of performing calculations they decide by making reference to existing classifications and personal values and general attitudes.

However, the transition from the general to the specific level can lead to poor correlations between measured constructs (Heberlein and Black, 1976). A way to deal with this problem is to aggregate

measurements of specific behaviours into an index of average behavioural tendency in which case correlations may become higher indicating that patterns of behaviour, in contrast with specific behaviours, indeed are better explained through values and attitudes measured at a general level (Ajzen, 1991; 2005; Epstein, 1983). This constitutes another reason for including personal values and general attitudes in a generic model that explains human behaviour.

Social norms, another factor that can influence behaviour directly (Do Valle et al., 2005; Barr, 2007; Vining and Ebreo, 1992), refer to social pressure for or against performing a specific behaviour. This is a main component of the theory of planned behaviour (Ajzen, 1991) and, accordingly, it was included in the model.

A factor common to both the theory of planned behaviour (Ajzen, 1991) and the causal model of environmental concern (Stern et al., 1995) is **behavioural intention** (or **motivation**). Intention is an indication of people's willingness to perform some behaviour and, generally, stronger intentions result in higher behaviour adoption (Ajzen, 1991). Sheppard et al. (1988) found that intentions can be used as predictors of behaviours that are under one's volitional control (i.e., the individual can decide whether to perform or not the behaviour). Other studies (Barr, 2007; Boldero, 1995; Taylor and Todd, 1997) also reported links between intention and behaviour.

Along the second path (i.e., the "ability path") and in accordance with theory of planned behaviour (Ajzen, 1991), the model utilises one's **perceived ability to perform the behaviour** which (as discussed above) may be substantially different from one's actual ability to perform the behaviour. Actual control can depend on availability of necessary resources (e.g., money or time) and opportunities (Ajzen, 1991). Therefore, the inclusion of **demographics** (discussed later in this section) in the model was deemed necessary since factors such as income, education, or age form part of the resources one may require to engage in certain behaviours (e.g., Barr, 2007; Gatersleben et al., 2002; Poortinga et al., 2004). This

approach is in agreement with the views of Kaiser et al. (1999) who suggested incorporating measures of actual control as a possible way to improve the theory of planned behaviour (Ajzen, 1991).

The importance of perceived ability is evident in the work of Bandura et al. (1977) who found that confidence in one's ability to perform a given behaviour is strongly associated with behaviour adoption. Such confidence can result in stronger interest in the behaviour and more effortful attempts to perform it (Bandura, 1982; 1991). Perceived ability (in the model), which must be measured at the same level of generality as behaviour, stems from **experiences with the behaviour** (either personal or from other people's accounts) and **external information** (e.g., from the media). This is in accordance with Ajzen's views (1991) about factors that shape perceived behavioural control.

In addition to the reasons mentioned above, demographics were included because a number of studies have shown that they can play a role in shaping environmental behaviour (e.g., Barr, 2007; Gatersleben et al., 2002; Hallin, 1995; Oskamp et al., 1991; Poortinga et al., 2004; Tanner et al., 2004). However, since their influence on behaviour appears rather inconsistent and dependent on the specifics of the behaviour (Gatersleben et al., 2002; Klineberg et al., 1998; Schultz et al., 1995; Stern, 2000), there are no arrows to directly link demographics to other factors in the model. Instead, they are assumed to potentially influence all other factors in this generic version of the model (i.e., a version that is not specific to any given behaviour). In case the model is modified to accommodate for a particular behaviour, arrows can be redrawn to show detailed links based on relevant research findings. For example, a study (Gatersleben et al., 2002) found that household size was significantly associated with energy use but not with recycling.

All major categories of factors that have been associated with environmental concern and behaviour (Ajzen, 1991; Blake, 2001; Corraliza and Berenguer, 2000; Schultz et al., 1995; Stern et al., 1995; Tanner et al., 2004) are included in the theoretical model. The categories are:

- Internal factors (e.g., attitudes)

- External factors (e.g., media campaigns)
- Demographics
- Prior behavioural experiences

Straight arrows signify hypothesised causal links while the three curved bi-directional arrows signify correlation links, as suggested by Ajzen (1991) and shown in Figure 1. The model can assist in understanding how the various factors that influence environmental behaviour work together to achieve their result. Given that research (Gatersleben et al., 2002; Poortinga et al., 2004) has shown that low-cost (in terms of money, effort, and time) environmental behaviours tend to be related to attitudinal (motivational) factors while high-cost behaviours seem to be more influenced by socio-demographic variables that affect one's ability to perform those behaviours, the model's two paths may prove useful in exploring differences between the two behaviour types and their determinants. Specifically, the motivation path could be more relevant in explaining low-cost behaviours and the ability path could be more appropriate for explaining high-cost ones. An additional use of the model could be to point out factors for consideration as predictors of specific behaviours (e.g., in a regression model). The following section deals with modifications that were required in the theoretical model to render it operational (i.e., to adapt it so as to be possible to employ it by using data collected from the survey).

3.3.2.2. Development of an operational environmental behaviour model

To assess the level of support that collected data provided to the theoretical model to explain environmental behaviour both a logistic regression and a partial correlation analysis were carried out. However, the initial model (as conceived by taking into account relevant theories) could not be used directly for these two analyses because it included variables that were not measured in this study. Therefore, certain modifications were required to arrive at an operational model (i.e., one that could be evaluated by using the variables measured). The operational model is presented in Figure 5 below and the modifications needed to produce it from the theoretical model were as follows:

1. As mentioned in section 2.3.1, measuring intention (or motivation) to perform past behaviours presents difficulties (Do Valle et al., 2005). Consequently, motivation (which was not measured in the survey) was omitted and factors that were reaching behaviour through motivation (i.e., specific attitude and social norms) were re-drawn in a way to reach behaviour directly.

2. Three factors that may influence one's generalised environmental attitudes and concern are environmental problems awareness, witnessing environmental problems, and frequency of visits in nature (Blake, 2001; Kals et al., 1999; Meinhold and Malkus, 2005; Tikka et al., 2000). These were measured in this study and have been added as having a direct link with generalised environmental attitudes.

3. Perceived ability to perform the behaviour (not directly measured in this study) has been replaced by familiarity with the specific behaviour. This was based on Ajzen's (1991) factors that influence perceived ability (i.e., prior personal experience with the behaviour, external information related to the behaviour, and relevant experiences of people in one's social environment) that can be considered, in general, to be shaping familiarity as well.

4. Prior experience with a given behaviour was omitted, as it was not measured. However, its influence was assumed to have been accounted for in the operational model given that an assessment of familiarity with behaviour incorporates potential prior experiences with the behaviour.

5. Perceptions of convenience and increased opportunities in performing a specific behaviour can increase perceptions of ability to perform the behaviour (Ajzen, 1991). Given the similarities between perceived ability and familiarity (as stated in 3. above), convenience and familiarity were directly linked.

6. The particular demographic factors and types of personal values measured were explicitly mentioned in the operational model. These are presented in section 3.3.3.

In accordance with the theoretical model, straight arrows signify hypothesised causal links. The three curved bi-directional arrows indicate correlation links.

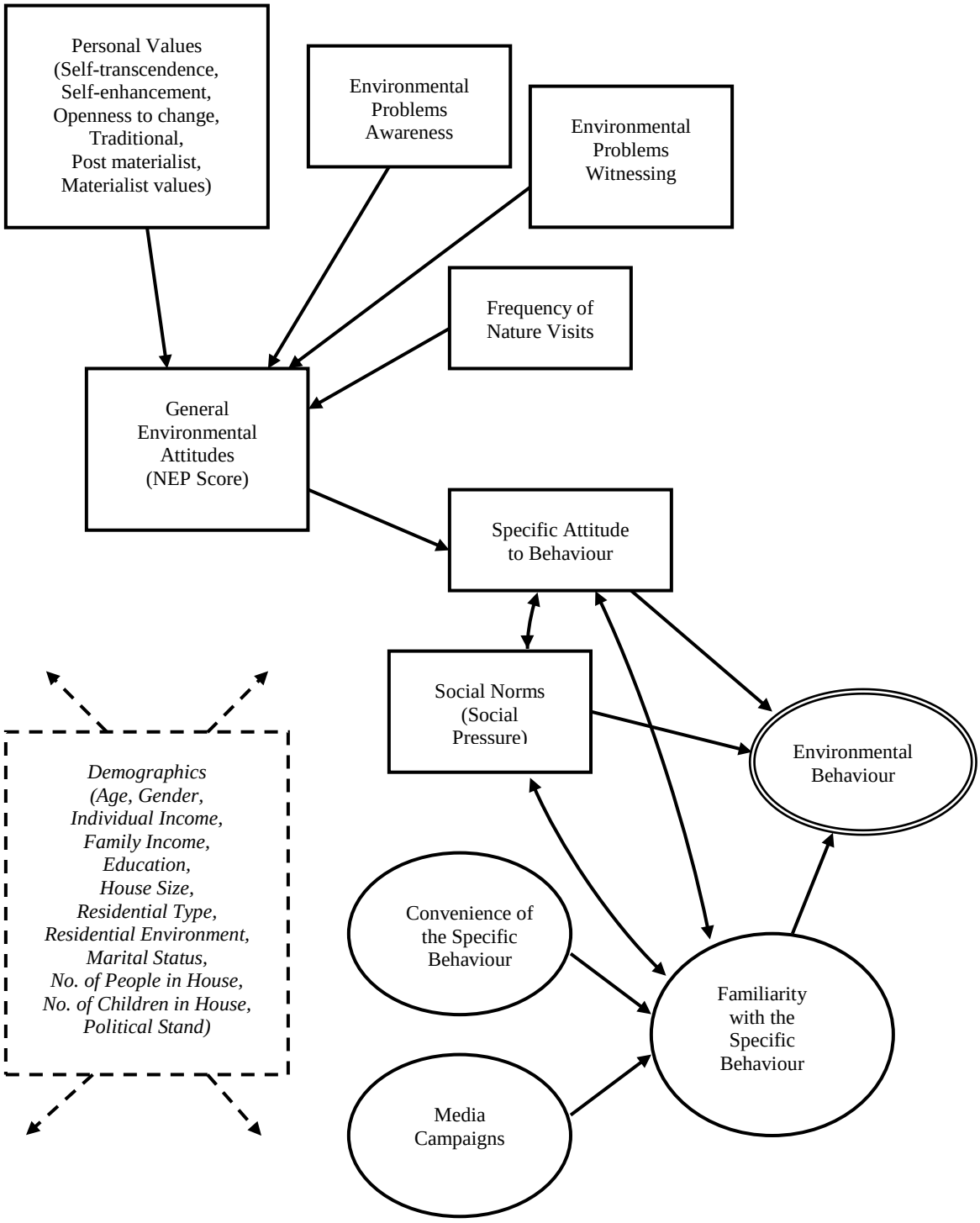

Figure 5. Operational model to explain environmental behaviour (developed using inputs primarily from Ajzen, 1991 and Stern et al., 1995)

Note: Factors in single-lined rectangles belong to the motivation path and factors in single-lined ovals belong to the ability path. Demographics are in a dashed-lined rectangle and behaviour in a double-lined oval.

The variables included in the operational model were evaluated regarding their ability to predict behaviour during a logistic regression analysis that followed. A description of this analysis is presented in the next section.

3.3.3. Logistic regression

Logistic regression is a type of regression that can be used when the outcome variable (i.e., the dependent variable) is nominal while the predictors (i.e., the independent variables) may belong to any type of measurement level (i.e., nominal, ordinal, interval, or continuous) (Tabachnick and Fidell, 2001). Logistic regression can be used with either two or more categories of outcome. If there are two categories (i.e., a dichotomous outcome), it is called binary logistic regression and if there are more than two categories, it is called multinomial logistic regression (Hosmer and Lemeshow, 2000). An example of an outcome variable with two categories can be whether one will or will not purchase a given product within a certain time frame. Since binary logistic regression was performed in the analysis presented below, the remaining presentation of logistic regression focuses on this type of technique.

Logistic regression can be used for predicting an outcome variable based on other variables (Field, 2004; Tabachnick and Fidell, 2001). Therefore, it was applied in this study to identify predictors of adoption of environmental behaviours, in accordance with the stated objectives. Potential predictors that were included in the logistic regression analysis were initially identified in the literature review during the theoretical model formulation (see Table 3). These predictors belonged to four categories of factors:

- Internal factors
- External factors
- Demographics
- Prior behavioural experiences

Table 3. Variables entered as predictors in logistic regressions

Variables entered as predictors in logistic regressions	Notes
Familiarity with environmental problems	Both within the respondents' Province and in the world
Having personally witnessed human made environmental disasters	Both within the respondents' Province and in the world
Frequency of nature visits within the past 12 months	
Familiarity with media campaigns	Depending on the outcome behaviour, one of four types of campaigns was used per regression. There were campaigns that promoted: a) conservation of energy, b) conservation of water, c) minimisation of waste material, d) protection of surrounding ecosystems
Extent to which environmental actions belonging to a group of environmental activities were influenced by neighbours, friends, or relatives	Depending on the outcome behaviour, one of four types of group of environmental activities was used per regression. There were groups of activities about: a) conservation of energy, b) conservation of water, c) minimisation of waste material, d) protection of surrounding ecosystems
Convenience to perform the specific behaviour examined	Due to questionnaire space constraints, there were only eight behaviours for which convenience was examined. These were: a) Using energy efficient appliances b) Turning off appliances when not using them c) Using water efficient appliances d) Using water saving plumbing fixtures e) Repair things that are broken instead of buying new f) Recycling g) Taking toxic waste to special disposal sites h) Using non-toxic cleaners
Personal values	There were six types of personal values per regression: a) Self-enhancement b) Self-transcendence c) Openness to change d) Traditional e) Materialist f) Post materialist
General environmental attitudes	These were assessed by the subjects' score on the New Environmental Paradigm scale
Specific attitude to the behaviour examined	An attitude relevant for a particular behaviour (i.e., the behaviour is the attitude object). In this study, t is assessed by the perceived importance of the specific behaviour examined
Familiarity with the specific behaviour examined	This variable was used instead of 'perceived ability to perform a behaviour' (which was not measured directly) and it was thought to incorporate prior behavioural experiences
Demographic variables	The following demographic variables were entered per regression: a) Gender b) Age c) Highest educational level attained d) Individual income e) Family income f) Type of residence g) House size h) Residential environment i) Marital status j) Total number of people in the house k) Total number of children in the house l) Stand on political issues

The equation that describes the outcome of logistic regression equation is given below (Tabachnick and Fidell, 2001):

$$\hat{Y}_i = \frac{e^u}{1+e^u}$$

Equation 1.

where

e = the base of natural logarithms, which is approximated to 2.71828

u = the linear regression equation ($u = A + B_1X_1 + B_2X_2 + \ldots + B_kX_k$)

$\hat{Y}_i$ = predicted probability that the *i*th case (i = 1, 2, …n) is in one of the two possible outcome categories

In terms of assumptions, logistic regression is relatively relaxed. The predictor variables do not have to follow a normal distribution, be in linear relationships, or have homoscedasticity (Tabachnick and Fidell, 2001).

However, logistic regression is sensitive to multicollinearity (Tabachnick and Fidell, 2001) and addressing this issue was the starting point for this analysis. Multicollinearity was assessed by inspecting the output from linear regressions after using the variables identified in the theoretical model as potential predictors and using the adoption of each of the environmental behaviours in the questionnaire as the outcome variable. In total, 35 linear regressions were performed. If tolerance values were less than 0.1 or variance inflation factor (VIF) values were greater than 10, then multicollinearity would be present (Field, 2004).

Logistic regression analysis proceeded by following a structured approach using the five steps described below. These steps are based on recommendations by Hosmer and Lemeshow (2000) for situations when there are many predictor variables included initially in the model, which was the case for the present study:

1. Production of the preliminary reduced model. After having identified which variables to include in the regression model based on the theoretical model developed earlier and having tested for multicollinearity, a stepwise logistic regression was performed to eliminate variables that were statistically unimportant. The derived reduced model was further validated in the subsequent step. The logistic regression method used was backward with the likelihood ratio test since backward methods, compared to forward ones, have a lower risk of resulting in type II errors (Field, 2004).

   The likelihood ratio test (or log-likelihood test) is a goodness of fit measure that is calculated based on the likelihood ratio which is a function of the log likelihood (or LL). The log likelihood is the logarithm of the probability that an observed value for an outcome can be predicted from observed values of predictor variables. Values for the –2LL statistic (i.e., log likelihood multiplied by –2) follow a chi square distribution and, therefore, can be used for evaluation of the significance of a logistic regression model. However, it is the difference between two likelihood ratios (i.e., the difference between two –LL values) that is used for testing significance when comparing of two models instead of the likelihood ratio alone and better models have lower –LL values (Garson, 2009a).

2. Production of the preliminary main effects model. This step assisted in verifying the importance of the variables that were included in the reduced model. In this stage, the reduced model was compared to the full model (i.e., the model at the beginning of the first step) by performing a hierarchical logistic regression. In hierarchical (or sequential) logistic regression, the researcher specifies the order by which predictors are entered into the analysis (Tabachnick and Fidell,

2001). In this case, variables were entered into the model twice. The first block of entry included those variables identified in the first step (i.e., the reduced model) and the second block included the remaining variables. At that point, a non significant value in the likelihood ratio test for the second block of entry indicated (and verified) that the reduced model was better than the initial full model and that variables eliminated in the first step were indeed unimportant.

Although the reduced model had been assessed overall by the likelihood ratio test, there could still be predictors (in the reduced model) with a non significant value for their Wald statistic indicating that the individual contribution of these predictors in the model was not significant (i.e., whether their inclusion in the model significantly improves prediction) (Tabachnick and Fidell, 2001). However, the Wald statistic tends to become unreliable when sample size is small (Garson, 2009a) or when the corresponding regression coefficient is large (Field, 2004). Specifically, the Wald statistic may have an increased probability of evaluating an individual predictor as non-significant when the predictor is significant (i.e., a type II error) (Field, 2004). Therefore, the Wald statistic was used only as an indicator that a given predictor potentially had to be removed from the model. The ultimate evaluation was performed by employing again the likelihood ratio test, which can evaluate individual predictors on top of its ability to evaluate the overall fit of a model (i.e., the contribution of a number of predictors simultaneously) (Tabachnick and Fidell, 2001).

Therefore, another series of hierarchical logistic regressions were conducted to evaluate each predictor individually using the likelihood ratio test. The first block of entry was the reduced model minus the particular predictor being tested while that predictor was added in the second block. A non-significant value for the likelihood ratio test would indicate the predictor was not significant for inclusion in the model.

3. Production of the main effects model. At this step, the assumption of linearity in the logit was evaluated. There must be a linear relationship between continuous predictor variables and the logit transform of the outcome variable and this can be tested using the Box-Tidwell test (Menard, 2002; Tabachnick and Fidell, 2001). According to this test, products of each continuous predictor variable and its natural logarithm were added to the logistic regression model. In case the coefficient for such an added product was found to be statistically significant, the assumption of linearity in the logit would be violated. This assumption was tested using a stepwise logistic regression as suggested by Menard (2002) and when it was found to be in violation, transformations were performed to the violating variables. The transformed variables were evaluated again for linearity in the logit until a suitable transformation was found.

4. Production of the preliminary final model. During this step, a number of interactions among variables were evaluated for inclusion in the final model. Selection of plausible interactions to be evaluated was initially based on theoretical grounds and, subsequently, on statistical ones (Hosmer and Lemeshow, 2000). Based on the literature review, three hypothesised interactions on behaviour were identified and considered for inclusion in the model: (1) gender with age (Zelezny et al., 2000), (2) knowledge of environmental issues with general environmental attitudes (which were assessed by a subject's score in the New Environmental Paradigm scale) (Meinhold and Malkus, 2005), and (3) personal values (six types of values including: self-enhancement, self-transcendence, conservation, openness to change, materialist, and post materialist values) with general environmental attitudes (which were assessed by a subject's score in the New Environmental Paradigm scale) (Joireman et al., 2001). Interactions were examined one at a time (Hosmer and Lemeshow, 2000).

   To test whether an interaction between two variables was significant, products of the values of the two variables were entered into the model. Subsequently, a hierarchical logistic regression was performed and using the likelihood ratio test the product of the two variables was evaluated.

The first block of entry was the reduced model from step three and the product term was added in the second block. The interaction would be considered not significant if a non-significant value for the likelihood ratio test was found (Jaccard, 2001).

5. Production of the final model. Goodness of fit of the model was further assessed by examining overall measures of fit (Hosmer and Lemeshow test and classification tables) and specialized measures of fit (residuals and DFBeta values).

Field (2004) provides information regarding these four measures. Starting with the Hosmer and Lemeshow goodness of fit statistic, it evaluates how well a certain model fits the data. If this statistic has a non-significant value, this indicates an adequate fit of the model to the data. Classification tables assess the model's ability to predict correctly the dependent variable (outcome) when existing data are entered. They provide the percentage of cases for which the outcome is correctly predicted.

Regarding specialized measures of fit, a residual is the difference between the outcome value predicted by the model and the outcome value observed in the sample while a studentized residual is a residual divided by an estimate of its standard deviation. Studentized residuals outside the ±2 range point to cases that are outliers and if there are more than 5% of residuals outside that range the fit of the model may be negatively affected. Cases with studentized residual values outside the ±2.5 range should be inspected for data input errors as well as cases with studentized residual values outside the ±3.0 range, which is a cause for concern. Finally, the DFBeta statistic is used to identify cases that exert excessive influence on the model. Influential cases can result in a regression model that is excessively based on these cases and does not represent the whole sample in an accurate way. DFBeta values greater than one may indicate influential cases.

In case there are any categorical (nominal) variables among the predictors, a dummy variable coding is performed on them (DeMaris, 2004; Field, 2004). This is a necessary step to represent the qualitative information within a categorical variable in quantitative terms (Hardy, 1993). In dummy coding, if there are initially n mutually exclusive categories within a nominal variable there will be n – 1 dummy variables created (Cohen et al., 2003; DeMaris, 2004; Hardy, 1993). A reference category is selected from the various categories of a nominal variable. When interpreting the output of regression using indicator contrasts (that were used in the present study), the coefficients of all other categories will be compared to this reference category (Garson, 2009a). Categories of a nominal variable are represented with zeros (0) and ones (1) in indicator contrasts (the name 'indicator' is derived from the fact that they indicate presence or absence of a nominal attribute) (Menard, 2002). Commonly, a reference category is chosen in a way that allows for meaningful comparisons with other categories while it is recommended that the reference category does not have a small sample size compared to the other categories (Cohen et al., 2003). It is also recommended that the reference category be one that lies somewhere in the midrange of categories (if an underlying ordinality exists in the categories) although the choice of a particular reference category does not alter the regression analysis results (Hardy, 1993).

In the present study, there were six categorical variables that were transformed into dummy variables. The reference categories (based on the suggestions described above for selecting a reference category) for these variables were as follows:

Table 4. Dummy coding reference categories for categorical predictors

Categorical variables used as predictors	Reference category
Gender	Male
Highest educational level attained	College or university graduate
Current type of residence	Detached house
Current residential environment	Suburban
Marital status	Married
Stand on political issues	Moderate

The methodology, thus far, has dealt with analyses which attempted to identify factors as significant predictors of behaviours. However, acquiring evidence regarding how these factors might be linked

together (i.e., drawing appropriate arrows to link the factors in the model) is also essential. Therefore, analysis proceeded with an examination of partial correlations that can aid in that respect.

3.3.4. Partial correlation analysis

This analysis was performed after having arrived at a parsimonious model (containing only four predictor variables) to explain environmental behaviour at a general level (i.e., not specific to any particular behaviour) based on logistic regression results. The parsimonious model, which was developed from the operational model described earlier, is presented in Figure 12 in section 4.4.5. The aim of the partial correlation analysis was to provide evidence regarding the presence of links (i.e., lines with arrows) among all of the factors in the model, the strength of those links, and the type of relationship (i.e., positive or negative). This was achieved by calculating partial correlation values for all variables included in the parsimonious model.

Partial correlation analysis was preferred over a simple correlation analysis because it can reveal the unique relationship between two variables after removing any effects from other potentially intervening variables (Field, 2004). For this reason, partial correlation can identify spurious correlations (i.e., a correlation between two variables that have no causal connection) which can exist when partial correlation has a value close to zero while the original correlation, calculated without removing any effects from other variables, has a value different from zero. Spurious correlations have to be identified and removed to more accurately construct a model that attempts to explain environmental behaviour. The small number of variables in the parsimonious model was another reason for selecting the technique of partial correlation which is not recommended for models containing more than five variables (Garson, 2009b).

In order not to exceed a total of five variables in the model, only one type of personal values was included when analysing each separate behaviour. The type of personal values having the largest effect (either

positive or negative) on behaviour, as assessed by exp(B) values from logistic regression analysis, was selected for inclusion.

The specific type of analysis performed was third-order partial correlation (i.e., controlling for the effects of three variables) (Field, 2004; Garson, 2009b). Due to limitations of the software used (i.e., SPSS), partial correlation analysis could only be performed using Pearson correlations which are parametric. This was a reason for concern given that variables in this study appeared to deviate from normality. However, Pearson correlation is considered generally robust to violations of normality and homoscedasticity for large sample sizes (Baghi and Badii, 2005; Field, 2004) and use of nonparametric alternatives is recommended mainly when normality violations are severe (Garson, 2008). Consequently, variables that severely violated the assumption of normality were dealt with by applying transformations. However, after a variety of transformations (i.e., square root, sine, cosine, natural logarithm, inversion, and exponentiation) proved to be ineffective in remedying the situation, these variables were removed from this analysis. The removed variables were:

- Adoption of turning off appliances when not in use (an outcome behaviour)
- Familiarity with recycling (a predictor variable)
- Personal importance of recycling (a predictor variable)
- Adoption of recycling (an outcome behaviour)

After removing the two outcome behaviours mentioned above (i.e., adoption of turning off appliances when not in use and adoption of recycling) from partial correlation analysis for severely violating the assumption of normality, it was decided to include only three outcome behaviours (i.e., adoption of using energy efficient appliances, adoption of using water efficient appliances, and adoption of using water saving plumbing fixtures) from the remaining ones in this analysis. A prerequisite for performing this analysis was to use behaviours (i.e., outcome variables) for which all four predictor variables (i.e., personal values, specific attitude to the behaviour, convenience of the specific behaviour, and familiarity

with the specific behaviour) included in the parsimonious model had been identified as significant predictors by logistic regressions. Otherwise, the resulting models would be lacking variables that were found to be important (as identified by logistic regression analysis) to understand environmental behaviour. The three behaviours used in partial correlation analysis did satisfy this prerequisite.

Outliers can substantially influence correlation coefficient values (Garson, 2008) and, therefore, cases identified as multivariate outliers during data screening were removed from this analysis. Pearson correlation assumes linear relationships between the two variables and violation of this assumption results in lower correlation coefficient values (Garson, 2008). Variables used in this analysis were found to depart from linearity after examining scatterplots (Tabachnick and Fidell, 2001). Spearman correlation, which is nonparametric and makes no assumptions about the distribution of variables (Garson, 2008), would be considered suitable for partial correlations with the data collected. To ensure that use of Pearson instead of (nonparametric) Spearman correlations would not substantially alter the results of the partial correlation analysis, the following procedure was carried out. For all pairs of variables, both Pearson and Spearman correlation coefficient values were first computed. Subsequently, absolute differences between Pearson and Spearman correlation coefficient values were calculated and then averaged. This procedure was performed separately for each of the three behaviours included in the analysis. The averages of these differences were relatively small (the average difference for adoption of using energy efficient appliances was 0.04, the average difference for adoption of using water efficient appliances was 0.03, and the average difference for adoption of using water saving plumbing fixtures was 0.04) indicating that using Pearson correlation for partial correlation analysis was acceptable for these data.

Having identified which predictor variables to include in the model (from logistic regression analysis) and how these variables were linked together and with behaviour (from partial correlation analysis), the next step was to investigate in detail how changes in these variables affected behaviour. This was approached by using cross-tabulations.

3.3.5. Cross-tabulation analysis

Analysis, thus far, attempted to identify variables that exhibited a generally consistent and non spurious association with behaviour. Cross-tabulations were performed next to assist in suggesting ways to enhance behavioural adoption by promoting (or potentially obstructing in case of a negative association with behaviour) predictor variables in the parsimonious model with the aim of creating an environment beneficial to the expansion of environmental behaviours.

Cross-tabulations (or contingency tables) present the distribution of two or more variables and are considered the simplest form of multivariate analysis (Putler, 2009). Both frequency counts and percentages can be provided in the output.

During this analysis, predictor variables and outcome behaviours in the parsimonious model (described in section 3.3.4.) were included. One predictor variable and one outcome behaviour were employed at a time to examine the distribution of these two variables simultaneously. Results from this analysis could be useful in identifying the importance of interventions to alter predictor variables to enhance adoption of environmental behaviours. For example, if moderate levels of familiarity with a particular behaviour were associated with relatively high behavioural adoption and high levels of familiarity were associated with only slightly higher behavioural adoption, then it could be concluded that increasing familiarity levels from medium to high would not likely constitute a particularly useful and efficient approach to enhance adoption of the given behaviour.

To make cross-tabulation results more easily interpretable, data from the sums of materialist and post materialist values used in this analysis that were at a ratio scale ranging from zero to one were divided into five groups. These groups were as follows:

- Cases with a score from 0.00 to 0.20 were included in a group named 1
- Cases with a score from 0.21 to 0.40 were included in a group named 2

- Cases with a score from 0.41 to 0.60 were included in a group named 3
- Cases with a score from 0.61 to 0.80 were included in a group named 4
- Cases with a score from 0.81 to 1.00 were included in a group named 5

In a similar fashion, data from self-transcendence values that ranged from a value of three to a value of fifteen were divided into four groups. These groups were as follows:

- Cases with a score from 3 to 6 were included in a group named 1
- Cases with a score from 7 to 9 were included in a group named 2
- Cases with a score from 10 to 12 were included in a group named 3
- Cases with a score from 13 to 15 were included in a group named 4

Cross-tabulations were the last type of analysis employed. The next chapter presents detailed results.

4. RESULTS

This chapter begins by presenting results from the mail survey conducted. Results are provided about the three mailings sent out and the number of completed questionnaires received, the response rate achieved (26%), and tests that were performed to detect non-response bias (that was not present).

The chapter continues with a detailed presentation of descriptive statistics including normality assessment for all survey variables (with fewer than 10% found to be severely violating the assumption of normality), detection for outliers, means for all questionnaire items, 95% confidence intervals for those means, standard deviations, and frequencies. An assessment of reliability and validity (which were found to be satisfactory) of the three standardised scales and the specific attitudes scale used follows.

Logistic regression analysis results are presented using as outcome the adoption of each of the 35 behaviours examined in this study. This analysis enabled identification of significant predictors of environmental behaviours (with four of these predictors – personal values, specific attitude to the behaviour, familiarity with the specific behaviour, and convenience of the specific behaviour – identified as the most important, in general). An evaluation of the assumption of multicollinearity is offered and difficulties that led to the exclusion of a number of behaviours from logistic regression analysis are discussed. Results are included for individual behaviours and collectively. A section is provided that evaluates how these results supported the operational model from which a parsimonious model (with a total of five variables) was created to explain environmental behaviour. The likely influence from Provinces or Territories on environmental housing behaviour is also examined.

The chapter ends with a presentation of results from partial correlation analysis and cross-tabulation analysis. Partial correlation analysis was performed to provide a detailed understanding of the relationships (diagrammatical arrows) among variables in the parsimonious model while cross-tabulation analysis enabled an evaluation of the most apparently promising variables in the parsimonious model for manipulations that could result in a higher level of adoption of environmental behaviours.

4.1. Mail survey

This section presents results about the mail survey that was conducted in 2007 to collect primary data. Specifically, results regarding mailings, the response rate achieved, and tests that were executed to detect non-response bias are provided.

4.1.1. Mailings

There were three mailings from June 6th, 2007 to July 4th, 2007. Survey packages were sent to each of the 5,000 addresses across Canada (see section 3.1.).

The first mailing lasted from June 6, 2007 to June 11, 2007 (since questionnaires and cover letters were being printed and mailed during this period the mailing could not be completed on a single day). Inside the envelope, there were a questionnaire, a cover letter printed on a University of British Columbia letterhead, and one pre-paid return envelope. The second mailing lasted from June 20th, 2007 to June 21st, 2007 and it included only a reminder cover letter printed on a University of British Columbia letterhead. Finally, the third mailing lasted from July 3rd, 2007 to July 4th, 2007. It included the same contents as the first mailing with exception of the cover letter which was modified accordingly (see Appendix C).

In total, 1,234 completed questionnaires were received from the three mailings although not all of them were used in data analyses. Due to time constraints, only data from questionnaires that arrived, at the latest, three weeks after the last mailing were entered and analysed. The number of the questionnaires that were included in data analyses was 1,027. More detailed information about the responses is found in section 4.2.2.

4.1.2. Response rate

Response rates are defined (Czaja and Blair, 1996) as: "the number of eligible sample members who complete a questionnaire divided by the total number of eligible sample members". The following equation was used to calculate the response rate in this study:

$$Response\ Rate = \frac{Returned\ Completed\ Questionnaires}{Total\ Mail\ Outs - Respondents\ Unable\ to\ Participate\ /\ Outside\ Study's\ Population}$$

Equation 2.

The number of respondents unable to participate or outside the study's population was 251. This number was calculated as follows:

Table 5. Respondents unable to participate or outside the study's population

Category of respondents	Number
Undeliverables/Returned to sender	184
Respondents that were at an advanced age, blind, ill, unable to communicate in English/French, or illiterate	18
Deceased, not in the population	36
Respondents that neither rented nor owned the house they lived in*	13
Total number of respondents unable to participate or outside the study's population	**251**

* These respondents were outside the study's population

The total number of mail outs was 5,000 and there were 1,234 returned completed questionnaires. Accordingly, the response rate was calculated as:

$$Response\ Rate = \frac{1{,}234}{5{,}000 - 251} = 26.0\%$$

Given the absence of rewards offered (except for copy of the results upon the respondent's request) and the relatively long length of the questionnaire (eight pages for questionnaires in the English language and ten pages for questionnaires in the French language), the response rate of 26% is considered satisfactory.

4.1.3. Non-response bias

When people who responded to a survey are substantially different on certain characteristics that are important to the study from those who did not respond then non-response bias is present (Dillman, 2000). Detection of non-response bias is important in order to make generalisations of results to the population under study. Indeed, if study participants who responded differ considerably from those who did not respond then the characteristics of the whole population are not accurately reflected in the study's results (Armstrong and Overton, 1977).

One approach to estimate non-response error is to use an extrapolation method (Armstrong and Overton, 1977; Kanuk and Berenson, 1975). Such a method assumes that people who respond later (i.e., after they receive a reminder letter) share more characteristics with those who never respond than with those who respond readily. In practice, this is accomplished by comparing a number of important variables for the study between early and late respondents. In case significant statistical differences are found, then this provides evidence that non-response bias is present.

Responses used for this analysis arrived between June 13, 2007 and July 20, 2007. These were divided into two groups: one with responses that arrived between June 13, 2007 and July 9, 2007 (550 responses) and one with responses that arrived after July 9, 2007 (466 responses).

In total, sixteen variables were examined from all sections of the questionnaire (i.e., from section A to section F). First, the Kolmogorov-Smirnov test was used to assess normality and it was significant for all variables examined. Since variables were non normal, the Mann-Whitney U test for equality of means (non-parametric) was performed. There were three variables having binary data (from sections B and F of the questionnaire, as shown in Table 6) and for these variables the two independent sample z-test for proportions was used. To assist in the calculations of z-scores, a small program in the C++ programming language was used (see Appendix E) that was developed (i.e., written, built, and tested) by the researcher.

For all sixteen variables examined, there were no significant differences found between early and late respondents regarding means of groups or proportions, as shown in Table 6. This led to the conclusion that non-response bias could not be detected in this study and, therefore, results from analysing the sample could be inferred to the population under investigation.

Table 6. Tests performed for detecting non-response bias (early vs. late respondents).

Variable	Questionnaire section	Sample size (n)	Mann-Whitney U test	z-test
How familiar are you with media campaigns that promote conserving water?	A	1003	×	
How much are your environmental actions on conserving energy influenced by your neighbours, friends, or relatives?	A	994	×	
How convenient is it for you to turn off appliances when not using them?	A	966	×	
Self-transcendence Value: A world at peace, free of war and conflict	A	969	×	
Behaviour Familiarity: Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	B	805	×	
Behaviour Familiarity: Use water saving plumbing fixtures	B	810	×	
Behaviour Importance: Use non-toxic cleaners	B	796	×	
Behaviour Importance: Use a programmable thermostat to reduce energy use	B	775	×	
Behaviour Adoption: Use energy efficient appliances	B	735		×
Behaviour Adoption: Wear more clothing to reduce heating costs	B	735		×
Behaviour Familiarity: Winterize windows and doors to prevent drafts	C	88	×	
Behaviour Familiarity: Use local building materials (from no further than 500 miles from your home)	D	150	×	
Behaviour Familiarity: Choose a location that minimizes transportation needs	E	102	×	
Gender	F	993		×
Age	F	999	×	
How useful is the advice from friends or relatives for finding information about green building/housing practices?	F	944	×	

Note: × = test is not significant at a = 0.05

4.2. Descriptive statistics

This section starts with a normality assessment for all survey variables as well as information on the detection of outliers that was performed. Various descriptive statistics for each questionnaire item are subsequently provided.

4.2.1. Normality assessment and outliers

The assumption of normal distribution was assessed for every variable (i.e., 390 variables) of the study. First, the Kolmogorov-Smirnov and Shapiro-Wilk tests were used and both tests were significant for all variables examined indicating non-normality. Subsequently, skewness and kurtosis values were calculated to provide an indication of the extent of non-normality. Severe violations of the normality assumption are present when $|skewness| > 2$ or $|kurtosis| > 7$ (Fabrigar et al., 1999). Although all 390 variables were non-normal according to normality tests, only 34 were severely violating the assumption of normality. Therefore, techniques considered robust to small and medium violations of the assumption of normality could be applied to most of these data.

Univariate outliers were not detected. However, there were cases that were classified as multivariate outliers using Mahalanobis distance (Tabachnick and Fidell, 2001). Specifically, Mahalanobis distance was calculated using the linear regression output, as described by Schwab (2003). However, the evaluation for outliers is based not on the Mahalanobis distance values themselves but on the probability associated with Mahalanobis distance (i.e., the cumulative probability that a value from the chi-square distribution with degrees of freedom equal to the number of variables used in the calculations would be less than the value for Mahalanobis distance) that follows a chi-square distribution. Cases with probability values less than 0.001 are identified as multivariate outliers. There were five cases that were considered to be multivariate outliers because their probability values were 0.000001, 0.00012, 0.00025, 0.00031, and 0.00062, respectively. These were removed from those subsequent analyses that are sensitive to the presence of outliers, as described in each respective section.

4.2.2. Means, confidence intervals, standard deviations, and frequencies

Various descriptive statistics for each item in the questionnaire are presented in the tables below. Specifically, means, 95% confidence intervals for means, standard deviations, frequencies, percentages of frequencies, and sample sizes are given. The numbering of items in the questionnaire is maintained. Only responses that arrived until July 20th, 2007 (three weeks after the final mailing) were included in all analyses. Presentation of these results (means, confidence intervals, standard deviations, and frequencies) is divided into two parts:

1. Results from respondents who owned the house they lived in at the time of the survey. This group is given special attention as it contains the largest number of responses and was the focus of the multivariate analyses. Specifically, this part presents results from section F (predominantly demographic questions for house owners), section A (diverse factors influencing environmental behaviours for house owners), section B (familiarity, perceived importance, and adoption of environmental behaviours for house owners), section D (familiarity, perceived importance, and adoption of environmental behaviours for house owners who had renovated their house within the last 12 months from the time of the survey), and section E (familiarity, perceived importance, and adoption of environmental behaviours for house owners who had built or purchased a house within the last 12 months from the time of the survey). It should be noted that originally in section D all cases but seven and in section E all cases but one were from house owners. These few cases that were collected from non house owners were excluded from the analyses so that sections D and E referred to house owners exclusively (i.e., the respondents' category where analyses focused) and did not form two separate categories for which to draw separate conclusions.

2. Miscellaneous results from the remaining questionnaire sections. These include results from section F (mostly demographic questions for house owners and house renters), section A (various determinants of environmental behaviours, such as personal values and attitudes for house

owners and house renters), and section C (familiarity, perceived importance, and adoption of environmental behaviours for house renters).

4.2.2.1. Results from house owners

Results begin with section F (mostly demographics) and continue with section A (miscellaneous factors influencing environmental behaviours), section B (familiarity, perceived importance, and adoption of environmental behaviours), section D (familiarity, perceived importance, and adoption of environmental behaviours for house owners who had renovated their house within the last 12 months from the time of the survey), and section E (familiarity, perceived importance, and adoption of environmental behaviours for house owners who had built or purchased a house within the last 12 months from the time of the survey).

Provinces of respondents

Most responses arrived from Ontario while no responses were received from the Territory of Nunavut. The distribution of responses collected per Province or Territory is comparable with that of the entire Canadian population for 2007 (when the survey was conducted), as shown in Table 7.

Table 7. Number of responses collected from house owners per Province or Territory

Province or Territory	Frequency	Percentage	Actual percentage in 2007*
Ontario	370	41.3%	38.9%
Quebec	173	19.3%	23.3%
British Columbia	122	13.6%	13.1%
Alberta	115	12.8%	10.7%
Manitoba	31	3.5%	3.6%
Saskatchewan	25	2.8%	3.0%
Nova Scotia	25	2.8%	2.8%
New Brunswick	15	1.7%	2.3%
Newfoundland and Labrador	10	1.1%	1.5%
Yukon	4	0.4%	0.1%
Prince Edward Island	3	0.3%	0.4%
Northwest Territories	2	0.2%	0.1%
Nunavut	0	0.0%	0.1%
TOTAL	895	100.0%	100.0%

* Source: Statistics Canada, 2009b.

Question F1: Indicate your gender.

Over three quarters of respondents were male, as shown in Table 8.

Table 8. Descriptive statistics from house owners about gender

Gender	Frequency	Percentage
Male	682	77.7%
Female	196	22.3%
TOTAL	878	100.0%

Question F2: What is your current age?

The most common age group of respondents was from 51 to 60 years old, as shown in Table 9.

Table 9. Descriptive statistics from house owners about age

Age group	Frequency	Percentage
51 – 60	253	28.6%
61 – 70	201	22.7%
41 – 50	196	22.2%
71 or more	138	15.6%
31 – 40	73	8.3%
21 – 30	23	2.6%
20 or younger	0	0.0%
TOTAL	884	100.0%

Question F3: What is your highest educational level attained?

The most commonly reported educational level for house owners was college or university graduate, as shown in Table 10.

Table 10. Descriptive statistics from house owners about education

Educational level	Frequency	Percentage
College or university graduate	231	26.9%
High school diploma	141	16.4%
Vocational or tech school	124	14.5%
Some college or university	116	13.5%
Some high school	99	11.5%
Master's degree	91	10.6%
Some graduate work	30	3.5%
Ph.D.	26	3.0%
TOTAL	858	100.0%

Question F4: Indicate your individual 2006 annual income before taxes.

The most frequent groups of individual annual income before taxes for 2006 were from $20,000 to $39,000 and from $40,000 to $59,999, as shown in Table 11.

Table 11. Descriptive statistics from house owners about individual income

Income group	Frequency	Percentage
$20,000 to $39,999	182	23.7%
$40,000 to $59,999	182	23.7%
$60,000 to $79,999	138	18.0%
$100,000 or more	125	16.3%
$80,000 to $99,999	78	10.2%
Less than $20,000	62	8.1%
TOTAL	767	100.0%

Question F5: Indicate your 2006 family income before taxes.

The most common group of family income before taxes for 2006 was from $40,000 to $79,999, as shown in Table 12.

Table 12. Descriptive statistics from house owners about family income

Income group	Frequency	Percentage
$40,000 to $79,999	272	35.0%
$80,000 to $119,999	186	23.9%
Less than $40,000	126	16.2%
$120,000 to $159,999	110	14.1%
$160,000 or more	84	10.8%
TOTAL	778	100.0%

Question F6: What is your current type of residence?

The most frequent type of residence was a detached house, as shown in Table 13.

Table 13. Descriptive statistics from house owners about residence type

Residence type	Frequency	Percentage
Detached house	746	86.4%
Duplex (Attached) house	59	6.8%
Town house	43	5.0%
Apartment	15	1.7%
TOTAL	863	100.0%

Question F8: What is the size of your current house?

The most common house size was from 1200 ft^2 to 1799 ft^2, as shown in Table 14.

Table 14. Descriptive statistics from house owners about house size

House size group	Frequency	Percentage
1200 ft^2 to 1799 ft^2	296	34.2%
800 ft^2 to 1199 ft^2	240	27.7%
1800 ft^2 to 2199 ft^2	130	15.0%
2200 ft^2 to 2599 ft^2	82	9.5%
3000 ft^2 or more	53	6.1%
2600 ft^2 to 2999 ft^2	40	4.6%
400 ft^2 to 799 ft^2	25	2.9%
TOTAL	866	100.0%

Question F9: What is the type of your current residential environment?

The most common residential environment of house owners was suburban, as shown in Table 15.

Table 15. Descriptive statistics from house owners about residential environment

Environment type	Frequency	Percentage
Suburban	364	42.2%
Urban	315	36.5%
Rural	134	15.5%
Downtown	50	5.8%
TOTAL	863	100.0%

Question F10: What is your marital status?

The majority of house owners were married, as shown in Table 16.

Table 16. Descriptive statistics from house owners about marital status

Marital status	Frequency	Percentage
Married	699	80.2%
Common-law partner	63	7.2%
Never married	34	3.9%
Divorced	33	3.8%
Widowed	28	3.2%
Separated	15	1.7%
TOTAL	872	100.0%

Question F11: How many people, including yourself, live in your current house?

The most common number of people living in respondents' houses was two, as shown in Table 17.

Table 17. Descriptive statistics from house owners about number of people in the house

Number of people	Frequency	Percentage
2 persons	411	46.6%
4 persons	167	18.9%
3 persons	137	15.5%
1 person	81	9.2%
5 persons	55	6.2%
More than 5 persons	31	3.5%
TOTAL	882	100.0%

Question F12: How many children under 19 live in your current house?

The majority of house owners did not have any children under 19 living in their houses (Table 18).

Table 18. Descriptive statistics from house owners about number of children in the house

Number of children	Frequency	Percentage
No children	594	68.8%
2 children	121	14.0%
1 child	107	12.4%
3 children	32	3.7%
4 children	9	1.0%
5 children	0	0.0%
More than 5 children	0	0.0%
TOTAL	863	100.0%

Question F13: What is your stand on political issues?

The most common stand on political issues for respondents was moderate, as shown in Table 19.

Table 19. Descriptive statistics from house owners about stand on political issues

Political stand	Frequency	Percentage
Moderate	207	27.1%
Moderate to conservative	164	21.4%
Moderate to liberal	163	21.3%
Liberal	125	16.3%
Conservative	106	13.9%
TOTAL	765	100.0%

Question F14: How useful are the following methods for finding information about green building/housing practices.

(1 = not at all useful, 4 = neutral, 7 = very useful)

Television shows were reported as being the most useful method for finding information about green building/housing practices, as shown in Table 20. In addition, a small number of respondents reported

methods other than those in the original questionnaire as useful. These methods (not shown in Table 20) included:

- Studies, seminars, workshops, and research articles (mean value = 6.25, 95% confidence intervals = 0.87, standard deviation = 1.04, and n = 8)
- Private businesses (mean value = 6.10, 95% confidence intervals = 0.50, standard deviation = 1.07, and n = 20)
- Government and utility publications (mean value = 6.00, 95% confidence intervals = 1.08, standard deviation = 1.61, and n = 11)
- Miscellaneous (mean value = 6.00, 95% confidence intervals = 4.30, standard deviation = 1.73, and n = 3)

Table 20. Descriptive statistics from house owners about usefulness of various methods for finding information about green building/housing practices

Method for finding information	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Television shows	5.08	±0.10	1.56	838
Newspaper articles	4.88	±0.11	1.64	848
Magazines	4.69	±0.11	1.62	838
Advice from friends or relatives	4.67	±0.11	1.56	839
Books	4.57	±0.11	1.67	824
Specific websites	4.40	±0.14	2.06	808
Television advertisements	4.34	±0.12	1.80	826
Radio programs	4.09	±0.12	1.76	833
Exhibitions	4.07	±0.12	1.77	822
Radio advertisements	3.63	±0.12	1.73	818
Online newsletters	3.43	±0.12	1.76	803
Billboards	3.08	±0.12	1.70	807

Question A1: How familiar are you with the following?

(1 = not at all familiar and 5 = very familiar)

Respondents appeared somewhat familiar with environmental problems in their Province and in the world, as shown in Table 21.

Table 21. Descriptive statistics from house owners about familiarity with environmental problems

Environmental problems	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Within your Province	3.57	±0.06	0.92	874
In the world	3.48	±0.07	0.93	842

Question A2: Have you personally witnessed human made environmental disasters?

(1 = never and 5 = many times)

House owners had not personally witnessed human made environmental disasters many times, as shown in Table 22.

Table 22. Descriptive statistics from house owners about having witnessed human made environmental disasters

Environmental disasters	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
In your Province	2.32	±0.09	1.29	852
In the world	2.13	±0.09	1.33	826

Question A3: How often did you spend time in nature within the last 12 months?

The most common frequency at which house owners spent time in nature was at least once a week, as shown in Table 23.

Table 23. Descriptive statistics from house owners about frequency of nature visits

Nature visits frequency	Frequency	Percentage
At least once a week	382	43.3%
At least once a month	237	26.8%
Once in three months	108	12.2%
Once in six months	72	8.2%
Once a year	54	6.1%
Not once	30	3.4%
TOTAL	883	100.0%

Question A4: How familiar are you with media campaigns (e.g. TV, print, etc.) that promote each of the following?

(1 = not at all familiar and 5 = very familiar)

House owners were most familiar with media campaigns promoting conservation of energy, as shown in Table 24.

Table 24. Descriptive statistics from house owners about familiarity with media campaigns

Type of campaigns	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Conserving energy	4.05	±0.06	0.93	884
Minimizing waste material	3.92	±0.07	1.02	885
Conserving water	3.80	±0.07	1.10	884
Protecting surrounding ecosystems	3.51	±0.07	1.13	880

Question A5: How much impact on the environment on each of the following do you think the activities in your house may have?

(1 = my activities have no impact and 7 = my activities have a major impact)

Respondents perceived that their environmental activities had an impact on the environment though not a major one, as shown in Table 25.

Table 25. Descriptive statistics from house owners about perceived impact on the environment of various activities

Group of activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Minimizing waste material	5.00	±0.11	1.58	878
Conserving energy	4.75	±0.10	1.55	875
Conserving water	4.74	±0.11	1.65	875
Protecting surrounding ecosystems	4.60	±0.12	1.74	871

Question A6: How much are your environmental actions on each of the following influenced by your neighbours, friends, or relatives?

(1 = not at all influenced and 7 = very heavily influenced)

House owners felt that for all the environmental behaviours examined they were invariably not much influenced by their neighbours, friends, or relatives, as shown in Table 26.

Table 26. Descriptive statistics from house owners about influence from others on various groups of environmental activities

Group of activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Minimizing waste material	2.89	±0.12	1.82	876
Conserving water	2.74	±0.12	1.74	874
Protecting surrounding ecosystems	2.74	±0.11	1.75	874
Conserving energy	2.73	±0.11	1.72	878

Question A7: Please indicate how convenient is it for you to perform each of the following?

(1 = very inconvenient and 5 = very convenient)

House owners felt that performing all of the environmental actions examined was convenient with recycling being the most convenient, as shown in Table 27.

Table 27. Descriptive statistics from house owners about perceived convenience to perform various environmental activities

Environmental activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Recycle (e.g., paper, glass)	4.47	±0.06	0.87	852
Turn off appliances (e.g., computers, lamps) when not using them	4.43	±0.06	0.85	851
Use energy efficient appliances	3.95	±0.07	1.02	836
Use water saving plumbing fixtures (e.g., low-flow showerheads)	3.89	±0.07	1.07	832
Use water efficient appliances	3.74	±0.08	1.09	817
Repair things that are broken instead of buying new	3.68	±0.08	1.15	857
Use non-toxic cleaners	3.65	±0.06	1.02	840
Take toxic waste to special disposal sites	3.53	±0.10	1.40	815

Question A8: How important are the following to you?

(1 = not at all important and 7 = extremely important)

Conserving energy in the house was thought to be the most important category of environmental behaviours, as shown in Table 28.

Table 28. Descriptive statistics from house owners about perceived importance of groups of environmental activities

Group of environmental activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Conserving energy in your house	6.07	±0.08	1.11	878
The natural environment around your house is protected	5.90	±0.09	1.26	876
Waste materials are minimized in your house	5.74	±0.08	1.30	877
Conserving water in your house	5.70	±0.09	1.35	878

Question A9

This is the question with the standardised scale Brief Inventory of Values scale (Stern et al., 1998) to measure four value categories. Each value category was measured with three items except for the category self-transcendence values that was measured with both three and six items. The four value categories are: (1) self-transcendence measured by the six items: “a world at peace, free of war and conflict”, “social justice, correcting injustice, care for the weak”, “protecting the environment, preserving nature”, “equality, equal opportunity for all”, “unity with nature, fitting into nature”, and “respecting the earth, harmony with other species”, or, alternatively, measured by the first three of these six items, (2) self-enhancement measured by the three items: “authority, the right to lead or command”, “influential, having an impact on people and events”, and “wealth, material possessions, money”, (3) conservation measured by the three items: “honouring parents and elders, showing respect”, “family security, safety for loved ones”, and “self-discipline, self restraint, resistance to temptation”, and (4) openness to change values measured by the three items: “a varied life, filled with challenge, novelty, and change”, “an exciting life, stimulating experiences”, and “curious, interested in everything, exploring”.

Descriptive statistics were calculated for an aggregate score in each category obtained by summing the three items and, additionally, by summing the six items in the case of self-transcendence values. Higher

scores indicate higher perceived importance of a given value category. The possible range for three item sums is from 3 (in which case the respondent was opposed to the value category) to 15 (in which case the respondent felt the value category was extremely important in his/her life) while for six item sums it is from 6 to 30.

Among the four value categories measured by three items, conservation values received the highest score by house owners, as shown in Table 29.

Table 29. Descriptive statistics from house owners about the Brief Inventory of Values scale

Value category	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Self-transcendence values (six items sum)	27.23	±0.23	3.30	812
Conservation values (three items sum)	13.93	±0.09	1.35	845
Self-transcendence values (three items sum)	13.88	±0.12	1.70	843
Openness to change values (three items sum)	12.25	±0.14	2.09	843
Self-enhancement values (three items sum)	10.82	±0.15	2.09	783

Question A10

This is the question with the standardised scale Postmaterialism Index scale (Blake, 2001) to measure materialist and post materialist values. For both these value categories, scores were summed. However, since materialist values were measured using six items and post materialist values were measured using five items, sum scores were adjusted to arrive to a scale that ranged from zero (no priority for the specific value) to one (high priority for the specific value) so as to make materialist and post materialist values more readily comparable.

Post materialist values were slightly higher among house owners compared to materialist values, as shown in Table 30.

Table 30. Descriptive statistics from house owners about the Postmaterialism Index scale

Value category	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Post materialist values (five items sum adjusted to 0 – 1 range)	0.77	±0.01	0.19	843
Materialist values (six items sum adjusted to 0 – 1 range)	0.74	±0.01	0.17	825

Question A11

This is the question with the standardised scale New Environmental Paradigm (NEP) (Dunlap and Van Liere, 1978). Descriptive statistics were calculated for an aggregate NEP score obtained by summing the twelve scale items. Before summing items, scores for negatively worded ones were reversed (Streiner, 2003). In this way, for every NEP item a higher score meant higher acceptance of the NEP. The possible range for the variable NEP score is from 12 (strong disagreement with the NEP) to 48 (strong agreement with the NEP).

In general, house owners were found to be in agreement with the NEP (Table 31).

Table 31. Descriptive statistics from house owners about the NEP scale

	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
NEP score	38.60	±0.38	5.32	740

Question B1

This question presented respondents (home owners) with a list of environmental behaviours. Respondents were asked to state their level of familiarity with the behaviours, their perceived importance, and whether they had adopted or not the behaviours. Results from level of familiarity with environmental behaviours follow.

(1 = not at all familiar and 5 = very familiar)

House owners were most familiar with recycling. Familiarity was lowest with using an on-demand (tankless) water heater, as shown in Table 32.

Table 32. Descriptive statistics from house owners about familiarity with environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Recycle (e.g., paper or glass)	4.81	±0.03	0.49	826
Turn off appliances (e.g., lamps) when not in use	4.74	±0.04	0.54	834
Set thermostat no higher than 20°C	4.42	±0.06	0.86	822
Use energy efficient lighting	4.38	±0.06	0.87	817
Use energy efficient appliances	4.33	±0.06	0.89	840
Use compact fluorescent lighting	4.32	±0.07	0.98	837
Winterize windows and doors to prevent drafts	4.31	±0.06	0.94	803
Increase insulating capability of windows	4.30	±0.07	0.98	810
Wash laundry in cold water	4.29	±0.07	1.00	826
Use water efficient appliances (e.g., dishwashers)	4.27	±0.07	0.96	822
Hang clothes to dry	4.26	±0.08	1.06	815
Take toxic waste to special disposal sites	4.25	±0.07	1.09	807
Use a programmable thermostat to reduce energy use	4.24	±0.08	1.13	805
Wear more clothing to reduce heating costs	4.19	±0.07	1.04	822
Use water saving plumbing fixtures (e.g., low-flow showerheads)	4.16	±0.07	1.06	819
Repair broken items instead of buying new	4.14	±0.07	1.01	825
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	4.12	±0.07	1.02	814
Use Energy Star appliances	4.10	±0.09	1.25	809
Use water saving toilets (e.g., low flow)	4.05	±0.08	1.18	809
Use a high-efficiency furnace/boiler	4.02	±0.08	1.25	774
Use lighting controls (e.g., motion sensors)	3.96	±0.09	1.23	798
Use non-toxic cleaners	3.95	±0.07	1.07	816
Compost organic waste	3.94	±0.09	1.30	806
Use natural ventilation – no air conditioning	3.93	±0.09	1.24	801
Use non-toxic paints when painting your home	3.92	±0.08	1.26	799
Install a water meter	3.58	±0.11	1.48	743
Use a low-maintenance lawn (no water or pesticides)	3.57	±0.09	1.32	802
Use skylights for natural lighting	3.53	±0.11	1.43	757
Plant climate appropriate plants (less irrigation)	3.47	±0.09	1.35	804
Use an environmental heating source (e.g., geothermal, wind, hydroelectric, instead of oil)	3.46	±0.10	1.42	788
Collect rainwater for irrigation and car washing	3.33	±0.10	1.47	794
Reduce lawn area	3.28	±0.10	1.41	785
Install drip garden irrigation to save water	3.04	±0.11	1.50	760
Use garden paving stones to reduce water run-off	2.88	±0.11	1.49	762
Use an on-demand (tankless) water heater	2.82	±0.11	1.54	773

Results about perceived importance of behaviours are presented in Table 33 below.

(1 = not at all important and 5 = very important)

House owners considered recycling to be the most important of the behaviours examined.

Table 33. Descriptive statistics from house owners about perceived importance of environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Recycle (e.g., paper or glass)	4.67	±0.04	0.65	821
Turn off appliances (e.g., lamps) when not in use	4.62	±0.05	0.67	819
Take toxic waste to special disposal sites	4.35	±0.07	1.00	788
Use energy efficient appliances	4.26	±0.06	0.81	827
Increase insulating capability of windows	4.25	±0.07	0.98	794
Winterize windows and doors to prevent drafts	4.25	±0.06	0.95	783
Use energy efficient lighting	4.23	±0.06	0.93	804
Use water efficient appliances (e.g., dishwashers)	4.21	±0.07	0.94	808
Use Energy Star appliances	4.20	±0.08	1.05	771
Set thermostat no higher than 20ºC	4.13	±0.07	1.01	806
Use a programmable thermostat to reduce energy use	4.10	±0.08	1.14	785
Use a high-efficiency furnace/boiler	4.08	±0.08	1.11	750
Wash laundry in cold water	4.07	±0.08	1.07	815
Use compact fluorescent lighting	4.05	±0.07	1.01	820
Use non-toxic paints when painting your home	4.03	±0.08	1.11	783
Repair broken items instead of buying new	3.99	±0.07	1.02	818
Use water saving plumbing fixtures (e.g., low-flow showerheads)	3.98	±0.07	1.10	806
Use non-toxic cleaners	3.91	±0.08	1.04	804
Use water saving toilets (e.g., low flow)	3.90	±0.08	1.16	795
Wear more clothing to reduce heating costs	3.88	±0.08	1.13	813
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	3.84	±0.07	1.11	811
Hang clothes to dry	3.78	±0.09	1.24	803
Use natural ventilation – no air conditioning	3.70	±0.09	1.23	783
Compost organic waste	3.66	±0.09	1.30	787
Use lighting controls (e.g., motion sensors)	3.63	±0.08	1.23	783
Install a water meter	3.55	±0.10	1.38	717
Use a low-maintenance lawn (no water or pesticides)	3.53	±0.09	1.29	794
Plant climate appropriate plants (less irrigation)	3.53	±0.08	1.19	789
Use an environmental heating source (e.g., geothermal, wind, hydroelectric, instead of oil)	3.50	±0.09	1.29	766
Use skylights for natural lighting	3.17	±0.10	1.35	734
Reduce lawn area	3.08	±0.09	1.32	772
Install drip garden irrigation to save water	3.08	±0.10	1.32	730
Collect rainwater for irrigation and car washing	3.10	±0.10	1.36	778
Use garden paving stones to reduce water run-off	2.93	±0.10	1.35	731
Use an on-demand (tankless) water heater	2.91	±0.09	1.31	746

Results about adoption of behaviours are presented below. The frequencies and percentages refer to those house owners who had adopted the specific behaviours.

The most commonly adopted environmental behaviour was recycling, as shown in Table 34.

Table 34. Descriptive statistics from house owners about adoption of environmental behaviours

Environmental behaviours	Frequency (having adopted)	Percentage (having adopted)	n (Sample size)
Recycle (e.g., paper or glass)	731	96.1%	761
Turn off appliances (e.g., lamps) when not in use	733	95.6%	767
Use energy efficient appliances	651	87.7%	742
Repair broken items instead of buying new	621	83.6%	743
Use energy efficient lighting	613	82.2%	746
Take toxic waste to special disposal sites	552	80.7%	684
Use compact fluorescent lighting	590	80.1%	737
Wash laundry in cold water	598	79.3%	754
Use water efficient appliances (e.g., dishwashers)	562	78.2%	719
Winterize windows and doors to prevent drafts	550	77.6%	709
Use Energy Star appliances	535	77.3%	692
Set thermostat no higher than 20ºC	570	76.8%	742
Increase insulating capability of windows	551	76.1%	724
Wear more clothing to reduce heating costs	565	75.9%	744
Use non-toxic paints when painting your home	502	74.4%	675
Use non-toxic cleaners	523	72.5%	721
Use water saving plumbing fixtures (e.g., low-flow showerheads)	520	70.0%	743
Use a programmable thermostat to reduce energy use	450	63.6%	708
Hang clothes to dry	453	61.5%	736
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	434	61.2%	709
Use a high-efficiency furnace/boiler	398	61.2%	650
Use natural ventilation – no air conditioning	424	60.1%	706
Use water saving toilets (e.g., low flow)	430	59.1%	728
Plant climate appropriate plants (less irrigation)	359	55.8%	643
Use lighting controls (e.g., motion sensors)	367	53.7%	683
Compost organic waste	375	53.1%	706
Install a water meter	304	51.2%	594
Use a low-maintenance lawn (no water or pesticides)	310	44.9%	691
Reduce lawn area	271	41.1%	659
Use garden paving stones to reduce water run-off	196	32.4%	605
Use skylights for natural lighting	164	27.4%	598
Collect rainwater for irrigation and car washing	135	20.4%	661
Use an environmental heating source (e.g., geothermal, wind, hydroelectric, instead of oil)	127	20.2%	628
Install drip garden irrigation to save water	105	17.9%	588
Use an on-demand (tankless) water heater	38	6.0%	629

Information from the third column in Table 34 (i.e., percentage of house owners having adopted the various behaviours) is alternatively presented in the following bar chart. The variation in adoption levels is apparent although the majority of behaviours have adoption levels of over 50%.

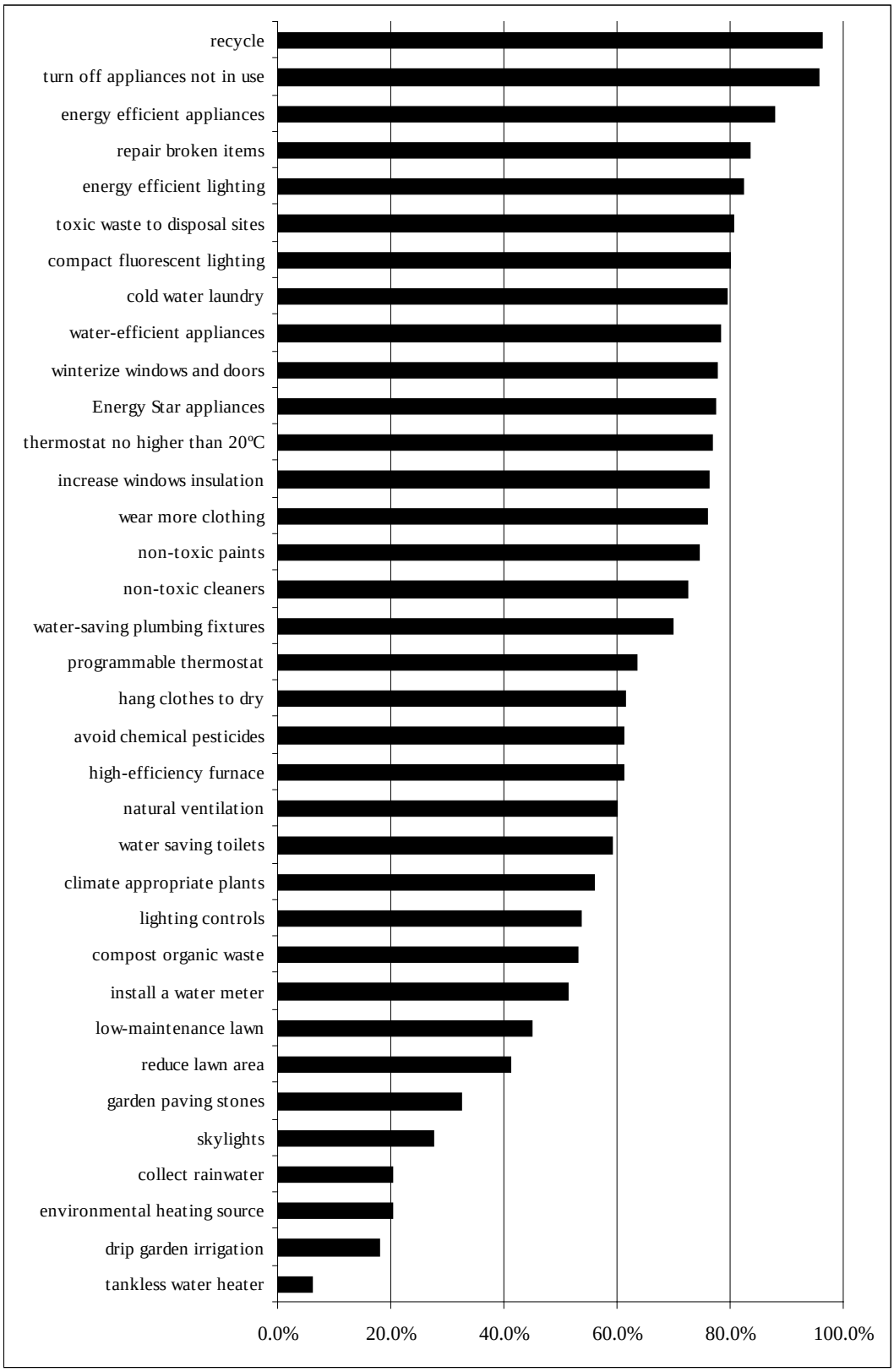

Figure 6. Bar chart showing percentage of house owners having adopted environmental behaviours

Table 35 below was produced to better enable identification of likely discernible trends of groups of behaviours (i.e., groups related to energy conservation, water conservation, waste management and reduction, and use and reduction of toxic materials). Values from percentages of people having adopted the behaviour (taken from Table 34) were averaged for each of these groups. During calculations of these averages, one behaviour (i.e., using a low-maintenance lawn – no water or pesticides –) because of its phrasing was used both in the water conservation and in the toxic materials use groups. Additionally, two groups were created for each of the water conservation, waste management, and toxic materials use categories. One of these groups included all of the behaviours in that category (e.g., all of the behaviours related to water conservation) and the other excluded those behaviours that were related to gardening or exterior uses (this group is referred to as the interior behaviours group in Table 35). Behaviours related to energy conservation were included in one group only as all of them were considered to be relevant to interior household use.

The group of waste management behaviours (excluding behaviours related to gardening or exterior uses) had the highest average adoption level (89.9%) while the group of water conservation (including behaviours related to gardening or exterior uses) had the lowest average adoption level (47.1%). The average adoption level for all of the 35 behaviours examined was 61.6%.

Table 35. Average percentages of house owners having adopted groups of behaviours

Group of behaviours	Number of behaviours	Average percentage of people having adopted
Waste management (interior behaviours)	2	89.9%
Waste management (all behaviours)	3	77.6%
Toxic materials use (interior behaviours)	3	75.9%
Toxic materials use (all behaviours)	5	66.7%
Energy conservation	18	64.6%
Water conservation (interior behaviours)	4	64.6%
Water conservation (all behaviours)	10	47.1%
All behaviours	35	61.6%

Results from question D1 below are from house owners who had renovated their house within the last 12 months from the time of the survey.

Question D1

This question presented respondents (house owners who had renovated their house within the last 12 months from the time of the survey) with a list of environmental behaviours. Participants were asked to state their level of familiarity with the behaviours, their perceived importance, and whether they had adopted or not the behaviours. Results from level of familiarity with behaviours are given below.

(1 = not at all familiar and 5 = very familiar)

House renovators were most familiar with insulating windows and doors to reduce drafts, as shown in Table 36.

Table 36. Descriptive statistics from house owners who had renovated their house about familiarity with environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Insulate windows and doors to reduce drafts	4.58	±0.12	0.70	125
Switch to more insulating windows	4.55	±0.14	0.81	131
Improve insulation in ceilings, floors, and walls	4.50	±0.15	0.85	123
Switch to compact fluorescent light bulbs, if possible	4.48	±0.16	0.92	138
Replace old appliances with more energy-efficient ones	4.47	±0.16	0.92	126
Switch to a programmable thermostat to reduce energy use	4.47	±0.16	0.91	125
Switch to energy efficient appliances	4.46	±0.15	0.82	125
Replace heating equipment with more energy-efficient models	4.46	±0.17	0.98	121
Switch to water saving toilets (e.g., low flow)	4.36	±0.17	0.97	128
Switch to water saving plumbing fixtures (e.g., low-flow showerheads)	4.35	±0.18	1.01	127
Switch to more water efficient appliances	4.29	±0.17	0.95	122
Use materials that require little maintenance	4.26	±0.17	0.96	128
Switch to a high-efficiency furnace/boiler	4.26	±0.21	1.13	111
Switch to more environmental heating sources (e.g., oil to natural gas or gas to renewable such as geothermal, wind, and hydroelectric)	4.00	±0.23	1.24	110
Use non-toxic paints when painting your home	3.97	±0.21	1.23	134
Deconstruct rather than demolish portions of the house to be remodelled	3.83	±0.24	1.34	121
Switch to natural ventilation – no air conditioning	3.82	±0.24	1.35	119
Install skylights for natural lighting	3.78	±0.26	1.39	112
Use local building materials (from no further than 500 miles from your home)	3.74	±0.23	1.34	129
Use recycled building materials	3.73	±0.24	1.36	120
Plant climate appropriate plants (less irrigation)	3.55	±0.27	1.48	120
Reduce lawn area	3.50	±0.28	1.48	115
Select building materials produced in a sustainable manner (e.g. using fair trade imported materials)	3.36	±0.26	1.47	118
Avoid using wood from old-growth trees or high conservation areas	3.34	±0.30	1.61	113
Switch to an instantaneous or on-demand (tankless) water heater	3.28	±0.27	1.49	116

Results about perceived importance of behaviours are presented below.

(1 = not at all important and 5 = very important)

The environmental behaviour perceived to be the most important by house renovators was improving insulation in ceilings, floors, and walls, as shown in Table 37.

Table 37. Descriptive statistics from house owners who had renovated their house about perceived importance of environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Improve insulation in ceilings, floors, and walls	4.59	±0.14	0.77	121
Insulate windows and doors to reduce drafts	4.56	±0.14	0.79	122
Replace heating equipment with more energy-efficient models	4.53	±0.16	0.86	118
Switch to more insulating windows	4.51	±0.16	0.89	126
Replace old appliances with more energy-efficient ones	4.47	±0.16	0.90	127
Switch to a programmable thermostat to reduce energy use	4.40	±0.17	0.96	121
Use materials that require little maintenance	4.39	±0.16	0.86	127
Switch to compact fluorescent light bulbs, if possible	4.39	±0.16	0.92	134
Switch to energy efficient appliances	4.35	±0.17	0.98	124
Switch to water saving toilets (e.g., low flow)	4.34	±0.18	1.04	126
Switch to water saving plumbing fixtures (e.g., low-flow showerheads)	4.29	±0.19	1.05	125
Switch to a high-efficiency furnace/boiler	4.23	±0.23	1.19	110
Switch to more water efficient appliances	4.23	±0.20	1.07	120
Use non-toxic paints when painting your home	4.11	±0.18	1.07	133
Switch to more environmental heating sources (e.g., oil to natural gas or gas to renewable such as geothermal, wind, and hydroelectric)	4.02	±0.23	1.18	109
Use local building materials (from no further than 500 miles from your home)	3.86	±0.21	1.23	125
Deconstruct rather than demolish portions of the house to be remodelled	3.76	±0.22	1.19	117
Use recycled building materials	3.76	±0.22	1.24	118
Avoid using wood from old-growth trees or high conservation areas	3.74	±0.24	1.30	112
Switch to natural ventilation – no air conditioning	3.67	±0.24	1.29	115
Plant climate appropriate plants (less irrigation)	3.62	±0.23	1.28	116
Select building materials produced in a sustainable manner (e.g. using fair trade imported materials)	3.59	±0.23	1.28	116
Install skylights for natural lighting	3.56	±0.27	1.37	108
Switch to an instantaneous or on-demand (tankless) water heater	3.51	±0.25	1.33	111
Reduce lawn area	3.43	±0.27	1.44	111

Results about adoption of behaviours are given below. The frequencies and percentages are for those who had adopted the specific behaviours.

The most commonly adopted environmental behaviour by house owners during renovations was using materials that require little maintenance, as shown in Table 38.

Table 38. Descriptive statistics from house owners who had renovated their house about adoption of environmental behaviours

Environmental behaviours	Frequency (having adopted)	Percentage (having adopted)	n (Sample size)
Use materials that require little maintenance	109	94.0%	116
Insulate windows and doors to reduce drafts	99	92.5%	107
Switch to compact fluorescent light bulbs, if possible	115	88.5%	130
Replace old appliances with more energy-efficient ones	97	85.8%	113
Switch to energy efficient appliances	93	84.5%	110
Switch to more insulating windows	98	84.5%	116
Improve insulation in ceilings, floors, and walls	86	81.1%	106
Switch to water saving toilets (e.g., low flow)	87	79.8%	109
Switch to water saving plumbing fixtures (e.g., low-flow showerheads)	88	78.6%	112
Switch to more water efficient appliances	78	75.7%	103
Deconstruct rather than demolish portions of the house to be remodelled	76	75.2%	101
Switch to a programmable thermostat to reduce energy use	75	74.3%	101
Use non-toxic paints when painting your home	89	74.2%	120
Replace heating equipment with more energy-efficient models	67	70.5%	95
Use local building materials (from no further than 500 miles from your home)	71	65.7%	108
Switch to a high-efficiency furnace/boiler	47	64.4%	73
Use recycled building materials	63	59.4%	106
Avoid using wood from old-growth trees or high conservation areas	43	57.3%	75
Plant climate appropriate plants (less irrigation)	46	51.7%	89
Switch to natural ventilation – no air conditioning	43	48.9%	88
Select building materials produced in a sustainable manner (e.g. using fair trade imported materials)	42	43.8%	96
Reduce lawn area	36	43.4%	83
Switch to more environmental heating sources (e.g., oil to natural gas or gas to renewable such as geothermal, wind, and hydroelectric)	33	40.2%	82
Install skylights for natural lighting	16	20.8%	77
Switch to an instantaneous or on-demand (tankless) water heater	3	3.9%	77

Results from section E of the questionnaire follow. They pertain to house owners having built or purchased a house in the past 12 months from the time of the survey.

Question E1

Did you build or purchase a house in the past 12 months?

Of those house owners who built or purchased a house, most had purchased rather than built one, as shown in Table 39.

Table 39. Descriptive statistics from house owners about whether they built or purchased a house

Built/purchased a house	Frequency	Percentage
I purchased a house in the past 12 months	29	93.5%
I built a house in the past 12 months	2	6.5%
TOTAL	31	100.0%

Question E2

This question presented respondents (house owners who had built or purchased a house within the last 12 months from the time of the survey) with a list of environmental behaviours. Respondents were asked to state their level of familiarity with the behaviours, their perceived importance, and whether they had adopted or not the behaviours.

Results from level of familiarity are given below.

(1 = not at all familiar and 5 = very familiar)

House owners who had built or purchased a house within the last 12 months from the time of the survey were most familiar with building or purchasing a house with well insulated windows, as shown in Table 40.

Table 40. Descriptive statistics from house owners who had built or purchased a house within the last 12 months from the time of the survey about familiarity with environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Build or purchase a house with well insulated windows	4.43	±0.17	0.83	93
Choose a location that minimizes transportation needs (e.g., close to work, school, shopping)	4.24	±0.20	1.00	90
Landscaping to provide shadow and windbreaks	4.05	±0.25	1.14	86
Avoid building on ecologically sensitive areas (e.g., wetlands)	4.04	±0.27	1.23	82
Take steps to protect the natural environment of the site (e.g., water flows, large trees, etc.)	4.01	±0.24	1.12	89
Build or purchase a house that has a high-efficiency furnace/boiler	3.95	±0.25	1.18	86
Build or purchase a house that has water saving toilets (e.g., low flow)	3.89	±0.26	1.20	89
Use building materials that need little maintenance	3.86	±0.25	1.22	92
Plant climate appropriate plants (less irrigation)	3.74	±0.26	1.20	88
Build or purchase a house that has natural ventilation – no air conditioning	3.73	±0.25	1.19	91
Build or purchase a house that uses more environmental heating sources (e.g., geothermal, wind, hydroelectric, and natural gas instead of oil)	3.60	±0.29	1.35	89
Build or purchase a house with reduced lawn area	3.56	±0.27	1.28	91
Select a house or contractor that was environmentally friendly	3.44	±0.30	1.41	88
Minimize building material use	3.42	±0.29	1.36	85
Minimize area of house per resident	3.31	±0.30	1.43	89
Build or purchase a house that has skylights for natural lighting	3.30	±0.32	1.49	87
Build or purchase a house that has local building materials (from no further than 500 miles from your home)	3.18	±0.33	1.54	87
Use recycled building materials	3.08	±0.32	1.49	89
Select building materials produced in a sustainable manner (e.g., fair trade imported materials)	3.07	±0.31	1.42	85
Avoid using wood from old-growth trees or high conservation areas	2.90	±0.32	1.50	84

Results from level about perceived importance are given below.

(1 = not at all important and 5 = very important)

House owners perceived building or purchasing a house with well insulated windows as the most important behaviour when they were building or purchasing their house, as shown in Table 41.

Table 41. Descriptive statistics from house owners who had built or purchased a house within the last 12 months from the time of the survey about perceived importance of environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Build or purchase a house with well insulated windows	4.50	±0.16	0.76	94
Use building materials that need little maintenance	4.19	±0.20	1.00	93
Take steps to protect the natural environment of the site (e.g., water flows, large trees, etc.)	4.16	±0.20	0.96	85
Avoid building on ecologically sensitive areas (e.g., wetlands)	4.14	±0.25	1.17	83
Landscaping to provide shadow and windbreaks	4.07	±0.21	0.98	86
Choose a location that minimizes transportation needs (e.g., close to work, school, shopping)	4.05	±0.21	1.03	92
Build or purchase a house that has a high-efficiency furnace/boiler	3.93	±0.25	1.17	86
Plant climate appropriate plants (less irrigation)	3.86	±0.24	1.12	86
Build or purchase a house that uses more environmental heating sources (e.g., geothermal, wind, hydroelectric, and natural gas instead of oil)	3.74	±0.27	1.23	87
Select a house or contractor that was environmentally friendly	3.71	±0.26	1.24	87
Build or purchase a house that has water saving toilets (e.g., low flow)	3.71	±0.25	1.22	90
Minimize building material use	3.59	±0.27	1.23	83
Build or purchase a house that has natural ventilation – no air conditioning	3.55	±0.26	1.25	91
Build or purchase a house that has local building materials (from no further than 500 miles from your home)	3.49	±0.29	1.37	83
Avoid using wood from old-growth trees or high conservation areas	3.48	±0.31	1.35	80
Select building materials produced in a sustainable manner (e.g., fair trade imported materials)	3.44	±0.28	1.27	82
Use recycled building materials	3.34	±0.27	1.26	89
Build or purchase a house with reduced lawn area	3.34	±0.28	1.34	91
Minimize area of house per resident	3.19	±0.30	1.37	86
Build or purchase a house that has skylights for natural lighting	3.16	±0.29	1.36	86

Results about adoption of behaviours are given below. The frequencies and percentages are for participants who had adopted the specific behaviours.

The environmental behaviour adopted with the highest frequency by house owners who built or purchased a house was building or purchasing a house with well insulated windows, as shown in Table 42.

Table 42. Descriptive statistics from house owners who had built or purchased a house within the last 12 months from the time of the survey about adoption of environmental behaviours

Environmental behaviours	Frequency (having adopted)	Percentage (having adopted)	n (Sample size)
Build or purchase a house with well insulated windows	70	89.7%	78
Take steps to protect the natural environment of the site (e.g., water flows, large trees, etc.)	51	89.5%	57
Use building materials that need little maintenance	56	83.6%	67
Landscaping to provide shadow and windbreaks	55	82.1%	67
Choose a location that minimizes transportation needs (e.g., close to work, school, shopping)	61	79.2%	77
Plant climate appropriate plants (less irrigation)	48	73.8%	65
Avoid building on ecologically sensitive areas (e.g., wetlands)	28	71.8%	39
Minimize building material use	33	70.2%	47
Build or purchase a house that has local building materials (from no further than 500 miles from your home)	36	64.3%	56
Build or purchase a house that has a high-efficiency furnace/boiler	41	63.1%	65
Build or purchase a house with reduced lawn area	42	58.3%	72
Build or purchase a house that has water saving toilets (e.g., low flow)	39	53.4%	73
Build or purchase a house that uses more environmental heating sources (e.g., geothermal, wind, hydroelectric, and natural gas instead of oil)	35	52.2%	67
Build or purchase a house that has natural ventilation – no air conditioning	38	52.1%	73
Select a house or contractor that was environmentally friendly	28	49.1%	57
Minimize area of house per resident	26	44.1%	59
Select building materials produced in a sustainable manner (e.g., fair trade imported materials)	17	38.6%	44
Avoid using wood from old-growth trees or high conservation areas	15	35.7%	42
Use recycled building materials	16	30.2%	53
Build or purchase a house that has skylights for natural lighting	17	27.4%	62

Results from the remaining sections of the questionnaire follow. These results pertain to either house owners and house renters collectively or house renters exclusively.

4.2.2.2. Miscellaneous results

Presentation of results for house owners and house renters combined starts with demographic information (from section F of the questionnaire) and then it continues with results from section A (various factors determining environmental behaviours, such as personal values and attitudes). Finally, results from section C (familiarity, perceived importance, and adoption of environmental behaviours) for house renters

are provided. Some of the results in the previous section (4.2.2.1.) that were for house owners exclusively are repeated for house owners and house renters collectively or for house renters exclusively, as indicated.

Request to receive a copy of the results

Out of 1027 respondents (house owners and house renters) 56 (5.5%) asked to receive a copy of the study's results.

Provinces of respondents

As shown in Table 43, most responses came from Ontario with Quebec being the next most frequent Province of respondents. No responses were collected from the Territory of Nunavut.

Table 43. Number of responses collected from house owners and renters per Province or Territory

Province	Frequency	Percentage	Actual percentage in 2007*
Ontario	393	38.3%	38.9%
Quebec	214	20.8%	23.3%
British Columbia	158	15.4%	13.1%
Alberta	130	12.7%	10.7%
Manitoba	36	3.5%	3.6%
Saskatchewan	30	2.9%	3.0%
Nova Scotia	25	2.4%	2.8%
New Brunswick	18	1.8%	2.3%
Newfoundland and Labrador	12	1.2%	1.5%
Prince Edward Island	5	0.5%	0.4%
Yukon	4	0.4%	0.1%
Northwest Territories	2	0.2%	0.1%
Nunavut	0	0.0%	0.1%
TOTAL	1027	100.0%	100.0%

* Source: Statistics Canada, 2009b.

Question F1: Indicate your gender.

About three out of four respondents were male, as shown in Table 44.

Table 44. Descriptive statistics from house owners and renters about gender

Gender	Frequency	Percentage
Male	769	76.6%
Female	235	23.4%
TOTAL	1004	100.0%

Question F2: What is your current age?

The most common age group of respondents was from 51 to 60 years old, as shown in Table 45.

Table 45. Descriptive statistics from house owners and renters about age

Age group	Frequency	Percentage
51 – 60	282	27.9%
41 – 50	228	22.6%
61 – 70	214	21.2%
71 or more	158	15.6%
31 – 40	86	8.5%
21 – 30	42	4.2%
20 or younger	0	0.0%
TOTAL	1010	100.0%

Question F3: What is your highest educational level attained?

The most commonly reported educational level was college or university graduate, as shown in Table 46.

Table 46. Descriptive statistics from house owners and renters about education

Educational level	Frequency	Percentage
College or university graduate	262	26.7%
High school diploma	160	16.3%
Vocational or tech school	143	14.6%
Some college or university	130	13.3%
Some high school	121	12.3%
Master's degree	100	10.2%
Some graduate work	38	3.9%
Ph.D.	26	2.7%
TOTAL	980	100.0%

Question F4: Indicate your individual 2006 annual income before taxes.

The most frequent group of individual annual income before taxes for 2006 was from $20,000 to $39,000, as shown in Table 47.

Table 47. Descriptive statistics from house owners and renters about individual income

Income group	Frequency	Percentage
$20,000 to $39,999	229	25.9%
$40,000 to $59,999	209	23.6%
$60,000 to $79,999	145	16.4%
$100,000 or more	128	14.5%
Less than $20,000	91	10.3%
$80,000 to $99,999	82	9.3%
TOTAL	884	100.0%

Question F5: Indicate your 2006 family income before taxes.

The most frequent group of family income before taxes for 2006 was from $40,000 to $79,999, as shown in Table 48.

Table 48. Descriptive statistics from house owners and renters about family income

Income group	Frequency	Percentage
$40,000 to $79,999	311	35.1%
$80,000 to $119,999	199	22.5%
Less than $40,000	179	20.2%
$120,000 to $159,999	112	12.6%
$160,000 or more	85	9.6%
TOTAL	886	100.0%

Question F6: What is your current type of residence?

The most frequent type of residence was a detached house, as shown in Table 49.

Table 49. Descriptive statistics from house owners and renters about residence type

Residence type	Frequency	Percentage
Detached house	772	78.1%
Apartment	83	8.4%
Duplex (Attached) house	81	8.2%
Town house	53	5.4%
TOTAL	989	100.0%

Question F7: What is the ownership status of your current residence?

The most common ownership status for respondents was to own their house, as shown in Table 50.

Table 50. Descriptive statistics from house owners and renters about residence ownership status

Ownership status	Frequency	Percentage
Own	895	88.9%
Rent	112	11.1%
Neither rent or own (e.g., live with friends or family)	0	0.0%
TOTAL	1007	100.0%

Question F8: What is the size of your current house?

The most common house size was from 1200 ft^2 to 1799 ft^2, as shown in Table 51.

Table 51. Descriptive statistics from house owners and renters about house size

House size group	Frequency	Percentage
1200 ft^2 to 1799 ft^2	325	33.4%
800 ft^2 to 1199 ft^2	275	28.2%
1800 ft^2 to 2199 ft^2	136	14.0%
2200 ft^2 to 2599 ft^2	82	8.4%
400 ft^2 to 799 ft^2	61	6.3%
3000 ft^2 or more	54	5.5%
2600 ft^2 to 2999 ft^2	41	4.2%
TOTAL	974	100.0%

Question F9: What is the type of your current residential environment?

The most common residential environment of respondents was suburban, as shown in Table 52.

Table 52. Descriptive statistics from house owners and renters about residential environment

Environment type	Frequency	Percentage
Suburban	396	40.2%
Urban	366	37.2%
Rural	142	14.4%
Downtown	81	8.2%
TOTAL	985	100.0%

Question F10: What is your marital status?

The majority of respondents were married, as shown in Table 53.

Table 53. Descriptive statistics from house owners and renters about marital status

Marital status	Frequency	Percentage
Married	744	74.9%
Common-law partner	79	8.0%
Never married	70	7.0%
Divorced	49	4.9%
Widowed	34	3.4%
Separated	17	1.7%
TOTAL	993	100.0%

Question F11: How many people, including yourself, live in your current house?

The most frequent number of people living in respondents' houses was two, as shown in Table 54.

Table 54. Descriptive statistics from house owners and renters about number of people in the house

Number of people	Frequency	Percentage
2 persons	459	45.6%
4 persons	177	17.6%
3 persons	158	15.7%
1 person	120	11.9%
5 persons	59	5.9%
More than 5 persons	33	3.3%
TOTAL	1006	100.0%

Question F12: How many children under 19 live in your current house?

The majority of respondents did not have any children under 19 living in their houses, as shown in Table 55.

Table 55. Descriptive statistics from house owners and renters about number of children in the house

Number of children	Frequency	Percentage
No children	689	69.9%
2 children	129	13.1%
1 child	125	12.7%
3 children	33	3.4%
4 children	9	0.9%
5 children	0	0.0%
More than 5 children	0	0.0%
TOTAL	985	100.0%

Question F13: What is your stand on political issues?

As shown in Table 56, the most common stand on political issues for respondents was moderate. This question along with Question F4 about individual income and Question F5 about family income were completed by the lowest number of respondents (872, 884, and 886, respectively) among demographic questions. The number of respondents who failed to complete this question was 155.

Table 56. Descriptive statistics from house owners and renters about stand on political issues

Political stand	Frequency	Percentage
Moderate	232	26.6%
Moderate to liberal	185	21.2%
Moderate to conservative	182	20.9%
Liberal	153	17.5%
Conservative	120	13.8%
TOTAL	872	100.0%

Question F14: How useful are the following methods for finding information about green building/housing practices.

(1 = not at all useful, 4 = neutral, 7 = very useful)

Television shows were considered to be the most useful method for finding information about green building/housing practices, as shown in Table 57. Additionally, a small number of respondents reported methods other than those in the original questionnaire as useful. These methods (not shown in Table 57) included:

- Studies, seminars, workshops, and research articles (mean value = 6.40, 95% confidence intervals = 0.69, standard deviation = 0.97, and n = 10)
- Miscellaneous (mean value = 6.33, 95% confidence intervals = 1.27, standard deviation = 1.21, and n = 6)
- Private businesses (mean value = 6.10, 95% confidence intervals = 0.50, standard deviation = 1.07, and n = 20)
- Government and utility publications (mean value = 6.08, 95% confidence intervals = 0.99, standard deviation = 1.56, and n = 12)

Table 57. Descriptive statistics from house owners and renters about usefulness of various methods for finding information about green building/housing practices

Method for finding information	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Television shows	5.14	±0.10	1.54	961
Newspaper articles	4.90	±0.11	1.64	970
Magazines	4.71	±0.10	1.62	952
Advice from friends or relatives	4.68	±0.10	1.57	955
Books	4.61	±0.10	1.67	936
Specific websites	4.41	±0.13	2.07	919
Television advertisements	4.40	±0.12	1.80	942
Radio programs	4.15	±0.11	1.74	950
Exhibitions	4.05	±0.12	1.80	933
Radio advertisements	3.69	±0.11	1.74	931
Online newsletters	3.50	±0.11	1.79	914
Billboards	3.12	±0.11	1.72	916

Question A1: How familiar are you with the following?

(1 = not at all familiar and 5 = very familiar)

Respondents appeared somewhat familiar with environmental problems, as shown in Table 58.

Table 58. Descriptive statistics from house owners and renters about familiarity with environmental problems

Environmental problems	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Within your Province	3.54	±0.06	0.95	1002
In the world	3.47	±0.06	0.95	965

Question A2: Have you personally witnessed human made environmental disasters?

(1 = never and 5 = many times)

Respondents had not personally witnessed human made environmental disasters many times, as shown in Table 59.

Table 59. Descriptive statistics from house owners and renters about having witnessed human made environmental disasters

Environmental disasters	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
In your Province	2.34	±0.08	1.31	981
In the world	2.16	±0.09	1.36	946

Question A3: How often did you spend time in nature within the last 12 months?

The majority of respondents spent time in nature at least once a week or once a month, as shown in Table 60.

Table 60. Descriptive statistics from house owners and renters about frequency of nature visits

Nature visits frequency	Frequency	Percentage
At least once a week	435	43.0%
At least once a month	269	26.6%
Once in three months	119	11.8%
Once in six months	84	8.3%
Once a year	63	6.2%
Not once	42	4.2%
TOTAL	1012	100.0%

Question A4: How familiar are you with media campaigns (e.g. TV, print, etc.) that promote each of the following?

(1 = not at all familiar and 5 = very familiar)

Results indicated that respondents were, in general, familiar with the various types of media campaigns, as shown in Table 61.

Table 61. Descriptive statistics from house owners and renters about familiarity with media campaigns

Type of campaigns	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Conserving energy	4.03	±0.06	0.93	1013
Minimizing waste material	3.91	±0.06	1.02	1014
Conserving water	3.80	±0.07	1.10	1014
Protecting surrounding ecosystems	3.50	±0.07	1.13	1009

Question A5: How much impact on the environment on each of the following do you think the activities in your house may have?

(1 = my activities have no impact and 7 = my activities have a major impact)

Respondents perceived their housing activities as having a certain (but not major) impact on the environment, as shown in Table 62.

Table 62. Descriptive statistics from house owners and renters about perceived impact on the environment of various activities

Group of activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Minimizing waste material	4.97	±0.10	1.61	1008
Conserving water	4.72	±0.10	1.67	1005
Conserving energy	4.71	±0.10	1.58	1004
Protecting surrounding ecosystems	4.58	±0.11	1.78	999

Question A6: How much are your environmental actions on each of the following influenced by your neighbours, friends, or relatives?

(1 = not at all influenced and 7 = very heavily influenced)

Respondents felt their environmental actions were not very much influenced by their neighbours, friends, or relatives, as shown in Table 63.

Table 63. Descriptive statistics from house owners and renters about influence from others on various groups of environmental activities

Group of activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Minimizing waste material	2.90	±0.11	1.83	999
Conserving water	2.78	±0.11	1.75	998
Conserving energy	2.77	±0.11	1.74	1005
Protecting surrounding ecosystems	2.77	±0.11	1.75	997

Question A7: Please indicate how convenient is it for you to perform each of the following?

(1 = very inconvenient and 5 = very convenient)

Performing the environmental actions examined was thought, in general, to be convenient by survey participants, as shown in Table 64.

Table 64. Descriptive statistics from house owners and renters about perceived convenience to perform various environmental activities

Environmental activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Recycle (e.g., paper, glass)	4.43	±0.05	0.91	977
Turn off appliances (e.g., computers, lamps) when not using them	4.41	±0.06	0.87	977
Use energy efficient appliances	3.94	±0.07	1.05	948
Use water saving plumbing fixtures (e.g., low-flow showerheads)	3.87	±0.07	1.11	947
Use water efficient appliances	3.72	±0.08	1.12	922
Use non-toxic cleaners	3.67	±0.07	1.04	959
Repair things that are broken instead of buying new	3.66	±0.07	1.17	980
Take toxic waste to special disposal sites	3.50	±0.09	1.42	917

Question A8: How important are the following to you?

(1 = not at all important and 7 = extremely important)

All categories of environmental activities examined were found to be important by respondents with conserving energy being the most important, as shown in Table 65.

Table 65. Descriptive statistics from house owners and renters about perceived importance of groups of environmental activities

Group of environmental activities	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Conserving energy	6.05	±0.07	1.15	1006
Protecting surrounding ecosystems	5.85	±0.08	1.32	1004
Minimizing waste material	5.72	±0.08	1.32	1006
Conserving water	5.70	±0.09	1.39	1007

Question A9

This is the question with the standardised scale Brief Inventory of Values scale (Stern et al., 1998) to measure four value categories:

- Self-transcendence values, measured both by three and six items
- Self-enhancement values, measured by the three items

- Conservation values, measured by the three items
- Openness to change values, measured by the three items

Descriptive statistics were calculated for aggregate scores in each category obtained by summing the three items and, additionally, by summing the six items in the case of self-transcendence values. The possible range for three item sums is from 3 (in which case the respondent was opposed to the value category) to 15 (in which case the respondent felt the value category was extremely important in his/her life) while for six item sums it is from 6 to 30.

Among the four value categories measured by three items, conservation values received the highest score, as shown in Table 66.

Table 66. Descriptive statistics from house owners and renters about Brief Inventory of Values scale

Value category	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Self-transcendence values (six items sum)	27.26	±0.22	3.41	927
Conservation values (three items sum)	13.91	±0.09	1.42	962
Self-transcendence values (three items sum)	13.88	±0.11	1.76	963
Openness to change values (three items sum)	12.28	±0.14	2.13	960
Self-enhancement values (three items sum)	10.75	±0.14	2.17	894

Question A10

This is the question with the standardised scale Postmaterialism Index scale (Blake, 2001) that measured materialist and post materialist values. As in question A9, scores were summed for each value category. Subsequently, since materialist values were measured using six items and post materialist values were measured using five items, sum scores were adjusted so that a scale that ranged from zero (no priority for the specific value) to one (high priority for the specific value) was produced.

Post materialist values were slightly higher among respondents compared to materialist values, as shown in Table 67.

Table 67. Descriptive statistics from house owners and renters about Postmaterialism Index scale

Value category	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Post materialist values (five items sum adjusted to 0 – 1 range)	0.78	±0.01	0.19	971
Materialist values (six items sum adjusted to 0 – 1 range)	0.74	±0.01	0.17	943

Question A11

This is the question that measured agreement with the New Environmental Paradigm (NEP) (Dunlap and Van Liere, 1978). An aggregate NEP score was produced by summing the twelve items and descriptive statistics were calculated for the variable NEP score. Before summation of items, scores for negatively worded ones were reversed (Streiner, 2003). The possible range for NEP score is from 12 (strong disagreement with the NEP) to 48 (strong agreement with the NEP).

In general, respondents showed agreement with the NEP, as shown in Table 68.

Table 68. Descriptive statistics from house owners and renters about the NEP scale

	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
NEP score	38.69	±0.36	5.30	847

Question C1

This question presented respondents (house renters) with a list of environmental behaviours. Respondents were asked to state their level of familiarity with the behaviours, their perceived importance, and whether they had adopted or not the behaviours.

Results from level of familiarity with environmental behaviours are given below.

(1 = not at all familiar and 5 = very familiar)

The environmental behaviour house renters were most familiar with was turning off appliances when not in use, as shown in Table 69.

Table 69. Descriptive statistics from house renters about familiarity with environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Turn off appliances (e.g., lamps) when not in use	4.76	±0.11	0.52	95
Recycle (e.g., paper or glass)	4.60	±0.17	0.82	91
Set thermostat no higher than 20ºC	4.43	±0.17	0.80	94
Winterize windows and doors to prevent drafts	4.33	±0.21	1.00	88
Wash laundry in cold water	4.32	±0.22	1.03	92
Use energy efficient lighting	4.24	±0.20	0.95	89
Wear more clothing to reduce heating costs	4.23	±0.20	0.98	94
Use water saving plumbing fixtures (e.g., low-flow showerheads)	4.22	±0.21	0.99	86
Hang clothes to dry	4.17	±0.24	1.14	90
Use energy efficient appliances	4.14	±0.20	0.97	93
Use water efficient appliances (e.g., dishwashers)	4.13	±0.24	1.12	86
Use compact fluorescent lighting	4.13	±0.24	1.18	91
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	4.06	±0.23	1.05	88
Use a programmable thermostat to reduce energy use	4.02	±0.27	1.27	84
Use non-toxic cleaners	4.01	±0.23	1.11	90
Take toxic waste to special disposal sites	3.98	±0.27	1.25	85
Repair broken items instead of buying new	3.96	±0.24	1.13	92
Use non-toxic paints when painting your home	3.94	±0.29	1.31	83
Use Energy Star appliances	3.80	±0.32	1.51	88
Use lighting controls (e.g., motion sensors)	3.75	±0.30	1.40	88
Use a low-maintenance lawn (no water or pesticides)	3.43	±0.33	1.45	76
Compost organic waste	3.38	±0.31	1.53	91
Reduce lawn area	3.29	±0.34	1.51	75
Plant climate appropriate plants (less irrigation)	3.18	±0.32	1.49	83
Use garden paving stones to reduce water run-off	3.14	±0.36	1.55	73
Collect rainwater for irrigation and car washing	3.11	±0.34	1.56	85
Install drip garden irrigation to save water	3.08	±0.36	1.58	75

Results about perceived importance of behaviours follow.

(1 = not at all important and 5 = very important)

Turning off appliances when not in use was considered to be the most important environmental behaviour by house renters, as shown in Table 70.

Table 70. Descriptive statistics from house renters about perceived importance of environmental behaviours

Environmental behaviours	Mean value	95% Confidence intervals	Standard deviation	n (Sample size)
Turn off appliances (e.g., lamps) when not in use	4.61	±0.15	0.73	92
Recycle (e.g., paper or glass)	4.52	±0.19	0.88	89
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	4.26	±0.24	1.05	82
Use energy efficient appliances	4.23	±0.19	0.87	87
Wash laundry in cold water	4.23	±0.22	1.03	87
Take toxic waste to special disposal sites	4.23	±0.25	1.11	80
Use water efficient appliances (e.g., dishwashers)	4.22	±0.22	1.00	83
Use water saving plumbing fixtures (e.g., low-flow showerheads)	4.19	±0.24	1.09	84
Winterize windows and doors to prevent drafts	4.19	±0.25	1.15	85
Use energy efficient lighting	4.17	±0.20	0.97	86
Use non-toxic cleaners	4.16	±0.23	1.07	86
Set thermostat no higher than 20°C	4.09	±0.24	1.13	88
Use non-toxic paints when painting your home	4.05	±0.26	1.19	80
Use compact fluorescent lighting	4.02	±0.23	1.10	85
Use Energy Star appliances	4.02	±0.29	1.33	82
Wear more clothing to reduce heating costs	4.00	±0.23	1.11	89
Use a programmable thermostat to reduce energy use	4.00	±0.27	1.21	81
Hang clothes to dry	3.88	±0.27	1.25	85
Repair broken items instead of buying new	3.85	±0.24	1.17	89
Use lighting controls (e.g., motion sensors)	3.65	±0.28	1.26	83
Use a low-maintenance lawn (no water or pesticides)	3.55	±0.32	1.39	74
Plant climate appropriate plants (less irrigation)	3.53	±0.30	1.33	80
Compost organic waste	3.48	±0.29	1.34	86
Install drip garden irrigation to save water	3.33	±0.35	1.50	72
Reduce lawn area	3.21	±0.34	1.43	71
Use garden paving stones to reduce water run-off	3.13	±0.34	1.44	71
Collect rainwater for irrigation and car washing	3.06	±0.34	1.55	80

Results about adoption of behaviours are given below. The frequencies and percentages are for respondents who had adopted the specific behaviours.

Frequency of adopting environmental behaviours for house renters varied substantially between 93.0% for turning off appliances when not in use to 14.3% for installing drip garden irrigation to save water, as shown in Table 71.

Table 71. Descriptive statistics from house renters about adoption of environmental behaviours

Environmental behaviours	Frequency (having adopted)	Percentage (having adopted)	n (Sample size)
Turn off appliances (e.g., lamps) when not in use	80	93.0%	86
Recycle (e.g., paper or glass)	79	92.9%	85
Set thermostat no higher than 20ºC	69	84.1%	82
Wash laundry in cold water	68	81.9%	83
Wear more clothing to reduce heating costs	66	80.5%	82
Repair broken items instead of buying new	61	76.3%	80
Use energy efficient appliances	52	75.4%	69
Use energy efficient lighting	56	72.7%	77
Use non-toxic paints when painting your home	41	71.9%	57
Winterize windows and doors to prevent drafts	47	71.2%	66
Use non-toxic cleaners	61	70.9%	86
Use water saving plumbing fixtures (e.g., low-flow showerheads)	50	69.4%	72
Use compact fluorescent lighting	54	69.2%	78
Take toxic waste to special disposal sites	41	67.2%	61
Avoid the use of chemical pesticides, herbicides, or fertilizers (use natural products only)	39	66.1%	59
Use water efficient appliances (e.g., dishwashers)	42	66.7%	63
Use Energy Star appliances	40	63.5%	63
Hang clothes to dry	48	60.8%	79
Use a programmable thermostat to reduce energy use	29	51.8%	56
Use a low-maintenance lawn (no water or pesticides)	16	45.7%	35
Reduce lawn area	15	45.5%	33
Use lighting controls (e.g., motion sensors)	22	39.3%	56
Plant climate appropriate plants (less irrigation)	19	38.0%	50
Use garden paving stones to reduce water run-off	10	32.3%	31
Compost organic waste	17	25.8%	66
Collect rainwater for irrigation and car washing	9	16.7%	54
Install drip garden irrigation to save water	5	14.3%	35

Table 72 below was created in a fashion similar to the one used to produce Table 35 (see section 4.2.2.1.) by averaging percentage values from Table 71. Table 72 presents average adoption levels from house renters for groups of behaviours (i.e., groups related to energy conservation, water conservation, waste management and reduction, and use and reduction of toxic materials).

The group of waste management behaviours (excluding behaviours related to gardening or exterior uses) had the highest average adoption level (84.6%) while the group of water conservation (including behaviours related to gardening or exterior uses) had the lowest average adoption level (41.1%). The average adoption level for all of the 27 behaviours that were specific to house renters was 60.9%.

Table 72. Average percentages of house renters having adopted groups of behaviours

Group of behaviours	Number of behaviours	Average percentage of people having adopted
Waste management (interior behaviours)	2	84.6%
Energy conservation	12	70.3%
Toxic materials use (interior behaviours)	3	70.0%
Water conservation (interior behaviours)	2	68.1%
Waste management (all behaviours)	3	65.0%
Toxic materials use (all behaviours)	5	64.4%
Water conservation (all behaviours)	8	41.1%
All behaviours	27	60.9%

With this section, the presentation of descriptive statistics is complete. Results pertaining to reliability and validity assessments follow.

4.3. Reliability and validity

Analyses of reliability and validity of the three standardised scales and the specific attitudes scale used in this study are presented below. In general, evidence discovered to assess reliability and validity was satisfactory. Only cases with house owners were included in these analyses since subsequent analyses focused on this group.

4.3.1. Internal consistency reliability

A two step approach (Hulin et al., 2001) was used to assess internal consistency reliability. In the first step, a factor analysis was performed to identify the dimensionality of scales used (i.e., the three standardised scales and the scale used to measure specific attitudes that was created for this study) while in the second step an estimation of Cronbach's coefficient alpha was implemented to assess internal consistency reliability of scores from those scales. The scales used in this analysis include:

- The Brief Inventory of Values scale (Stern et al., 1998)
- The Postmaterialism Index scale (Blake, 2001)
- The New Environmental Paradigm scale (Dunlap and Van Liere, 1978)
- The specific attitudes scale (section B, column B of the questionnaire found in Appendix B).

Skewness and kurtosis values of items from the four scales were examined for an assessment of normality and severe violations of normality were found for certain items of the Brief Inventory of Values scale and specific attitudes scale but not for items from the other two standardised scales. For the Brief Inventory of Values scale, the highest skewness and kurtosis values (–4.9 and 33.2, respectively) were found for the variable "Family security, safety for loved ones". For the Postmaterialism Index scale, the highest skewness and kurtosis values (–1.7 and 3.0, respectively) were found for the variable "Fight against crime". For the New Environmental Paradigm scale, the highest skewness and kurtosis values (–1.5 and 2.4, respectively) were found for the variable "Humans must live in harmony with nature in order to survive".

There were also moderate and severe violations of normality for the specific attitudes scale with highest skewness and kurtosis values (–2.1 and 4.7, respectively) found for the variable "Importance of recycling". Due to these severe violations, the factor analysis extraction method selected was principal axis factoring for the Brief Inventory of Values scale and the specific attitudes scale while for items from the Postmaterialism Index scale and the New Environmental Paradigm scale the extraction method was maximum likelihood (Costello and Osborne, 2005; Fabrigar et al., 1999). Multivariate outliers were identified using Mahalanobis distance (section 4.2.1.) and removed because factor analysis is very sensitive to them (Stewart et al., 2001; Tabachnick and Fidell, 2001).

4.3.1.1. Internal consistency reliability of the Brief Inventory of Values scale

The Brief Inventory of Values scale (Stern et al., 1998) was created to measure four value clusters. These are given below:

- Self-transcendence values
- Self-enhancement values
- Conservation values
- Openness to change values

Stern et al. (1998) offer two variations of the scale. The shorter version (having a total of twelve items) measures each of the above constructs (value clusters) with three items and the longer version (having a total of fifteen items) includes three more items so as to put more emphasis on self-transcendence values which are further divided into biospheric and altruistic values. In this study, the longer version was included in the questionnaire but results from a factor analysis revealed that it was the shorter version that produced a more interpretable solution with four factors emerging that clearly corresponded to the four value clusters. Therefore, the shorter version was further examined for its reliability and validity and was also used in subsequent analyses.

A Varimax rotation was used and the first four factors accounted for 46.9% of the variance. Although only the first three factors had eigenvalues greater than one, examination of the scree plot identified a four factor solution (Figure 7).

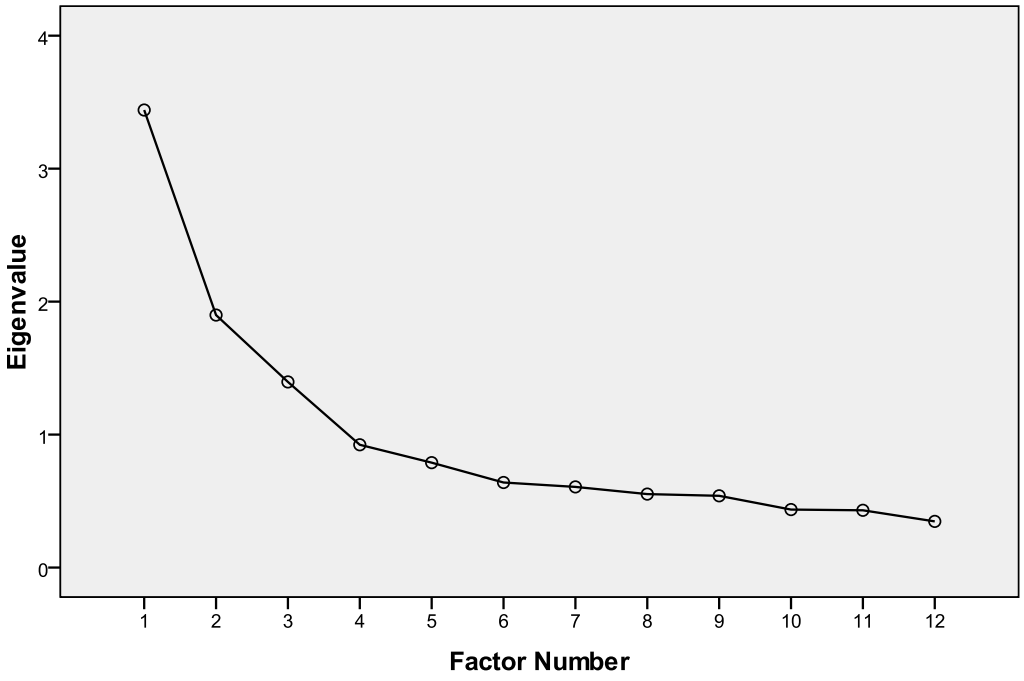

Figure 7. Scree plot for the Brief Inventory of Values scale

It was decided to keep the fourth factor both because its eigenvalue was close to one (i.e., it was 0.92) and because the scree plot can be used to determine the number of factors extracted when certain conditions are met (Field, 2004). The conditions that were met were: (1) the sample size was greater than 200 (i.e., it was 747) and (2) the average communality was below 0.6 (i.e., it was 0.5). Loadings for the four factors are shown in Table 73. Factor 1 corresponded to the openness to change values cluster, Factor 2 corresponded to the self-transcendence values cluster, Factor 3 corresponded to the self-enhancement values cluster, and Factor 4 corresponded to the conservation values cluster.

Table 73. Rotated factor analysis loadings matrix for the Brief Inventory of Values scale

Value cluster	Cluster items	Factor 1	Factor 2	Factor 3	Factor 4
Self-transcendence values	A world at peace, free of war and conflict	0.04	0.64	–0.01	0.21
	Social justice, correcting injustice, care for the weak	0.10	0.68	0.12	0.15
	Protecting the environment, preserving nature	0.16	0.55	0.03	0.26
Conservation values	Honouring parents and elders, showing respect	–0.01	0.31	0.15	0.61
	Family security, safety for loved ones	0.07	0.24	0.10	0.59
	Self-discipline, self restraint, resistance to temptation	0.08	0.31	0.33	0.36
Self-enhancement values	Authority, the right to lead or command	0.03	0.03	0.81	0.12
	Influential, having an impact on people and events	0.22	0.23	0.58	0.04
	Wealth, material possessions, money	0.21	–0.10	0.35	0.16
Openness to change values	A varied life, filled with challenge, novelty, and change	0.74	0.07	0.13	0.05
	An exciting life, stimulating experiences	0.82	0.04	0.15	0.04
	Curious, interested in everything, exploring	0.63	0.18	0.09	0.03

Cronbach's coefficient alpha values are reported for each of the four value clusters as well as for the whole scale in Table 74. In general, values for alpha were satisfactory. The lowest alpha values were found for conservation values (0.65) and self-enhancement values (0.63). However, the creators of this scale (Stern et al., 1998) reported rather similar values for these two clusters (0.64 to 0.65 for conservation values and 0.67 to 0.70 for self-enhancement values).

Table 74. Cronbach's coefficient alpha values for the Brief Inventory of Values scale

Value cluster	No. of items	Cronbach's coefficient alpha
Openness to change values	3	0.79
Self-transcendence values	3	0.75
Conservation values	3	0.65
Self-enhancement values	3	0.63
All four value clusters	12	0.76

Results from both the factor analysis and Cronbach's coefficient alpha calculations provided evidence of acceptable internal consistency reliability for the Brief Inventory of Values scale. Results regarding internal consistency reliability of the Postmaterialism Index scale (Blake, 2001) follow.

4.3.1.2. Internal consistency reliability of the Postmaterialism Index scale

The Postmaterialism Index scale (Blake, 2001) is expected to measure two constructs: post materialist and materialist values. A Varimax rotated factor analysis produced a two factor solution, as shown in the scree plot (Figure 8).

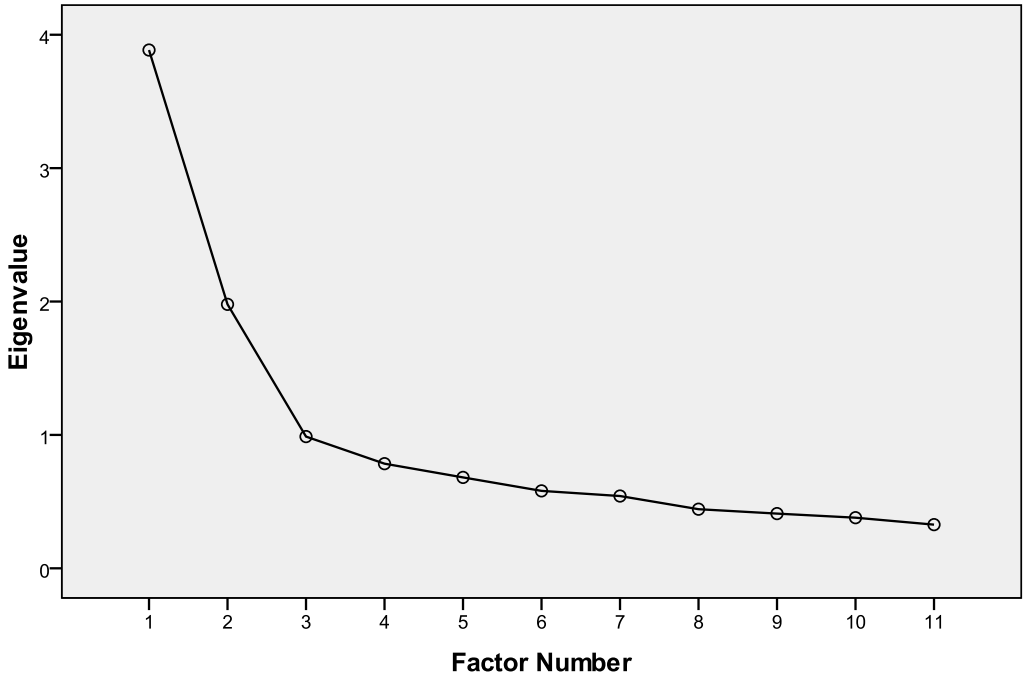

Figure 8. Scree plot for the Postmaterialism Index scale

These two factors (with eigenvalues of 3.89 and 1.98, respectively) accounted for 43.8% of the variance. As Table 75 shows, Factor 1 corresponded to the post materialist values cluster and Factor 2 corresponded to the materialist values cluster.

Table 75. Rotated factor analysis loadings matrix for the Postmaterialism Index scale

Value cluster	Cluster items	Factor 1	Factor 2
Materialist values	Maintain a high rate of economic growth	–0.01	0.62
	Make sure Canada has strong defense forces	0.08	0.55
	Maintain a strong economy	0.03	0.77
	Fight rising prices	0.38	0.40
	Maintain order in the nation	0.26	0.54
	Fight against crime	0.26	0.50
Post materialist values	Give people more say in important government decisions	0.69	0.21
	Progress toward a less impersonal, more humane society	0.77	0.12
	See that people have more say in how things get decided at work and in their community	0.82	0.09
	Protect freedom of speech	0.46	0.23
	Progress toward a society where ideas are more important than money	0.68	–0.02

Cronbach's coefficient alpha values were relatively good with an alpha value of 0.82 for the whole scale. Post materialist and materialist values were found to have Cronbach's coefficient alpha values of 0.76 or higher (Table 76).

Table 76. Cronbach's coefficient alpha values for the Postmaterialism Index scale

Value cluster	No. of items	Cronbach's coefficient alpha
Post materialist values	5	0.83
Materialist values	6	0.76
Both value clusters	11	0.82

In conclusion, evidence of rather good internal consistency reliability was gathered for the Postmaterialism Index scale. Results about the internal consistency reliability of the New Environmental Paradigm scale (Dunlap and Van Liere, 1978) are presented below.

4.3.1.3. Internal consistency reliability of the NEP scale

The issue of dimensionality of the New Environmental Paradigm scale has not been a straightforward one with researchers reporting finding one (Dunlap and Van Liere, 1978), two (Noe and Hammitt, 1992), three (Vining and Ebreo, 1992), or even four (Roberts and Bacon, 1997) dimensions. In this study, the original statement from the creators of the New Environmental Paradigm scale (Dunlap and Van Liere,

1978) that it measures only one construct (which is acceptance of the New Environmental Paradigm) was adopted. Therefore, instead of performing a rotated factor analysis (as in the other two standardised scales above) a slightly different approach was adopted based on procedures that Dunlap and Van Liere (1978) followed to examine the dimensionality of the New Environmental Paradigm scale.

Scores for certain items that were negatively worded were reversed (Streiner, 2003) so that for all items a higher score meant higher acceptance of the New Environmental Paradigm. According to recommendations from Dunlap and Van Liere (1978) an unrotated factor analysis was performed to detect presence of unidimensionality. Three factors with eigenvalues greater than one were found (i.e., eigenvalues of 3.40, 1.86, and 1.05, respectively), as shown in the scree plot (Figure 9).

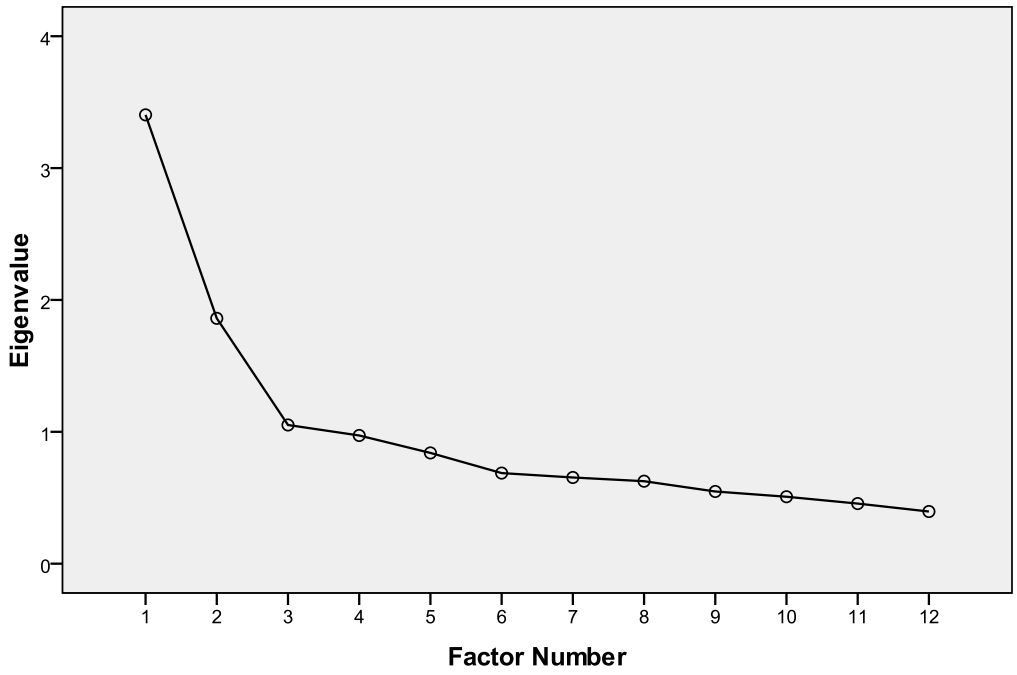

Figure 9. Scree plot for the NEP scale

However, the scree plot was not used in this case. Instead, some evidence of unidimensionality was provided by the fact that all items had relatively high loadings on the first unrotated factor (Dunlap and Van Liere, 1978) although that factor accounted for only 23.1% of the variance (Table 77).

Table 77. Unrotated factor analysis loadings matrix for the NEP scale

NEP items	Factor 1	Factor 2	Factor 3
We are approaching the limit of the number of people the earth can support.	0.49	0.25	–0.39
The balance of nature is very delicate and easily upset.	0.52	0.21	0.05
Humans have the right to modify the natural environment to suit their needs.	0.44	–0.33	0.18
Mankind was created to rule over the rest of nature.	0.51	–0.59	–0.05
When humans interfere with nature it often produces disastrous consequences.	0.35	0.16	0.22
Plants and animals exist primarily to be used by humans.	0.41	–0.60	–0.10
To maintain a healthy economy we will have to develop a "steady-state" economy where industrial growth is controlled.	0.37	0.28	0.12
Humans must live in harmony with nature in order to survive.	0.55	0.20	0.25
The earth is like a spaceship with only limited room and resources.	0.64	0.31	–0.25
Humans need not adapt to the natural environment because they can remake it to suit their needs.	0.35	–0.24	0.17
There are limits to growth beyond which our industrialized society cannot expand.	0.47	0.26	–0.01
Mankind is severely abusing the environment.	0.57	0.23	0.25

Furthermore, the value for Cronbach's coefficient alpha was acceptable with an alpha value of 0.75 (Table 78). This provided additional evidence that all items in the New Environmental Paradigm scale indeed measured one construct reliably.

Table 78. Cronbach's coefficient alpha values for the NEP scale

Items examined	No. of items	Cronbach's coefficient alpha
All items	12	0.75

4.3.1.4. Internal consistency reliability of the specific attitudes scale

Reliability scores were calculated for the specific environmental attitudes measured. In particular, Cronbach's coefficient alpha (Cronbach, 1951) values were calculated for clusters of related attitudes (e.g., a cluster of energy related attitudes) although these attitudes were used in subsequent analyses mostly individually and not in clusters. Cronbach's coefficient alpha values could not be calculated for individual attitudes as these were measured with a single item. However, a reliability assessment for

clusters of related attitudes was selected since it would provide an indication that groups of supposedly related attitudes were indeed related as expected.

A principal axis factoring factor analysis with Varimax rotation was used and although the first five factors had eigenvalues greater than one, only four of them were used after examining the scree plot (Figure 10). Since sample size was above 200 (i.e., it was 451) and the average communality was below 0.6 (i.e., it was 0.5), the scree plot could be used to determine the number of factors (Field, 2004), as explained in section 4.3.1.1. These four factors accounted for 46.2% of the variance.

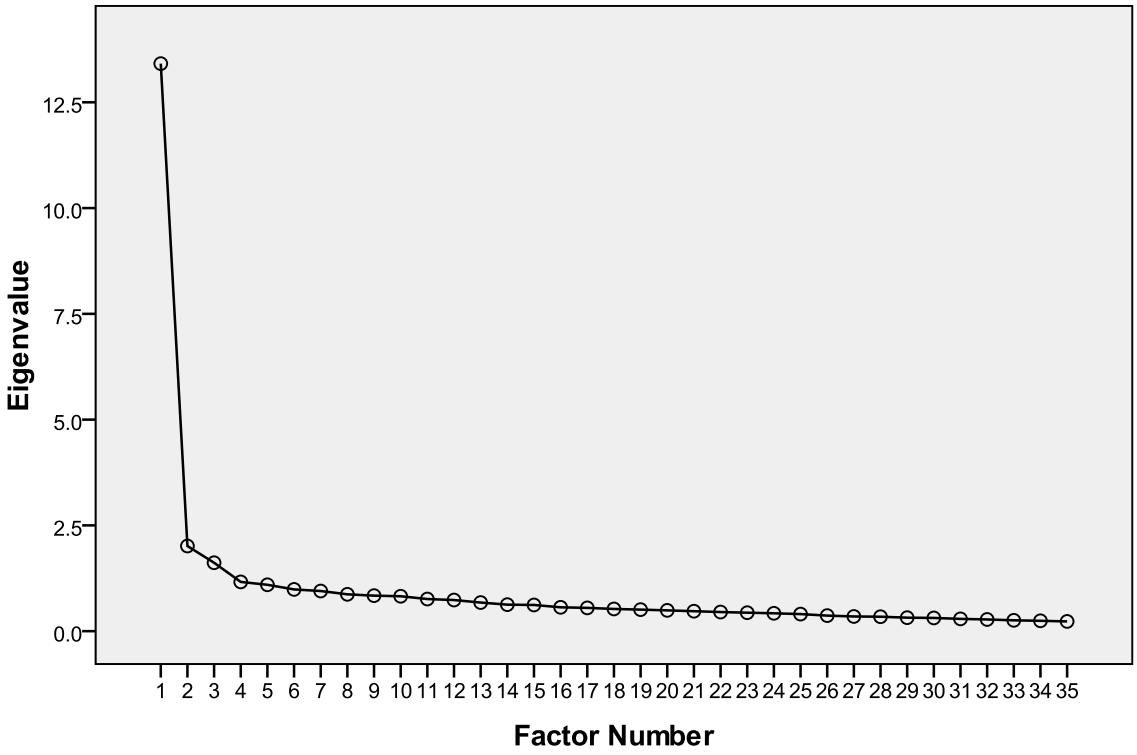

Figure 10. Scree plot for the specific attitudes scale

Based on the factor loadings, the following interpretation was obtained: Factor 1 included, in general, water related items, Factor 2 included mainly energy related items that require use of an appliance, Factor 3 included mostly energy related items that contribute to heating, and Factor 4 included predominantly items related to avoidance of using toxic materials. The table below shows the four factors and includes

only those variables having loadings 0.45 and above since those variables were considered during interpretation of factors.

Table 79. Rotated factor analysis loadings matrix for the specific attitudes scale

Factor 1		Factor 2		Factor 3		Factor 4	
Use an on-demand water heater	0.65	Use water efficient appliances	0.69	Increase insulating capability of windows	0.66	Avoid the use of chemical pesticides, herbicides, or fertilizers	0.56
Install drip garden irrigation to save water	0.64	Use energy efficient appliances	0.60	Winterize windows and doors to prevent drafts	0.65	Use non-toxic cleaners	0.53
Use skylights for natural lighting	0.63	Use Energy Star appliances	0.60	Use a high-efficiency furnace/boiler	0.52	Plant climate appropriate plants	0.49
Reduce lawn area	0.62	Turn off appliances when not in use	0.47	Take toxic waste to special disposal sites	0.50		
Use garden paving stones to reduce water run-off	0.62	Wash laundry in cold water	0.47	Use a programmable thermostat to reduce energy use	0.48		
Install a water meter	0.56	Use water saving plumbing fixtures	0.47				
Collect rainwater for irrigation and car washing	0.53	Recycle	0.46				
Use a low-maintenance lawn	0.46	Use energy efficient lighting	0.46				
Use natural ventilation – no air conditioning	0.45						

Following this analysis, Cronbach's coefficient alpha values were calculated for a variety of groups of attitudes, as shown in Table 80. Cronbach's coefficient alpha values were, in general, relatively high with the exception of the value calculated (0.56) for the group of items related to waste reduction. However, the small number of items in that group (only 3 items) can be considered, to some extent, responsible for the low value for Cronbach's coefficient alpha (Streiner, 2003).

Table 80. Cronbach's coefficient alpha values for groups of specific attitudes

Group of items	No. of items	Cronbach's coefficient alpha
Items related to energy consumption	18	0.90
Items related to water consumption	10	0.88
Items related to materials consumption (non toxic & waste reduction)	7	0.81
Items related to consumption of non toxic materials	4	0.77
Items related to waste reduction	3	0.56
All items	35	0.95

Therefore, in general, reliability analysis provided evidence that there are underlying dimensions in the data collected from the specific environmental attitudes scale. Results from validity analysis of the Brief Inventory of Values scale (Stern et al., 1998) and the Postmaterialism Index scale (Blake, 2001) are given below.

4.3.2. Evidence for convergent and discriminant validity

A multitrait-multimethod matrix (Campbell and Fiske, 1959) with correlations of scores from the Brief Inventory of Values scale (Stern et al., 1998) and the Postmaterialism Index scale (Blake, 2001) was created to examine convergent and discriminant validity. For both of these scales, scores on items that were supposed to measure the same construct (e.g., self-enhancement) were summed. In this way, the matrix included correlations among sums of item scores on self-transcendence, self-enhancement, post materialist, and materialist values. Cases with missing data were deleted (so as to ensure that the sum of each case would include the same number of items) and thus 697 cases were used. Non parametric Spearman correlations were used since tests scores were found to be non normal after performing the Kolmogorov-Smirnov test. Table 81 shows the multitrait-multimethod matrix with the correlations among tests scores.

Table 81. Multitrait-multimethod matrix

		Brief Inventory of Values scale		Postmaterialism Index scale	
		Self-transcendence values	Self-enhancement values	Post materialist values	Materialist values
Brief Inventory of Values scale	Self-transcendence values	1.00			
	Self-enhancement values	0.17	1.00		
Postmaterialism Index scale	Post materialist values	*0.49*	0.13	1.00	
	Materialist values	0.18	*0.39*	0.36	1.00

Note: Monotrait-heteromethod correlations are shown in italics and heterotrait-heteromethod correlations are underlined. All correlations are significant at alpha = 0.01.

The information in Table 81 was evaluated based on the four criteria (Campbell and Fiske, 1959) presented in section 3.3.1.2. Specifically, inspection of that table revealed the following:

Criterion 1: Monotrait-heteromethod correlations are sufficiently large to justify further analyses of validity (mean r = 0.44) and all are statistically significant at alpha = 0.01.

Criterion 2: All monotrait-heteromethod correlations are higher than the heterotrait-heteromethod correlations.

Criterion 3: Monotrait-heteromethod correlations are higher than heterotrait-monomethod correlations.

Criterion 4: Patterns of correlations among traits could not be examined as there are not enough traits or methods to assess this criterion (i.e., there were no patterns to examine).

Therefore, criterion 1 provided evidence for convergent validity and criteria 2 and 3 provided evidence for discriminant validity of the two scales. The next section offers logistic regression analysis results.

4.4. Logistic regression analysis

This section presents results from logistic regression analysis using as outcome the adoption of each of the 35 behaviours included in the questionnaire. The analysis aimed mainly at identifying significant predictors of environmental behaviours.

First, results pertaining to the satisfaction of the assumption of multicollinearity are included. Subsequently, information on numerical problems that were encountered during further analyses is presented. These problems prevented using the adoption of certain behaviours as outcome for logistic regression analysis. The section continues with a presentation of detailed results per behaviour. Collective results are also provided to offer a general appreciation of the impacts of predictor variables on behaviours. The support of the operational model provided by these collective results is subsequently presented. Finally, an examination of the likely influence from Provinces or Territories on environmental housing behaviour is included.

4.4.1. Multicollinearity results

Since logistic regression must satisfy the assumption of multicollinearity, the first part of regression analysis included multicollinearity tests. To perform these tests, the output of 35 linear regressions was examined. In these regressions, the variables identified in the operational model (developed to explain environmental behaviour) as potential predictors (as shown in Table 3) were entered as predictors while the outcome variables used were the adoption of each of the 35 environmental behaviours in the questionnaire (found in section B of the questionnaire in Appendix B).

No violation of the assumption of multicollinearity was detected in all of this microanalysis (i.e., separate analysis for each of the 35 behaviours). Multicollinearity problems appear when tolerance values are less than 0.10 or VIF values are higher than 10 (Field, 2004). The lowest tolerance value observed was 0.27 and the highest VIF value observed was 3.74 for the predictor variable ‘Indicate your individual 2006 annual income before taxes’ using as outcome the variable ‘Adoption of using a high-efficiency furnace/boiler’.

Analysis continued by performing the five steps described in section 3.3.3. that were based on recommendations by Hosmer and Lemeshow (2000). However, when certain behaviours were used as outcome variables, numerical problems appeared as described below.

4.4.2. Behaviours excluded from logistic regression analysis

There were important problems uncovered during logistic regressions after using as outcome each of fifteen behaviours. The problems pointed to the exclusion of these behaviours from further logistic regression analysis. Explanations follow.

For the behaviour 'Adoption of turning off appliances when not in use' estimation was terminated by the computer program because a perfect fit was detected indicating that a logistic regression model could not be determined (Garson, 2009a). Therefore, that variable was excluded from further regression analysis.

The software used for logistic regressions (SPSS) performs the analysis with a default value of twenty iterations. When each of the eleven behaviours presented below were entered, a message warned that estimation was terminated by the program because a final solution could not be found after twenty iterations. After manually switching to a maximum of 500 iterations, a final solution could still not be found. Therefore, the following behaviours were excluded from logistic regression analysis due to numerical problems with the data:

- Adoption of using an environmental heating source
- Adoption of increasing insulating capability of windows
- Adoption of using skylights for natural lighting
- Adoption of composting organic waste
- Adoption of planting climate appropriate plants
- Adoption of collecting rainwater for irrigation and car washing
- Adoption of reducing lawn area
- Adoption of using garden paving stones to reduce water run-off
- Adoption of using a low-maintenance lawn
- Adoption of installing drip garden irrigation to save water

- Adoption of installing a water meter

There were another two behaviours excluded from further logistic regression analysis because the parameter covariance matrix could not be computed and this resulted in an automatic termination of estimation by the program. These two behaviours were:

- Adoption of recycling
- Adoption of using an on-demand (tankless) water heater

Finally, for the behaviour 'Adoption of winterising windows and doors to prevent drafts' an error message was produced indicating that estimation failed because of a numerical problem and the variable had to be excluded from further logistic regression analysis. The remaining twenty behaviours did not present any numerical problems and analysis proceeded for them with the five structured steps described in the methodology based on recommendations by Hosmer and Lemeshow (2000).

4.4.3. Detailed results per behaviour

Detailed logistic regression results for all of the twenty behaviours examined (after excluding the fifteen behaviours mentioned in the previous section) are presented below and in Appendix F. These results present information from the five step analysis performed for every behaviour separately. The five steps procedure used is a way to arrive at a logistic regression model containing all significant predictors and interactions for each behaviour (i.e., the final model). Results presented in section 4.4.3.1. include information regarding predictor variables that remained significant at the fifth step and a description of information concerning all five steps which is found in Appendix F. Section 4.4.3.2. presents an examination of various measures of goodness of fit and information on testing for linearity in the logit and interactions.

4.4.3.1. Results from the five step analysis

The tables in this section include the predictor variables remaining as significant in the fifth step (see section 3.3.3. for a description of the five steps). For each of these predictor variables, the tables show the regression coefficient B value (that can be used to construct the logistic regression equation), the significance value of the predictor variable (where the null hypothesis is that the coefficient of that variable is zero and hence a significant value identifies a variable as a significant predictor of the outcome behaviour), the exp(B) or odds ratio (explained in the next paragraph), and the 95% confidence intervals for exp(B).

The exp(B) value gives information on the magnitude and the direction of the relationship between a given predictor and the outcome. That value represents the amount by which the odds of the outcome occurring are multiplied when the predictor is increased by one unit (or, for categorical predictors, when the predictor belongs to a different category from the reference category) (Cohen et al., 2003). If the exp(B) value is greater than one, then as the predictor increases by one unit (or, for categorical predictors, as the predictor changes into a different category from the reference category) the odds of the outcome occurring increase while for exp(B) values below one the odds of the outcome occurring decrease. The term 'odds' refers to the ratio of the probability of an event occurring divided by the probability of the same event not occurring (Field, 2004).

In case the 95% confidence intervals for exp(B) include a minimum value below one and a maximum value above one, then changes in the predictor are not associated with changes in the odds of the outcome occurring. Consequently, such predictors are of no use in a logistic regression model (Garson, 2009a).

Results in the tables below are given in descending order of their exp(B) values so that variables included in the first rows of a table have the greatest positive contribution on the adoption of the outcome behaviour. Where categorical variables (e.g., highest educational level attained) are included, presentation of the various categories starts with those having a significant coefficient.

The most influential predictor on adoption of using energy efficient appliances was materialist values, as shown in Table 82. The second most influential predictor was personal importance of (or specific attitude about) using energy efficient appliances.

Table 82. Predictor variables for adoption of using energy efficient appliances

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Materialist values	2.31	0.03	10.08	1.30	77.94
Personal importance of using energy efficient appliances	0.95	<0.01	2.60	1.63	4.14
Familiarity with using energy efficient appliances	0.74	<0.01	2.08	1.42	3.06
Convenience of using energy efficient appliances	0.48	0.01	1.62	1.15	2.28
Having personally witnessed human made environmental disasters in their Province	0.38	0.04	1.47	1.03	2.10
Individual 2006 annual income before taxes	0.20	0.07	1.22	0.98	1.51
Openness to change values	–0.18	0.05	0.83	0.70	1.00
Having personally witnessed human made environmental disasters in the world	–0.46	<0.01	0.63	0.46	0.86
Gender *	–0.74	0.06	0.48	0.22	1.03
Constant	–6.29	<0.01	<0.01		

* Reference category for dummy coding is ‘male’

Personal importance of using compact fluorescent lighting was the most influential predictor on adoption of that behaviour (Table 83). The second most influential predictor was familiarity with that behaviour.

Table 83. Predictor variables for adoption of using compact fluorescent lighting

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using compact fluorescent lighting	1.34	<0.01	3.81	2.84	5.09
Familiarity with using compact fluorescent lighting	0.39	<0.01	1.48	1.14	1.92
Age	0.31	<0.01	1.37	1.12	1.67
Total number of people in the house	0.27	0.02	1.31	1.05	1.63
Self-transcendence values	–0.21	0.01	0.81	0.69	0.95
Constant	–4.55	<0.01	<0.01		

The most influential predictor on adoption of setting the thermostat no higher than 20ºC was personal importance of setting the thermostat no higher than 20ºC (Table 84). The second most influential predictor was the size of the current house, which had a negative relationship with the behaviour.

Table 84. Predictor variables for adoption of setting the thermostat no higher than 20ºC

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of setting the thermostat no higher than 20ºC	1.46	<0.01	4.32	3.38	5.52
Size of current house	–0.20	0.01	0.82	0.71	0.94
Constant	–3.71	<0.01	0.02		

Personal importance of avoiding the use of chemical pesticides, herbicides, or fertilizers was the most influential predictor on adoption of that behaviour (Table 85). The second most influential predictor was familiarity with avoiding the use of chemical pesticides, herbicides, or fertilizers.

Table 85. Predictor variables for adoption of avoiding the use of chemical pesticides, herbicides, or fertilizers

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of avoiding the use of chemical pesticides, herbicides, or fertilizers	1.09	<0.01	2.98	2.40	3.71
Familiarity with avoiding the use of chemical pesticides, herbicides, or fertilizers	0.24	0.03	1.27	1.02	1.59
Constant	–4.66	<0.01	0.01		

The most influential predictor on adoption of using water efficient appliances was personal importance of using water efficient appliances (Table 86). The second most influential predictor was convenience of using water efficient appliances.

Table 86. Predictor variables for adoption of using water efficient appliances

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using water efficient appliances	0.85	<0.01	2.33	1.66	3.28
Convenience of using water efficient appliances	0.70	<0.01	2.01	1.56	2.59
Familiarity with using water efficient appliances	0.54	<0.01	1.72	1.25	2.36
Age	0.31	<0.01	1.36	1.12	1.66
Having personally witnessed human made environmental disasters in their Province	0.22	0.04	1.25	1.01	1.54
Self-transcendence values	–0.32	<0.01	0.72	0.61	0.87
Constant	–4.19	<0.01	0.02		

Familiarity with using Energy Star appliances was the most important predictor of adoption of that behaviour (Table 87). Except for the constant, there was not another predictor for that behaviour.

Table 87. Predictor variables for adoption of using Energy Star appliances

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Familiarity with using Energy Star appliances	1.39	<0.01	4.01	3.16	5.08
Constant	–4.31	<0.01	0.01		

The most influential predictor on adoption of using lighting controls was personal importance of using lighting controls (Table 88). The second most influential predictor was familiarity with using lighting controls.

Table 88. Predictor variables for adoption of using lighting controls

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using lighting controls	1.05	<0.01	2.86	2.26	3.63
Familiarity with using lighting controls	0.55	<0.01	1.72	1.35	2.21
Openness to change values	–0.18	<0.01	0.83	0.75	0.93
Familiarity with environmental problems in the world	–0.29	0.02	0.75	0.58	0.96
Constant	–2.64	<0.01	0.07		

Personal importance of using energy efficient lighting was the most influential predictor on adoption of that behaviour (Table 89). The second most influential predictor was age.

Table 89. Predictor variables for adoption of using energy efficient lighting

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using energy efficient lighting	1.39	<0.01	4.01	3.09	5.21
Age	0.18	0.06	1.19	0.99	1.43
Constant	–4.75	<0.01	0.01		

The most influential predictor on adoption of hanging clothes to dry was personal importance of hanging clothes to dry (Table 90). The second most influential predictor was familiarity with media campaigns that promote conservation of energy. Specifically, familiarity with media campaigns had a negative relationship with the behaviour.

Table 90. Predictor variables for adoption of hanging clothes to dry

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of hanging clothes to dry	1.23	<0.01	3.41	2.79	4.17
Having personally witnessed human made environmental disasters in the world	–0.19	0.01	0.83	0.71	0.96
Familiarity with media campaigns that promote conservation of energy	–0.23	0.04	0.79	0.63	0.99
Constant	–2.75	<0.01	0.06		

Personal importance of wearing more clothing to reduce heating costs was the most influential predictor on adoption of that behaviour (Table 91). The second most influential predictor was familiarity with wearing more clothing to reduce heating costs.

Table 91. Predictor variables for adoption of wearing more clothing to reduce heating costs

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of wearing more clothing to reduce heating costs	1.21	<0.01	3.37	2.58	4.40
Familiarity with wearing more clothing to reduce heating costs	0.32	0.02	1.38	1.06	1.78
Constant	–4.52	<0.01	0.01		

The most influential predictor on adoption of washing laundry in cold water was materialist values (Table 92). Specifically, the more materialist values increase the less the behaviour becomes adopted. The second most influential predictor was personal importance of washing laundry in cold water.

Table 92. Predictor variables for adoption of washing laundry in cold water

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of washing laundry in cold water	1.55	<0.01	4.73	3.42	6.55
Having personally witnessed human made environmental disasters in their Province	0.31	0.03	1.36	1.03	1.80
Individual 2006 annual income before taxes	0.21	0.02	1.24	1.04	1.47
Self-enhancement values	0.19	0.02	1.21	1.04	1.41
Openness to change values	–0.16	0.05	0.85	0.73	1.00
Having personally witnessed human made environmental disasters in the world	–0.40	<0.01	0.67	0.51	0.88
Materialist values	–2.67	<0.01	0.07	0.01	0.43
Constant	–3.26	0.01	0.04		

The most important predictor of adoption of using non-toxic paints when painting their home was familiarity with using non-toxic paints when painting their home, as shown in Table 93. The second most important predictor was personal importance of using non-toxic paints when painting their home.

Table 93. Predictor variables for adoption of using non-toxic paints when painting their home

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Familiarity with using non-toxic paints when painting their home	1.03	<0.01	2.80	2.17	3.61
Personal importance of using non-toxic paints when painting their home	0.79	<0.01	2.21	1.67	2.92
Familiarity with environmental problems in the world	–0.43	0.02	0.65	0.48	0.88
Constant	–4.33	<0.01	0.01		

Convenience of repairing things that are broken instead of buying new was the most important predictor of adoption of that behaviour (Table 94). The second most important predictor was familiarity with that behaviour.

Table 94. Predictor variables for adoption of repairing things that are broken instead of buying new

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Convenience of repairing things that are broken instead of buying new	0.69	<0.01	1.98	1.54	2.55
Familiarity with repairing broken items instead of buying new	0.62	<0.01	1.85	1.34	2.56
Personal importance of repairing broken items instead of buying new	0.53	<0.01	1.70	1.22	2.36
Age	0.26	0.02	1.30	1.05	1.60
Having personally witnessed human made environmental disasters in the world	–0.40	<0.01	0.67	0.56	0.82
Familiarity with media campaigns that promote minimization of waste materials	–0.44	<0.01	0.64	0.49	0.84
Constant	–3.58	<0.01	0.03		

Personal importance of using non-toxic cleaners was the most influential predictor on adoption of that behaviour (Table 95). The second most influential predictor was familiarity with that behaviour.

Table 95. Predictor variables for adoption of using non-toxic cleaners

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using non-toxic cleaners	0.73	<0.01	2.07	1.62	2.66
Familiarity with using non-toxic cleaners	0.60	<0.01	1.82	1.45	2.30
Constant	0.29	0.78	1.34		
Openness to change values	–0.17	<0.01	0.85	0.76	0.95
Self-transcendence values	–0.16	0.02	0.85	0.74	0.98
Gender *	–0.42	0.08	0.66	0.41	1.05

***** Reference category for dummy coding is 'male'

The most important predictor of adoption of using water saving toilets was materialist values (cosine transformed), as shown in Table 96. Specifically, materialist values had a negative relationship with the behaviour. The second most important predictor was post materialist values (cosine transformed).

Table 96. Predictor variables for adoption of using water saving toilets

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Post materialist values (cosine transformed)	3.34	<0.01	28.24	3.08	258.73
Personal importance of using water saving toilets	1.29	<0.01	3.63	2.79	4.73
Stand on political issues * (significance = 0.03)					
Liberal	1.10	<0.01	3.01	1.44	6.29
Moderate to liberal	0.78	0.02	2.17	1.13	4.16
Moderate to conservative	0.28	0.39	1.33	0.69	2.55
Conservative	0.27	0.53	1.30	0.57	4.73
Highest educational level attained ** (significance = 0.06)					
Some high school	0.92	0.09	2.51	0.86	7.36
Ph.D.	–1.96	0.01	0.14	0.04	0.57
Some graduate work	0.62	0.33	1.87	0.53	6.52
High school diploma	0.45	0.25	1.57	0.73	3.40
Vocational or tech school	0.28	0.48	1.32	0.62	2.80
Some college or university	0.24	0.52	1.28	0.61	2.67
Master's degree	–0.18	0.63	0.84	0.41	1.72
Gender ***	0.66	0.04	1.94	1.04	3.64
Individual 2006 annual income before taxes	0.25	0.01	1.28	1.08	1.52
Materialist values (cosine transformed)	–3.70	<0.01	0.03	<0.01	0.30
Constant	–5.91	<0.01	<0.01		

* Reference category for dummy coding is 'moderate', ** Reference category for dummy coding is 'college or university graduate', *** Reference category for dummy coding is 'male'

The most important predictor of adoption of using water saving plumbing fixtures was post materialist values (square root transformed), as shown in Table 97. Specifically, post materialist values had a negative relationship with the behaviour. The second most important predictor was materialist values (exponentially transformed).

Table 97. Predictor variables for adoption of using water saving plumbing fixtures

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Materialist values (exponentially transformed)	1.04	0.01	2.82	1.23	6.46
Personal importance of using water saving plumbing fixtures	1.00	<0.01	2.73	1.92	3.88
Convenience of using water saving plumbing fixtures	0.76	<0.01	2.15	1.65	2.79
Familiarity with using water saving plumbing fixtures	0.59	<0.01	1.80	1.30	2.49
Openness to change values	–0.14	0.05	0.87	0.75	1.00
Size of current house	–0.18	0.05	0.84	0.70	1.00
Familiarity with environmental problems within their Province	–0.47	<0.01	0.63	0.46	0.85
Highest educational level attained * (significance = 0.07)					
High school diploma	–0.71	0.09	0.49	0.22	1.11
Vocational or tech school	–0.78	0.05	0.46	0.21	1.01
Some college or university	0.50	0.27	1.64	0.68	3.94
Master's degree	0.42	0.31	1.52	0.67	3.43
Some graduate work	0.05	0.95	1.05	0.24	4.54
Some high school	–0.20	0.70	0.82	0.29	2.29
Ph.D.	–0.97	0.13	0.38	0.11	1.33
Current type of residence ** (significance = 0.03)					
Apartment	–2.31	0.01	0.10	0.02	0.50
Town house	0.58	0.36	1.79	0.52	6.19
Duplex (Attached) house	–0.13	0.81	0.88	0.31	2.51
Constant	–2.92	0.03	0.05		
Post materialist values (square root transformed)	–3.64	0.01	0.03	<0.01	0.33

* Reference category for dummy coding is 'college or university graduate', ** Reference category for dummy coding is 'detached house'

The most influential predictor on adoption of using a high-efficiency furnace/boiler was personal importance of using a high-efficiency furnace/boiler (Table 98). The second most influential predictor was familiarity with using a high-efficiency furnace/boiler.

Table 98. Predictor variables for adoption of using a high-efficiency furnace/boiler

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using a high-efficiency furnace/boiler	1.02	<0.01	2.76	1.94	3.92
Familiarity with using a high-efficiency furnace/boiler	0.60	<0.01	1.83	1.35	2.48
Family 2006 annual income before taxes	0.26	0.01	1.30	1.06	1.59
Having personally witnessed human made environmental disasters in their Province	0.26	0.02	1.30	1.05	1.60
Frequency of nature visits within the past 12 months	0.23	0.01	1.26	1.05	1.52
New Environmental Paradigm scale score	–0.05	0.08	0.96	0.91	1.01
Self-transcendence values	–0.30	<0.01	0.74	0.61	0.90
Constant	–1.98	0.17	0.14		

The most influential predictor on adoption of using a programmable thermostat to reduce energy use was post materialist values (Table 99). Specifically, post materialist values had a negative relationship with the behaviour. The second most influential predictor was personal importance of using a programmable thermostat to reduce energy use.

Table 99. Predictor variables for adoption of using a programmable thermostat to reduce energy use

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using a programmable thermostat to reduce energy use	1.73	<0.01	5.66	3.98	8.05
Familiarity with using a programmable thermostat to reduce energy use	0.47	<0.01	1.60	1.17	2.20
Familiarity with environmental problems in the world	–0.24	0.09	0.79	0.60	1.04
Post materialist values	–2.86	<0.01	0.06	0.02	0.22
Constant	–5.55	<0.01	<0.01		

The most influential predictor on adoption of taking toxic waste to special disposal sites was post materialist values, which had a negative relationship with the behaviour (Table 100). The second most influential predictor was personal importance of taking toxic waste to special disposal sites.

Table 100. Predictor variables for adoption of taking toxic waste to special disposal sites

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of taking toxic waste to special disposal sites	0.98	<0.01	2.66	1.99	3.55
Convenience of taking toxic waste to special disposal sites	0.69	<0.01	2.00	1.63	2..46
Age	0.28	0.01	1.32	1.07	1.63
Post materialist values	–1.81	0.01	0.16	0.04	0.68
Constant	–4.60	<0.01	0.01		

The most influential predictor on adoption of using natural ventilation – no air conditioning was living in a town house instead of a detached house, which had a negative relationship with the behaviour (Table 101). The second most influential predictor was personal importance of using natural ventilation – no air conditioning.

Table 101. Predictor variables for adoption of using natural ventilation – no air conditioning

Predictor	Coefficient B	Significance	exp(B)	95% Confidence intervals for exp(B)	
				Lower	Upper
Personal importance of using natural ventilation – no air conditioning	1.15	<0.01	3.15	2.59	3.83
Constant	0.26	0.83	1.30		
Traditional values	–0.20	0.02	0.82	0.69	0.96
Familiarity with media campaigns that promote conservation of energy	–0.26	0.02	0.77	0.62	0.96
Current type of residence * (significance 0.01)					
Town house	–1.53	<0.01	0.22	0.08	0.59
Duplex (Attached) house	–0.53	0.17	0.59	0.28	1.26
Apartment	–0.81	0.29	0.45	0.10	2.01

* Reference category for dummy coding is ‘detached house’

Appendix F presents information for each of the twenty behaviours concerning all five steps followed to produce the final model. Specifically, the following are presented:

- Step 1: Predictor variables remaining into the preliminary reduced model
- Step 2: Predictor variables remaining into the preliminary main effects model
- Step 3: Main effects model (testing for linearity in the logit)

- Step 4: Preliminary final model (testing for interactions)
- Step 5: Predictor variables in the final model

In addition, for each behaviour in Appendix F there is a table entitled 'Overall measures and specialized measures of goodness of fit for final model'. This table includes the following three measures of overall fit:

1. The significance of the likelihood ratio test for comparing the final model against a constant-only model (this is labelled as 'Significance of –2LL of final model against a constant-only model' in the table). The value of this test must be significant to indicate that the model with the given predictors is better than a constant-only model.

2. The significance of the Hosmer and Lemeshow test where a non-significant value indicates an adequate fit of the regression model to the data.

3. Percentage of cases classified correctly obtained by the classification table. This shows percentage of cases for which the outcome is correctly predicted after entering the observed data into the final model.

The table entitled 'Overall measures and specialized measures of goodness of fit for final model' also includes two specialized measures of goodness of fit. These measures include:

1. Percentage of studentized residuals outside the ±2 range that correspond to cases that can be considered outliers. If there are more than 5% of studentized residuals outside that range, they may have an impact on the fit of the model.

2. Presence of DFBeta values greater than one that would indicate influential cases. Such cases can result in regression models that do not represent the whole sample accurately.

After presenting detailed results per behaviour, a commentary on these results follows. This presents an examination of various measures of goodness of fit as well as information on testing for linearity in the logit and interactions.

4.4.3.2. A closer examination of the results

In general, goodness of fit measures for the twenty logistic regression models created were satisfactory. The value of the likelihood ratio test for comparing the final model against a constant-only model was found to be significant for all behaviours indicating the usefulness of including the given predictors. The percentage of cases classified correctly ranged between 74.6% and 89.0%. For all of the behaviours examined the percentage of studentized residuals outside the ±2 range was below 5% and there were no DFBeta values greater than one.

Cases with studentized residual values outside the ±2.5 range were individually inspected for data input errors, which were not detected, while there were only two cases with studentized residual values outside the ±3.0 range, which would constitute a cause for concern (Field, 2004). Information about these two cases is presented below.

The first of these two cases (with a value of 3.2) was found for the behaviour ‘adoption of using a programmable thermostat to reduce energy use’. That case was unusual because the subject reported that he/she perceived the behaviour as not at all important although he/she was very familiar with that behaviour, he/she was familiar with environmental problems in the world, and he/she scored highly on post-materialist values (0.87/1.00). However, the subject did adopt that behaviour and the discrepancy between feeling a given behaviour is unimportant while at the same time adopting it and being familiar

with it seemed to be within the expected limits of human behaviour. Therefore, that case was not dropped from the analysis.

The second case having a studentized residual value outside the ±3.0 range (the value was –3.1) was found for the behaviour 'adoption of repairing broken items instead of buying new'. That case was unusual because the subject reported that he/she had not adopted the behaviour although he/she was very familiar with that behaviour, he/she found it very important and very convenient, he/she was rather familiar with media campaigns that promoted minimization of waste materials, and he/she had personally witnessed human made environmental disasters in the world. However, that subject belonged to the 61 to 70 years of age group and perhaps his/her age did interfere in producing the observed results. Another plausible explanation could be that his/her attitude (i.e., perceived importance of repairing) was not generated by direct experience and, consequently, it had a rather low accessibility which was not enough to result in behaviour. Given that the theoretical model developed in this study to explain behaviour did not drill down to such a level of detail and that the various scores obtained from that subject were within acceptable limits, the case was not dropped from the analysis.

There were potentially problematic goodness of fit measures for only two (out of twenty) behaviours. For these behaviours ('avoiding the use of chemical pesticides, herbicides, or fertilizers' and 'using non-toxic paints when painting their home') the Hosmer and Lemeshow test was significant at the 0.05 level. This statistic is recommended to use when continuous variables are included in the model or sample size is small (Garson, 2009a). However, both these conditions did not apply in the models with these two variables (sample size was 682 and 611, respectively). In addition, the evaluation of goodness of fit for a model should be based on a variety of diagnostic statistics and not a single measure alone (Hosmer and Lemeshow, 2000). The two models classified correctly 78.6% and 82.3% of cases, respectively, which is an indication they can be considered acceptable. They also both had significant values for the likelihood ratio test (i.e., difference of –2LL of final model from a constant-only model) pointing that the set of predictors could predict the dependent variable (i.e., 'avoiding the use of chemical pesticides, herbicides,

or fertilizers' or 'using non-toxic paints when painting their home') significantly better than a model with only the intercept and this can be understood as an adequate fit of the data to the model. Menard (2002) states that the Hosmer and Lemeshow goodness of fit statistic was designed as an alternative to the likelihood ratio test. Finally, there were no problems with analysing residuals or DFBeta values. Therefore, the logistic regression models for those two variables were not rejected although a certain degree of caution is recommended in interpreting these results.

Transformations of predictor variables were necessary (to satisfy the linearity in the logit assumption) only when two outcome variables were used: 'adoption of using water saving plumbing fixtures' and 'adoption of using water saving toilets'. The analysis also did not reveal any statistically significant interactions between predictor variables on the outcome.

Except for detailed information per behaviour, results are also presented in a collective format. This can facilitate an overview of findings from the logistic regression analysis.

4.4.4. Collective results from logistic regression analysis

Results from performing logistic regressions analysis using as outcome the adoption of each of the twenty environmental behaviours (see section 4.4.3.1.) were combined to provide an overall view of the impacts of predictor variables on behaviours (there were also fifteen behaviours excluded from logistic regression analysis due to numerical problems as mentioned in section 4.4.2.). These collective results are given in table format below.

The first of these tables (Table 102) presents significant predictor variables per behaviour for all behaviours related to energy consumption. Specific attitude to the given behaviour and familiarity with the given behaviour were the most common significant predictors.

Table 102. Significant predictor variables per environmental behaviour (for behaviours related to energy consumption)

Outcome behaviours (Adoption of)	Predictor variables
Using energy efficient appliances	• Specific attitude to behaviour • Familiarity with specific behaviour • Convenience of specific behaviour • Personally witnessed human made environmental disasters: *in the world, in Province* • Personal values: *Materialist*
Using compact fluorescent lighting	• Specific attitude to behaviour • Familiarity with specific behaviour • Personal values: *Self-transcendence* • Demographics: *Age, Number of people in the house*
Setting thermostat no higher than 20ºC	• Specific attitude to behaviour • Demographics: *House size*
Using Energy Star appliances	• Familiarity with specific behaviour
Using lighting controls	• Specific attitude to behaviour • Familiarity with specific behaviour • Familiarity with environmental problems: *in world* • Personal values: *Openness to change*
Using energy efficient lighting	• Specific attitude to behaviour
Hanging clothes to dry	• Specific attitude to behaviour • Familiarity with media campaigns: *that promote conservation of energy* • Personally witnessed human made environmental disasters: *in the world*
Wearing more clothing to reduce heating costs	• Specific attitude to behaviour • Familiarity with specific behaviour
Washing laundry in cold water	• Specific attitude to behaviour • Personally witnessed human made environmental disasters: *in the world, in Province* • Personal values: *Materialist, Self-enhancement* • Demographics: *Individual income*
Using a high-efficiency furnace/boiler	• Specific attitude to behaviour • Familiarity with specific behaviour • Personally witnessed human made environmental disasters: *in Province* • Frequency of nature visits within the past 12 months • Personal values: *Self-transcendence* • Demographics: *Family income*
Using a programmable thermostat to reduce energy use	• Specific attitude to behaviour • Familiarity with specific behaviour • Personal values: *Post materialist*
Using natural ventilation – no air conditioning	• Specific attitude to behaviour • Familiarity with media campaigns: *that promote conservation of energy* • Personal values: *Traditional* • Demographics: *Type of residence*

Significant predictor variables per behaviour for all behaviours related to water and materials consumption are presented in Table 103. Specific attitude to the given behaviour was always a significant predictor with familiarity with the given behaviour also being commonly identified as a significant predictor.

Table 103. Significant predictor variables per environmental behaviour (for behaviours related to water and materials consumption)

Outcome behaviours (Adoption of)	Predictor variables
Avoiding the use of chemical pesticides, herbicides, or fertilizers	• Specific attitude to behaviour • Familiarity with specific behaviour
Using water efficient appliances	• Specific attitude to behaviour • Familiarity with specific behaviour • Convenience of specific behaviour • Personally witnessed human made environmental disasters: *in Province* • Personal values: *Self-transcendence* • Demographics: *Age*
Using non-toxic paints when painting your home	• Specific attitude to behaviour • Familiarity with specific behaviour • Familiar with environmental problems: *in the world*
Repairing broken items instead of buying new	• Specific attitude to behaviour • Familiarity with specific behaviour • Convenience of specific behaviour • Familiarity with media campaigns: *that promote minimisation of waste material* • Personally witnessed human made environmental disasters: *in the world* • Demographics: *Age*
Using non-toxic cleaners	• Specific attitude to behaviour • Familiarity with specific behaviour • Personal values: *Self-transcendence, Openness to change*
Using water saving toilets	• Specific attitude to behaviour • Personal values: *Materialist, Post materialist* • Demographics: *Gender, Individual income, Stand on political issues, Education*
Using water saving plumbing fixtures	• Specific attitude to behaviour • Familiarity with specific behaviour • Convenience of specific behaviour • Familiarity with environmental problems: *in Province* • Personal values: *Post Materialist, Materialist* • Demographics: *Type of residence*
Taking toxic waste to special disposal sites	• Specific attitude to behaviour • Convenience of specific behaviour • Personal values: *Post Materialist* • Demographics: *Age*

Table 104 below assists in revealing the importance of each significant predictor variable separately. This table presents predictors in a descending order of the number of behaviours they predict. It also informs about the direction of the relationship (i.e., positive or negative) these predictors have with environmental behaviours.

Specific attitude to the behaviour, familiarity with the given behaviour, and convenience of the given behaviour were the variables that were most commonly identified as predictors of environmental behaviours. Other results of note include the absence of the New Environmental Paradigm score (which

measures generalised environmental concern) from the predictors and the direction of the relationship between personal values and behaviours. Specifically, there were four instances (i.e., results from four different outcome variables) where materialist values were identified as predictors and in two of these instances materialist values had a positive relationship indicating that the more materialistic people were the more they tended to adopt environmental behaviours while in the other two instances they had a negative relationship. There were also four instances where post materialist values were identified as predictors and in three of these instances post materialist values had a negative relationship indicating that the less post materialistic people were the more they tended to adopt environmental behaviours while there was only one instance where post materialist values were found to have a positive relationship. The fact that self-transcendence values always had a negative relationship with behaviours while self-enhancement values always had a positive relationship with behaviours points to a related conclusion; that the more self centered people were the more they tended to adopt environmental behaviours. These results will be examined in more detail in the Discussion chapter.

Table 104. Significant predictor variables and their relationship with environmental behaviours

Predictor variable	Number of behaviours it predicts (out of 20) *	Number of times relationship is positive	Number of times relationship is negative
Specific attitude to behaviour	19	19	
Familiarity with specific behaviour	13	13	
Convenience of specific behaviour *	5 *	5	
Demographic: *Age*	4	4	
Personally witnessed human made environmental disasters: *in Province*	4	4	
Personal values: *Materialist*	4	2	2
Personal values: *Post materialist*	4	1	3
Personally witnessed human made environmental disasters: *in the world*	4		4
Personal values: *Self-transcendence*	4		4
Demographic: *Individual income*	2	2	
Familiarity with environmental problems: *in the world*	2		2
Personal values: *Openness to change*	2		2
Demographic: *Type of residence* **	2	See explanation in text below	See explanation in text below
Familiarity with media campaigns: *that promote conservation of energy*	2		2
Demographic: *Education* **	1	See explanation in text below	See explanation in text below
Personal values: *Self-enhancement*	1	1	
Frequency of nature visits within the past 12 months	1	1	
Demographic: *Family income*	1	1	
Demographic: *Number of people in the house*	1	1	
Demographic: *Gender* **	1	1	
Demographic: *Stand on political issues* **	1	See explanation in text below	See explanation in text below
Familiarity with media campaigns: *that promote minimisation of waste material*	1		1
Personal values: *Traditional*	1		1
Familiarity with environmental problems: *in Province*	1		1
Demographic: House size	1		1

* Due to space constraints in the questionnaire, convenience was examined for only six out of the twenty behaviours presented in the aggregate logistic regression results tables.

** For those categorical variables explanations about their relationships with the outcome behaviours are given in the text below.

In Table 104 above, certain explanations about the relationships of four categorical variables with the outcome behaviours were omitted due to space limitations. These explanations are provided below:

- For the variable ‘Gender’, a positive relationship means that if a person is a woman instead of a man, the chances of behaviour adoption increase.
- For the variable ‘Education’, in one instance (i.e., in the results from one outcome variable where ‘Education’ was found to be a significant predictor) those that belonged to the category ‘Ph.D. degree’ instead of being ‘college or university graduates’ were less likely to adopt the behaviour. For the rest of the categories (i.e., excluding the Ph.D. category), the 95% confidence intervals for exp(B) included a minimum value below one and a maximum value above one rendering these categories not useful as predictors. In another instance, for all of the various categories (i.e., high school diploma, vocational or tech school, etc.) the 95% confidence intervals for exp(B) included a minimum value below one and a maximum value above one rendering these categories not useful as predictors.
- For the variable ‘Type of residence’ in one instance those who lived in an apartment instead of a detached house were less likely to adopt the behaviour while for all other categories (i.e., town house or duplex) the 95% confidence intervals for exp(B) included a minimum value below one and a maximum value above one rendering these categories not useful as predictors. In another instance, those who lived in a town house instead of a detached house were less likely to adopt the behaviour while for all other categories (i.e., apartment or duplex) the 95% confidence intervals for exp(B) included a minimum value below one and a maximum value above one rendering these categories not useful as predictors.
- For the variable ‘Stand on political issues’ there was only one instance and being liberal or moderate to liberal instead of moderate increased the chances of adopting the behaviour. For the other categories (i.e., being moderate to conservative or being conservative) the 95% confidence intervals for exp(B) included a minimum value below one and a maximum value above one rendering these categories not useful as predictors.

Certain of the abovementioned variables that were identified as significant predictors of environmental behaviours were used to re-draw the operational model created to explain environmental concern and

behaviour that was presented in the methodology chapter. This enabled an evaluation of the level of support that logistic regression analysis results provided to the model at a general level (i.e., not specific to any particular behaviour).

4.4.5. Support of the operational model by logistic regression analysis

This part of the analysis assisted in identifying factors with the greatest influence on environmental behaviour as viewed from a general level (i.e., not specific to any given behaviour) and representing them in a visual format. Collective results from logistic regression analysis were entered into the operational model to evaluate the level of support they provided to it. This was approached by re-drawing the operational model after including only factors that were significant predictors of environmental behaviour for more than 50% of the behaviours examined so as to assist in ensuring that included factors would have a higher chance of being associated with any particular behaviour than not (see Figure 11 below).

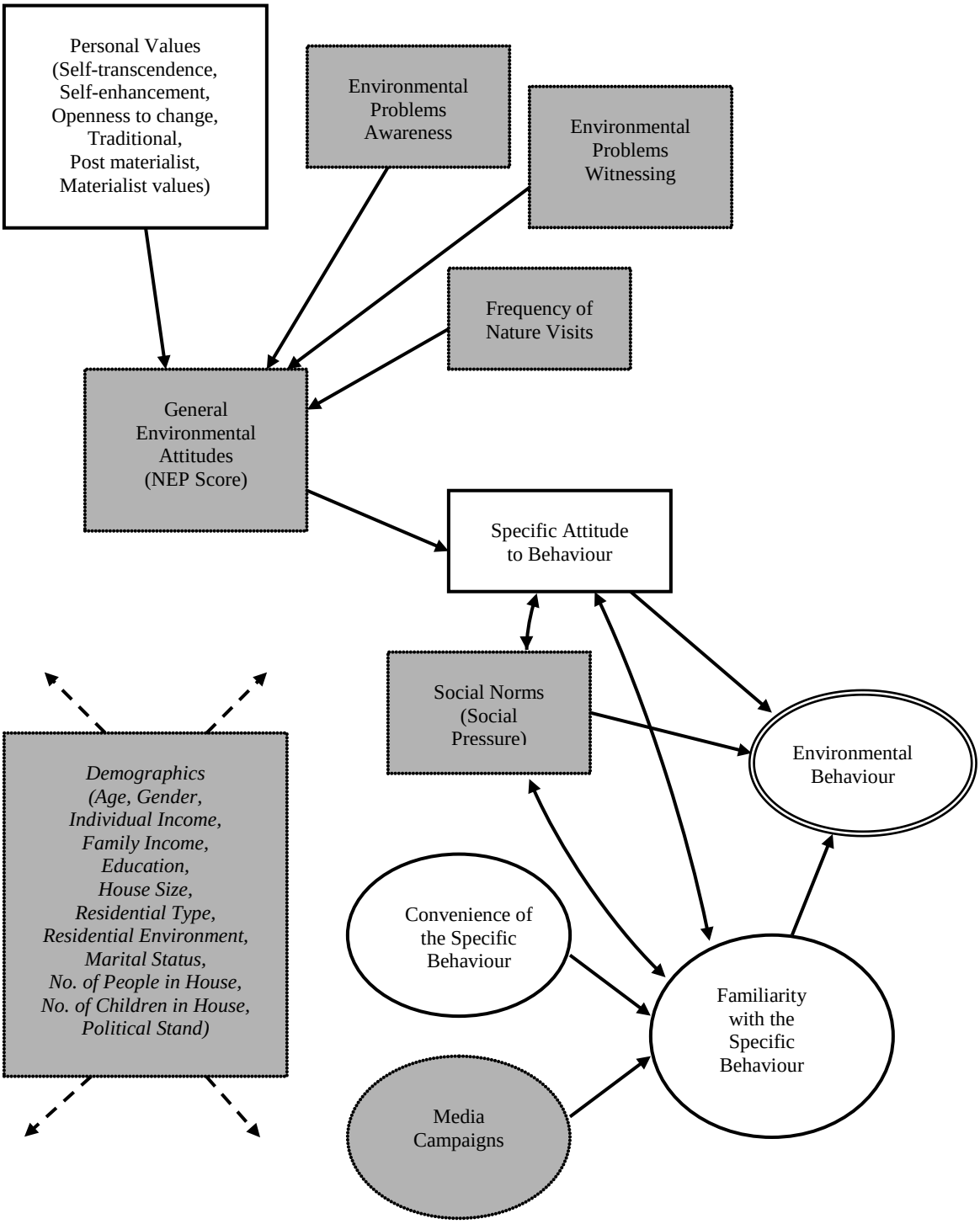

Figure 11. Operational model indicating (in white colour filled shapes) significant predictors of more than 50% of the environmental behaviours

Note: Factors in single-lined rectangles belong to the motivation path, factors in single-lined ovals belong to the ability path and behaviour is in a double-lined oval. Factors in round dotted shapes and filled with gray colour did not predict more than 50% of the behaviours examined.

Factors that were significant predictors of environmental behaviour for more than 50% of the behaviours were included in a new drawing without distinguishing whether their relationship with the behaviour was positive or negative (Figure 12). The emphasis at that point was in deciding which variables to include without paying a great deal of attention to the exact links among them which would be examined at a later stage. Presence of arrows in this model is mostly indicative of hypothesised causal relationships from the literature that would be investigated more closely at the following stage of the analysis. Specifically, straight arrows linking variables denote hypothesised causal relationships and the curved bi-directional arrow signifies a correlation between specific attitude to the behaviour and familiarity with the specific behaviour.

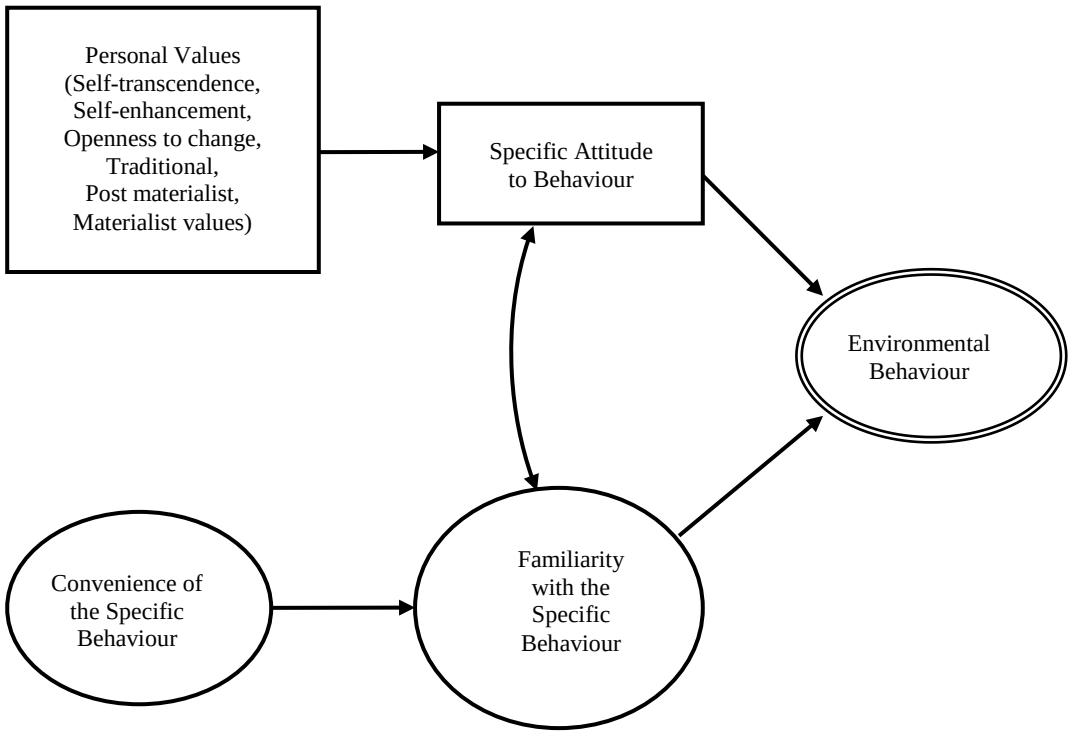

Figure 12. Parsimonious model as supported by collective results from logistic regression analysis (developed originally using inputs primarily from Ajzen, 1991 and Stern et al., 1995)

The obtained model was a parsimonious one containing only four predictors of behaviour. These four predictor variables can be considered (based on logistic regression analysis) as the most influential in explaining environmental behaviour related to housing activities at a general level. At the next stage of analysis, the likely influence from Provinces or Territories on behaviour was examined.

4.4.6. Influence from Provinces or Territories on environmental housing behaviour

After arriving at a parsimonious model to explain environmental housing behaviour, a number of hierarchical logistic regressions were performed to detect likely influences arising from the variation among Provinces or Territories on behaviour. For this analysis, the likelihood ratio test was used and the variables within the logistic regression final models (as described in section 3.3.3.) were included in the first block while the variable containing the name of the Provinces or Territories (after a dummy coding was implemented) was added in the second block. The outcome behaviours used in this analysis were the same three behaviours used in partial correlation analysis (see section 3.3.4.).

Provinces or Territories were combined during the dummy coding procedure into seven categories since for certain Provinces or Territories there were zero or only a small number of cases (e.g., there were zero cases from Nunavut and two cases from the Northwest Territories) in the results, as shown in Table 7. The categories created are given below:

- Alberta and Northwest Territories
- British Columbia and Yukon
- Manitoba and Nunavut
- New Brunswick, Newfoundland and Labrador, Nova Scotia, and Prince Edward Island
- Ontario
- Quebec
- Saskatchewan

Ontario, being the category with the largest number of cases, was selected as the reference category. This practice ensured that the reference category would not have a small sample size compared to the other categories (Cohen et al., 2003).

Results indicated that for the three behaviours examined the addition of the block containing the Province or Territory was not significant. Specifically, the significance values were as follows:

- 0.46 for adoption of using energy efficient appliances
- 0.06 for adoption of using water efficient appliances
- 0.12 for adoption of using water saving plumbing fixtures

After an effect from the variation between Provinces or Territories on behaviour was not detected, a partial correlation analysis was performed. This technique was used to determine with more detail the associations between variables in the parsimonious model (Figure 12) and the corresponding results are presented in the next section.

4.5. Partial correlation analysis

The parsimonious model as supported by logistic regression analysis (see Figure 12) focused on whether variables could or could not predict behaviour by including or excluding those variables (as necessary) from its depiction. That model did not incorporate accurate representations of the links (arrows) among the included variables. Results from partial correlation analysis provided a more thorough understanding of the relationships among variables based on collected data. In total, data from three environmental behaviours (i.e., adoption of using energy efficient appliances, adoption of using water efficient appliances, and adoption of using water saving plumbing fixtures) were used in this analysis, as explained in section 3.3.4. Results are offered for each of these behaviours in a separate subsection. All arrows in the following three figures (Figures 13, 14, and 15) are bi-directional to denote correlations (rather than hypothesised causal relationships as with earlier versions of the model based on existing literature) as

they resulted from this analysis. Non significant correlations (i.e., those with a significance value higher than 0.05) are omitted to provide a clearer picture of the most important relationships.

Both hypothesised paths (i.e., the motivation and ability paths) to reach behaviour were supported by this analysis. In addition, there were relationships bridging the two paths. The variables that consistently (i.e., in all three behaviours examined) had a direct relationship with behaviour were specific attitude to the behaviour, convenience of the specific behaviour, and familiarity with the specific behaviour. For all three outcome behaviours included in this analysis, the strongest association among model variables was found between specific attitude to the behaviour and familiarity with the specific behaviour.

4.5.1. Results from adoption of using energy efficient appliances

Using as outcome the adoption of using energy efficient appliances (Figure 13), the strongest direct association with behaviour was with familiarity with the specific behaviour. Personal values did not have a direct link with behaviour.

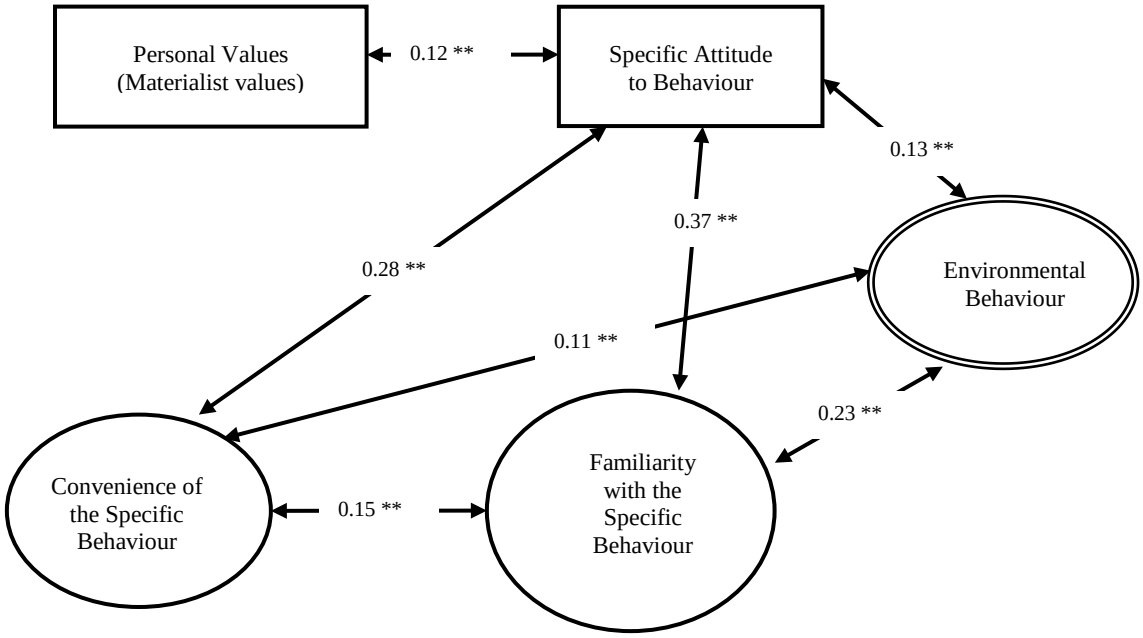

Figure 13. Partial correlation analysis results using as outcome the adoption of using energy efficient appliances

** Correlation is significant at alpha = 0.01. Non significant correlations are omitted.

4.5.2. Results from adoption of using water efficient appliances

Using as outcome the adoption of using water efficient appliances (Figure 14), it was again familiarity with the specific behaviour that had the strongest direct association with behaviour. A weak (although significant) direct relationship between personal values and behaviour was noted.

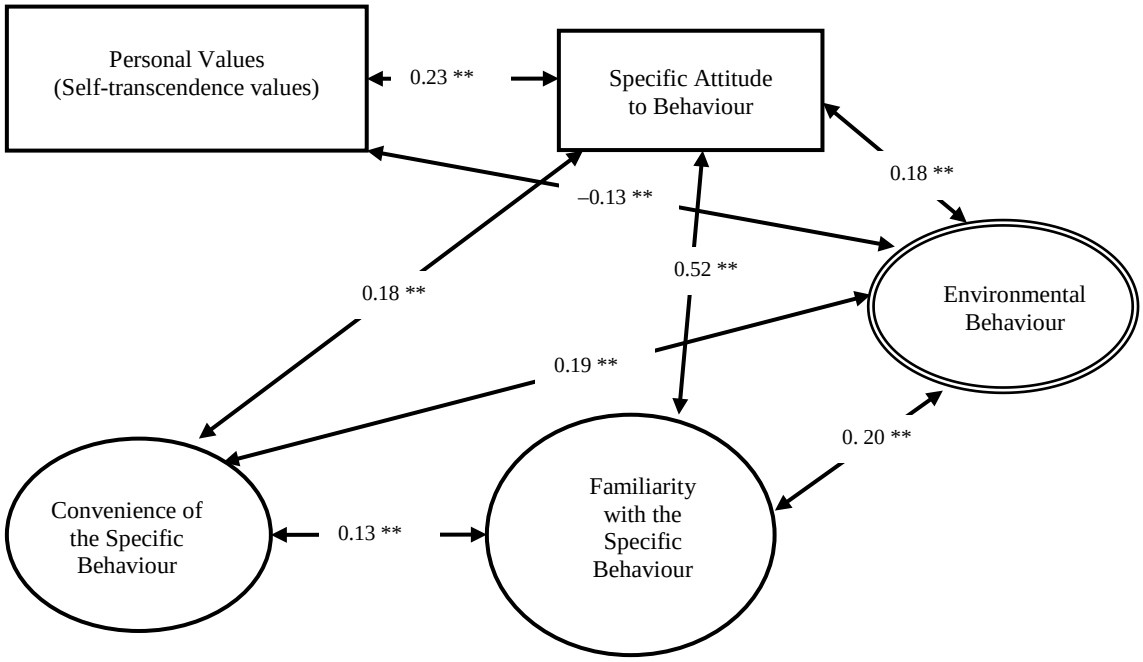

Figure 14. Partial correlation analysis results using as outcome the adoption of using water efficient appliances

** Correlation is significant at alpha = 0.01. Non significant correlations are omitted.

4.5.3. Results from adoption of using water saving plumbing fixtures

Using as outcome the adoption of using water saving plumbing fixtures (Figure 15), an equally strong direct association with behaviour came from both specific attitude to the behaviour and convenience of the specific behaviour. Personal values and behaviour were directly related (although the link was of minor importance) while no direct link appeared to exist between convenience and familiarity with the specific behaviour (in contrast to the results obtained from the two previous outcome behaviours).

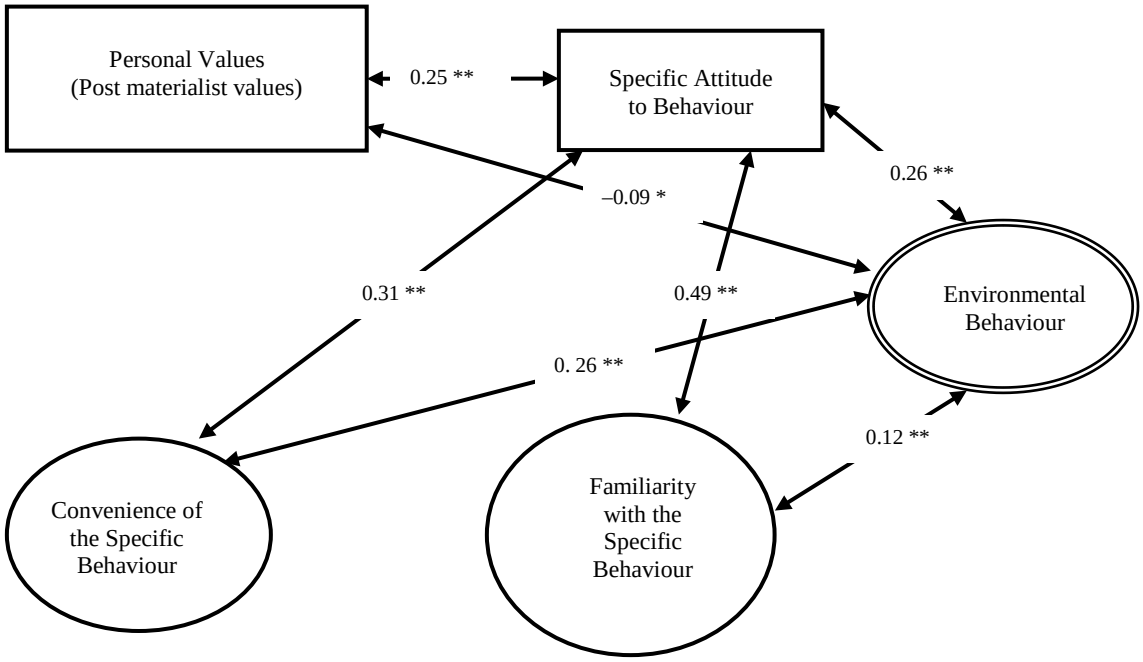

Figure 15. Partial correlation analysis results using as outcome the adoption of using water saving plumbing fixtures

** Correlation is significant at alpha = 0.01. * Correlation is significant at alpha = 0.05. Non significant correlations are omitted.

After performing partial correlations, analysis proceeded with cross-tabulations, which was the last type of analysis performed. The aim of cross-tabulations was to identify the most seemingly efficient ways of intervening in the factors in the parsimonious model to enhance adoption of environmental behaviours.

4.6. Cross-tabulation analysis

Cross-tabulations were used to provide a better understanding of which significant predictor variables (from those in the parsimonious model) appeared to be the most promising to manipulate to achieve a higher level of adoption of environmental behaviours. Since this analysis was a subsequent step to the partial correlation analysis described earlier, it included the same three behaviours (i.e., adoption of using energy efficient appliances, adoption of using water efficient appliances, and adoption of using water saving plumbing fixtures). Results are presented for each of these behaviours in a separate subsection and the tables below (Tables 105 to 116) include both frequency counts and percentages. In general,

manipulation of specific attitudes appeared to offer a greater potential for enhancing adoption of behaviours compared to manipulation of personal values.

4.6.1. Results from adoption of using energy efficient appliances

Examination of the column showing respondents having adopted the behaviour in Table 105 reveals that the relationship between materialist values and adoption of using energy efficient appliances is positive. Adoption increases from 33.3% to 92.8% as materialist values increase.

Table 105. Cross-tabulation between materialist values and adoption of using energy efficient appliances (frequency counts and percentages)

		Adoption of using energy efficient appliances		
		Respondents not adopted	**Respondents adopted**	**Row Total**
Materialist values	**1 (lowest score on materialist values)**	2 66.7%	1 33.3%	3 100.0%
	2	6 22.2%	21 77.8%	27 100.0%
	3	18 17.5%	85 82.5%	103 100.0%
	4	41 13.4%	264 86.6%	305 100.0%
	5 (highest score on materialist values)	18 7.2%	231 92.8%	249 100.0%
Total		85 12.4%	602 87.6%	687 100.0%

Table 106 below shows that the relationship between importance of using energy efficient appliances (which is also the specific attitude to that behaviour as measured in this study) and adoption of using energy efficient appliances is a positive one. Adoption increases from 0.0% to 95.0% (in the column presenting respondents having adopted the behaviour) as importance increases.

Table 106. Cross-tabulation between importance of using energy efficient appliances (specific attitude) and adoption of using energy efficient appliances (frequency counts and percentages)

		Adoption of using energy efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Importance of using energy efficient appliances (Specific attitude to using energy efficient appliances)	1 (not at all important)	4 100.0%	0 0.0%	4 100.0%
	2	7 87.5%	1 12.5%	8 100.0%
	3	28 27.2%	75 72.8%	103 100.0%
	4	33 11.5%	254 88.5%	287 100.0%
	5 (very important)	16 5.0%	306 95.0%	322 100.0%
Total		88 12.2%	636 87.8%	724 100.0%

Table 107 indicates a positive relationship between familiarity with using energy efficient appliances and adoption of using energy efficient appliances. As familiarity increases, adoption moves from 0.0% to 94.6%.

Table 107. Cross-tabulation between familiarity with using energy efficient appliances and adoption of using energy efficient appliances (frequency counts and percentages)

		Adoption of using energy efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Familiarity with using energy efficient appliances	1 (not at all familiar)	8 100.0%	0 0.0%	8 100.0%
	2	8 66.7%	4 33.3%	12 100.0%
	3	23 26.1%	65 73.9%	88 100.0%
	4	28 12.3%	199 87.7%	227 100.0%
	5 (very familiar)	21 5.4%	370 94.6%	391 100.0%
Total		88 12.1%	638 87.9%	726 100.0%

Convenience of using energy efficient appliances and adoption of using energy efficient appliances are positively related (Table 108). However, the relationship seems to be a relatively weak one since as convenience increases adoption changes only from 64.7% to 95.3%. Furthermore, when convenience is increased slightly between either low or high levels (i.e., from 1 to 2 or from 4 to 5) adoption appears to remain relatively constant.

Table 108. Cross-tabulation between convenience of using energy efficient appliances and adoption of using energy efficient appliances (frequency counts and percentages)

		Adoption of using energy efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Convenience of using energy efficient appliances	1 (very inconvenient)	6 35.3%	11 64.7%	17 100.0%
	2	14 35.9%	25 64.1%	39 100.0%
	3	31 18.6%	136 81.4%	167 100.0%
	4	21 9.7%	196 90.3%	217 100.0%
	5 (very convenient)	12 4.7%	246 95.3%	258 100.0%
Total		84 12.0%	614 88.0%	698 100.0%

4.6.2. Results from adoption of using water efficient appliances

Self-transcendence values and adoption of using water efficient appliances appear to share a positive and somewhat weak link between them (Table 109). Adoption increases from 50.0% to 79.0%.

Table 109. Cross-tabulation between self-transcendence values and adoption of using water efficient appliances (frequency counts and percentages)

		Adoption of using water efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Self-transcendence values	1 (lowest score on self-transcendence values)	1 50.0%	1 50.0%	2 100.0%
	2	5 41.7%	7 58.3%	12 100.0%
	3	27 24.1%	85 75.9%	112 100.0%
	4 (highest score on self-transcendence values)	117 21.0%	440 79.0%	557 100.0%
Total		150 22.0%	533 78.0%	683 100.0%

As Table 110 below indicates, adoption of using water efficient appliances changes positively in accordance with changes in importance of using water efficient appliances. Specifically, adoption increases from 11.1% to 90.9%.

Table 110. Cross-tabulation between importance of using water efficient appliances (specific attitude) and adoption of using water efficient appliances (frequency counts and percentages)

		Adoption of using water efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Importance of using water efficient appliances (Specific attitude to using water efficient appliances)	1 (not at all important)	8 88.9%	1 11.1%	9 100.0%
	2	15 68.2%	7 31.8%	22 100.0%
	3	49 45.4%	59 54.6%	108 100.0%
	4	49 22.9%	165 77.1%	214 100.0%
	5 (very important)	31 9.1%	311 90.9%	342 100.0%
Total		152 21.9%	543 78.1%	695 100.0%

Familiarity with using water efficient appliances appears to have a strong and positive relationship with adoption of using water efficient appliances (Table 111). Adoption changes from 0.0% to 90.3% as familiarity increases.

Table 111. Cross-tabulation between familiarity with using water efficient appliances and adoption of using water efficient appliances (frequency counts and percentages)

		Adoption of using water efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Familiarity with using water efficient appliances	1 (not at all familiar)	12 100.0%	0 0.0%	12 100.0%
	2	10 62.5%	6 37.5%	16 100.0%
	3	44 50.6%	43 49.4%	87 100.0%
	4	49 24.0%	155 76.0%	204 100.0%
	5 (very familiar)	37 9.7%	345 90.3%	382 100.0%
Total		152 21.7%	549 78.3%	701 100.0%

Convenience of using water efficient appliances and adoption of using water efficient appliances seem to be positively related after convenience has reached a moderate level with adoption increasing from 73.8% to 94.6% (Table 112). When convenience increases between low levels (i.e., from 1 to 2), adoption appears to remain, in general, constant.

Table 112. Cross-tabulation between convenience of using water efficient appliances and adoption of using water efficient appliances (frequency counts and percentages)

		Adoption of using water efficient appliances		
		Respondents not adopted	Respondents adopted	Row Total
Convenience of using water efficient appliances	1 (very inconvenient)	13 54.2%	11 45.8%	24 100.0%
	2	31 52.5%	28 47.5%	59 100.0%
	3	53 26.2%	149 73.8%	202 100.0%
	4	36 19.8%	146 80.2%	182 100.0%
	5 (very convenient)	11 5.4%	191 94.6%	202 100.0%
Total		144 21.5%	525 78.5%	669 100.0%

4.6.3. Results from adoption of using water saving plumbing fixtures

Based on results in Table 113, post materialist values and adoption of using water saving plumbing fixtures appear to have an unclear and rather weak relationship. Adoption ranges from a minimum of 60.6% to a maximum of 80.0%.

Table 113. Cross-tabulation between post materialist values and adoption of using water saving plumbing fixtures (frequency counts and percentages)

		Adoption of using water saving plumbing fixtures		
		Respondents not adopted	Respondents adopted	Row Total
Post materialist values	1 (lowest score on post materialist values)	1 20.0%	4 80.0%	5 100.0%
	2	13 39.4%	20 60.6%	33 100.0%
	3	39 33.9%	76 66.1%	115 100.0%
	4	93 33.8%	182 66.2%	275 100.0%
	5 (highest score on post materialist values)	69 25.0%	207 75.0%	276 100.0%
Total		215 30.5%	489 69.5%	704 100.0%

Importance of using water saving plumbing fixtures and adoption of using water saving plumbing fixtures seem to have a strong and positive relationship (Table 114). Adoption increases from 4.2% to 89.7% as importance increases.

Table 114. Cross-tabulation between importance of using water saving plumbing fixtures (specific attitude) and adoption of using water saving plumbing fixtures (frequency counts and percentages)

		Adoption of using water saving plumbing fixtures		
		Respondents not adopted	Respondents adopted	Row Total
Importance of using water saving plumbing fixtures (Specific attitude to using water saving plumbing fixtures)	1 (not at all important)	23 95.8%	1 4.2%	24 100.0%
	2	30 85.7%	5 14.3%	35 100.0%
	3	89 53.9%	76 46.1%	165 100.0%
	4	40 20.7%	153 79.3%	193 100.0%
	5 (very important)	31 10.3%	270 89.7%	301 100.0%
Total		213 29.7%	505 70.3%	718 100.0%

Table 115 reveals a strong and positive link between familiarity with using water saving plumbing fixtures and adoption of using water saving plumbing fixtures. Adoption increases from 7.1% to 85.8%.

Table 115. Cross-tabulation between familiarity with using water saving plumbing fixtures and adoption of using water saving plumbing fixtures (frequency counts and percentages)

		Adoption of using water saving plumbing fixtures		
		Respondents not adopted	Respondents adopted	Row Total
Familiarity with using water saving plumbing fixtures	1 (not at all familiar)	13 92.9%	1 7.1%	14 100.0%
	2	19 76.0%	6 24.0%	25 100.0%
	3	70 54.3%	59 45.7%	129 100.0%
	4	60 31.3%	132 68.8%	192 100.0%
	5 (very familiar)	51 14.2%	308 85.8%	359 100.0%
Total		213 29.6%	506 70.4%	719 100.0%

Convenience of using water saving plumbing fixtures and adoption of using water saving plumbing fixtures appear to share a positive relationship after convenience has increased to a moderate level with adoption increasing from 50.6% to 90.7% (Table 116). When convenience increases between low levels (i.e., from 1 to 2), adoption seems to remain, in general, constant.

Table 116. Cross-tabulation between convenience of using water saving plumbing fixtures and adoption of using water saving plumbing fixtures (frequency counts and percentages)

		Adoption of using water saving plumbing fixtures		
		Respondents not adopted	Respondents adopted	Row Total
Convenience of using water saving plumbing fixtures	1 (very inconvenient)	15 75.0%	5 25.0%	20 100.0%
	2	48 76.2%	15 23.8%	63 100.0%
	3	77 49.4%	79 50.6%	156 100.0%
	4	46 21.4%	169 78.6%	215 100.0%
	5 (very convenient)	23 9.3%	224 90.7%	247 100.0%
Total		209 29.8%	492 70.2%	701 100.0%

With this section, the presentation of results is complete. The next chapter discusses how the obtained results enabled achievement of the study's objectives.

5. DISCUSSION

The Discussion chapter is organised according to satisfaction of each of the four objectives of this study (the objectives were introduced in section 2.5.). Section 5.1. comments on the current levels of adoption of environmental housing behaviours in Canada (which are relatively satisfactory) and section 5.2. offers a discussion about factors that were found to be significant predictors of environmental housing behaviours (with the most influential on behaviour being specific attitude to the given behaviour, personal values, familiarity with the given behaviour, and convenience of performing the given behaviour). Section 5.3. reflects on the theoretical model developed to explain environmental housing behaviour (which despite certain shortcomings can be considered of value due to likely advantages over existing models) while section 5.4. offers a number of suggestions for enhancing adoption levels of environmental housing behaviours (based on elements from the elaboration likelihood model and the theory of diffusion of innovations).

Section 5.1. discusses results from either house owners or house renters. The remaining sections in this chapter (i.e., sections 5.2., 5.3., and 5.4.) deal with results that are exclusive to house owners (since multivariate analyses focused on house owners being the largest group of respondents).

5.1. Adoption of environmental housing behaviours in Canada

This section describes how the first objective of this study was satisfied. The objective was:

To ascertain the current situation regarding the adoption of environmental housing behaviours in Canada by house inhabitants.

Overall, adoption levels for the environmental housing behaviours by Canadians cannot be considered low (see Table 34 for adoption of behaviours for house owners and Table 71 for house renters). The average percentage of adoption of all of the 35 behaviours investigated for house owners was 61.6% (Table 35) while over 50% of respondents (house owners) had adopted 27 out of 35 behaviours (Table

34). Regarding adoption levels for categories of behaviours, there were low adoption levels for garden-related behaviours and to a lesser extent for water or energy conservation behaviours (see section 5.1.3.). These results assist in discovering behaviours for which adoption enhancements appear to be the most important. However, enhancing adoption for any type of environmental housing behaviour is beneficial, irrespective of current adoption levels. The following sections provide a commentary on the observation that adoption varied to a great extent among the different behaviours, offer likely explanations for the low adoption of certain behaviours, and discuss the variability in adoption levels for the different categories of behaviours.

5.1.1. Diversity in adoption levels

In general, adoption of environmental housing behaviours by house owners varied greatly from a minimum percentage of people having adopted the behaviour of 6.0% for using an on-demand (tankless) water heater to a maximum of 96.1% for recycling (Table 34 and Figure 6). A similarly diverse picture emerges when results from house renters are considered. Indeed, adoption of environmental housing behaviours by house renters ranged from a minimum percentage of people having adopted the behaviour of 14.3% for installing drip garden irrigation to save water to a maximum of 93.0% for turning off appliances when not in use (Table 71). These results are in agreement with findings from the Households and the Environment Survey (presented in section 2.5.) which reports a minimum participation rate of 30% for composting and a maximum participation rate of 97% for recycling in 2006 (Statistics Canada, 2008). This demonstrates the diversity that characterises the existing situation regarding adoption of environmental housing behaviours.

Different explanations can be theorised to account for the diversity in adoption levels. The large numbers of environmental housing behaviours examined vary considerably in terms of the type and resources required for their adoption. In addition, the time frame associated with each behaviour varies substantially (e.g., behaviours performed on a weekly or daily basis, or only a few times during the lifetime of a house). This variability can assist in comprehending the observed results. Moreover, as the logistic

regression results indicated (see Table 104), there are numerous predictors (that will be discussed in more detail in section 5.2.) of these behaviours. These predictors belong to different categories including: (1) internal variables (such as personal values, attitudes that are specific to the behaviour, or knowledge and experience of environmental conditions), (2) individual variables (i.e., socio-economic and demographic factors), (3) external variables (such as promotional campaigns or issues related to convenience), and (4) prior experience with a given behaviour (that was captured in the form of familiarity with a specific behaviour in this study). The variation in predictors of behaviours may be associated with the variation in adoption levels for these behaviours. From these predictor categories, internal variables (and primarily specific attitudes) were found to play a major role (Table 104) and one can reasonably expect that these variables will vary to a great extent among individuals, therefore, contributing to the diversity in adoption levels. Specific attitude toward a given behaviour may even vary within the same individual in the sense that a person can have two different attitudes for one object simultaneously (Ajzen, 2001), as explained in section 2.2.1.3.

Another possible explanation for the variation in adoption is based on the finding regarding personal values (i.e., self-transcendence, self-enhancement, materialist, and post materialist). Results indicated that among house owners the more self centered the respondents were the more they tended to have higher adoption levels of environmental behaviours (see section 4.4.4.). In other words, respondents seemingly adopted (at least to some extent) the behaviours for reasons such as promoting their personal health (e.g., by minimising use of toxic materials), contributing to personal monetary savings (e.g., by using energy efficient equipment), or satisfying their own convenience (e.g., by adopting to a lesser degree behaviours such as using non-toxic cleaners that were perceived to be not very convenient). Moreover, the fact that the New Environmental Paradigm Scale score (which measures generalised environmental concern) was not among the predictors of behaviours enhances this viewpoint that protecting the environment was not the primary reason that prompted respondents to adopt the behaviours.

Such beliefs are comparable to those expressed by Shelton (2009) who discovered that even for consumers who can be considered ecologically-minded the environment was neither their primary concern nor the main reason for adopting energy-saving behaviours. For those consumers, reducing their monetary expenditures was found to be the main reason for adopting energy-saving behaviours. To the point that these beliefs are correct, one can assume that respondents of the present study did not view the examined behaviours as having a common environmentally beneficial characteristic (i.e., that they all reduce human impacts on the environment from housing activities). For them, the behaviours may, therefore, have been largely unrelated, except for enhancing their personal well-being, which could contribute to the observed diversity in adoption levels.

5.1.2. Behaviours with low adoption levels

Despite this variability in adoption, only a small number of behaviours had low levels of adoption for either house owners or house renters. Specifically for house owners, eight out of the 35 behaviours examined had percentages of people having adopted them below 50% (Table 34). For house renters, eight out of the 27 behaviours examined had percentages of people having adopted them below 50% (Table 71). Potential explanations for the low adoption of these behaviours follow.

Most of these behaviours with low adoption levels (i.e., five out of eight behaviours for house owners and seven out of eight behaviours for house renters) are garden-related and this may provide an explanation about their low adoption. Since gardening is largely seen as a leisure activity (Bhatti and Church, 2004), one cannot be expected to regularly commit substantial resources to it. Furthermore, these behaviours with low adoption levels can be considered to involve, in general, a considerable commitment of resources, including monetary expenditures (e.g., cost to set up a rainwater collection system or high installation cost for skylights as well as possible subsequent leaking problems), which constitutes another likely reason for low adoption. The opposite can be said for behaviours that require a rather negligible commitment of resources. Indeed, for behaviours that may not be considered particularly bothersome (e.g., composting may be perceived as bothersome by some individuals) and involve a zero individual

monetary cost or may be supplied by local governments their adoption levels were over 75% (e.g., recycling, turning off appliances when not in use, washing laundry in cold water, setting the thermostat no higher than 20ºC, and wearing more clothing to reduce heating costs[4], as shown in Table 34). It may also be inferred from this last point that if the cost of a certain behaviour is borne by a government rather than individuals (e.g., recycling) then individuals tend to consider it a zero individual monetary cost behaviour.

The behaviour with the lowest adoption level for house owners in Table 34 (i.e., using an on-demand – tankless – water heater with an adoption rate of only 6.0%) also received the lowest scores for familiarity and perceived importance (i.e., values of 2.8 and 2.9 on a five-point scale, as shown in Tables 32 and 33, respectively) among all 35 behaviours. The influence of such factors on behaviour is examined in more detail in section 5.2.

5.1.3. Adoption levels for different categories of behaviours

Certain trends are apparent for adoption levels of behaviours that belonged to different categories (i.e., energy conservation, water conservation, waste management and reduction, and use and reduction of toxic materials). For house owners (Table 35), behaviours concerning waste management and reduction for interior use had the highest percentages of adoption (89.9%) while water conservation behaviours were the least adopted (47.1% for all of the water conservation behaviours examined).

The high average percentage of adoption of waste-related behaviours may reflect, to a certain degree, the popularity of recycling in Canada and the widespread implementation of municipal level recycling programs. Recycling, the behaviour with the highest adoption level for house owners (96.1% in Table 34), may have skewed these results given that there were only two and three behaviours, respectively, included in the two waste management groups (i.e., one group including only interior use behaviours and the other including all of the waste management behaviours). That being said, the other waste

[4] Assuming that the household possesses a washing machine and a thermostat for the inhabitants to be able to wash laundry in cold water and set the thermostat no higher than 20ºC.

management behaviour related to interior use (i.e., repairing broken items instead of buying new) had also a high adoption level (83.6% in Table 34), indicating that waste management seems to be generally popular among Canadian house owners. Despite this observation, Canada appears to promote waste reduction practices as evidenced by initiatives led by major municipalities such as Toronto (GRRN, 2008), Montreal (CNW Group, 2009), and Vancouver (Metro Vancouver, 2009). These initiatives aim to substantially reduce waste by encouraging additional recycling, composting, minimisation of material consumption, and enhancement of material re-use. Therefore, further increasing adoption levels of waste management and reduction behaviours appears to be relevant to policy makers.

The category containing interior use behaviours related to toxic materials also had a relatively high average percentage of adoption (75.9% in Table 35). This may reflect concerns regarding health issues (for respondents themselves or for their relatives and friends). Even the toxic material-related group that included gardening behaviours was found to have a rather high average percentage of adoption (66.7% in Table 35) which, again, points out likely health concerns that are taken seriously by respondents. However, considering that in 2007 a quarter of non-apartment households with a lawn or garden applied a chemical pesticide (Statistics Canada, 2009c) enhancements in adoption levels of behaviours related to use and reduction of toxic materials are advisable.

The average percentage of adoption of energy conservation behaviours of house owners was 64.6% (Table 35). This may reflect, to some extent, a reaction on the part of house owners to address rising energy costs that accounted for around 15% of an average household's yearly expenditures in 2006 (Statistics Canada, 2009c). Although the average percentage of 64.6% cannot be considered low, there is potential for improvement.

Water conservation behaviours had low average percentages of adoption levels (47.1% in Table 35) when all of the water-related behaviours were included in the group (i.e., including the garden-related behaviours). For these results, comments about gardening seen as a leisure activity for which one usually

does not commit substantial resources to it apply, as explained in section 5.1.2. Otherwise, the average adoption percentage of water-related behaviours (for interior use which excludes the gardening component) was equal to that of energy conservation behaviours (64.6% in Table 35) showing that house owners take notable steps to conserve water inside their houses. However, there is room for improvement by increased adoption of water-related behaviours since an individual in Canada is estimated to have consumed an average of 329 litres of water per day in 2004 (Statistics Canada, 2009c).

For house renters, the categories of behaviours that received the highest (i.e., waste management – interior use behaviours) and the lowest (i.e., water conservation – both interior and exterior use behaviours) average percentages of adoption were the same as for house owners. This may reflect certain underlying similarities in factors that shape environmental behaviour in the two Canadian populations of house owners and renters. Additionally, for house renters, all of the three categories that included gardening behaviours (i.e., waste management, toxic materials use, and water conservation categories) received the three lowest average percentages of adoption. This could signify (on top of the generally low importance associated with gardening, as explained earlier in this section and in section 5.1.2.) that renters do not feel a strong attachment to a garden they do not own.

After having examined current adoption levels for environmental housing behaviours in Canada, the following section comments on factors that can predict these behaviours. Although a cause and effect relationship (between predictors and behaviours) cannot be established, knowledge of such factors can assist in providing an environment that may be beneficial to the enhancement of adoption of environmental housing behaviours.

5.2. Factors influencing environmental housing behaviours

This section describes how the second objective of the present study was achieved. The objective was:

To identify the internal, individual, and external factors that are significant predictors of environmental behaviours of house inhabitants related to environmental housing practices. This includes possible interactions between factors.

The majority of the variables investigated were identified as significant predictors of adoption of environmental behaviours although, in general, their effect on behaviour was not particularly strong. Interactions among variables could not be detected. The following sections comment on the importance of each variable in terms of its influence on behaviour and on the results from testing for interactions.

5.2.1. Variables identified as predictors

Most of the variables examined in this study were identified as significant predictors of adoption of environmental behaviours, based on logistic regression results. These significant predictors are given below:

1. Specific attitude to a given behaviour
2. Familiarity with a given behaviour
3. Convenience of performing a given behaviour
4. Personal values (materialist, post materialist, self-transcendence, self-enhancement, openness to change, and traditional values)
5. Having personally witnessed human made environmental disasters (within one's Province or in the world)
6. Familiarity with environmental problems (within one's Province or in the world)
7. Familiarity with media campaigns (that promote conservation of energy or minimisation of waste material)

8. Frequency of nature visits
9. Demographic variables (age, income level, type of residence, education, number of people in the house, gender, stand on political issues, and house size)

From the above variables, the first four were the most influential on behaviour since they were predictors for more than 50% of the behaviours in this study. These four variables were also found to be associated with behaviour based on partial correlation analysis. The remaining variables (i.e., from 5. to 9. above) appeared to affect mostly a small number of behaviours and are considered to be of limited use in understanding environmental housing behaviour at a general level.

5.2.1.1. Specific attitude to behaviour

In agreement with existing studies (e.g., Ajzen, 2001; Dietz and Stern, 1995; Stern et al., 1995; Vining and Ebreo, 1992), attitudes about particular behaviours were found to be important in understanding adoption of those behaviours. Specific attitude to a given behaviour was, in general, the most consistent and strongest predictor of adoption of environmental housing behaviours, according to results from logistic regression. Specific attitude was a significant predictor of adoption for 19 out of the 20 behaviours and its relationship with adoption was always positive (Table 104). The odds ratio (or exp(B) value) for specific attitude ranged from a minimum of 1.7 for the behaviour 'repairing broken items instead of buying new' to a maximum of 5.7 for the behaviour 'using a programmable thermostat to reduce energy use' (section 4.4.3.). This signifies that for a unit increase in specific attitude (e.g., from 2 to 3, in the five-point scale it was measured) the odds for the behaviour 'repairing broken items instead of buying new' being adopted would be multiplied by 1.7 while for a unit increase in specific attitude the odds for the behaviour 'using a programmable thermostat to reduce energy use' being adopted would be multiplied by 5.7.

However, results from partial correlation analysis (sections 4.5.1., 4.5.2., and 4.5.3.) reveal a somewhat different picture. According to these results, the partial correlation coefficient values between specific

attitudes and adoption of behaviours (for the three behaviours examined: a. adoption of using energy efficient appliances, b. adoption of using water efficient appliances, and c. adoption of using water saving plumbing fixtures) ranged from 0.13 to 0.26. Such values indicate a relationship that ranged from being weak to approaching the limits of a moderate strength relationship, which is not completely aligned with logistic regression results that pointed to a relatively stronger relationship.

Despite these discrepancies, results from both logistic regression and partial correlation reinforce each other in showing there is a relationship between specific attitudes and adoption of behaviours and that the relationship has a positive direction. Moreover, the fact that the values obtained in the results refer to distributions and not to single points provides an additional explanation for the discrepancies. According to logistic regression results, the lower limits of the confidence intervals of exp(B) for specific attitude (for the three behaviours analysed using partial correlation) take values that range from 1.6 to 1.9. This signifies that for a unit increase in specific attitude the odds for the three behaviours being adopted would be multiplied by a minimum of 1.6 to a maximum of 1.9, which reveals a not particularly strong relationship (in accordance with partial correlation results). Therefore, despite the difference in the magnitude of the relationship between specific attitudes and behaviours as identified by the two techniques (i.e., logistic regression and partial correlation), there is overlap of these results.

Partial correlation analysis detected additional relationships between specific attitudes and other factors that affect environmental behaviour. A rather weak association was found between specific attitudes and personal values, as described in section 5.2.1.4. Given that values are considered to be formed at an earlier age than attitudes (Stern et at., 1995), it seems more likely that personal values shape, to some degree, specific attitudes and not vice versa. Another relationship was found between specific attitude to a given behaviour and convenience of performing that behaviour (section 5.2.1.3.). Finally, a relationship between specific attitude to a given behaviour and familiarity with that behaviour was also observed and it is described below (section 5.2.1.2.).

5.2.1.2. Familiarity with specific behaviour

Familiarity with a given behaviour may result from: (1) obtaining direct personal experience with the behaviour, (2) becoming aware of other people's experiences with the behaviour, and/or (3) acquiring information related to that behaviour. Both past behavioural experiences (Hamid and Cheng, 1995) and level of knowledge about a specific behaviour (Barr, 2007; Gamba and Oskamp, 1994) are known to predict behaviour, which is in accordance with the present study's results that revealed familiarity with a specific behaviour to have importance in explaining behaviour adoption.

Familiarity with a specific behaviour was identified as a predictor of adoption for thirteen out of twenty behaviours and its relationship with adoption was always positive (Table 104). The odds ratio for familiarity with a specific behaviour ranged from a minimum of 1.3 to a maximum of 4.0 with an average value of 2.0, signifying the relative importance of familiarity on behaviour (section 4.4.3.).

Partial correlation coefficients between familiarity with a specific behaviour and behaviour adoption identified a weaker relationship. These coefficients ranged from 0.12 to 0.23 (sections 4.5.1., 4.5.2., and 4.5.3.). However, both logistic regression and partial correlation results were in agreement (in a way similar to that observed about specific attitudes in section 5.2.1.1.) by revealing a positive relationship.

Familiarity with a specific behaviour was positively linked to the specific attitude to that behaviour. The partial correlation coefficients ranged between 0.37 and 0.52 revealing a moderate strength relationship (Figures 13, 14, and 15). This result is meaningful since the more knowledge about or exposure with a given behaviour people have, the more they can be expected to realise its likely importance and hold stronger attitudes about it. Alternatively, people feeling that a given behaviour is important and holding a stronger attitude about it may actively seek opportunities to familiarise themselves with that behaviour by learning more about it or implementing it. Finally, familiarity with a given behaviour was also linked to convenience of performing that behaviour, as described in section 5.2.1.3.

5.2.1.3. Convenience of specific behaviour

Logistic regression analysis revealed that convenience associated with a specific behaviour was important in explaining behaviour adoption. Convenience was found to predict adoption of five out of six behaviours and it always exhibited a positive relationship with adoption (Table 104). The odds ratio for convenience ranged from a minimum of 1.6 to a maximum of 2.2 with an average value of 2.0, which demonstrates the relative importance of convenience on behaviour (section 4.4.3.).

Based on partial correlation analysis, convenience was found to be of lesser importance to environmental behaviour. The coefficient values ranged from 0.11 to 0.26 (sections 4.5.1., 4.5.2., and 4.5.3.). However, both the techniques of logistic regression and partial correlation identified the existence of a positive relationship between convenience and behaviour, which is also mentioned by other researchers (Gamba and Oskamp, 1994; Schultz et al., 1995).

Convenience of performing a specific behaviour was also associated with the specific attitude to that behaviour. The partial correlation coefficients ranged between 0.18 and 0.31 for the behaviours examined (Figures 13, 14, and 15). This result is meaningful since it is logical to expect that people who perceive a given behaviour as important and have a stronger attitude about it may also feel more determined to perform it and less discouraged by likely difficulties in its adoption (i.e., they may not find the behaviour as inconvenient as they would if they considered it to be unimportant). Alternatively, people who find a given behaviour convenient may form more favourable attitudes toward it.

During partial correlation analysis, a weak association between convenience and familiarity with a given behaviour was also detected. In only two out of the three behaviours examined this relationship was present and the partial correlation coefficient values were 0.15 and 0.13, respectively. This result also appears meaningful since it is logical to expect that people who find a given behaviour convenient may also become more familiar with it, mostly by acquiring personal experiences. The possibility that being familiar with a certain behaviour may also render that behaviour more convenient exists as well. This

could happen if increased familiarity leads people to realise that inconvenience perceptions they held before learning more about the behaviour were inaccurate.

5.2.1.4. Personal values

As reported in other studies (e.g., Grob, 1995; Schultz and Zelezny, 1998; Van Vugt et al., 1995), a relationship between personal values and environmental behaviour was observed. The present study examined six types of personal values (i.e., materialist, post materialist, self-transcendence, self-enhancement, openness to change, and traditional values). Their influence on behaviour (based on logistic regression results) appeared important only when they were considered collectively since none of these value types alone could predict more than 20% of the behaviours (Tables 102 and 103). However, when all six types were considered collectively, they could predict twelve out of twenty behaviours.

In terms of the nature of the influence of personal values on behaviour, it appeared that the more self centered the participating house owners, the more they exhibited a tendency to have higher adoption levels of environmental behaviours. The quality of a person being self centered was assessed by four value types (i.e., self-transcendence, self-enhancement, materialist, and post materialist) and results pertaining to this issue were clearer to interpret for the self-transcendence and self-enhancement value types than for the materialist and post materialist value types. Values of partial correlation coefficients between personal values and behaviour adoption were particularly weak. Specifically, the coefficient for self-transcendence values was –0.13 (section 4.5.2.) and the coefficient for post materialist values was –0.09 (section 4.5.3.). Although a relationship between personal values of types other than self-transcendence or post materialist and behaviour could not be demonstrated based on partial correlation results, both analyses (i.e., logistic regression and partial correlation) revealed a relationship between personal values and behaviour that also exhibited a relatively consistent direction (i.e., self centered individuals having higher behaviour adoption).

A more detailed consideration of the influence of each value type on behaviour is presented in the remainder of this section. In addition, a generally weak relationship between personal values of three types (i.e., materialist, post materialist, or self-transcendence values) and specific attitudes that was discovered by partial correlation analysis is also described.

Materialist and post materialist values

A relationship with a positive direction between post materialist values and environmental behaviour is reported in certain studies (Blake, 2001; Grob, 1995). Although the present study did find an effect from post materialist values on behaviour, the influence from this type of values was mostly negative. Moreover, materialist values appeared to be of a certain importance in understanding adoption of environmental housing behaviours although their relationship with behaviours was ambiguous, as revealed by logistic regression results. Specifically, these values were identified as predictors of four out of twenty behaviours and with two of these behaviours the relationship was positive while with the other two it was negative (Table 104). The situation was less ambiguous with post materialist values that also were identified as predictors of four out of twenty behaviours. These values exhibited a negative relationship with three behaviours and a positive relationship with only one behaviour (Table 104). Moreover, partial correlation analysis also revealed a negative (albeit particularly weak with a coefficient value of –0.09) relationship between post materialist values and environmental behaviour (section 4.5.3.).

Examination of odds ratios for materialist and post materialist values revealed that they likely exhibited more extreme values when transformations were applied (section 4.4.3.). Specifically, odds ratios' values for un-transformed variables ranged from 0.1 to 10.1 while for transformed variables they ranged from less than 0.1 to 28.2 (with the last two values also constituting the minimum and maximum odds ratio values among all predictor variables in logistic regression analysis). However, there was no evidence that the direction of the relationship between materialist or post materialist values and behaviour adoption changed after applying transformations although this cannot be completely ruled out. This influence (i.e.,

the likely more extreme values for odds ratios) resulting from variable transformations has to be considered when examining the importance of materialist and post materialist values.

That said, materialist and post materialist values appeared to exert a relatively high influence on behaviours even when variable transformations had not been applied (as assessed by odds ratio values). Specifically for un-transformed materialist values, odds ratio values were substantially low at 0.1 when the relationship with behaviour was negative and substantially high at 10.1 when the relationship with behaviour was positive. For un-transformed post materialist values, odds ratio values were again low at 0.1 and 0.2. In conclusion, materialist and post materialist values exerted a considerable influence on environmental behaviour although there was ambiguity in the direction of their relationship with behaviour.

Materialist and post materialist values were also found to be associated with specific attitudes. As far as materialist values are concerned, they were weakly linked to specific attitudes with a partial correlation coefficient of 0.12 (Figure 13). Post materialist values were linked to specific attitudes with a relationship that approached a moderate-level strength. The value for that partial correlation coefficient was 0.25 (Figure 15).

Self-transcendence values

Self-transcendence values were of small to moderate importance in explaining adoption of behaviours. They were identified as predictors of four out of twenty behaviours and the direction of the relationship was always negative (Table 104). Odd ratios did not reveal a strong effect on behaviour with values of 0.8 for using compact fluorescent lighting, 0.7 for using a high-efficiency furnace/boiler, 0.7 for using water efficient appliances, and 0.9 for using non-toxic cleaners, as shown in section 4.4.3. A weak and negative relationship with behaviour was also identified by partial correlation analysis having a coefficient value of –0.13 (section 4.5.2.). However, the importance of this type of values is augmented by the fact that they were influential (according to logistic regression results) for behaviours covering almost all of the

broad categories of housing behaviours examined in this study (i.e., energy conservation, water conservation, and use of toxic materials).

Contrary to these results, a study conducted in several countries reports partial correlation coefficients between self-transcendence values and self-reported environmental behaviour that ranged from 0.01 to 0.14 with an average of 0.07 (Schultz and Zelezny, 1998), identifying the absence of a relationship. However, that study found that when considering only self-transcendence items pertaining to the natural environment (i.e., biospheric items, such as protecting the environment or preserving nature) while omitting altruistic items (e.g., a world at peace, free of war and conflict) the average partial correlation coefficient increased to 0.24. This may constitute a worthwhile direction for future research, yet due to reliability concerns, it was not possible in this study to focus on biospheric items alone, as mentioned in section 4.3.1.1. A positive effect from self-transcendence values on environmental behaviour is mentioned by Karp (1996). In conclusion, although the present study found a negative influence from self-transcendence values on behaviour, when results from other studies are considered the relationship appears unclear. Finally, a relatively weak association between self-transcendence values and specific attitudes with a partial correlation coefficient of 0.23 was also detected (Figure 14). This is in accordance with the views of Stern et al. (1995) that values may affect attitude formation.

Self-enhancement values

Self-enhancement values appeared to have a minor role in explaining behaviour. They were predictors of a single behaviour (i.e., washing laundry in cold water) with which they shared a positive relationship, as shown in Table 104. Furthermore, the odds ratio had a value of only 1.2 (section 4.4.3.). However, the importance of this value type is strengthened by the fact that self-enhancement values exhibited a relationship with behaviour in the opposite direction to that of self-transcendence values, as expected. The positive direction found is in contrast with results from the study by Schultz and Zelezny (1998) mentioned earlier in this section where the average partial correlation coefficient between self-enhancement values and behaviour for various countries was –0.19. However, although that study

managed to identify a relationship in the opposite direction, the relationship was weak. Finally, Karp (1996) also reports that self-enhancement values negatively affected environmental behaviour.

Openness to change values

Openness to change values were found to have a small influence on behaviour. The relationship had a negative direction (Table 104) and values for odds ratios were only 0.8 for using lighting controls and 0.9 for using non-toxic cleaners (section 4.4.3.). The negative direction in the case of using lighting controls, which constitutes a rather innovative product, was unexpected. However, the small odd ratio value reduces substantially the importance of this finding.

Contrary to this study's results, other studies (Karp, 1996; Schultz and Zelezny, 1998) report a positive relationship between openness to change values and behaviour although the average (for several countries) partial correlation coefficient in one of these studies (Schultz and Zelezny, 1998) was only 0.10. Another study by Poortinga et al. (2004) could not find a significant effect from openness to change values on environmental housing behaviour. Therefore, based on results and existing literature, openness to change values appear to play an unclear and not necessarily primary role in shaping environmental behaviour, which may be useful to examine in future studies .

Traditional values

Traditional values were of minimal assistance in understanding behaviour adoption. They predicted adoption of one behaviour only (i.e., using natural ventilation – no air conditioning) with which they had a negative relationship (Table 104). Respondents likely considered using air conditioning as a traditional approach for house ventilation. The conclusion that this value type does not seem promising in explaining environmental behaviour was also supported by the odds ratio value (i.e., 0.8 in section 4.4.3.). The negative influence from traditional values on behaviour is in line with the views of Karp (1996).

5.2.1.5. Personally witnessing human made environmental disasters

Personal experiences with environmental disasters created by humans appeared to play a rather secondary role in explaining behaviour adoption given that this variable predicted only six out of twenty behaviours (Tables 102 and 103). In addition, the specifics of that relationship are rather ambiguous. Experiences with such disasters within one's Province exhibited the expected relationship direction with adoption (i.e., a positive relationship where more experiences are associated with more adoption). However, experiences with human made environmental disasters in the world were characterised by a negative relationship with adoption (Table 104). Odds ratio values were neither particularly low for negative relationships (i.e., ranging from 0.6 to 0.8) nor particularly high for positive relationships (i.e., ranging from 1.3 to 1.5), revealing a generally weak effect on behaviour (section 4.4.3.).

In an effort to further investigate these results and provide explanations about the opposite directions, six cross-tabulations were conducted (see Appendix G). It was hypothesised that if a certain important demographic variable exhibited a relationship with having personally witnessed human made environmental disasters that had a given direction (e.g., positive) when the disasters had been witnessed in the Province whereas the direction was inverted (i.e., negative in this example) when the disasters had been witnessed in the world, then this demographic variable could be considered a factor contributing to the observed results. Three such demographics (i.e., age, educational level, and individual income) were cross-tabulated with having personally witnessed human made environmental disasters both in the Province and in the world.

Based on chi square values (Appendix G), the only significant association among those variables was observed between educational level and having personally witnessed human made environmental disasters in the world. Examination of the column showing respondents never having witnessed any environmental disasters reveals a relatively clear falling trend as educational level increases. In other words, as respondents become more educated fewer of them appear to have never witnessed human made environmental disasters in the world. Such a conclusion could not be drawn for the relationship between

educational level and having personally witnessed human made environmental disasters in the Province because the chi square value for that relationship was not significant and, therefore, these two variables could not be considered associated. With the rest of the cross-tabulations, since the chi square values were also not significant (Appendix G) an association between those variables could not be detected and, moreover, no clearly visible trends (inverted relationships or otherwise) could be observed that would render these variables potentially contributing factors for the results, as hypothesised.

The detection of the relationship between educational level and having personally witnessed human made environmental disasters in the world prompted a search for a potential interaction between these two variables on behaviour adoption, which could contribute to produce the opposite directions mentioned in the beginning of this section. However, based on logistic regression results (Tables 102 and 103) there was no outcome variable (i.e., behaviour adoption) that could be predicted from both of these variables (i.e., educational level and having personally witnessed human made environmental disasters). Since interactions are assessed among variables that have been identified as predictors for a given outcome, the hypothesised interaction could not be investigated (Hosmer and Lemeshow, 2000).

The positive relationship between adoption of behaviours and having witnessed human made environmental disasters within one's Province points to the importance of acquiring experiences of that type. It is also noteworthy that personally acquiring disaster experiences was a more important predictor of environmental behaviours than simply becoming aware of such problems (Table 104). Accordingly, acquisition of experiences with local, human made environmental disasters is recommended, especially for younger individuals who are in the process of forming their personal values Stern et al., 1995). This approach assists in ensuring a lasting impact from those experiences.

Currently available results failed to provide insights about the negative relationship between disaster experiences in the world and behaviour adoption. This relationship constitutes a topic for further research

and it is likely that respondents perceived disaster experiences acquired outside their Province as personally irrelevant, to some degree, which may have contributed to the observed results.

5.2.1.6. Familiarity with environmental problems

In general, familiarity can be considered to occur either by acquiring personal experiences with an issue or by acquiring information about that issue (by studying it or by becoming exposed to relevant narratives). In the present study, the item inquiring about familiarity with environmental problems was placed next to the item inquiring about having personally witnessed environmental disasters (items A1 and A2 in Appendix B) to prompt respondents to consider familiarity resulting from secondary sources, rather than their own experiences.

An effect from familiarity with environmental problems was indeed detected. However, logistic regression results pointed to a negative relationship with behaviour (Table 104). Although this is contrary to findings reported by another study (Blake, 2001), that study discovered only a small positive effect on behaviour. Familiarity with environmental problems in the world was a predictor of two behaviours while familiarity with environmental problems in the respondents' Province was a predictor of only one behaviour (Table 104).

Values for odds ratios ranged from 0.6 to 0.8 for the three behaviours (i.e., using lighting controls, using non-toxic paints when painting their home, and using water saving plumbing fixtures) pointing to a moderate to small size effect on behaviour (section 4.4.3.). A clear explanation regarding the negative influence of familiarity with environmental problems on behaviour adoption could not be produced. However, in case respondents adopted the green behaviours out of self interest (see section 5.1.1.), then familiarity with environmental problems would likely be unrelated to green behaviour adoption. This is not completely unlikely given the generally weak effect observed (as revealed by odds ratio values) and the small number of behaviours predicted (i.e., three out of twenty). However, further investigating the influence from this type of familiarity in future studies could be of interest.

5.2.1.7. Familiarity with media campaigns

Familiarity with media campaigns was a variable of lesser importance in understanding environmental behaviour, based on logistic regression results. An effect on adoption was observed only from campaigns promoting either conservation of energy or minimisation of waste material (Tables 102 and 103). There was no measurable effect on behaviour from campaigns promoting conservation of water or protection of surrounding ecosystems. However, the direction of the relationship with adoption was consistently negative (Table 104), which is the opposite from what was expected. Assuming the effect on adoption was not a random outcome (which is not unlikely given that familiarity with media campaigns was a predictor of only three out of twenty behaviours), then media campaigns appear to operate as obstacles in enhancing adoption of environmental behaviours. The effect of campaigns on adoption was not substantial with odds ratio values ranging from 0.6 to 0.8 (section 4.4.3.).

A likely explanation for the negative direction of the relationship may be that respondents experience a certain fatigue from such campaigns that in turn produces the opposite from expected results. This study did not focus on collecting detailed data regarding media campaigns and this renders an insightful explanation of these results elusive. However, further research in that area could be useful despite the low importance of media campaigns in explaining behaviour because such campaigns constitute a valuable tool for policy makers to reach efficiently large populations.

5.2.1.8. Frequency of nature visits

Frequency of nature visits within the past twelve months was a marginally important factor to explain environmental behaviour. It was identified as a predictor (Table 102) of only one behaviour (out of twenty) and its odd ratio value of 1.3 (section 4.4.3.) indicates a generally weak effect on environmental behaviour.

5.2.1.9. Demographics

Various demographic variables were found to play a role in shaping green behaviour although none of them was particularly influential. A more detail description of each demographic that was identified as a predictor of at least one environmental behaviour follows.

Age had a certain importance in explaining adoption since it was a predictor of four out of twenty behaviours (Tables 102 and 103). Odds ratio values ranged from 1.3 to 1.4, rendering the effect from age on behaviour relatively weak (section 4.4.3.). However, the consistently positive relationship between age and adoption of behaviours (Table 104) increases, to some degree, its value as an influential factor in understanding environmental behaviour.

Regarding other studies, the mixed results reported point also to a limited effect from age on adoption. Barr (2007) found that older people tended to have higher green behaviour adoption levels. Poortinga et al. (2004) did not find an effect on environmental housing behaviour while Schultz et al. (1995) report an unclear relationship between age and green behaviour.

A positive influence of income level on adoption of behaviours was discovered in accordance with other studies (e.g., Gamba and Oskamp, 1994; Poortinga et al., 2004) although it appeared to be of limited importance. Income (either from individuals or from whole families) was a predictor of only three out of twenty behaviours and its relationship with them was positive, as expected (Table 104). Odds ratios ranged from 1.2 to 1.3 (section 4.4.3.) signifying relatively modest increases in adoption as income increases. Two of the behaviours predicted by income (i.e., using water saving toilets and using a high-efficiency furnace/boiler) can be considered rather costly and, consequently, the influence of income on their adoption is clear. However, it was not possible to explain income's contribution to washing laundry in cold water since that behaviour does not require any monetary expenditure (provided that a washing machine exists in the house). This result may have been a random one and given income's small explanatory power on behaviour further research to clarify it seems to be of secondary importance.

Type of residence played a small role in explaining behaviour. People living in a town house instead of a detached house were less likely (odds ratio value was 0.2 in section 4.4.3.) to use natural ventilation without air conditioning. The result is meaningful since people in a detached house usually have more control of their home environment both during house construction and during house use. Those living in an apartment instead of a detached house were less likely (odds ratio value was 0.1 in section 4.4.3.) to use water saving plumbing fixtures. This result also appears meaningful for the same reasons as the previous result. Therefore, type of residence may affect adoption of certain behaviours by providing more control to house occupants. However, given that this variable only predicted two out of twenty behaviours (Table 104), its importance does not seem to be substantial.

Education was barely of importance in explaining adoption of environmental behaviours. Only one educational level (i.e., Ph.D.) was identified as a predictor (Table 104) of adoption of a single behaviour (i.e., using water saving toilets with an odds ratio value of 0.1 in section 4.4.3.). However, a straightforward explanation for this result could not be formulated. Given that no other educational level was a predictor for that behaviour and that education was not a predictor for any other of the behaviours included in the analysis (Table 104), the result concerning Ph.D. holders could be a random one. Therefore, further research in that direction, although not completely inadvisable, cannot be considered a priority. The same conclusion is drawn by the fact that education was overall (i.e., by considering all of the educational levels simultaneously) significant as a predictor for using water saving toilets only at the alpha level of 0.10 (its significance value was 0.06, as shown in section 4.4.3.). Another study (Poortinga et al., 2004) discovered that higher educational levels were associated with lower house energy consumption although the effect from education was not substantial.

In agreement with findings from Gamba and Oskamp (1994), number of people in the house was influential on environmental behaviour although the effect was of a minor importance. It was able to predict adoption of one behaviour only (i.e., using compact fluorescent lighting, as shown in Table 102)

and its relationship with adoption had a positive direction (Table 104). This appears meaningful since economic savings can be achieved by replacing incandescent lighting with compact fluorescent lighting and the savings can be proportionate to the areas that have to be lit up that would increase as the number of people in the house increases. However, the odds ratio value of 1.3 (section 4.4.3.) is relatively small and since the number of people in the house was not helpful in predicting adoption of any other behaviours it can be concluded that this variable is of limited use in the study of green behaviours.

In terms of the respondents' gender, women tended to have higher adoption of using water saving toilets (Tables 103 and 104). The odds ratio value of 1.9 revealed a rather substantial effect on behaviour (section 4.4.3.). This is another result for which an obvious explanation appears problematic to produce. However, since gender was a predictor of a single behaviour out of twenty, its value in understanding environmental behaviour is likely small. Barr (2007) also found that females are more likely to have higher levels of environmental behaviour adoption while according to Schultz et al. (1995) gender is not a predictor of recycling.

Stand on political issues was a significant predictor for only one out of twenty behaviours (Table 103). Being liberal (odds ratio value of 3.0 in section 4.4.3.) or moderate to liberal (odds ratio value of 2.2 in section 4.4.3.) instead of moderate increased adoption of using water saving toilets (Table 104). However, this result could not be explained in a meaningful way and given that stand on political issues was not able to predict any other behaviour this finding is likely a random one. Consequently, further research in that area does not appear to be promising.

Finally, house size was of minor importance in explaining behaviour since it was a predictor of only one out of twenty behaviours (Table 102). Findings indicated that as house size became larger adoption of setting the thermostat no higher than 20ºC was decreasing (Table 104). A possible explanation for this may be that in larger houses only some of the rooms are heated and these rooms may need to be heated above 20ºC as the rest of the house being colder continuously lowers the temperature of the heated rooms.

However, this result appears to be very specific to the particular behaviour and given its effect on behaviour was weak (odds ratio value of 0.8 in section 4.4.3.) house size can be considered of limited importance in understanding environmental behaviour at a general level.

5.2.2. Variables not identified as predictors

A number of variables were not identified as predictors of any of the twenty environmental behaviours during logistic regression analysis. These included social norms, general environmental attitudes (measured by the New Environmental Paradigm scale), and three demographic variables (i.e., residential environment, marital status, and total number of children in the house).

Certain studies report an effect on environmental behaviour from social norms (e.g., Barr, 2007; Do Valle et al., 2005; Gamba and Oskamp, 1994) or from general environmental attitudes (e.g., Barr, 2007; Gagnon Thompson and Barton, 1994; Poortinga et al., 2004). However, Do Valle et al. (2005) found only a weak positive relationship between social norms and behaviour while Schultz et al. (1995) mention studies that both did and did not detect an association between social norms and environmental behaviour, rendering the contribution of social pressure in understanding behaviour relatively unclear. Barr (2007) found that general environmental attitudes influenced behavioural intentions rather than adoption of behaviours.

To further investigate the absence of a relationship between social norms or general environmental attitudes and behaviour, the average absolute Spearman correlation values were calculated and they were indeed negligible. The average absolute correlation value between social norms related to conservation of energy and adoption of energy related behaviours was 0.03, the average absolute correlation value between social norms related to conservation of water and adoption of water related behaviours was 0.05, the average absolute correlation value between social norms related to minimisation of waste material and adoption of waste related behaviours was 0.04, and the average absolute correlation value between social norms related to protection of surrounding ecosystems (i.e., in terms of reducing toxic materials) and

adoption of behaviours related to toxic materials was 0.05. As far as general environmental attitudes are concerned, their average absolute correlation value with adoption of behaviours was again particularly low at 0.06. Therefore, this study could not detect any influence from either social norms or general environmental attitudes on environmental housing behaviours.

With respect to social norms, it appears that pressure from other people is not strong enough to produce a measurable effect on adoption of behaviours. However, as far as general environmental attitudes (or NEP scale score) are concerned, at least two explanations can be offered regarding their inability to predict behaviour. The first explanation posits that environmental behaviours were adopted primarily to enhance the house occupants' personal well-being, as described in section 5.1.1. Accordingly, level of concern about the natural environment would be unrelated to adoption of any green behaviour. The second explanation stems from studies reporting that attitudes can better predict behaviour when they are measured at the same level of specificity as behaviour (Ajzen, 2005; Fazio and Roskos-Ewoldsen, 2005). Accordingly, the lack of an association between the two variables (i.e., general environmental attitudes and behaviour adoption) could be due to the fact that the NEP scale assessed general environmental attitudes while adoption was measured for specific behaviours. The two explanations presented here are not necessarily mutually exclusive.

The three demographic variables (i.e., residential environment, marital status, and total number of children in the house) that also did not demonstrate any influence on behaviour were included in the questionnaire for exploratory purposes without any prior knowledge regarding their ability to affect environmental housing behaviour. In the literature, residential environment (i.e., urban vs. rural) has been identified as a factor influencing ecological consumerism behaviour (i.e., food purchasing decisions) which although related to environmental issues constitutes a largely different area from environmental housing behaviour (Tanner et al., 2004).

5.2.3. Interactions among factors

Interactions among factors were tested during step 4 of the logistic regression analysis (see section 3.3.3.). During that step, the variables remaining in the regression model after step 2 of the logistic regression analysis were considered to decide whether a plausible interaction was present. Plausible interactions (as identified by the literature and presented in section 3.3.3.) would include at least one of the following combinations of variables in the regression model:

- Gender and age
- New Environmental Paradigm scale score and familiarity with environmental problems
- New Environmental Paradigm scale score and personal values

The only plausible interaction detected was the combination of New Environmental Paradigm scale score and self-transcendence values for the behaviour: using a high-efficiency furnace/boiler. This interaction was examined statistically (during step 4 of the logistic regression analysis) and it was not significant (significance = 0.34, as presented in Appendix F). Moreover, a hypothesised interaction between educational level and having personally witnessed human made environmental disasters in the world on behaviour adoption could not be investigated (see section 5.2.1.5.). However, the failure to detect interactions is not surprising. Ajzen (1991) states that successful detection of interactions among factors that affect environmental behaviour is uncommon in existing studies.

5.3. A critique of the environmental housing behaviour model developed

This section describes how the third objective of the present study was accomplished. The objective was:

To develop a theoretical model to explain environmental behaviour of house inhabitants based on existing related models. The new model would be specific to housing practices in contrast to existing models that are generic about environmental behaviour.

The final model is presented below in Figure 16 and it is referred to as the environmental housing behaviour model henceforth. The following sections offer a description of the model, a comparison of the model to the two theories that were used as its primary inputs (i.e., the theory of planned behaviour and the causal model of environmental concern, presented in sections 2.3.1. and 2.3.2., respectively), and its likely advantages and disadvantages.

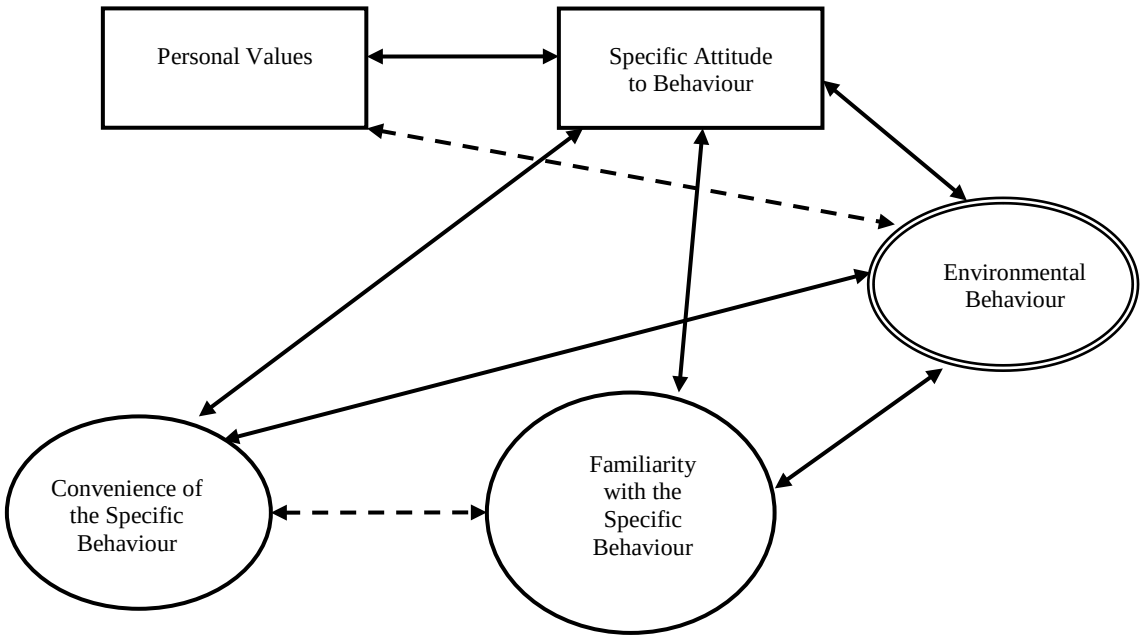

Figure 16. The environmental housing behaviour model

Note: Factors in single-lined rectangles belong to the motivation path and factors in single-lined ovals belong to the ability path. Behaviour is in a double-lined oval and relationships that are only partially supported have been drawn using dashed-lines.

5.3.1. Description of the model

The environmental housing behaviour model includes four predictors of behaviour (i.e., personal values, specific attitude to the given behaviour, convenience of performing the given behaviour, and familiarity with the given behaviour). The dashed lines represent links that were only partially supported by results (i.e., relationships that during partial correlation analysis were not found to be present for all of the three

behaviours examined). To better establish the nature of these relationships, relevant future studies are recommended. The bi-directional arrows are maintained to denote associations between adjacent variables rather than causal relationships that cannot be established with the methodology followed in this study.

Except for personal values, the variables in the model are measured at a level that is specific to the given behaviour. Thus, the model appears to be somewhat closer to the theory of planned behaviour (Ajzen, 1991) than to the causal model of environmental concern (Stern et al., 1995). Regarding the two paths that were hypothesised to exist (i.e., the motivation path and the ability path), although both proved to be influential on behaviour adoption none of them appeared to be more important than the other for the three behaviours included in partial correlation analysis (section 4.5.).

The model suggests that personal values have mostly an indirect effect on behaviour through specific attitude to the behaviour although a direct effect is also possible (likely depending on the nature of the specific behaviour examined) (section 5.2.1.4.). Convenience of performing the given behaviour may have a direct effect on behaviour although it may also have an indirect effect on behaviour through specific attitude to the behaviour or through familiarity with the behaviour (a relationship that is not always present) (section 5.2.1.3.). Specific attitude can affect behaviour directly or likely through either familiarity (section 5.2.1.2.) or convenience with the given behaviour (section 5.2.1.3.). Finally, familiarity may exert a direct influence on behaviour or affect it indirectly through either specific attitude (section 5.2.1.2.) or, less likely, convenience with the given behaviour (section 5.2.1.3.).

5.3.2. Comparison of the model to its source theories

There was satisfactory support for Ajzen's (1991) theory of planned behaviour. In the present study, three variables were used from the original four in Ajzen's model (i.e., intentions were not measured in this study). Two out of these three variables, (i.e., attitude toward the behaviour and familiarity with the

behaviour, which was used in this study as a surrogate for perceived behavioural control that is instead present in Ajzen's model) were identified as important predictors of behaviours.

However, the environmental housing behaviour model includes elements that may render it more advantageous compared to the theory of planned behaviour. The elimination of intentions can be considered an improvement. It is difficult to assess past intentions that may have guided current actions (Do Valle et al., 2005) and, therefore, removing them from the model likely increases its usability by researchers. Another advantage can be considered the inclusion of personal values in the environmental housing behaviour model because it provides a more complete understanding of the factors that play an important role in shaping behaviour at a general level. Moreover, considering the relatively stable nature of personal values during one's life (Stern et al., 1995) and the fact that people likely possess a substantially smaller number of values compared to attitudes (Rokeach, 1968), measuring values seems to be an efficient tool to use at an operational level in the study of behaviour.

One of the shortcomings of the theory of planned behaviour is that it utilises one's perceived rather than actual control to perform a given behaviour (section 2.3.1.). The environmental housing behaviour model could not overcome this issue since it is problematic to measure one's actual control given the multitude of external factors that may interfere and influence it.

Compared to the causal model of environmental concern (Stern et al., 1995), the environmental housing behaviour model by omitting certain factors (i.e., position in the social structure, generalised attitudes, and intentions) may provide a more limited view of the variety of variables involved in shaping behaviour. However, omitted variables, such as demographics or generalised attitudes, were found to have a questionable or even trivial role in the study of environmental housing behaviour at a general level. These variables may be of interest when examining either environmental behaviour outside a housing context or specific environmental housing behaviours, which may be of an idiosyncratic nature. For example, a demographic variable related to one's position in the social structure (i.e., house size) was

found to be a significant predictor of setting the thermostat no higher than 20ºC (Table 102). For studying particular behaviours, the operational model (shown in Figure 5) could be a useful tool. Omission of intentions from the environmental housing behaviour model may be beneficial, as explained earlier in this section.

Another difference of the environmental housing behaviour model from the causal model of environmental concern (Stern et al., 1995) is the lack of general environmental attitudes in the former. However, including such attitudes in a behaviour model can limit its scope and flexibility. The present study found that adoption of environmental housing behaviours was not influenced by general environmental attitudes but rather seemed to be based more on whether individuals were self centered or not. Therefore, addition of these attitudes may render a theoretical model problematic in terms of its ability to take into account self centered approaches to environmental behaviour. In contrast, the environmental housing behaviour model allows for more flexibility by being able to handle such differences using a variety of personal values that may apply in every situation. For example, a self centered approach can be captured with self-enhancement values while an altruistic approach can be captured by self-transcendence values. The environmental housing behaviour model appears to be well equipped to deal also with dimensions other than environmentalism that may affect green behaviour.

5.3.3. Advantages of the model

A number of likely advantages render the environmental housing behaviour model useful. Except for the fact that the model appears to be intuitively logical, one of the most obvious advantages is its parsimony. It includes only four variables to explain and predict behaviour and, in that sense, it performs comparably to the theory of planned behaviour (section 2.3.1) and the causal model of environmental concern (section 2.3.2.), two popular models to explain green behaviour.

By including only predictors of environmental behaviour that could predict at least 50% of the behaviours examined during logistic regression analysis (see section 4.4.5.), the possibility that random results (i.e.,

variables that are not predictors of behaviour) are included in the model is minimised. This practice also emphasises the importance of variables that affect behaviour at a general level (i.e., variables that are not specific to only a small number of behaviours).

The elimination of intentions that may facilitate the model's use by researchers and the inclusion of personal values that can provide a more complete understanding of factors involved in shaping behaviour constitute additional advantages, as described in section 5.3.2. Finally, the model seems flexible enough to be of use irrespective of the underlying reasons for adopting environmental behaviour (i.e., self centered or altruistic, as described in section 5.3.2.).

Therefore, the environmental housing behaviour model appears to be a valuable tool that can assist in understanding environmental behaviour related to housing activities. It may be useful to both researchers and policy makers to effectively point out the most prominent factors that may shape environmental housing behaviour at a general level. Moreover, the model can also suggest the likely ways these factors influence each other and behaviour although in this respect its usability may be limited, as explained in the following section.

5.3.4. Model limitations

Despite the advantages of the environmental housing behaviour model presented above, certain limitations are also present. One shortcoming is the relatively limited empirical support found by partial correlation analysis (section 4.5.). The highest correlation coefficient value among direct associations between the model's variables and behaviour was only 0.26 (Figure 15), indicating a relationship of an almost moderate magnitude. In addition, the highest correlation coefficient value among any associations in the model (i.e., not necessarily associations with behaviour) was 0.52 (Figure 14), indicating a link of a moderate strength.

Behaviours with low adoption levels (see Table 34) were excluded from the environmental housing behaviour model due to the procedure followed during model development. The lowest adoption percentage for behaviours included in the model was 70.0% (for the behaviour: using water saving plumbing fixtures) while among all of the 35 behaviours examined the lowest adoption percentage was 6.0% (for the behaviour: using an on-demand water heater). This may have caused the model to become less reliable as a tool when used to explain behaviours that have low adoption levels.

At the last stage of model development (i.e., during partial correlation analysis), data from only three outcome behaviours were used due to various limitations, as explained in section 3.3.4. For this reason, the model, as far as the links among its variables are concerned, is valid only for these three behaviours and not for a wide variety of environmental housing behaviours, as it was originally intended. However, the presence of the four predictor variables in the model was determined using a large number of behaviours (i.e., the twenty behaviours used in logistic regression analysis and shown in Tables 102 and 103). Therefore, the model can be considered to have an acceptable generalisability in terms of its constituent variables although the generalisability of the relationships among these variables appears more limited. Future research may improve the environmental housing behaviour model regarding this issue, as discussed in the next chapter.

Although the procedure to develop the model used variables collected within an environmental housing context, the variables included in the final model cannot be considered to apply only to the area of housing. Specifically, personal values, specific attitude to behaviour, familiarity with the specific behaviour, and convenience of the specific behaviour (i.e., the model's constituent variables) can be measured for both behaviours that are and are not related to housing. This characteristic of the model may not necessarily constitute a limitation although further research may provide an explanation. However, the reason for the absence of factors specific to housing could be the fact that the model was developed to be valid at a general level (i.e., not specific to any behaviours).

After examining the factors that shape environmental housing behaviour and their likely links, the following section attempts to suggest ways to enhance adoption of this type of behaviours. To assist in this respect, elements from the elaboration likelihood model (Petty and Cacioppo, 1986) and the theory of diffusion of innovations (Rogers, 1995) are considered.

5.4. Enhancing adoption of environmental housing behaviours

This section describes how the fourth objective of this study was achieved. The objective was:

To propose suitable methods for enhancing the adoption of environmental housing behaviours to the general public.

Despite the substantial current levels of adoption of all categories of environmental housing behaviours in Canada (see section 5.1), enhancing those levels even further is recommended to not only improve present environmental conditions, but also assist in dealing with the country's expanding population (Statistics Canada, 2009b) that could put additional pressures on the environment. Cross-tabulation results (see section 4.6.) demonstrated that for the three behaviours examined (i.e., using energy efficient appliances, using water efficient appliances, and using water saving plumbing fixtures) the most promising variables to manipulate in order to increase adoption were specific attitude to the given behaviour, familiarity with the given behaviour, and convenience of the given behaviour. Personal values, although part of the environmental housing behaviour model, do not constitute a priority for manipulation due to both cross-tabulation results and their enduring nature (Stern et al., 1995) that renders them troublesome as possible intervention targets (Reardon, 1991). Convenience of performing a specific behaviour was found to be less influential on behaviour compared to specific attitude or familiarity (see cross-tabulation results in section 4.6.). However, it demonstrated a consistently positive relationship with behaviour and can be considered of value in enhancing behaviour adoption.

The following sections present suggestions that may be of assistance in enhancing adoption of environmental housing behaviours and are based on elements from the elaboration likelihood model (Petty and Cacioppo, 1986) and the theory of diffusion of innovations (Rogers, 1995). Consideration is given to the three variables described earlier in this section (i.e., specific attitude, familiarity, and convenience) although the employment of other likely beneficial factors (e.g., a persuasive message's reduced complexity) is discussed as well.

5.4.1. Recommendations based on the elaboration likelihood model

Recommendations based on the elaboration likelihood model (Petty and Cacioppo, 1986) ultimately pertain to influencing one's specific attitude, which may lead to behavioural change. As described earlier (section 2.4.1.), the elaboration likelihood model (Petty and Cacioppo, 1986) posits that central processing of a persuasive message is more likely to result in long-term behavioural change compared to peripheral processing. Therefore, it is recommended to base efforts to modify one's behaviour on central processing, which involves carefully scrutinising a message's contents. The likelihood of an individual utilising central processing increases if he/she has the ability and the motivation to evaluate a persuasive message and its source (Perloff, 1993; Petty and Cacioppo, 1986; Petty and Wegener, 1999).

5.4.1.1. Variables affecting ability to process a message

Various factors affect an individual's ability to evaluate a persuasive message. Some of these factors are controllable by the persuader and some are, in general, uncontrollable (e.g., external distractions or the intelligence of the message recipient) with the latter not being considered in this discussion. Specifically, this section addresses the complexity of a message, the means through which messages are communicated, and message repetition (Petty and Cacioppo, 1986).

A factor controllable, to some extent, by the persuader is the complexity of the message communicated. Under conditions of high motivation to process a message, an individual is likely to better process and understand a simpler and more comprehensible message. Hence care should be taken to simplify

messages (as much as possible and after considering the type of audience) that inform about the merits of a specific environmental behaviour. Reduced complexity can be produced by simplifying a persuasive message in terms of both its quality (e.g., by minimising complex vocabulary) and quantity (i.e., by avoiding being overly verbose). However, complex messages can be considered more credible under conditions of low motivation to process them. Although this situation can facilitate attitudinal change, the resulting change would be rather ephemeral since peripheral processing would have been employed.

The means through which messages are presented may influence one's ability to evaluate these messages. Messages presented on printed material provide individuals with more control to process them compared to messages presented through other means such as television or radio (Petty and Cacioppo, 1986). Accordingly, although results in Table 20 about usefulness of various methods for finding information about green building/housing practices indicate that television shows are preferred over newspaper articles, magazines, and books, it is advisable to base campaigns that inform about green practices on printed materials (including websites and online newsletters). Other means (such as television or radio) may also be of use when the message to be communicated is relatively simple and a high degree of ability to process it is not required.

Message repetition for a moderate number of times assists in comprehension of a behaviour's advantages although tedium and/or reactance to the message may be generated if the message is repeated for a large number of times. The appropriate number of repetitions is determined by factors such as the recipient's familiarity with the behaviour or the message's complexity. Therefore, for behaviours with which subjects reported low levels of familiarity and which can be considered rather complicated to describe and explain (e.g., installing drip garden irrigation to save water or using an environmental heating source in Table 32) the number of message repetitions would be higher than for behaviours demonstrating the opposite characteristics.

5.4.1.2. Variables affecting motivation to process a message

In a similar fashion with factors affecting one's ability, factors that affect motivation may be either controllable or uncontrollable by the persuader. Certain controllable variables pertaining to one's motivation to process a persuasive message are considered next, as presented by Petty and Cacioppo (1986). The variables discussed are personal relevance of the message and the number of message sources.

Personal relevance of the message refers to important consequences for one's life that are associated with the message. Specifically, dimensions such as the number, the magnitude, and the duration of these consequences determine the degree of personal relevance. Accordingly, a way to enhance adoption of green behaviours by encouraging central processing of relevant messages is to make obvious to message recipients that the behaviours may be personally relevant to them. A central point in this regard may be the fact that adoption levels appeared to be higher for self centered individuals (sections 5.1.1. and 5.2.1.4.). Therefore, by explicitly stating how environmental housing behaviours may have a direct positive impact on their personal well being (i.e., by contributing to cost savings or minimising exposure to toxic substances), subjects can be expected to increase their levels of adoption. Quantified information may have a stronger impact (i.e., by specifying the number, magnitude, and duration of important consequences for the lives of message recipients) than vague qualitative statements about the benefits of green behaviours. Moreover, as Boninger et al. (1995) and Petty and Cacioppo (1986) point out, instead of trying to force people to change their existing attitudes, it is likely more efficient to build on existing attitudes and strengthen them by demonstrating how they are relevant with the given persuasion issue. In this way, basing an adoption enhancing campaign on the self centered aspect of individuals may be a more economic approach to increase adoption compared to focusing on benefits for the natural environment.

Additionally, overcoming likely perceptions of inconvenience associated with a specific behaviour may render that behaviour more personally relevant for some individuals. For example, people may start

considering that repairing broken items instead of buying replacements is not as inconvenient as they believed after attending an appropriate information session.

Increasing the number of independent sources that communicate the same persuasive message may also increase one's motivation to engage in elaborate processing of that message (Petty and Cacioppo, 1986). Therefore, implementation of a campaign to enhance behaviour adoption can involve coordinating a number of different sources to present the same message about the advantages of a particular environmental housing behaviour. For example, such independent sources can include (section 4.2.2.1. and Table 20) research articles, private business information sessions, governmental publications, television shows, newspaper articles, books, and magazines. However, the message arguments presented by these sources must be strong otherwise the resulting enhanced elaboration on them will likely contribute to their rejection.

5.4.2. Recommendations based on the theory of diffusion of innovations

According to the theory of diffusion of innovations (Rogers, 1995), the five characteristics of innovations that can influence their rate of adoption (i.e., relative advantage, compatibility, trialability, complexity, and observability) were presented in section 2.4.2. Based on these characteristics, a number of suggestions to enhance adoption of environmental housing behaviours can be formulated.

The relative advantage of a green behaviour compared to existing less environmentally friendly alternatives can be communicated through appropriate messages. For example, cost benefits can be explained in a detailed fashion to stress that many environmental behaviours (such as using compact fluorescent lighting or using a high-efficiency furnace/boiler), although costly initially, will be more economical over the lifetime of use of the given product/appliance. In addition, perceptions of prestige due to living in a relatively clean environment at a time when environmental pressures globally pose substantial concerns (MA, 2005) may be emphasised.

To demonstrate compatibility of a given behaviour with one's personal values and views, the aspect of certain green practices that relates to personal well-being (e.g., economic savings from using energy efficient lighting) can be influential on self centered individuals. Moreover, compatibility of a specific behaviour with one's prior experiences may effectively be utilised to increase adoption. Lee et al. (1995) found that a certain environmental behaviour (i.e., recycling) appeared to be diffusing from households to offices based on whether people possessed prior experiences with that behaviour. Although not specifically stated in that report, the opposite diffusion direction (i.e., from offices to households) may also be possible. Accordingly, a relevant recommendation can be to promote green behaviours (especially behaviours that respondents of the present study were less familiar with, such as using an environmental heating source or using an on-demand water heater in Table 32) at the office environment that may, in time, be adopted at higher levels at the home environment.

Use of behaviours at the office environment may also provide opportunities for individuals to experiment with them on a limited basis (i.e., trialability of an innovation). For example, using lighting controls at the office may motivate people to use them at home too.

Perceptions that a given behaviour is complicated to understand and use should also be dealt with. The present study did not measure the degree to which the various behaviours were considered challenging to comprehend by participants. This could be a starting point to develop a campaign to address likely concerns about complexity associated with green behaviours that may hinder adoption enhancement. Measures should also be taken to reduce the complexity of persuasive message that aims to enhance adoption, as mentioned in section 5.4.1.1.

Finally, observability (i.e., the degree to which an innovation's results are visible) may be used to enhance adoption of green behaviours. One way to achieve this is through providing feedback on the effects of adopting a given behaviour (Schultz et al., 1995). For example, providing households with

detailed feedback on energy consumption before and after using energy efficient appliances may result in energy savings.

With this section, the Discussion chapter is complete. The next and final chapter includes the general conclusions reached by this study, a presentation of the study's limitations, and the most important of the recommendations regarding future research directions.

6. CONCLUSION AND RECOMMENDATIONS FOR FUTURE RESEARCH

The present study attempted to examine the situation regarding environmental behaviour of house inhabitants in Canada. An environmental psychology approach was followed focusing on constructs such as personal values and attitudes. Numerous environmental housing behaviours and factors that may influence those behaviours were examined. A theoretical framework to explain behaviour was formulated and suggestions to further enhance adoption of behaviours were offered. This chapter summarises concluding remarks and presents the study's main limitations as well as the most important recommendations for future research.

6.1. Concluding remarks

Overall, adoption levels of environmental housing behaviours in Canada were satisfactory. However, additional enhancements in adoption levels are recommended to further improve present environmental conditions and to deal more effectively with pressures from Canada's increasing population (Statistics Canada, 2009b).

A large variation in adoption levels among behaviours was noted. The majority of behaviours with low adoption levels were garden-related, which is likely the result of gardening being considered a leisure activity. Regarding adoption levels for categories of environmental housing behaviours, behaviours concerning waste management and reduction for interior use had the highest percentages of adoption while water conservation behaviours had the lowest.

Although the majority of the variables investigated were identified as significant predictors of adoption of environmental behaviours, their influence on behaviour appeared to be, in general, from small to moderate. It was found that variables measured at a level specific to a given behaviour (e.g., familiarity with using energy efficient appliances) were the most influential on that behaviour. The most influential

variables on behaviour were: (1) the specific attitude to a given behaviour, (2) familiarity with a given behaviour, (3) convenience of performing a given behaviour, and (4) personal values.

These four variables were the elements of a theoretical model (i.e., the environmental housing behaviour model, as presented in section 5.3.) developed to explain environmental housing behaviour at a general level (i.e., not specific to any particular behaviour). The environmental housing behaviour model is considered to perform satisfactorily in terms of capturing the main factors that influence behaviour and being adequately flexible to allow for different underlying reasons to be shaping behaviour. However, both its empirical support and its generalisability regarding the depicted links among factors were relatively limited. The model can be of use to both researchers and policy makers as a starting point to reveal those factors that are likely most influential on environmental housing behaviour at a general level. For studying specific behaviours, the operational model (section 3.3.2.2.) may be more appropriate to use instead.

A number of suggestions for increasing adoption levels for environmental behaviours were offered. To this end, variables that may affect an individual's ability and motivation to process a persuasive message can be employed. In addition, adoption levels can be enhanced by implementing approaches that utilise a given behaviour's relative advantage, compatibility, trialability, complexity, and observability.

6.2. Limitations and recommendations for future research

One limitation of the present study is that its research design did not allow it to reveal causal relationships, which could further enhance understanding of environmental housing behaviour. However, the quasi-experimental approach followed (i.e., by employing partial correlation to avoid spurious correlations) is considered to have provided a clearer understanding of the relationships among variables.

In this study, only sixteen out of the 390 variables measured were tested for non-response bias. Therefore, the possibility that this type of bias is present, to some extent, cannot be completely ruled. Such a

possibility would likely reduce the generalisability of the results to the population under investigation. However, certain of the most important variables in this study, as revealed by data analysis (i.e., the five variables included in the environmental housing behaviour model), were found to be free of non-response bias.

Another limitation stems from the fact that adoption of behaviours was measured using a binary variable (i.e., whether people had adopted the behaviour or not). This was decided to both save questionnaire space and reduce the required effort on part of the respondents. Items asking how often or to what degree they performed a given behaviour would have provided a greater level of detail for measuring adoption of certain appropriate behaviours such as using energy efficient appliances or hanging clothes to dry. Moreover, adoption data collected by using an ordinal or interval scale would be more useful from a statistical point of view. For example, data collected by using a binary scale are considered to be at an inappropriately low level of measurement to be used in factor analysis (Shapiro et al., 2002). Therefore, use of more detailed scales to measure adoption can be suggested for future studies of environmental housing behaviour.

The present study did not collect suitable data on behaviour adoption to produce a generalised measure of behaviour adoption. This may have contributed to the observed lack of an association between general attitudes and specific behaviours (section 5.2.2.). Therefore, a likely promising research direction could be to produce a measure of behaviour adoption at a general level and, subsequently, investigate its relationship with generalised environmental attitudes. Such a measure could be operationalised by aggregating adoption for various behaviours occurring over a number of occasions (Ajzen, 2005).

Another recommendation for future research can be conceived based on an additional way to use the New Environmental Paradigm scale score. In this project, the New Environmental Paradigm scale score was used as a predictor variable of environmental behaviours. However, it could also be used to segment respondents into those who scored highly on the scale, and, therefore, can be considered to be more

sensitive to environmental issues, and those who did not score highly. Different approaches to promote adoption of environmental practices could subsequently be followed for the two segments.

Regarding the environmental housing behaviour model, additional studies may enhance both its empirical support and its generalisability as far as links among factors are concerned. Specifically, generalisability can be enhanced by including a larger number of behaviours. In the present study, several behaviours (i.e., adoption of using compact fluorescent lighting, adoption of using lighting controls, adoption of using a high-efficiency furnace/boiler, adoption of using a programmable thermostat to reduce energy use, and adoption of using natural ventilation) were excluded from model development for the sole reason that convenience (an essential component of the model) was not measured for these behaviours due to questionnaire space constraints.

A rather unexpected result of this study was the discovery that it was self centered individuals who mostly appeared to adopt environmental housing practices. General pro-environmental attitudes (expressed by score in the New Environmental Paradigm scale), although self reported as important, did not have any effect on adoption of behaviours. It was, accordingly, suggested in the previous chapter to base campaigns to enhance adoption on stressing those characteristics of behaviours that can promote personal well being. Such a practice may indeed be effective in increasing adoption levels up to a point. However, given the continuous expansion of global human population and the increasing environmental pressures, to achieve a healthy natural environment over the long-term, a shift in personal values may be required. This would involve embracing environmental responsibility and accepting the constraints of the planet (Cole, 2000b).

Ways to influence personal values exist (e.g., through education) although their implementation is not without difficulties. In a recent study, Hofmann-Towfigh (2007) found that value change had occurred in high school students over a ten-month interval (i.e., a school year). However, the magnitude of that change was very small and, consequently, of limited practical use. Such a value change is postulated to

have been the result of existing values re-prioritisation rather than new values acquisition. Despite these problems, personal values can directly shape green building practices (Cole, 2000a) and, consequently, may constitute a focal point for future efforts that attempt to minimise impacts from behaviour of house inhabitants on the natural environment.

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APPENDIX A: CRITERIA ASSESSED BY LEED FOR HOMES VERSION 1.4, BREEAM, AND NAHB GREEN HOME BUILDING GUIDELINES

LEED for Homes Version 1.4 (USGBC, 2005) includes the following criteria:

- Sustainable Sites (site protection, landscape restoration, storm water control, minimal poison use)
- Location and Linkages (neighbourhood design, site selection, infrastructure availability, transportation access, compact development – efficient land use)
- Energy and Atmosphere (performance bundles, envelope – insulation – air leakage – windows, comfort systems, water heating, lighting, appliances, renewable electricity generation system, ozone – refrigerant)
- Water Efficiency (outdoor use – re-use – irrigation, indoor use – low flow fixtures)
- Materials and Resources (efficiency, local sources, durability, environmentally improved products, waste management)
- Indoor Environmental Quality (performance, combustion venting, control – humidity – outside air ventilation – exhaust – air distribution – HVAC (heating, ventilation, and air-conditioning) air filters, contaminant control)
- Homeowner Awareness (guidance)
- Innovation and Design Process

Areas assessed by BREEAM (BREEAM, 2005) include:

- Site management
- Operational energy and carbon dioxide issues
- External and indoor and issues affecting health and well-being
- Air and water pollution
- Transportation-related carbon dioxide and factors related to location
- Land use
- Site ecology
- Construction materials impacts on the environment
- Water consumption and efficiency

Areas covered by the National Association of Home Builders (NAHB) Green Home Building Guidelines (NAHB, 2005) include:

- Site design, preparation, and development
- Resource efficiency (resource efficient materials, construction waste reduction, life cycle analysis)
- Energy efficiency
- Water efficiency
- Indoor environmental quality
- Operation, maintenance, and homeowner education
- Global impact

APPENDIX B: MAIL QUESTIONNAIRE

SURVEY ON FACTORS AFFECTING ENVIRONMENTAL BEHAVIOUR OF HOUSE INHABITANTS IN RELATION TO GREEN HOUSING PRACTICES

Only answer if you are 19 years or older.

SECTION A

A1. How familiar are you with the following? (Please mark one number on each row)

	1 = not at all familiar and 5 = very familiar
Environmental problems within your Province	① ② ③ ④ ⑤
Environmental problems in the world	① ② ③ ④ ⑤

A2. Have you personally witnessed human made environmental disasters?

	1 = never and 5 = many times
In your Province	① ② ③ ④ ⑤
In the world	① ② ③ ④ ⑤

A3. How often did you spend time in nature within the last 12 months? (Please check only one box)

At least once a week	☐
At least once a month	☐
Once in three months	☐
Once in six months	☐
Once a year	☐
Not once	☐

A4. How familiar are you with media campaigns (e.g. TV, print, etc.) that promote each of the following?

	1 = not at all familiar and 5 = very familiar
Conserving energy	① ② ③ ④ ⑤
Conserving water	① ② ③ ④ ⑤
Minimizing waste material	① ② ③ ④ ⑤
Protecting surrounding ecosystems	① ② ③ ④ ⑤

A5. How much impact on the environment on each of the following do you think the activities in your house may have?

	1 = my activities have no impact and 7 = my activities have a major impact
Conserving energy	① ② ③ ④ ⑤ ⑥ ⑦
Conserving water	① ② ③ ④ ⑤ ⑥ ⑦
Minimizing waste material	① ② ③ ④ ⑤ ⑥ ⑦
Protecting surrounding ecosystems	① ② ③ ④ ⑤ ⑥ ⑦

A6. How much are your environmental actions on each of the following influenced by your neighbours, friends or relatives?

	1 = not at all influenced and 7 = very heavily influenced
Conserving energy	① ② ③ ④ ⑤ ⑥ ⑦
Conserving water	① ② ③ ④ ⑤ ⑥ ⑦
Minimizing waste material	① ② ③ ④ ⑤ ⑥ ⑦
Protecting surrounding ecosystems	① ② ③ ④ ⑤ ⑥ ⑦

A7. Please indicate how convenient is it for you to perform each of the following? (N/A = not applicable for me)

	N/A	1 = very inconvenient and 5 = very convenient
Use energy efficient appliances	○	① ② ③ ④ ⑤
Use non-toxic cleaners	○	① ② ③ ④ ⑤
Recycle (e.g., paper, glass)	○	① ② ③ ④ ⑤
Turn off appliances (e.g., computers, lamps) when not using them	○	① ② ③ ④ ⑤
Use water-saving plumbing fixtures (e.g., low-flow showerheads)	○	① ② ③ ④ ⑤
Take toxic waste to special disposal sites	○	① ② ③ ④ ⑤
Use water-efficient appliances	○	① ② ③ ④ ⑤
Repair things that are broken instead of buying new	○	① ② ③ ④ ⑤

A8. How important are the following to you?

	1 = not at all important and 7 = extremely important
Conserving energy in your house	① ② ③ ④ ⑤ ⑥ ⑦
Conserving water in your house	① ② ③ ④ ⑤ ⑥ ⑦
Waste materials are minimized in your house	① ② ③ ④ ⑤ ⑥ ⑦
The natural environment around your house is protected	① ② ③ ④ ⑤ ⑥ ⑦

A9. Please tell us how important each of the following is as a guiding principle in YOUR life. We will use a 4-point scale in Column A, where 4 means that the statement is *extremely important* as a guiding principle for you. If you are opposed to any of these statements, please tell us that by skipping column A and checking the box in Column B.

	Column A 1 = not at all important and 4 = extremely important	**Column B** I am opposed to the statement No Yes
A world at peace, free of war and conflict	① ② ③ ④	ⓝ ⓨ
Social justice, correcting injustice, care for the weak	① ② ③ ④	ⓝ ⓨ
Equality, equal opportunity for all	① ② ③ ④	ⓝ ⓨ
Protecting the environment, preserving nature	① ② ③ ④	ⓝ ⓨ
Unity with nature, fitting into nature	① ② ③ ④	ⓝ ⓨ
Respecting the earth, harmony with other species	① ② ③ ④	ⓝ ⓨ
Honouring parents and elders, showing respect	① ② ③ ④	ⓝ ⓨ
Family security, safety for loved ones	① ② ③ ④	ⓝ ⓨ
Self-discipline, self restraint, resistance to temptation	① ② ③ ④	ⓝ ⓨ
Authority, the right to lead or command	① ② ③ ④	ⓝ ⓨ
Influential, having an impact on people and events	① ② ③ ④	ⓝ ⓨ
Wealth, material possessions, money	① ② ③ ④	ⓝ ⓨ
A varied life, filled with challenge, novelty, and change	① ② ③ ④	ⓝ ⓨ
An exciting life, stimulating experiences	① ② ③ ④	ⓝ ⓨ
Curious, interested in everything, exploring	① ② ③ ④	ⓝ ⓨ

A10. Do you give high priority, medium priority, low priority, or no priority to each of the following goals?

	1 = no priority, 2 = low priority, 3 = medium priority, 4 = high priority
Maintain a high rate of economic growth	① ② ③ ④
Make sure Canada has strong defense forces	① ② ③ ④
Maintain a strong economy	① ② ③ ④
Fight rising prices	① ② ③ ④
Maintain order in the nation	① ② ③ ④
Fight against crime	① ② ③ ④
Give people more say in important government decisions	① ② ③ ④
Progress toward a less impersonal, more humane society	① ② ③ ④
See that people have more say in how things get decided at work and in their community	① ② ③ ④
Protect freedom of speech	① ② ③ ④
Progress toward a society where ideas are more important than money	① ② ③ ④

A11. Indicate how much you agree or disagree with the following statements:

	1 = strongly disagree, 2 = mildly disagree, 3 = mildly agree, 4 = strongly agree
We are approaching the limit of the number of people the earth can support.	① ② ③ ④
The balance of nature is very delicate and easily upset.	① ② ③ ④
Humans have the right to modify the natural environment to suit their needs.	① ② ③ ④
Mankind was created to rule over the rest of nature.	① ② ③ ④
When humans interfere with nature it often produces disastrous consequences.	① ② ③ ④
Plants and animals exist primarily to be used by humans.	① ② ③ ④
To maintain a healthy economy we will have to develop a "steady-state" economy where industrial growth is controlled.	① ② ③ ④
Humans must live in harmony with nature in order to survive.	① ② ③ ④
The earth is like a spaceship with only limited room and resources.	① ② ③ ④
Humans need not adapt to the natural environment because they can remake it to suit their needs.	① ② ③ ④
There are limits to growth beyond which our industrialized society cannot expand.	① ② ③ ④
Mankind is severely abusing the environment.	① ② ③ ④

If you own the house you currently live in please fill section B.
If you rent the house you currently live in please go to section C.
If you neither rent nor own the house you currently live in please go to section D.

SECTION B

This section is only for people who own the house they currently live in.

B1. The following represent practices associated with sustainable building. For each, state your level of familiarity in Column A, how important or not the practice is to you in Column B, and whether you have adopted the practice in Column C. For Column C, N/A = the practice is not applicable for me.

	Column A 1 = not at all familiar 5 = very familiar	Column B 1 = not at all important 5 = very important	N/A	Column C I do it / have done it No Yes
Use energy efficient appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use compact fluorescent lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Set thermostat no higher than 20°C	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Compost organic waste	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Avoid the use of chemical pesticides, herbicides or fertilizers (use natural products only)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Plant climate appropriate plants (less irrigation)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Recycle (e.g., paper or glass)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use water-efficient appliances (e.g., dishwashers)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use Energy Star appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Turn off appliances (e.g., lamps) when not in use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use lighting controls (e.g., motion sensors)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Collect rainwater for irrigation and car washing	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use energy efficient lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Hang clothes to dry	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Wear more clothing to reduce heating costs	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Wash laundry in cold water	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use non-toxic paints when painting your home	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Repair broken items instead of buying new	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use non-toxic cleaners	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use an environmental heating source (e.g., geothermal, wind, hydroelectric, instead of oil)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Reduce lawn area	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use garden paving stones to reduce water run-off	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Increase insulating capability of windows	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use a low-maintenance lawn (no water or pesticides)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use an on-demand (tankless) water heater	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use water saving toilets (e.g., low flow)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use water-saving plumbing fixtures (e.g., low-flow showerheads)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use a high-efficiency furnace/boiler	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Winterize windows and doors to prevent drafts	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use a programmable thermostat to reduce energy use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Take toxic waste to special disposal sites	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Install a water meter	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use natural ventilation – no air conditioning	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use skylights for natural lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Install drip garden irrigation to save water	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ

After you finish the above section please go to section D.

SECTION C

This section is only for people who rent the house they currently live in.

C1. The following represent practices associated with sustainable building. For each, state your level of familiarity in Column A, how important or not the practice is to you in Column B and whether you have adopted the practice in Column C. For Column C, N/A = the practice is not applicable for me.

	Column A 1 = not at all familiar 5 = very familiar	Column B 1 = not at all important 5 = very important	N/A	Column C I do it / have done it No	Yes
Use energy efficient appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use compact fluorescent lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Set thermostat no higher than 20°C	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Compost organic waste	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Avoid the use of chemical pesticides, herbicides or fertilizers (use natural products only)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Plant climate appropriate plants (less irrigation)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Recycle (e.g., paper or glass)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use water-efficient appliances (e.g., dishwashers)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use Energy Star appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Turn off appliances (e.g., lamps) when not in use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use lighting controls (e.g., motion sensors)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Collect rainwater for irrigation and car washing	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use energy efficient lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Hang clothes to dry	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Wear more clothing to reduce heating costs	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Wash laundry in cold water	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use non-toxic paints when painting your home	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Repair broken items instead of buying new	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use non-toxic cleaners	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Reduce lawn area	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use garden paving stones to reduce water run-off	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use a low-maintenance lawn (no water or pesticides)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use water-saving plumbing fixtures (e.g., low-flow showerheads)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Winterize windows and doors to prevent drafts	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use a programmable thermostat to reduce energy use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Take toxic waste to special disposal sites	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Install drip garden irrigation to save water	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ

SECTION D

If you renovated your house within the last twelve months please fill section D and then go to section E. If you did not have a house renovation within the last twelve months please go directly to section E.

D1. The following represent practices associated with sustainable building you might have done during your renovation. For each, state your level of familiarity in Column A, how important or not the practice is to you in Column B, and whether you have adopted the practice in Column C. For Column C, N/A = the practice is not applicable for me.

	Column A 1 = not at all familiar 5 = very familiar	Column B 1 = not at all important 5 = very important	N/A	Column C Did you do this? No Yes
Deconstruct rather than demolish portions of the house to be remodelled	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to energy efficient appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Plant climate appropriate plants (less irrigation)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Avoid using wood from old-growth trees or high conservation areas	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use recycled building materials	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Select building materials produced in a sustainable manner (e.g. using fair trade imported materials)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use materials that require little maintenance	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use local building materials (from no further than 500 miles from your home)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Replace old appliances with more energy-efficient ones	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to compact fluorescent light bulbs, if possible	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to more insulating windows	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to water-saving plumbing fixtures (e.g., low-flow showerheads)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to natural ventilation – no air conditioning	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to more environmental heating sources (e.g., oil to natural gas or gas to renewable such as geothermal, wind, and hydroelectric)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Improve insulation in ceilings, floors, and walls	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Insulate windows and doors to reduce drafts	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to a programmable thermostat to reduce energy use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Replace heating equipment with more energy-efficient models	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to an instantaneous or on-demand (tankless) water heater	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to water saving toilets (e.g., low flow)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Install skylights for natural lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to a high-efficiency furnace/boiler	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Reduce lawn area	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Switch to more water-efficient appliances	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ
Use non-toxic paints when painting your home	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ ⓨ

If you built or purchased a house in the past 12 months go to section E. Otherwise go to section F.

SECTION E

E1. Did you build or purchase a house in the past 12 months? (Check all that apply)

I built a house in the past 12 months	☐
I purchased a house in the past 12 months	☐

E2. The following represent practices associated with sustainable building that you might have done when you were building or purchasing your house. For each, state your level of familiarity in Column A, how important or not the practice is to you in Column B, and whether you have adopted the practice in Column C. For Column C, N/A = the practice is not applicable for me.

	Column A 1 = not at all familiar 5 = very familiar	Column B 1 = not at all important 5 = very important	N/A	Column C Did you do this? No	Yes
Use recycled building materials	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Use building materials that need little maintenance	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that has local building materials (from no further than 500 miles from your home)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Take steps to protect the natural environment of the site (e.g., water flows, large trees, etc.)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Minimize building material use	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Landscaping to provide shadow and windbreaks	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Select building materials produced in a sustainable manner (e.g., fair trade imported materials)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Avoid using wood from old-growth trees or high conservation areas	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Plant climate appropriate plants (less irrigation)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Minimize area of house per resident	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that has skylights for natural lighting	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Select a house or contractor that was environmentally friendly	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Avoid building on ecologically sensitive areas (e.g., wetlands)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Choose a location that minimizes transportation needs (e.g., close to work, school, shopping)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that has natural ventilation – no air conditioning	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that uses more environmental heating sources (e.g., geothermal, wind, hydroelectric, and natural gas instead of oil)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that has water saving toilets (e.g., low flow)	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house that has a high-efficiency furnace/boiler	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house with reduced lawn area	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ
Build or purchase a house with well insulated windows	① ② ③ ④ ⑤	① ② ③ ④ ⑤	○	ⓝ	ⓨ

SECTION F

F1. Indicate your gender:

Female	☐	Male	☐

F2. What is your current age? (Please check one box):

20 or younger	☐	51 – 60	☐
21 – 30	☐	61 – 70	☐
31 – 40	☐	71 or more	☐
41 – 50	☐		

F3. What is your highest educational level attained?

Some high school	☐
High school diploma	☐
Vocational or tech school	☐
Some college or university	☐
College or university graduate	☐
Some graduate work	☐
Master's degree	☐
Ph.D.	☐

F4. Indicate your individual 2006 annual income before taxes?

Less than $20,000	☐	$60,000 to $79,999	☐
$20,000 to $39,999	☐	$80,000 to $99,999	☐
$40,000 to $59,999	☐	$100,000 or more	☐

F5 Indicate your 2006 family income before taxes?

Less than $40,000	☐
$40,000 to $79,999	☐
$80,000 to $119,999	☐
$120,000 to $159,999	☐
$160,000 or more	☐

F6. What is your current type of residence?

Apartment	☐
Town house	☐
Duplex (Attached) house	☐
Detached house	☐

F7. What is the ownership status of your current residence?

Own	☐
Rent	☐
Neither rent or own (e.g., live with friends or family)	☐

F8. What is the size of your current house?

400 ft² to 799 ft²	☐
800 ft² to 1199 ft²	☐
1200 ft² to 1799 ft²	☐
1800 ft² to 2199 ft²	☐
2200 ft² to 2599 ft²	☐
2600 ft² to 2999 ft²	☐
3000 ft² or more	☐

F9. What is the type of your current residential environment?

Downtown	☐	Suburban	☐
Urban	☐	Rural	☐

F10. What is your marital status?

Never married	☐	Widowed	☐
Married	☐	Divorced	☐
Common-law partner	☐	Separated	☐

F11. How many people, including yourself, live in your current house?

1 person	☐	4 persons	☐
2 persons	☐	5 persons	☐
3 persons	☐	More than 5 persons	☐

F12. How many children under 19 live in your current house?

No children	☐	4 children	☐
1 child	☐	5 children	☐
2 children	☐	More than 5 children	☐
3 children	☐		

F13. What is your stand on political issues?

Liberal	☐	Moderate to conservative	☐
Moderate to liberal	☐	Conservative	☐
Moderate	☐		

14. How useful are the following methods for finding information about green building/housing practices. For each method, check only one response.

	1 = Not at all useful, 4 = Neutral, 7 = Very useful
Newspaper articles	① ② ③ ④ ⑤ ⑥ ⑦
Magazines	① ② ③ ④ ⑤ ⑥ ⑦
Books	① ② ③ ④ ⑤ ⑥ ⑦
Televisions shows	① ② ③ ④ ⑤ ⑥ ⑦
Television advertisements	① ② ③ ④ ⑤ ⑥ ⑦
Radio programs	① ② ③ ④ ⑤ ⑥ ⑦
Radio advertisements	① ② ③ ④ ⑤ ⑥ ⑦
Advice from friends or relatives	① ② ③ ④ ⑤ ⑥ ⑦
Online newsletters	① ② ③ ④ ⑤ ⑥ ⑦
Specific websites	① ② ③ ④ ⑤ ⑥ ⑦
Billboards	① ② ③ ④ ⑤ ⑥ ⑦
Exhibitions	① ② ③ ④ ⑤ ⑥ ⑦
Other (please specify below) _____	① ② ③ ④ ⑤ ⑥ ⑦

Thank you very much for your help!

APPENDIX C: COVER LETTERS - TEMPLATES

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Wood Science
Faculty of Forestry
Forest Sciences Centre
#2900 – 2424 Main Mall
Vancouver, British Columbia
Canada V6T 1Z4

Mail Merge information

DATE

Dear Madam/Sir:

As part of a Doctoral thesis at the University of British Columbia, we are attempting to understand how people's actions impact the natural environment. The project is entitled "Factors affecting environmental behaviour of house inhabitants in relation to green housing practices". We are interested in learning about the activities of the head of the household within your house that can affect the environment. A single house may not seem to seriously impact environmental conditions. However, the collective effects of houses can be massive. As one of 5,000 scientifically selected households across Canada, you can help us better understand this impact by completing the attached questionnaire. You may also discover new ideas about how to better protect the environment once you have read through the questionnaire. Please note that your participation is completely voluntary. However, if you are the head of the household and are 19 years or older, your collaboration would be very much appreciated. If you are not the head of the household, please pass the survey on to him or her.

Data collection and analysis will be conducted at the University of British Columbia. We would be grateful if you would take the time (about 20 minutes) to complete this survey. Simply answer the questions and return it to us in the enclosed pre-paid business reply envelope or fax it to (604) 822-9159.

Please note that your participation is extremely important for the completion of my Doctoral thesis. If the questionnaire is completed, it will be assumed that consent has been given to use the information you provided in aggregated form only. Remember that you can be assured of **complete confidentiality**. Your questionnaire has an identification number to let us know whether you completed it or not. However, your name will not appear on the survey itself, unless you request a copy of the results upon completion. If this is indeed the case, please leave your name and address on the last page of the questionnaire for a free summary of results.

We would be happy to answer any questions you may have. Please e-mail me at (Pavlos Alexiadis, pavlosa@interchange.ubc.ca), or my academic supervisor at (604) 822-6716 (David Cohen, david.cohen@ubc.ca). If you have any concerns about your rights or treatment as a research subject you may contact the Research Subject Information Line in the UBC Office of Research Services at (604) 822-8598.

Thank you very much for your co-operation.

Sincerely,
David Cohen
Professor

Pavlos Alexiadis,
Graduate student

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Wood Science
Faculty of Forestry
Forest Sciences Centre
#2900 – 2424 Main Mall
Vancouver, British Columbia
Canada V6T 1Z4

Mail Merge information

DATE

Dear Madam/Sir:

Two weeks ago, a questionnaire seeking the opinions of the head of your household about *the impact your activities may have on the environment* was mailed to you. You were one of the 5,000 scientifically selected households across Canada asked to participate in this study – one of the most comprehensive studies of this type ever undertaken.

If you have already completed and returned the survey to us, please accept our sincere thanks. If not, please do so as soon as possible. We are attempting to understand how people's actions impact the natural environment. It is extremely important that your thoughts on this subject be included in our study to ensure that the results accurately reflect the opinions of Canadian households. Your involvement in this investigation is critical to us. Remember, your responses are **completely confidential**.

If, by some chance, you did not receive the questionnaire, or it has been misplaced, please e-mail me at (Pavlos Alexiadis, pavlosa@interchange.ubc.ca), or my academic supervisor at (604) 822-6716 (David Cohen, david.cohen@ubc.ca) and a replacement will be sent to you immediately. We can be reached by fax at (604) 822-9159. We would also be happy to answer any questions that you may have. If you have any concerns about your rights or treatment as a research subject you may contact the Research Subject Information Line in the UBC Office of Research Services at (604) 822-8598.

Thank you very much for your co-operation.

Sincerely,
David Cohen
Professor

Pavlos Alexiadis,
Graduate student

THE UNIVERSITY OF BRITISH COLUMBIA

Department of Wood Science
Faculty of Forestry
Forest Sciences Centre
#2900 – 2424 Main Mall
Vancouver, British Columbia
Canada V6T 1Z4

Mail Merge information

DATE

Dear Madam/Sir:

About a month ago, we sent you a questionnaire seeking the opinions of the head of your household about *the impact your activities may have on the environment*. If you have already sent us your survey, thank you and please ignore this letter.

We have undertaken this study in an attempt to better understand how people's actions impact the natural environment. We are writing to you again because it is extremely important that your thoughts on this subject be included in our study to ensure that the results accurately reflect the opinions of Canadian households.

If you are the head of the household and are 19 years or older, please take the time to complete the survey (about 20 minutes). If you are not the head of the household, please pass the survey on to him or her. Simply answer the questions and return it to us by putting the completed questionnaire in the pre-paid envelope and dropping it in the mail. You can also fax the questionnaire to (604) 822-9159. Remember, you can be assured of **complete confidentiality**. Your name should be included only if you wish to request a copy of the survey results.

We would be happy to answer any questions that you may have. Please e-mail me at (Pavlos Alexiadis, pavlosa@interchange.ubc.ca), or my academic supervisor at (604) 822-6716 (David Cohen, david.cohen@ubc.ca). In the event that your questionnaire has been misplaced, a replacement is enclosed. If you have any concerns about your rights or treatment as a research subject you may contact the Research Subject Information Line in the UBC Office of Research Services at (604) 822-8598.

Your contribution to the success of this study will be greatly appreciated.

Sincerely,

David Cohen
Professor

Pavlos Alexiadis,
Graduate student

APPENDIX D: CERTIFICATE OF APPROVAL FROM THE BEHAVIOURAL RESEARCH ETHICS BOARD OF THE UNIVERSITY OF BRITISH COLUMBIA

The University of British Columbia
Office of Research Services
Behavioural Research Ethics Board
Suite 102, 6190 Agronomy Road, Vancouver, B.C. V6T 1Z3

CERTIFICATE OF APPROVAL - MINIMAL RISK

PRINCIPAL INVESTIGATOR:	INSTITUTION / DEPARTMENT:	UBC BREB NUMBER:
David H. Cohen	UBC/Forestry/Wood Science	H07-00101

INSTITUTION(S) WHERE RESEARCH WILL BE CARRIED OUT:

Institution	Site
N/A	N/A

Other locations where the research will be conducted:
N/A

CO-INVESTIGATOR(S):
Pavlos Alexiadis

SPONSORING AGENCIES:
International Environmental Institute

PROJECT TITLE:
Factors affecting environmental behaviour of house inhabitants in relation to green housing practices.

CERTIFICATE EXPIRY DATE: May 22, 2008

DOCUMENTS INCLUDED IN THIS APPROVAL: **DATE APPROVED: May 22, 2007**

Document Name	Version	Date
Questionnaire, Questionnaire Cover Letter, Tests:		
cover letter 2 english	N/A	May 21, 2007
cover letter 3 french	N/A	May 21, 2007
cover letter 1 french	N/A	May 21, 2007
cover letter 3 english	N/A	May 21, 2007
cover letter 2 french	N/A	May 21, 2007
questionnaire english	N/A	May 21, 2007
questionnaire french	N/A	May 21, 2007

The application for ethical review and the document(s) listed above have been reviewed and the procedures were found to be acceptable on ethical grounds for research involving human subjects.

Approval is issued on behalf of the Behavioural Research Ethics Board and signed electronically by one of the following:

Dr. Peter Suedfeld, Chair
Dr. Jim Rupert, Associate Chair
Dr. Arminee Kazanjian, Associate Chair
Dr. M. Judith Lynam, Associate Chair
Dr. Laurie Ford, Associate Chair

APPENDIX E: PROGRAM IN THE C++ PROGRAMMING LANGUAGE DEVELOPED TO CALCULATE Z-SCORES

```
// Program to calculate z-scores for two proportions

#include <iostream>
#include <math.h>
using namespace std;

int main()
{
    double p1, p2, z_score;
    int n1, n2;

    cout << "What is the value of p1? ";
    cin >> p1;

    cout << "What is the value of p2? ";
    cin >> p2;

    cout << "What is the value of n1? ";
    cin >> n1;

    cout << "What is the value of n2? ";
    cin >> n2;

    z_score = (p1-p2)/sqrt((p1*(1-p1)/n1)+(p2*(1-p2)/n2));

    if (fabs(z_score) >= 1.96)
       {
        cout << "\nThe value of the z-score is " << z_score << ".";
        cout << "\nThe difference is significant at the 0.05 level.";
       }
    else
        {
         cout << "\nThe value of the z-score is " << z_score << ".";
         cout << "\nThe difference is not significant at the 0.05 level.";
        }

    getchar();
    getchar();    /* Used to prevent the console window from
                  closing until a character is entered */

    return 0;
}
```

APPENDIX F: LOGISTIC REGRESSION – RESULTS PER BEHAVIOUR

DEPENDENT VARIABLE: ADOPTION OF USING ENERGY EFFICIENT APPLIANCES

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Materialist values
2. Personal importance of using energy efficient appliances
3. Familiarity with using energy efficient appliances
4. Convenience of using energy efficient appliances
5. Having personally witnessed human made environmental disasters in their Province
6. Individual 2006 annual income before taxes
7. Openness to change values
8. Having personally witnessed human made environmental disasters in the world
9. Gender

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Materialist values
2. Personal importance of using energy efficient appliances
3. Familiarity with using energy efficient appliances
4. Convenience of using energy efficient appliances
5. Having personally witnessed human made environmental disasters in their Province
6. Individual 2006 annual income before taxes
7. Openness to change values
8. Having personally witnessed human made environmental disasters in the world
9. Gender

Step 3: Main effects model (testing for linearity in the logit)

The coefficient of the product of materialist values and their natural logarithm was not statistically significant (significance = 0.63).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Materialist values
2. Personal importance of using energy efficient appliances
3. Familiarity with using energy efficient appliances
4. Convenience of using energy efficient appliances

5. Having personally witnessed human made environmental disasters in their Province
6. Individual 2006 annual income before taxes
7. Openness to change values
8. Having personally witnessed human made environmental disasters in the world
9. Gender

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.50
Percentage of cases classified correctly	89.0%
Percentage of studentized residuals outside the ±2 range	3.0%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING COMPACT FLUORESCENT LIGHTING

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Self-transcendence values
2. Self-enhancement values
3. Traditional values
4. Age
5. Total number of people in the house
6. Familiarity with using compact fluorescent lighting
7. Personal importance of using compact fluorescent lighting

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using compact fluorescent lighting
2. Familiarity with using compact fluorescent lighting
3. Age
4. Total number of people in the house
5. Self-transcendence values

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using compact fluorescent lighting

2. Familiarity with using compact fluorescent lighting
3. Age
4. Total number of people in the house
5. Self-transcendence values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.65
Percentage of cases classified correctly	84.2%
Percentage of studentized residuals outside the ±2 range	3.0%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF SETTING THERMOSTAT NO HIGHER THAN 20ºC

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Personal importance of setting the thermostat no higher than 20ºC
2. Size of current house

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of setting the thermostat no higher than 20ºC
2. Size of current house

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of setting the thermostat no higher than 20ºC
2. Size of current house

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.63
Percentage of cases classified correctly	83.0%
Percentage of studentized residuals outside the ±2 range	2.9%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF AVOIDING THE USE OF CHEMICAL PESTICIDES, HERBICIDES, OR FERTILIZERS

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with media campaigns that promote protection of surrounding ecosystems
2. Familiarity with avoiding the use of chemical pesticides, herbicides, or fertilizers
3. Personal importance of avoiding the use of chemical pesticides, herbicides, or fertilizers

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of avoiding the use of chemical pesticides, herbicides, or fertilizers
2. Familiarity with avoiding the use of chemical pesticides, herbicides, or fertilizers

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of avoiding the use of chemical pesticides, herbicides, or fertilizers
2. Familiarity with avoiding the use of chemical pesticides, herbicides, or fertilizers

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.04
Percentage of cases classified correctly	78.6%
Percentage of studentized residuals outside the ±2 range	4.8%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING WATER EFFICIENT APPLIANCES

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Having personally witnessed human made environmental disasters in their Province
2. Convenience of using water efficient appliances
3. Self-transcendence values
4. New Environmental Paradigm scale score
5. Family 2006 annual income before taxes
6. Highest educational level attained
7. Current type of residence
8. Familiarity with using water efficient appliances

9. Personal importance of using water efficient appliances

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using water efficient appliances
2. Convenience of using water efficient appliances
3. Familiarity with using water efficient appliances
4. Age
5. Having personally witnessed human made environmental disasters in their Province
6. Self-transcendence values

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using water efficient appliances
2. Convenience of using water efficient appliances
3. Familiarity with using water efficient appliances
4. Age
5. Having personally witnessed human made environmental disasters in their Province
6. Self-transcendence values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.74
Percentage of cases classified correctly	83.0%
Percentage of studentized residuals outside the ±2 range	3.0%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING ENERGY STAR APPLIANCES

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems within their Province
2. Familiarity with environmental problems in the world
3. Frequency of nature visits within the past 12 months
4. Size of current house
5. Total number of people in the house

6. Highest educational level attained
7. Stand on political issues
8. Familiarity with using Energy Star appliances

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Familiarity with using Energy Star appliances

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Familiarity with using Energy Star appliances

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.57
Percentage of cases classified correctly	85.0%
Percentage of studentized residuals outside the ±2 range	4.3%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING LIGHTING CONTROLS

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems in the world
2. Having personally witnessed human made environmental disasters in the world
3. Openness to change values
4. Highest educational level attained
5. Familiarity with using lighting controls
6. Personal importance of using lighting controls

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using lighting controls
2. Familiarity with using lighting controls
3. Openness to change values
4. Familiarity with environmental problems in the world

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using lighting controls
2. Familiarity with using lighting controls
3. Openness to change values
4. Familiarity with environmental problems in the world

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.79
Percentage of cases classified correctly	78.6%
Percentage of studentized residuals outside the ±2 range	3.4%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING ENERGY EFFICIENT LIGHTING

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems within their Province
2. Age
3. Size of current house
4. Highest educational level attained
5. Residential environment
6. Personal importance of using energy efficient lighting

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using energy efficient lighting
2. Age

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using energy efficient lighting
2. Age

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.27
Percentage of cases classified correctly	85.8%
Percentage of studentized residuals outside the ±2 range	3.5%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF HANGING CLOTHES TO DRY

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Personal importance of hanging clothes to dry
2. Familiarity with media campaigns that promote conservation of energy
3. Having personally witnessed human made environmental disasters in the world

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of hanging clothes to dry
2. Familiarity with media campaigns that promote conservation of energy
3. Having personally witnessed human made environmental disasters in the world

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of hanging clothes to dry
2. Familiarity with media campaigns that promote conservation of energy
3. Having personally witnessed human made environmental disasters in the world

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.55
Percentage of cases classified correctly	76.6%
Percentage of studentized residuals outside the ±2 range	3.5%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF WEARING MORE CLOTHING TO REDUCE HEATING COSTS

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems within their Province
2. Having personally witnessed human made environmental disasters in their Province

3. Materialist values
4. Gender
5. Residential environment
6. Familiarity with wearing more clothing to reduce heating costs
7. Personal importance of wearing more clothing to reduce heating costs

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of wearing more clothing to reduce heating costs
2. Familiarity with wearing more clothing to reduce heating costs

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of wearing more clothing to reduce heating costs
2. Familiarity with wearing more clothing to reduce heating costs

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.71
Percentage of cases classified correctly	82.7%
Percentage of studentized residuals outside the ±2 range	3.5%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF WASHING LAUNDRY IN COLD WATER

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Personal importance of washing laundry in cold water
2. Having personally witnessed human made environmental disasters in their Province
3. Individual 2006 annual income before taxes
4. Self-enhancement values
5. Openness to change values
6. Having personally witnessed human made environmental disasters in the world
7. Materialist values

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of washing laundry in cold water

2. Having personally witnessed human made environmental disasters in their Province
3. Individual 2006 annual income before taxes
4. Self-enhancement values
5. Openness to change values
6. Having personally witnessed human made environmental disasters in the world
7. Materialist values

Step 3: Main effects model (testing for linearity in the logit)

The coefficient of the product of materialist values and their natural logarithm was not statistically significant (significance = 0.63).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of washing laundry in cold water
2. Having personally witnessed human made environmental disasters in their Province
3. Individual 2006 annual income before taxes
4. Self-enhancement values
5. Openness to change values
6. Having personally witnessed human made environmental disasters in the world
7. Materialist values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.21
Percentage of cases classified correctly	83.6%
Percentage of studentized residuals outside the ±2 range	4.3%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING NON-TOXIC PAINTS WHEN PAINTING YOUR HOME

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems in the world
2. Post materialist values
3. Current type of residence
4. Familiarity with using non-toxic paints when painting their home
5. Personal importance of using non-toxic paints when painting their home

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Familiarity with using non-toxic paints when painting their home
2. Personal importance of using non-toxic paints when painting their home
3. Familiarity with environmental problems in the world

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Familiarity with using non-toxic paints when painting their home
2. Personal importance of using non-toxic paints when painting their home
3. Familiarity with environmental problems in the world

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	<0.01
Percentage of cases classified correctly	82.3%
Percentage of studentized residuals outside the ±2 range	3.1%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF REPAIRING BROKEN ITEMS INSTEAD OF BUYING NEW

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Having personally witnessed human made environmental disasters in the world
2. Familiarity with media campaigns that promote minimization of waste materials
3. Convenience of repairing things that are broken instead of buying new
4. Age
5. Individual 2006 annual income before taxes
6. Highest educational level attained
7. Familiarity with repairing broken items instead of buying new
8. Personal importance of repairing broken items instead of buying new

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Convenience of repairing things that are broken instead of buying new
2. Familiarity with repairing broken items instead of buying new
3. Personal importance of repairing broken items instead of buying new

4. Age
5. Having personally witnessed human made environmental disasters in the world
6. Familiarity with media campaigns that promote minimization of waste materials

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Convenience of repairing things that are broken instead of buying new
2. Familiarity with repairing broken items instead of buying new
3. Personal importance of repairing broken items instead of buying new
4. Age
5. Having personally witnessed human made environmental disasters in the world
6. Familiarity with media campaigns that promote minimization of waste materials

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.23
Percentage of cases classified correctly	85.2%
Percentage of studentized residuals outside the ±2 range	2.7%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING NON-TOXIC CLEANERS

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Extent to which their environmental actions on protecting surrounding ecosystems are influenced by their neighbours, friends, or relatives
2. Self-transcendence values
3. Openness to change values
4. Individual 2006 annual income before taxes
5. Size of current house
6. Gender
7. Familiarity with using non-toxic cleaners
8. Personal importance of using non-toxic cleaners

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using non-toxic cleaners
2. Familiarity with using non-toxic cleaners
3. Openness to change values
4. Self-transcendence values
5. Gender

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using non-toxic cleaners
2. Familiarity with using non-toxic cleaners
3. Openness to change values
4. Self-transcendence values
5. Gender

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.32
Percentage of cases classified correctly	77.6%
Percentage of studentized residuals outside the ±2 range	3.1%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING WATER SAVING TOILETS

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Post materialist values
2. Materialist values
3. Individual 2006 annual income before taxes
4. Gender
5. Highest educational level attained
6. Marital status
7. Stand on political issues
8. Personal importance of using water saving toilets

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Post materialist values
2. Personal importance of using water saving toilets
3. Stand on political issues
4. Highest educational level attained
5. Gender
6. Individual 2006 annual income before taxes
7. Materialist values

Step 3: Main effects model (testing for linearity in the logit)

- The coefficient of the product of post materialist values and its natural logarithm was statistically significant (significance <0.01). After a using a cosine transformation on post materialist values, the coefficient of the product of cosine transformed post materialist values and their natural logarithm was not statistically significant (significance = 0.78).
- The coefficient of the product of materialist values and its natural logarithm was statistically significant (significance = 0.01). After a using a cosine transformation on materialist values, the coefficient of the product of cosine transformed materialist values and their natural logarithm was not statistically significant (significance = 1.00).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Post materialist values (cosine transformed)
2. Personal importance of using water saving toilets
3. Stand on political issues
4. Highest educational level attained
5. Gender
6. Individual 2006 annual income before taxes
7. Materialist values (cosine transformed)

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.20
Percentage of cases classified correctly	76.2%
Percentage of studentized residuals outside the ±2 range	2.7%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING WATER SAVING PLUMBING FIXTURES

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems within their Province
2. Convenience of using water saving plumbing fixtures
3. Traditional values
4. Openness to change values
5. Post materialist values
6. New Environmental Paradigm scale score
7. Size of current house
8. Highest educational level attained
9. Current type of residence
10. Familiarity with using water saving plumbing fixtures
11. Personal importance of using water saving plumbing fixtures

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Materialist values
2. Personal importance of using water saving plumbing fixtures
3. Convenience of using water saving plumbing fixtures
4. Familiarity with using water saving plumbing fixtures
5. Openness to change values
6. Size of current house
7. Familiarity with environmental problems within their Province
8. Highest educational level attained
9. Current type of residence
10. Post materialist values

Step 3: Main effects model (testing for linearity in the logit)

- The coefficient of the product of post materialist values and its natural logarithm was statistically significant (significance = 0.10). After a using a square root transformation on post materialist values, the coefficient of the product of square root transformed post materialist values and their natural logarithm was not statistically significant (significance = 0.16).
- The coefficient of the product of materialist values and its natural logarithm was statistically significant (significance = 0.02). After a using an exponential transformation on materialist values, the coefficient of the product of exponentially transformed materialist values and their natural logarithm was not statistically significant (significance = 0.83).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Materialist values (exponentially transformed)
2. Personal importance of using water saving plumbing fixtures
3. Convenience of using water saving plumbing fixtures
4. Familiarity with using water saving plumbing fixtures
5. Openness to change values
6. Size of current house
7. Familiarity with environmental problems within their Province
8. Highest educational level attained
9. Current type of residence
10. Post materialist values (square root transformed)

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.18
Percentage of cases classified correctly	84.4%
Percentage of studentized residuals outside the ±2 range	3.7%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING A HIGH-EFFICIENCY FURNACE/BOILER

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Having personally witnessed human made environmental disasters in their Province
2. Frequency of nature visits within the past 12 months
3. Extent to which their environmental actions on conserving energy are influenced by their neighbours, friends, or relatives
4. Self-transcendence values
5. Traditional values
6. New Environmental Paradigm scale score
7. Family 2006 annual income before taxes
8. Stand on political issues
9. Familiarity with using a high-efficiency furnace/boiler
10. Personal importance of using a high-efficiency furnace/boiler

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using a high-efficiency furnace/boiler
2. Familiarity with using a high-efficiency furnace/boiler
3. Family 2006 annual income before taxes
4. Having personally witnessed human made environmental disasters in their Province
5. Frequency of nature visits within the past 12 months
6. New Environmental Paradigm scale score
7. Self-transcendence values

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

The interaction between New Environmental Paradigm scale score and self-transcendence values was not significant (significance = 0.34)

Step 5: Predictor variables in the final model:

1. Personal importance of using a high-efficiency furnace/boiler
2. Familiarity with using a high-efficiency furnace/boiler
3. Family 2006 annual income before taxes
4. Having personally witnessed human made environmental disasters in their Province
5. Frequency of nature visits within the past 12 months
6. New Environmental Paradigm scale score
7. Self-transcendence values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.71
Percentage of cases classified correctly	77.0%
Percentage of studentized residuals outside the ±2 range	2.3%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING A PROGRAMMABLE THERMOSTAT TO REDUCE ENERGY USE

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with environmental problems in the world
2. Post materialist values
3. Gender

4. Marital status
5. Stand on political issues
6. Familiarity with using a programmable thermostat to reduce energy use
7. Personal importance of using a programmable thermostat to reduce energy use

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using a programmable thermostat to reduce energy use
2. Familiarity with using a programmable thermostat to reduce energy use
3. Familiarity with environmental problems in the world
4. Post materialist values

Step 3: Main effects model (testing for linearity in the logit)

The coefficient of the product of post materialist values and their natural logarithm was not statistically significant (significance = 0.95).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using a programmable thermostat to reduce energy use
2. Familiarity with using a programmable thermostat to reduce energy use
3. Familiarity with environmental problems in the world
4. Post materialist values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.09
Percentage of cases classified correctly	82.9%
Percentage of studentized residuals outside the ±2 range	3.5%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF TAKING TOXIC WASTE TO SPECIAL DISPOSAL SITES

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Extent to which their environmental actions on protecting surrounding ecosystems are influenced by their neighbours, friends, or relatives
2. Convenience of taking toxic waste to special disposal sites
3. Post materialist values
4. Age

5. Highest educational level attained
6. Personal importance of taking toxic waste to special disposal sites

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of taking toxic waste to special disposal sites
2. Convenience of taking toxic waste to special disposal sites
3. Age
4. Post materialist values

Step 3: Main effects model (testing for linearity in the logit)

The coefficient of the product of post materialist values and their natural logarithm was not statistically significant (significance = 0.81).

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of taking toxic waste to special disposal sites
2. Convenience of taking toxic waste to special disposal sites
3. Age
4. Post materialist values

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.60
Percentage of cases classified correctly	85.8%
Percentage of studentized residuals outside the ±2 range	3.7%
DFBeta values greater than one	No

DEPENDENT VARIABLE: ADOPTION OF USING NATURAL VENTILATION – NO AIR CONDITIONING

Step 1: Predictor variables remaining into the preliminary reduced model:

1. Familiarity with media campaigns that promote conservation of energy
2. Traditional values
3. Age
4. Individual 2006 annual income before taxes
5. Current type of residence
6. Personal importance of using natural ventilation – no air conditioning

Step 2: Predictor variables remaining into the preliminary main effects model:

1. Personal importance of using natural ventilation – no air conditioning
2. Traditional values
3. Familiarity with media campaigns that promote conservation of energy
4. Current type of residence

Step 3: Main effects model (testing for linearity in the logit)

There were no continuous variables among the predictors and therefore no need to test for linearity in the logit.

Step 4: Preliminary final model (testing for interactions)

Based on the literature examined, there were no variables in the model that could interact.

Step 5: Predictor variables in the final model:

1. Personal importance of using natural ventilation – no air conditioning
2. Traditional values
3. Familiarity with media campaigns that promote conservation of energy
4. Current type of residence

Overall measures and specialized measures of goodness of fit for final model

Significance of –2LL of final model against a constant-only model	<0.01
Significance of Hosmer & Lemeshow test	0.06
Percentage of cases classified correctly	74.6%
Percentage of studentized residuals outside the ±2 range	2.9%
DFBeta values greater than one	No

APPENDIX G: CROSS-TABULATIONS FOR HAVING PERSONALLY WITNESSED HUMAN MADE ENVIRONMENTAL DISASTERS

Cross-tabulation between having personally witnessed human made environmental disasters in the Province and age

		Having personally witnessed human made environmental disasters in the Province					
		1 (never)	2	3	4	5 (many times)	Row Total
Age	1 (20 or younger)	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
	2 (21 – 30)	7 30.4%	5 21.7%	4 17.4%	5 21.7%	2 8.7%	23 100.0%
	3 (31 – 40)	30 41.7%	19 26.4%	13 18.1%	6 8.3%	4 5.6%	72 100.0%
	4 (41 – 50)	61 32.1%	42 22.1%	51 26.8%	25 13.2%	11 5.8%	190 100.0%
	5 (51 – 60)	82 34.3%	53 22.2%	58 24.3%	22 9.2%	24 10.0%	239 100.0%
	6 (61 – 70)	79 40.9%	37 19.2%	36 18.7%	24 12.4%	17 8.8%	193 100.0%
	7 (71 or more)	51 40.5%	26 20.6%	25 19.8%	14 11.1%	10 7.9%	126 100.0%
Total		310 36.8%	182 21.6%	187 22.2%	96 11.4%	68 8.1%	843 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
17.095	20	0.65

Cross-tabulation between having personally witnessed human made environmental disasters in the world and age

		Having personally witnessed human made environmental disasters in the world					
		1 (never)	2	3	4	5 (many times)	Row Total
Age	1 (20 or younger)	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%	0 0.0%
	2 (21 – 30)	6 26.1%	8 34.8%	6 26.1%	2 8.7%	1 4.3%	23 100.0%
	3 (31 – 40)	38 54.3%	8 11.4%	9 12.9%	4 5.7%	11 15.7%	70 100.0%
	4 (41 – 50)	87 48.3%	30 16.7%	31 17.2%	20 11.1%	12 6.7%	180 100.0%
	5 (51 – 60)	116 49.2%	45 19.1%	32 13.6%	22 9.3%	21 8.9%	236 100.0%
	6 (61 – 70)	89 48.4%	23 12.5%	39 21.2%	20 10.9%	13 7.1%	184 100.0%
	7 (71 or more)	62 50.0%	14 11.3%	26 21.0%	12 9.7%	10 8.1%	124 100.0%
Total		398 48.7%	128 15.7%	143 17.5%	80 9.8%	68 8.3%	817 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
27.751	20	0.12

Cross-tabulation between having personally witnessed human made environmental disasters in the Province and educational level

		Having personally witnessed human made environmental disasters in the Province					
		1 (never)	2	3	4	5 (many times)	Row Total
Educational level	1 (Some high school)	39 42.4%	11 12.0%	19 20.7%	14 15.2%	9 9.8%	92 100.0%
	2 (High school diploma)	55 41.4%	25 18.8%	30 22.6%	12 9.0%	11 8.3%	133 100.0%
	3 (Vocational or tech school)	50 41.0%	26 21.3%	27 22.1%	11 9.0%	8 6.6%	122 100.0%
	4 (Some college or university)	41 36.6%	23 20.5%	28 25.0%	12 10.7%	8 7.1%	112 100.0%
	5 (College or university graduate)	70 31.5%	57 25.7%	46 20.7%	29 13.1%	20 9.0%	222 100.0%
	6 (Some graduate work)	10 35.7%	7 25.0%	5 17.9%	4 14.3%	2 7.1%	28 100.0%
	7 (Master's degree)	28 33.3%	20 23.8%	22 26.2%	8 9.5%	6 7.1%	84 100.0%
	8 (Ph.D.)	7 28.0%	9 36.0%	4 16.0%	3 12.0%	2 8.0%	25 100.0%
Total		300 36.7%	178 21.8%	181 22.1%	93 11.4%	66 8.1%	818 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
20.164	28	0.86

Cross-tabulation between having personally witnessed human made environmental disasters in the world and educational level

		Having personally witnessed human made environmental disasters in the world					
		1 (never)	2	3	4	5 (many times)	Row Total
Educational level	1 (Some high school)	46 52.9%	6 6.9%	16 18.4%	9 10.3%	10 11.5%	87 100.0%
	2 (High school diploma)	76 58.9%	8 6.2%	18 14.0%	15 11.6%	12 9.3%	129 100.0%
	3 (Vocational or tech school)	70 59.3%	16 13.6%	16 13.6%	5 4.2%	11 9.3%	118 100.0%
	4 (Some college or university)	57 52.8%	19 17.6%	24 22.2%	3 2.8%	5 4.6%	108 100.0%
	5 (College or university graduate)	85 39.7%	44 20.6%	42 19.6%	24 11.2%	19 8.9%	214 100.0%
	6 (Some graduate work)	12 44.4%	6 22.2%	3 11.1%	3 11.1%	3 11.1%	27 100.0%
	7 (Master's degree)	30 36.1%	19 22.9%	16 19.3%	12 14.5%	6 7.2%	83 100.0%
	8 (Ph.D.)	7 28.0%	7 28.0%	5 20.0%	5 20.0%	1 4.0%	25 100.0%
Total		383 48.4%	125 15.8%	140 17.7%	76 9.6%	67 8.5%	791 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
59.665	28	<0.01

Cross-tabulation between having personally witnessed human made environmental disasters in the Province and individual income

		Having personally witnessed human made environmental disasters in the Province					
		1 (never)	**2**	**3**	**4**	**5 (many times)**	**Row Total**
Individual income	**1 (Less than $20,000)**	31 51.7%	10 16.7%	9 15.0%	5 8.3%	5 8.3%	60 100.0%
	2 ($20,000 to $39,999)	71 41.3%	34 19.8%	34 19.8%	19 11.0%	14 8.1%	172 100.0%
	3 ($40,000 to $59,999)	61 34.5%	37 20.9%	42 23.7%	21 11.9%	16 9.0%	177 100.0%
	4 ($60,000 to $79,999)	38 29.5%	34 26.4%	37 28.7%	13 10.1%	7 5.4%	129 100.0%
	5 ($80,000 to $99,999)	23 30.7%	17 22.7%	17 22.7%	10 13.3%	8 10.7%	75 100.0%
	6 ($100,000 or more)	40 33.3%	30 25.0%	27 22.5%	12 10.0%	11 9.2%	120 100.0%
Total		264 36.0%	162 22.1%	166 22.6%	80 10.9%	61 8.3%	733 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
18.216	20	0.57

Cross-tabulation between having personally witnessed human made environmental disasters in the world and individual income

		Having personally witnessed human made environmental disasters in the world					
		1 (never)	**2**	**3**	**4**	**5 (many times)**	**Row Total**
Individual income	**1 (Less than $20,000)**	34 58.6%	6 10.3%	9 15.5%	5 8.6%	4 6.9%	58 100.0%
	2 ($20,000 to $39,999)	87 51.5%	17 10.1%	36 21.3%	16 9.5%	13 7.7%	169 100.0%
	3 ($40,000 to $59,999)	82 48.2%	25 14.7%	32 18.8%	14 8.2%	17 10.0%	170 100.0%
	4 ($60,000 to $79,999)	61 51.7%	23 19.5%	17 14.4%	9 7.6%	8 6.8%	118 100.0%
	5 ($80,000 to $99,999)	32 42.1%	17 22.4%	10 13.2%	7 9.2%	10 13.2%	76 100.0%
	6 ($100,000 or more)	46 39.0%	27 22.9%	19 16.1%	18 15.3%	8 6.8%	118 100.0%
Total		342 48.2%	115 16.2%	123 17.3%	69 9.7%	60 8.5%	709 100.0%

Chi square test

Pearson chi square value	Degrees of freedom	Significance
27.427	20	0.12