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SUBJECTIVE AND OBJECTIVE BARRIERS TO ENVIRONMENTAL HEALTH PROMOTION: THE CASE OF TRANSPORTATION BEHAVIOUR

by

Jeffrey Ray Masuda

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Science

Centre for Health Promotion Studies

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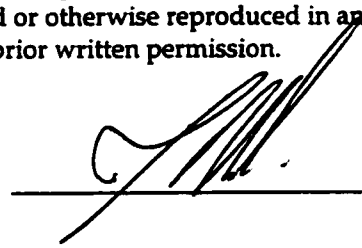

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The undersigned certify that they have read, and recommended to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled SUBJECTIVE AND OBJECTIVE BARRIERS TO ENVIRONMENTAL HEALTH PROMOTION: THE CASE OF TRANSPORTATION BEHAVIOUR submitted by Jeffrey Ray Masuda in partial fulfillment of the requirements for the degree of Master of Science.

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17 APRIL 2001.

Abstract

This study examined subjective and objective factors that influence decision-making and support for government involvement related to proenvironmental transportation choices. Using the Theory of Reasoned Action (Ajzen, 1985) to predict decision-making, a series of sociodemographic, subjective, and objective factors were analyzed for their relative contributions to behavioural outcomes. Results showed a weak contribution of sociodemographic characteristics (age, number of household residents, education, and income) to proenvironmental intentions and behaviour, but not support for government involvement. Subjective variables, including attitudes, subjective norms, and responsibility demonstrated the strongest association with behavioural outcomes and support for government involvement. Objective factors, including geographic variables (commuting distance and distance to public transit) and personal ownership of transportation means (number of vehicles and bicycles) also accounted for unique variance, albeit weakly in behavioural outcomes, but not support for government involvement. Overall, results show support for the integration of subjective and objective factors in environmental behaviour theory.

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Chapter 1

Background and Scope of the Issue

The integrity of our environment has become one of the most urgent issues of our time. We have entered the new millennium with the legacy of industrialization behind us, and its resulting ecological impact amidst and ahead of us. The economic success of the last century has been the product of a rising dependence on our planet's resources to serve the consumptive habits of a global industrial economy. In doing so, we have placed considerable stress on our ecosystem, to the point that its sustainability has become threatened. In Canada, primary and secondary industry, as well as high consumer demands arising from our colder northern climate and expansive geography, have resulted in our country being rated the highest per capita energy user on the planet (Last, Trouton, and Pengelly, 1998).

Living within Canadian society are millions of individuals whose lifestyles reflect this consumptive pattern. Our personal lives mirror societal values, suggesting that "more is better", "self is more important than others", and convenience takes precedence over ecological responsibility. Individuals build communities to fit the way of life that they are conditioned to expect in relation to these societal norms. Communities in turn provide their citizens with the resources they require to perpetuate their consumptive patterns of life, thereby becoming politically, economically, culturally, and physically dependent upon non-sustainable industrial and commercial practices.

Gallagher and Tierney (1996) argue that "the traditional view of the 'environment' is that it is remote from the individual", whereas, it is in fact "proximal to the individual and impinges on every aspect of their physiological and social behaviour

with potential negative consequences" (p. 362). There is a growing consensus that our long tradition of environmental negligence is no longer acceptable, acknowledging the need for a more harmonious relationship between humans and the ecosystem. More people see that the consumptive lifestyle is beginning to have significant impacts not only on the environment, but on human health and quality of life as well. This thesis explores the human health—environment interface in an examination of factors affecting a community's adoption of proenvironmental behaviour with regard to transportation. Results will be used to mutually inform both research and practice by contributing to current psychological theory and providing useful information for a community-based plan to encourage a shift toward alternative transportation choices in order to prevent an impending air pollution threat to the Okanagan Valley in the southern interior of the province of British Columbia, Canada.

Environmental Health Promotion

The World Health Organization, in the European Charter on Environment and Health (1989):

> Recognizes the dependence of human health on a wide range of crucial environmental factors; stresses the vital importance of preventing health hazards by protecting the environment; acknowledges the benefits of health and well-being that accrue from a clean and harmonious environment; and encourages the abatement of pollution and the restoration of a healthy environment. (p. 1)

Health Promotion has come of age over the past 30 years as a distinct area of health research and practice. Its beginnings as a lifestyle approach to health early in the 1970s gradually evolved as researchers became increasingly aware of the need to view health in its larger social and cultural context. No longer limited to just the individual, health promotion can inform the social and ecological worlds within which individuals exist to

prevent specific diseases, to prevent sickness, and to promote an optimal level of physical and social functioning. Consistent with this broader conception, Brown (1991) proposes that health promotion includes research and practice at three levels: (1) directly changing personal behaviours, (2) changing environmental influences on health-related personal behaviours, and (3) changing environmental conditions that directly influence health status.

Changing personal behaviour has been the longest-standing method of health promotion, and is an important element of preventive health action in several domains (i.e. health education, social marketing). However, while recognizing the importance of personal behaviour in determining health status, health promotion also includes action taken on socioenvironmental conditions that may influence health behaviour, and these conditions may have impacts on health directly through other mechanisms. The social environment influences health by presenting individuals with conditions that encourage either health-enhancing or health-damaging behaviour. Putting this into the context of proenvironmental transportation, this includes consumptive lifestyles that people are socialized into through the diffusion of norms such as materialism and convenience. For example, we are influenced by creative advertising to desire larger and more comfortable vehicles which, when spread over an entire population, leads to resource consumption well beyond our basic transportation requirements. Canada, with a population of 30 million consumes the same amount of fossil fuels as the entire continent of Africa, with a population of 700 million (Keating, 1997). Additionally, the social and physical environment may present people with innumerable barriers to affecting change toward healthier practices. For example, inadequate public transit and lack of political support

for environmentally friendly practices can prevent people from adopting proenvironmental behaviours. Finally, health may be influenced by environmental risk factors independently of individual behaviour. Communities may be situated in geographic locations that are prone to particular hazards, either of natural or anthropogenic origin. Large-scale industry may affect human health through the release of hazardous material into the air.

The Ottawa Charter for Health Promotion was the pivotal document that led to the recognition that the health of a population is largely determined by factors outside of the traditional health care sector (World Health Organization, 1986; see also Joffe and Sutcliffe, 1997). According to the Charter, the fundamental conditions and resources for health are peace, shelter, education, food, income, a stable ecosystem, sustainable resources, social justice, and equity. With regard to environmental determinants, health promotion helps people to improve their health by addressing policy, planning, and individual decision-making capacity to facilitate the adoption of environmentally friendly practices by individuals, communities, and society as a whole. This may involve the elimination of barriers that prevent healthful decision-making, such as providing economic or structural incentives to taking the bus, cycling, walking, or carpooling (hereafter referred to as 'proenvironmental transportation'). It may also involve the modification of environments to reduce health-damaging behaviours, such as imposing new regulations on vehicle emissions to reduce pollution levels and improve community air quality. Importantly, such efforts should always remember that individuals and communities will base their decisions largely on what is the "easy choice" (Brown, 1991). This is a central programmatic strategy in the health promotion programs

encouraged by the European region of the World Health Organization (World Health Organization, 1985). Skov *et al* (1991) provide further explanation of this strategy:

> It should be kept in mind that preventive behaviours which clash with other daily activities stand a poor chance of being carried out. 'The preventive behaviour must be the easy behaviour'. As long as people need a car to perform the job and/or it is very unhandy to use public transportation they are not likely to adopt an altruistic attitude. In view of these considerations, it is questionable whether policies, which rely on modification of individual health behaviour will have any great effect on the emission from motor vehicles. Unless, of course, new ways are found to influence peoples' health behaviour". (p. 626)

These arguments highlight the complexity of behaviour change, in this case toward adopting proenvironmental transportation practices. If health promotion practice claims to effectively target such behaviour change, then it must be based on a solid foundation of research directed at finding these new ways influencing health behaviour. Planning directed at these three levels of action should be informed by a clear picture of the multiple and interdependent structural, social, and individual variables affecting transportation behaviour.

Air Pollution: Prevalence, Physical and Psychosocial Impacts

Air pollution results from both natural processes and human activities. Although the former can have significant impacts on air quality, they are usually only transient, due mainly to sporadic processes such as volcanoes and forest fires. Human activity, primarily through the burning of fossil fuels, contributes a large proportion of many of the harmful and persistent pollutants that are in our atmosphere today. These include elevated levels of carbon dioxide, carbon monoxide, oxides of nitrogen, sulfur dioxide, volatile inorganic compounds and airborne particulates. These pollutants can have effects on global climate, local ecosystems, as well as direct impacts on human health.

Canada is the second highest per capita emitter of greenhouse gases in the world, and our emissions are growing by 1.5% per year (Last, Trouton, and Pengelly, 1998). A recent report by the David Suzuki Foundation (Hornung, 1998) claims that over 16,000 deaths annually can be attributed to air pollution. This translates into 8 per cent, or 1 of every 12 non-traumatic deaths in Canada. In addition, tens of thousands more suffer from respiratory ailments associated with pollutants in the air, even at concentrations below national standards (Brunekreef, Dockery, and Krzyzanowski, 1995). From these statistics alone, it can be asserted that air pollution exerts a tremendous burden on our nation's health, with resulting costs to our health care system. For example, it has been estimated that more stringent fuel and vehicle emission standards alone would result in health benefits of up to $1 billion per year in Canada (Health Canada, 1997).

Air pollutants, particularly in combination, contribute to a wide range of health effects including impaired lung function, shortness of breath, wheezing, asthma attacks, and premature death. Even within regulatory limits, pollutants impact both mortality and morbidity (Last, Trouton, and Pengelly, 1998). Furthermore, many pollutants, such as ozone, show no threshold effect, having detrimental health effects even at minute concentrations.

One example of the physical effects of air pollution that affects Canadians of all age groups is asthma. Asthma affects between 5 and 8 per cent of the population, or approximately one million Canadians, resulting in more than 60,000 hospital admissions, 250,000 days in hospital, and more than 450 deaths annually. More importantly, the prevalence of asthma has risen by about 30 per cent in Canada during the past 20 to 30 years for reasons that are far from clear (Last, Trouton, and Pengelly, 1998). In 1990, it

was estimated that the total cost of asthma to the country exceeded $500 million (Health Canada, 1997). Importantly, the rate of hospitalization for asthma has increased by 27% for boys and 18% for girls between 1987 and 1997 (Health Canada, 1997). This means that it is children who are increasingly vulnerable to air pollution. The Declaration of the Environment Leaders of the Eight on Children's Environmental Health stated that pollution was among the most important environmental health threats to children worldwide (1997). As children grow, their developing pulmonary tissue is highly sensitive to pollutants and their rate of respiration is higher than adults. Children living in poverty are even more susceptible to developmental impairment due to air pollution (Chaudhuri, 1998). Not only are they more likely to be born with pre-existing conditions such as low birth weight, but social factors such as living adjacent to industry and major transportation corridors also contribute to the added burden that they face while growing up in a polluted environment.

Although asthmatics and other vulnerable populations are the predominant victims of the range of pollutants in the air, it has also been shown that long-term exposure to air pollution will affect the health of all people. High pollution days in urban areas have the potential to cause a variety of physiological effects, which over time, may lead to decreased lung function and increased mortality across all groups (Last, Trouton, and Pengelly, 1998).

Not only are the physical effects of air pollution a concern, but quality of life issues are also at the forefront of issues in affected communities. "More difficult to quantify, but no less important, are the social, cultural, and psychological effects observed when environmental pollution disrupts a community's way of life" (Health

Canada, 1997, p. 50; see also Bullinger, 1989). Indeed, environmental quality and quality of life may be considered "different sides of the same coin" (Eyles, 1990, p. 147). The World Health Organization Quality of Life Group defines quality of life as "individuals' perceptions of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards, and concerns" (The WHOQOL Group, 1998; p. 551). In transportation decision-making, this initiates a social dilemma of competing aspects of quality of life. By consistently exceeding the carrying capacity of the physical environment through our present culture and value systems, we will ultimately place enough of an ecological burden on the environment that these systems become self-limiting, thereby inhibiting the full realization of goals. Environmental sociologists refer to this process as *autogenic succession* (Grambling and Freudenburg, 1996). In other words, the convenience and luxury of consumptive lifestyles to individuals in the short term may be detrimental in the long term to the community as the degraded environment impacts health and quality of life. As population increases, the natural environment and air quality will begin to suffer from dirty roadways, tradeoffs between nature and roadways to compensate for increased traffic volumes, and replacement of parks for parkades. In turn, human quality of life will begin to erode as daily activity becomes more restricted as a result of the added environmental burden.

Environmental quality of life issues affect people at individual, social, and community levels (Taylor, Elliott, Eyles, *et al*, 1991). Individuals may be affected by perceptions of limited functionality and mobility due to physical restrictions placed on them by the combination of pollution and pre-existing disease. Social patterns may be

disrupted by the occurrence of "high pollution" days and accompanying advisories to remain indoors, or at least restrict outdoor activities. Vulnerable populations may in turn lose social networks as they become increasingly isolated from their exacerbated disease. Children suffering from asthma will feel increasingly isolated from their peers and social circles due to increased incidence and severity of asthmatic episodes. The entire community may be affected in other ways as increased pollution in the region begins to exert aesthetic and economic effects, resulting in losses of commercially-dependent industries (i.e. tourism), thereby affecting the overall social fabric of local society.

One must be careful, however, to avoid taking a radical "healthist" perspective, as health is also tied very strongly to a robust economy (WHO, 1999). To shut down a nation's economy in the name of the environment would only replace one problem with another. The key therefore, is to find a middle ground—to ignore either economy or environment will each lead to human heath impacts. Unfortunately, it is the latter that is most often neglected at all levels of decision-making.

Community Awareness

Canadians have educated themselves about the reality of these environmental impacts. Over 90% of Canadians believe that our air, water, and land are more contaminated now than ever before (Kindra and Chynoweth, 1993). Linking these effects to health has also been increasingly brought to light, with evidence that 33% of Canadians feel that environmental problems *very much* affect their health and that of their families (Kindra and Chynoweth, 1993), and that one in two Canadians believes that his or her long-term health is affected by the environment (James and Eyles, 1999). Referring specifically to pollution, a 1991 survey revealed that 92% of Canadians believe

that the health of our population is affected by pollution (Kindra and Chynoweth, 1993). In addition, 51% stated that their own health is affected by pollution. By 1996, this number increased to almost two thirds saying that their health has likely or has definitely been affected by pollution (Health Canada, 1997). In fact, 44% Canadians perceive environmental pollution to be a greater health risk factor than exercise and diet or smoking and drinking (Go for Green, 1998). Referring specifically to transportation, 40% of Canadians believe that the greatest improvement to municipal transportation would be expanding or improving transit services (Environics, 1999; In David Suzuki Foundation, 1999). Such statistics highlight the fact that environmental advocates, professionals, and agencies in our country have succeeded remarkably in conveying their message to the general public.

Not only are we aware of our exposure to pollution and its effects, but we have been educated as to what needs to be done. In general, Canadians believe that the health of the environment should take precedence over economic conditions (Health Canada, 1997). Indeed, as a nation, we are becoming more committed to "walking the talk". One notable recent example has been Canada's participation in an international initiative that began in Kyoto in 1997 that commits our country to reducing greenhouse gas emissions to six per cent below 1990 levels by 2012. Although significant from a symbolic perspective, this amount does not come close to approaching the 60-80 per cent reductions that environmental groups claim are required to effectively slow the rate of climate change (Last, Trouton, and Pengelly, 1998). Another indicator of success has been the significant reduction of several major pollutants since the 1970s, including particulates (PM_x)/volatile organic compounds (VOCs), carbon monoxide (CO), nitrogen

oxides (NO_x), and sulphur dioxide (SO_x). These successes can be largely attributed to advances in vehicle and industrial technology. Again however, this progress must be tempered by the fact that consumer trends toward larger "sport utility" and "minivan" vehicles are reversing that trend. The resulting levels of certain pollutants negates previous gains. For example, overall ground-level ozone levels have increased by 29% in this same thirty-year period. In addition, emissions of NO_x are expected to remain constant and VOC to increase by 25% by 2010 (Canada-U.S. Air Quality Accord , 1996, *In*: Last, Trouton, and Pengelly, 1998). In fact, one study showed that, across Canadian cities, air pollution related mortality risk has increased between 3.6 and 11 per cent between 1980 and 1991 (Burnett *et al*, 1998). These statistics suggest that people and society as a whole, although educated to the significance of air pollution, have not taken responsibility toward effective action.

Government Action

> To maintain the quality of life in our cities and rural communities, we must ensure that we have clean air and water.
>
> Right Honourable Adrienne Clarkson, Governor General, Speech from the Throne, October 12, 1999

For its part, the government has taken some steps toward addressing the issues reviewed earlier, but so far has focused mainly on regulatory action on "acceptable limits" rather than proactive, preventive policymaking and action toward environmental issues (notable exceptions include the Health Canada's Community Action Projects). Air quality is regulated at both provincial and national levels. The Motor Vehicle Safety Act regulates CO, NO_x, VOCs, and diesel particulates. National Ambient Air Quality Objectives are in place for all monitored pollutants, setting maximum desirable,

acceptable, and tolerable levels for each. Action at the national level includes government initiatives such as the National Air Pollution Surveillance Network, the NO_x /VOCs Management Plan, the Accelerated Reduction and Elimination of Toxics Program, the Canadian Environmental Protection Act, and the Canada-U.S. Air Quality Agreement. Each of these initiatives has targeted many of the macro-level issues in dealing with air quality.

Although these activities are useful, it can be argued that government action specifically on transportation has been misguided. The National Transportation Investment Strategy (NTIS) sets federal government priorities toward investment in the national highway system, rather than addressing the air quality problems being faced by communities nationwide. The emphasis of the $5-15 billion NTIS plan is to promote economic growth by improving transportation routes across the country. It has been argued however that the resulting indirect costs will result in net economic loss (David Suzuki Foundation, 1999). According to the Foundation, "it will put more vehicles, particularly trucks on roads, exacerbating rather than alleviating congestion problems in urban areas. It will also compromise new investments in urban transit, further eroding vital municipal infrastructure" (p. 1). The federal government's misguided agenda is further evidenced by the fact that Canada is the only OECD country that does not provide federal support for municipal public transit infrastructure (David Suzuki Foundation, 1999).

A World Bank study shows that automobile dependency reduces regional economic development, while transit investments contribute to more economically efficient and productive regional economies (Litman and Laube, 1999). One Canadian

study shows that comprehensive improvement in nationwide transit (alternative transportation including railways) can increase economic productivity, providing twice the return of highway investments (Aschauer, 1991). Canada's urban transit infrastructure has been neglected by the federal and provincial governments. According to a survey by the Canadian Urban Transit Association (1999), there is currently a $8.2 billion shortfall in federal monies allotted to total infrastructure and transit capital, replacement and rehabilitation, and expansion to sustain and moderately expand the system and attract new riders. Presently however, this neglect has been offloaded onto the communities themselves, leaving municipal governments responsible to address the air quality problems that manifest from federal-level policies or lack-thereof.

Air Quality in the Okanagan Valley

This study examines the issues of environmental health promotion and proenvironmental transportation in a specific community level context. Air quality in the Okanagan valley has become an issue of concern to its residents as population continues to grow in the region. The physical health of susceptible segments of the population (i.e. children, the elderly, people affected by chronic obstructive pulmonary disease (COPD) and asthma) may be adversely affected by high levels of smoke, chemicals, and particulates in the air as a result of vehicle emissions, incomplete combustion of backyard and commercial agriculture by-products, and industrial activity. A 1995 study by the B.C. Ministry of Environment on Provincial Emissions of major air pollutants (see Table 1) shows that the Southern Interior region, in which the Okanagan resides, is responsible for similar (i.e. CO), and sometimes even greater (i.e. particulate) quantities of pollutants than the provinces' most populated region, the Lower Mainland. A brief overview of

one of the major pollutants will be given to highlight the extent and potential severity of the problem.

Table 1

Total pollutant emissions by type in two regions of B.C. (B.C. Ministry of Environmental, Lands, and Parks, 1999)

	Tonnes*	
Pollutant	Southern Interior	Lower Mainland
CO	228,002 (15.7)	288300 (19.9)
NO_x	23,945 (9.2)	80405 (31.0)
SO_x	2432 (1.4)	14548 (8.3)
TRS	30 (1.2)	230 (9.2)
VOC	35,587 (14.3)	59713 (23.9)
Part	38172 (16.4)	27362 (11.7)
PM10	22549 (15.5)	16231 (11.1)
PM2.5	17521 (15.6)	10794 (9.6)

*Numbers in brackets indicate percent of total provincial emissions)

The top two pollutants in the Central Okanagan are PM_{10}, which in 1999 drove the air quality index (AQI) 65% of the time, and ground level ozone, which drove the AQI 35% of the time. As the sources of PM_{10} are mainly associated with industrial emissions and by-products (i.e. agricultural buring), only the ozone will be reviewed as it is primarily caused by motor vehicle emissions, and therefore is more applicable to this study.

Ozone (O_3) in the lower atmosphere is formed by the reaction of volatile organic compounds (VOCs) and nitrogen oxides (NO_x) in the presence of sunlight and warm temperatures. Vehicle exhaust is a large contributor to each of these, making it the most important form of pollution in terms of public accountability. The current national air quality objective one-hour maximum is 160 $\mu g/m^3$. Already in the study city, this standard is being exceeded (B.C. Ministry of Environment Lands, and Parks, 1999). Highest hourly concentrations have been reported as high as 168 $\mu g/m^3$. Hourly mean,

95th percentile, and maximum concentrations measured in 1997 showed that the study city had the highest concentrations of ozone in B.C. With continuing population growth, these exceedances will inevitably increase in both severity and frequency. "This finding indicates that these sites experience both a high background concentrations of ozone throughout the year, and periods of elevated ozone concentrations during the warm, sunny summer months. It also suggests that ozone may be an emerging issue in these rapidly growing areas." (B.C. Ministry of Environment, Lands, and Parks, 1998, p. 3-4)

At low concentrations, ground-level ozone can irritate the eyes, nose, and throat. At higher concentrations, symptoms increase in severity, leading to asthma, bronchitis, coughing, and chest pain as well as increased susceptibility to respiratory infections and decreased lung function and physical performance (B.C. Ministry of Environment, Lands, and Parks, 1992). In fact, a recent review has found a risk ratio for respiratory hospital admissions of 1.045 associated with a 99 $\mu g/m^3$ increase of ozone. In other words, when ambient ozone levels are at 60% of the National Ambient Air Quality Objectives mentioned above, 4.5 per cent more people than average are admitted to hospital than if no ozone was present (Hagler-Bailly Consulting, *In*: Last, Trouton, and Pengelly, 1998). Prolonged exposure can eventually damage lung tissue, cause premature aging of lungs, and contribute to chronic lung disease (Broadway, MacPhail, and Jacobson, 1998). As such, children and the elderly are considered to be the most at risk. In addition to human health impacts, ozone can cause economic damage to sensitive crops, trees, and other vegetation by damaging leaves, and reducing growth, productivity, and reproduction. This is especially important to the Okanagan Valley, as one of its primary economic activities is the fruit-growing industry.

Local Action. Economically, the Okanagan is highly regarded as both a tourist destination and a fruit-growing area. As development continues, increases in vehicles and urban sprawl will become important issues as the region approaches a carrying capacity that will not compromise the pristine nature that it boasts. Such concerns have sparked local governments to act on the issue by forming the Central Okanagan Regional Air Quality (CORAQ) Committee. This committee is composed of high-ranking elected officials and public servants, thus not only reflecting the high priority that this community gives to air quality and their health, but also giving it a high decision-making capacity at the policy level. Activities of this committee to date include awareness-raising projects such as school presentations, media broadcasts, brochures, and a web site, as well as direct measures in the public sector such as taking an inventory of the municipal vehicle fleet and other energy reduction measures.

Members of the committee have also been conscious of the need for public involvement in addressing the air quality issue. In fact, recent elections saw air pollution as the number one issue to the public. If part of the solution to the problem requires individuals to take action or be subject to more stringent or costly regulation, then their perceptions and input are essential to the decision-making process. On October 6th, 1999, the CORAQ committee took first steps toward community representation through a public air quality workshop. Key stakeholders from government, industry, advocacy groups, and the general public worked together to identify and prioritize issues and come up with recommendations for future action in the region. At the workshop, participants determined that motor vehicle emissions and motor vehicle volume increases were the most pressing air quality issues to be addressed. Indeed, light duty vehicles are a major

source of pollution in the air, accounting for 37.9% of CO, 27.6% of NO_x, 10.4% of SO_x, and 24.7% of VOC pollution in the Southern Interior (B.C. Ministry of Environment, Lands, and Parks, 1999). Based on workshop discussions, participants made recommendations that included various regulatory, planning, social marketing, and behaviour change strategies involving land use planning, fuel/vehicle efficiency and emission control, public transportation, and vehicle numbers (Goossens, 1999).

The results of the Air Quality Workshop prompted the local government of the study city, in conjunction with the Regional District of the Central Okanagan, and the Okanagan University College to plan a series of projects targeted at understanding and subsequently reducing vehicle usage and emissions in the Okanagan. Three projects were commissioned, including:

1) Transportation Survey of Central Okanagan Residents
2) Statistical study of vehicle volumes related to air quality in the Central Okanagan
3) Targeted campaign to reduce single occupancy vehicles

The purpose of the transportation survey, part of which comprises this thesis, is to determine the potential within given demographic groups and certain geographic sub-areas of attracting single occupant vehicle travelers to other modes of transportation. The information collected will be used to develop strategies that would assist in increasing the percentage of trips undertaken by proenvironmental modes of transportation.

Arrangements were negotiated for this author to provide a literature review (see Appendix 1) to local stakeholders and to contribute to the development and analysis of the survey. Each will inform the campaign by the city's transportation department to

reduce single occupant vehicle use. It should be noted that results of the survey were independently analyzed by city planners and the present author, as the timelines for completion for local stakeholders were not congruent with this thesis. However, upon completion, a copy of the thesis will be provided to the Regional Transportation Demand Management Supervisor, who acted as the liaison to the community during the data collection phase of the study.

Chapter 2

Barriers to Proenvironmental Action

Segments of the Canadian population are showing increased awareness of the importance of adopting pro-environmental behaviour, such as using public transportation, recycling, and participating in environmental organizations (Kindra and Chynoweth, 1993). In fact, almost 40 percent of our population may be classified as either activists (20 percent) or environmental enthusiasts (17 percent), according to their attitudes toward environmental issues (Kindra and Chynoweth, 1993; see Appendix 2). However, when it comes to actually engaging in proenvironmental behaviour, our high degree of awareness has not translated into as great a degree of action toward addressing many of the issues that we know very well affect the environment and ultimately our health. The question of interest in this study is why this is the case. A review of the literature suggests that part of the problem is that Canadians believe the problem to be beyond the scope of any one individual to make a difference (Kindra and Chynoweth, 1993). It may also be that although our collective consciences are forward thinking, the reality is that we are trapped by the consumptive nature of our way of life, and are hoping for larger forces such as governments to find the solutions for us. One key finding of the 1998 National Survey on Active Transportation was that while "Canadians are most likely to view environmental quality and fitness as the key factors in promoting individual health" they are "increasingly looking to governments for leadership on environmental issues, and less likely to feel personally empowered" (Go for Green, 1998, p.3). Research reported in this thesis will examine barriers inhibiting proenvironmental behaviour. In particular, the

study will characterize a population across subjective and objective variables that are predicted to influence proenvironmental decision-making in relation to transportation use.

Subjective Factors

Research consistently shows that subjective factors influence proenvironmental behaviour. These factors include threat perception, control (James and Eyles, 1999), concern (Fransson and Gärling, 1999), knowledge (Fransson and Gärling, 1999), attitudes (Kaiser *et al*, 1999; Axelrod and Lehman, 1993; Grob, 1995; Schultz and Zelezny, 1999), vulnerability (Skov *et al*, 1991), general and personal awareness, values, efficacy (Axelrod and Lehman, 1993), trust, responsibility (Kaiser and Shimoda, 1999; James and Eyles, 1999), and outcome desires (Axelrod and Lehman, 1993). This study examines subjective factors contributing to transportation behaviour through the lens of theory on attitude-behaviour relationships. One such theory that shows promise in the area of proenvironmental decision-making is the Theory of Reasoned Action (TRA; Ajzen, 1985; Ajzen and Madden, 1986). TRA proposes that behaviour is proximally determined by the intent of an individual to perform that behaviour (see Figure 2). Behavioural intention is in turn determined by the combined influence of two constructs: attitudes (one's evaluation of proenvironmental behaviour) and subjective norms (one's beliefs about how important others think proenvironmental behaviour is). This theory and the related Theory of Planned Behaviour have been successfully applied to a variety of environmental behaviours, including recycling (Boldero, 1995; Taylor and Todd, 1995; Cheung *et al*, 1999), water conservation (Lynne *et al*, 1995; Lam, 1999), environmental education (Haney *et al*, 1996), and "green" consumerism (Sparks and Shepherd, 1992),

but has not yet been examined in relation to transportation behaviour. One goal of the present study is to examine TRA in relation to these proenvironmental behaviours.

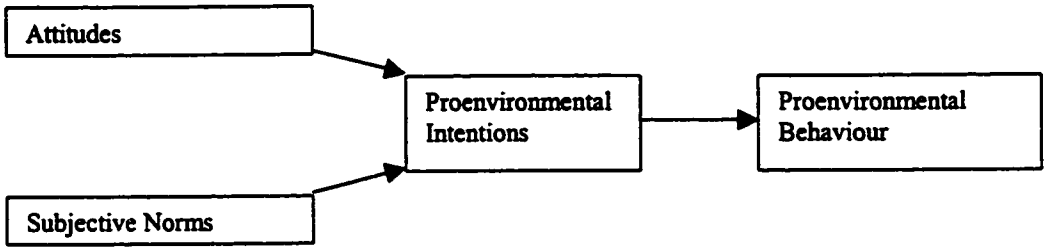

Figure 1. Subjective Factors: The Theory of Reasoned Action (Ajzen, 1985)

Attitudes. Attitudes are an expression of one's positive or negative evaluation of performing a given behaviour. A person's attitude towards a proposed behaviour will exert a strong influence on his/her willingness to partake in it. Attitudes arise out of a combination of people's beliefs about behavioural outcomes and their evaluations of those outcomes.

Subjective Norms. Subjective norms refer to beliefs and perceptions that other people are supportive of, or expect the specific behaviour, weighted by the individual's motivation to comply with their perception of the values and behaviours of others.

Responsibility. TRA has benefited from research showing that perceived responsibility adds to the prediction of proenvironmental intentions and behaviour . In contrast to Subjective Norms, where it is predicted that a person will act in accordance with the beliefs of others, responsibility refers to acknowledgement that one's own actions have effects on the environment and that one is morally obligated to act for the benefit of others (Kaiser, *et al*, 1999). Thus, whereas subjective norms exert external pressure to act for one's own benefit (i.e. the acceptance of others), responsibility exerts

an internal pressure to act for the benefit of others. Thus, in addition to attitudes and subjective norms, the present study examined responsibility as an additional predictor of proenvironmental behaviours.

Intentions. Intentions reflect on a person's overall willingness to engage in a new behaviour. In this study, several subsets of behavioural intentions were measured, including intentions to decrease private vehicle usage, intentions to increase alternative modes of transportation, and intentions to reduce one's personal impact on pollution episodes through proper maintenance of vehicles and through trip planning.

Behaviour. Behaviour is measured in this study as the actual use of proenvironmental transportation or recent changes in transportation modes measured over the last year.

Support for Government Involvement. In addition to examining factors relating to personal behaviour change, measures of support for government action were also used to identify possible connections between subjective and objective barriers and societal obligation to contribute to the environment. Specifically, support for various strategies related to proenvironmental transportation was examined as an additional outcome measure.

Objective Factors

Despite the influences of subjective factors, it is important to remember that personal transportation decisions occur within political, economic, and social contexts in which people live. Often, these contexts are interdependent and occur at many levels. For example, political reluctance to introduce environmental policy in community infrastructure development may reflect a dominant social conservatism among the local

population, and can therefore lead to urban planning that promotes commuting via personal vehicle. Other factors such as personal wealth or higher housing costs and taxation in core areas may lead to city planning that promotes suburban living, thereby resulting in longer travel distances. Automobile purchasing trends provides another example related to socioeconomic status. Those in higher-income neighbourhoods may choose to purchase more vehicles for their households out of perceived improvements in convenience or through social pressure (i.e. as status symbols). Indeed, referring specifically to public transit, each of these cases is supported by sociodemographic trends reported by the Canadian Urban Transit Association (1992):

> Relevant trends include the aging of the dominant baby-boom generation and related increases in affluence and expectations, increased female labour force participation, shifts in occupation from clerical and factory work, and decentralization of population and employment...While increased employment among women and concerns about the environment are supportive of increased transit ridership (at least in the short term), the other social trends identified will tend to reduce transit's share of urban travel. If transit systems do not respond to the changing needs of urban travel markets, ridership and modal share will be lost.

Consistent with these ideas, it was recognized early in the development of the TRA that it has limited applicability in instances where behaviour is not under complete volitional control of the individual. In other words, individuals who felt they had little power over their beliefs and attitudes were not likely to report compliance with a recommended behaviour. Indeed, some emerging studies support this idea that transportation behaviour can only be fully explained by a combination of subjective and objective factors (Frey, 1988; Tanner, 1999).

To address the issue of the potential influence of objective and sociodemographic factors on proenvironmental behaviours, a number of likely candidates for behaviour-

influencing agents were selected using both geographic and personal ownership criteria. Sociodemographic factors include age, gender, level of education, and annual household income. Objective factors include commuting distances, distance to nearest public transit stop, and number of vehicles and bicycles, each of which is explained below.

Commuting distance. Distance factors can pose several barriers to adopting new transportation behaviours. The commute may be too far to be reasonably accomplished on a daily basis by walking or bicycle. It may also be that the time it takes to travel such a distance is perceived to be too long.

Distance to nearest public transit stop. Distance to public transit stops also poses constraints on proenvironmental behaviour if the time and effort it takes to get to and from the bus exceeds what may be considered reasonable (i.e. no more than 10 minutes).

Number of vehicles and bicycles. A families' number of vehicles or bicycles should have a direct influence on transportation choice, as the purchase of a means of transportation may be an indicator that the members are either unwilling or unable to choose other modes of transportation.

Integrated Model

The preceding section has argued for a more expansive view of TRA in its application to transportation behaviour. Consideration of the potential role of intrinsic motivation to engage in behaviours consistent with one's sense of responsibility as well as recognition that such behaviours may not be entirely under volitional control leads us to an integrated model of TRA, to include the additional subjective factor of responsibility, as well as a new objective dimension, predicted to precede, and therefore influence, intentions and behaviour.

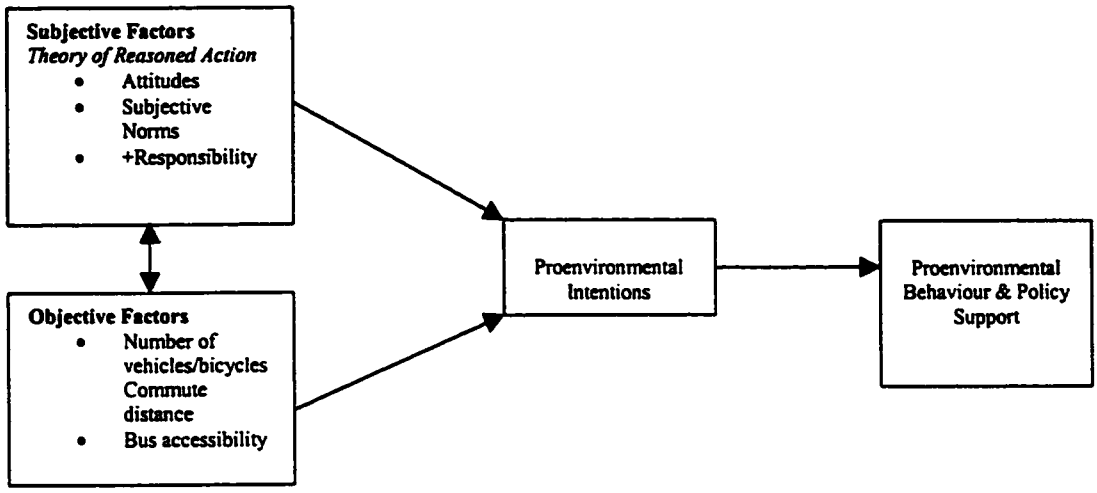

Figure 2. Integrated Model of Factors Influencing Proenvironmental Behaviour

Overall Purpose and Hypotheses

The purpose of this study is to identify the impact of objective and subjective factors on proenvironmental behaviour, in particular transportation behaviour. The study identified the relative impact of variables that affect peoples' transportation preferences, including (1) subjective barriers (attitudes, subjective norms, and responsibility) and (2) objective factors (distance, accessibility, automobile/cycle ownership, and demographics) on proenvironmental transportation intentions, behaviour, and support for government involvement.

The study will examine the following hypotheses:

Hypothesis 1. There will be a positive relationship between intentions to adopt proenvironmental transportation and actual use of proenvironmental transportation over the past year.

Hypothesis 2. Subjective factors, including attitudes, subjective norms, and responsibility, will account for unique variance in proenvironmental transportation intentions and behaviour.

Hypothesis 3. Objective factors, including commuting distance, accessibility of public transit stops, and automobile ownership, will account for unique variance in proenvironmental transportation intentions and behaviour.

Hypothesis 4. Objective and subjective factors will jointly predict public support for government involvement in proenvironmental transportation.

Finally, as this study is situated within a framework of environmental health promotion, the overarching goal of the research is to provide local decision-makers with a representative analysis of objective and subjective barriers in the population of the study city on which to base priority program planning toward a more comprehensive system of Healthy Transportation.

Chapter 3

Methods

Study Setting

The setting for this study was a medium-sized city in the Southern Interior region of British Columbia, Canada. The study city is situated over a 32 km stretch of lakeside within an area with a natural topography that forms an air shed through the entire valley in which it is situated.

> The Okanagan air shed is roughly defined as the South Okanagan to the North Okanagan, or more roughly speaking, from Osoyoos to Salmon Arm. Unlike well-defined watershed boundaries, however, activities and occurrences from as far south as the northwestern United States, and as far west as Asia also affect our local atmosphere, depending on airflow and ocean currents. (Okanagan Air Quality Management Background Report, 1999)

The region is considered semi-arid, with average temperature ranging from –7 to 27 degrees Celsius. The favourable climatic conditions make tourism, forestry, fruit growing, and wineries among the main industries in the region. The population of the city as of 1996 was 89,442 (Statistics Canada, 1998) and with current estimates at around 100,000, makes it the largest city in the Okanagan air shed. In addition, with a growth rate of 17.8 % between 1991 and 1996, the population is increasing very rapidly. This increase may be linked to a substantial in-migration into the region. Also the aging population (Statistics Canada, 1998) makes addressing air pollution even more urgent, as older people show higher morbidity and overall sensitivity than the population at large. Another important factor to the population density of the region is the number of tourists that it attracts. One study cites that in 1989, approximately 1.75 million tourists passed through the Okanagan region (Cannings and Durance, 1998).

Politically, the city has a very conservative history, with strong roots tied to the B.C. Social Credit party. Its current social and political tendencies are influenced by a large evangelical Christian community and population of seniors. The city itself is governed by an elected Council comprised of a Mayor and eight Councillors, each representing the city at large, rather than specific districts or wards. However, regionally, strategies related to the air shed fall under the combined jurisdiction of several municipalities, making political cooperation paramount, but cumbersome.

The natural topography and high rate of growth makes this region especially vulnerable to increasing pressure on its air quality as a result of higher economic and industrial activity. As described earlier, regional governments within the air shed, including the municipal government of the study city, have recognized this issue and are taking steps toward developing programs and policies to minimize its occurrence. Part of their strategy is to implement a transportation demand management (TDM) program. TDM involves the development of alternative transportation choices, a transit oriented transportation, and trip reduction and carpooling programs.

Procedures

The questionnaire items were administered under contract to a private sector survey firm. The appended draft (Appendix 3) was pilot tested by the contracted agency and appropriate amendments were made to ensure clarity in the questions, the length, and the statistical suitability of the measures. The final version was forwarded to the University of Alberta Health Research Ethics committee upon completion. The survey was administered by random selection of household telephone listings until a sample size of 400 residents of the study city and Electoral Area was reached. With a sample size of

400, we were able to detect proenvironmental behaviour characteristics as rare as 10% with relative standard errors of less than 20% (Dennis et al, 1997).

Inclusion criteria were applied to ensure that the sample represented a cross section of working, adult residents of the study city. Criteria are listed in Table 2 below:

Table 2

Inclusion criteria for the study

Inclusion Criteria	Rationale
≥ 18 years of age	Subjects were of the legal age of consent in Canada, thereby eliminating the need to obtain parental consent
Resident of study city	Subjects were selected from the population of potential users of the public transit system
English speaking	Subjects were able to understand spoken English as this was the language of the survey instrument

The surveyed households were randomly selected from phone numbers in telephone listings. After a brief introduction by the telephone administrator, a series of 28 questions were asked (see Appendix 3). The survey took approximately 20 minutes to complete.

Measures (See Appendix 3)

The survey items were organized into nine sections. Each section included items related to the hypotheses stated earlier. Of the 28 questions in the original survey, 9 were used as part of this study. The remaining questions were included by the local partners to serve specific needs unrelated to this study.

Subjective factors. Attitudes were measured with three items assessing the degree to which respondents rate the importance, their preference, and desire toward decreasing

automobile usage or increasing alternative transportation usage (Items 18.1 - 18.3, e.g. "I think it is important that I use my vehicle less often"). Subjective norms were measured with two items assessing the importance placed on alternative transportation by employers and friends (Items 18.4 and 18.5, e.g. "I believe that my friends think it is a good idea for people to reduce car usage"). Responsibility was measured with two items: degree of knowledge about personal impact of automobile use on the environment (hereinafter referred to as "responsibility 1"), and awareness of responsibility for causing air pollution (hereinafter referred to as "responsibility 2") (Items 18.6 and 18.7, e.g. "I acknowledge that my use of a motor vehicle has negative impacts on the community"). All subjective items were measured on 5-point Likert scales (strongly disagree –strongly agree).

Objective factors. Two items measured number of personal motor vehicles and usable bicycles in the household (Items 1 and 2). Accessibility to public transit was measured by the distance to nearest transit stop (0-5 minutes, 6-10 minutes, 11-15 minutes, more than 15 minutes, see Item 6). Finally, commuting distance was measured as the distance to the most frequently traveled destination (less than 2 km, 2-5 km, 6-10 km, more than 10 km, see Item 9).

Intentions to adopt proenvironmental behaviour. Intentions to adopt proenvironmental behaviour was measured with a series of seven items that ask about respondents' willingness to change current behaviour toward more environmentally sustainable options, including: increasing public transit use, cycling more, walking more, sharing a ride, planning trips better, rescheduling trips to off-peak hours, and ensuring vehicle maintenance (Items 19.1 – 19.7, e.g. "How willing would you be to changing

your actions in the next year to reduce the overall impact of vehicles and traffic?"). For subsequent analysis, response categories were recoded as to 1="very unwilling" to 5= "very willing".

Transportation behaviour. Use of alternative transportation over the last year was measured by the frequency of engaging in each of four types of transportation: public transit, bicycling, walking/rollerblading, and carpooling (Items 12.1 to 12.4). The response categories were "never" to "almost always". In addition, recent change in frequency of transportation use over the last year was measured for each of the four types of proenvironmental transportation (Items 13.1 to 13.4).

Support for government involvement. Support for government involvement was measured by items that ask whether government should be working towards increasing the public's use of public transit, cycling, walking/rollerblading, and carpooling (Items 16.1 – 16.4). For clarity in the reporting of frequencies, response categories were recoded as 1="No", 2="Uncertain", and 3="Yes".

Demographics. Finally, demographic information was collected from each respondent, including gender, age (response categories were "18-29", "30-39", "40-49", "50-59", "60-69", and "over 70" years), number members of the household (response categories were "one", "two", "three", "four", "five", and "six or more"), education (response categories were "elementary", "junior high", "high school", "college", "undergraduate degree", and "graduate degree"), and household income (response categories were "less than $20,000", "$20,000-$40,000", "$40,000-$60,000", "$60,000-$80,000", "$80,000-$100,000", and "over $100,000") (Items 20, 21, 22, 23, 26, and 27 respectively).

Chapter 4

Results

Description of the Sample

Table 3 provides a descriptive summary of the sample (N=400). Statistics of the study city from the 1996 Census (Statistics Canada, 1998) are also provided for comparison. The sample included 202 males (50.9%), and 195 females (49.1%); 3 respondents did not indicate gender. The largest age group was between 40 and 49 (28.7%), compared with other age groups (six respondents did not indicate age). Younger age groups (i.e. < 29 and 30-39) made up a lower proportion of the sample, suggesting that the city is an aging community. Comparison to the general population suggests a slight bias toward middle-aged respondents, with fewer older people taking part in the survey, however this remains inconclusive as the population statistics come from a data set taken four years earlier (possibly indicating a demographic shift). The over-sampling of the middle-age group may have implications for the results in that younger and older people tend to utilize different patterns of transportation due to affordability, and inability to continue driving into one's senior years. Most respondents lived in households with greater than two people, therefore representing a high proportion of families in the sample (7 respondents gave no information about household number). Indeed, almost half (46%) of the sample had children. A total of 63.9% of the respondents had a higher level of education (college or university, 15 respondents gave no information about education), which differs significantly from Census data that shows 31.2% of residents having completed higher education. This strongly suggests a bias

Table 3

Demographic Characteristics of 400 Surveyed Residents of the Study City

Variable		N	%	1996 Census %[a]
Gender (N=397)	Male	202	50.9	47.1
	Female	195	49.1	52.9
Age (N=394)	< 29	68	17.3	20.5
	30 – 39	93	23.6	19.5
	40 - 49	113	28.7	18.1
	50 – 59	54	13.7	12.6
	60 – 69	31	7.9	12.1
	>70	35	8.9	17.3
Household members (N=393)	Live alone	43	10.9	10.6[1]
	Two persons	130	33.1	54.5[2]
	Three persons	75	19.1	19.0[2]
	Four persons	93	23.7	18.3[2]
	Five or more persons	52	13.2	8.2[2]
Annual household income (N=323)	< $20,000	46	14.2	14.8
	$20,000 - $40,000	68	21.1	29.3
	$40,000 - $60,000	88	27.2	24.8
	$60,000 - $80,000	69	21.4	15.7
	$80,000 - $100,000	34	10.5	8.1
	> $100,000	18	5.6	7.2
Highest level of education (N=385)	< Grade 9	19	4.9	7.7
	High School	120	31.2	31.3[3]
	College	143	37.1	22.4[4]
	Undergraduate Degree or higher	103	26.8	8.8
Number of Children under 18 (N=400)	None	216	54.0	
	One	64	16.0	
	Two	83	20.8	
	Three	28	7.0	
	Four or more	9	2.3	

[a]Metropolitan area of study city, including sub-regions not part of inclusion criteria for this study
[1]% of size of census family out of total number of census families (20% sampling method)
[2]% of persons living alone out of total number of persons in private households (20% sampling method)
[3]Includes secondary school graduation certificate and non-completed non-university and university study
[4]Other non-university education completed

where higher educated people were less likely to decline interviewing. A total of 86.5% of the sample lived in single detached, semi-detached houses, or townhouses and the remaining in apartments or modular homes (6 respondents gave no information about housing type). A high proportion of the sample was relatively wealthy, with 37.5% earning more than $60,000 per year (77 respondents did not report income). The low number of residents living below the poverty line has important implications for public transit, as it may be considered a choice, rather than a necessity, among the rich.

Description of Outcome Measures

Use of proenvironmental modes of transportation. Rates with which the respondents used proenvironmental forms of transportation are presented in Table 4. Overall, use of proenvironmental transportation was low, with averages reporting "rare" to "no" use of 84.4% for public transit, 64.2% for bicycling, 44.3% for walking/rollerblading, and 76.7% for carpooling. This suggests that the majority of respondents used their car for their daily transportation needs. These results generally correspond to the Census data which reports that 83.9% of the labour force in the study city commutes by personal vehicle, as opposed to only 1.9% who use public transit, 4.6% who walk, 2.0% who bicycle, and 6.72% who carpool (Statistics Canada, 1998).

Overall, the four modes of alternative transportation were weakly to very weakly intercorrelated (Table 5), achieving highest correlations mainly between walking and bicycling (.31 $p < .01$) and public transit and carpooling (.25 $p<.01$), but also for public transit and walking/rollerblading (.16 $p<.01$), carpooling and bicycling (.17 $p<.01$), and walking/rollerblading and carpooling (.17 $p<.01$). The correlation between public transit and bicycling did not reach significance. The low overall intercorrelations among these

Table 4

Descriptive Statistics of Variables for Proenvironmental Transportation Behaviours: Use of Transportation in the Last 12 Months

Variable	M (SD)		N	%
Public transit (N=385)	1.57 (.99)	Never	263	68.3
		Rarely	62	16.1
		Sometimes	33	8.6
		Frequently	18	4.7
		Almost Always	9	2.3
Bicycle (N=366)	2.09 (1.11)	Never	150	41.0
		Rarely	85	23.2
		Sometimes	86	23.5
		Frequently	38	10.4
		Almost Always	7	1.9
Walking/Rollerblading (N=363)	2.58 (1.17)	Never	91	25.1
		Rarely	70	19.3
		Sometimes	113	31.1
		Frequently	78	21.5
		Almost Always	11	3.0
Carpooling (N=356)	1.72 (1.01)	Never	211	59.3
		Rarely	62	17.4
		Sometimes	55	15.4
		Frequently	26	7.3
		Almost Always	2	0.6

Note. Responses were scaled as 1=Never, 2=Rarely, 3=Sometimes, 4=Frequently, 5=Almost Always

Table 5

Intercorrelations among Variables for Proenvironmental Transportation Behaviours: Use of Transportation in the Last 12 Months

Variable	1	2	3
1. Public transit			
2. Bicycle	.01		
3. Walking/rollerblading	.16**	.31**	
4. Carpooling	.25**	.17**	.17**

Note. ** $p < 0.01$ (2-tailed), Ns varied between 351 and 366

behavioural outcomes suggest that the alternative modes of transportation do not (a) share much variance between each other, and (b) reflect a general "proenvironmental behaviour" factor, and therefore need to be separately analyzed.

Change in transportation behaviour. The degree of changes in the respondents' transportation use are presented in Table 6. For the most part, respondents indicated that their transportation patterns had not changed over the past year, with an average of only 17.1% and 24.6% reporting either a decrease or increase in proenvironmental transportation use. The majority of these respondents reported an increase (9.3% to 21.6%), with only 5.1% to 8.4% reporting a decrease.

Table 6

Descriptive Statistics of Variables for Proenvironmental Transportation Behaviours: Change in Transportation Patterns in the Last 12 Months

Variable	M (SD)		N	%
Public transit (N=346)	2.99 (.64)	Decreased Substantially	17	4.9
		Decreased Somewhat	12	3.5
		Same	285	82.4
		Increased Somewhat	22	6.4
		Increased Substantially	10	2.9
Bicycle (N=345)	3.09 (.69)	Decreased Substantially	15	4.3
		Decreased Somewhat	10	2.9
		Same	260	75.4
		Increased Somewhat	48	13.9
		Increased Substantially	12	3.5
Walking/Rollerblading (N=347)	3.17 (.71)	Decreased Substantially	10	2.9
		Decreased Somewhat	14	4.0
		Same	248	71.5
		Increased Somewhat	57	16.4
		Increased Substantially	18	5.2
Carpooling (N=332)	3.06 (.58)	Decreased Substantially	10	3.0
		Decreased Somewhat	7	2.1
		Same	275	82.8
		Increased Somewhat	32	9.6
		Increased Substantially	8	2.4

Intentions to adopt proenvironmental behaviour. Recall that a total of seven items were used to assess respondents' intentions to adopt proenvironmental transportation. Because several of these items were highly intercorrelated (r's reaching .55) a factor analysis was conducted to reduce these items to a smaller set of intention dimensions. Table 7 presents results of a principal components analysis of these items. Three factors were identified: (1) Transportation through exercise (cycling and walking), (2) Adapting vehicle use through proper planning (trip planning, scheduling peak hour trips, ensuring vehicle maintenance), and (3) Behaviour change through prosocial means (public transit and carpooling). Subscales were created to reflect these three dimensions of intention by summing the grouped variables.

Table 7

Factor Analysis of Variables for Proenvironmental Transportation Intentions

Variable	Factor		
	I Exercise	II Trip Planning	III Prosocial Transportation
Public Transit			.761
Carpooling			.686
Cycling	.881		
Walking	.853		
Planning Trips		.698	
Reschedule Peak		.613	
Vehicle Maintenance		.723	
Eigenvalue	2.12	1.37	1.02
% of total variance	22.9	22.0	19.4
Internal consistency (α)	0.71	0.48	0.43

Note. Varimax-rotated factor loadings above |.50| presented.

Support for government involvement. Opinions of respondents toward government involvement in increasing the public's use of proenvironmental forms of transportation are presented in Table 8. Overall, there is a considerable and consistent

level of support for all four types of transportation, ranging from 72.5% to 82.3% in favour of government involvement in proenvironmental strategies.

Intercorrelations among the items assessing public support for government involvement in proenvironmental transportation strategies are listed in Table 9. Overall, correlations were moderate,

Table 8

Descriptive Statistics of Variables for Support for Government Involvement in Proenvironmental Transportation

Variable	M (SD)		N	%
Public transit (N=379)	2.75 (.58)	No	28	7.4
		Uncertain	39	10.3
		Yes	312	82.3
Bicycle (N=367)	2.66 (.68)	No	43	11.7
		Uncertain	40	10.9
		Yes	284	77.4
Walking/Rollerblading (N=366)	2.57 (.74)	No	55	15.0
		Uncertain	46	12.6
		Yes	265	72.4
Carpooling (N=363)	2.59 (.71)	No	48	13.2
		Uncertain	52	14.3
		Yes	263	72.5

Note. Responses were scaled as 1=No, 2=Uncertain, 3=Yes.

Table 9

Intercorrelations among Variables for Support for Government Involvement in Proenvironmental Transportation

Variable	1	2	3
1. Public transport			
2. Bicycle	.25**		
3. Walking/rollerblading	.22**	.70**	
4. Carpooling	.40**	.39**	.40**

Note. ** $p < 0.01$ (2-tailed), Ns varied between 356 and 367

Table 10

Descriptive Statistics of Variables for Subjective Predictors of Proenvironmental Transportation Behaviours, Intentions, and Support for Government Involvement

Variable	M (SD)		N	%
Attitudes1 (N=390)	3.56 (1.02)	Strongly Disagree	12	3.1
"Important to decrease car use"		Disagree	52	13.3
		Neutral	100	25.6
		Agree	158	40.5
		Strongly Agree	68	17.4
Attitudes2 (N=386)	3.71 (.96)	Strongly Disagree	10	2.6
"Like idea of alternatives to car use"		Disagree	34	8.8
		Neutral	89	23.1
		Agree	178	46.1
		Strongly Agree	75	19.4
Attitudes3 (N=388)	3.65 (1.06)	Strongly Disagree	13	3.4
"Would like to reduce car use"		Disagree	51	13.1
		Neutral	79	20.4
		Agree	162	41.8
		Strongly Agree	83	21.4
Subjective Norms1 (N=349)	3.16 (1.09)	Strongly Disagree	32	9.2
"Employer supports alternatives"		Disagree	40	11.5
		Neutral	162	46.4
		Agree	69	19.8
		Strongly Agree	46	13.2
Subjective Norms2 (N=387)	3.58 (.88)	Strongly Disagree	6	1.6
"Friends think it's a good idea for		Disagree	30	7.8
people to reduce car usage"		Neutral	142	36.7
		Agree	153	39.5
		Strongly Agree	56	14.5
Responsibility1 (N=385)	3.84 (.73)	Strongly Disagree	1	.3
"Knowledgeable about impact of		Disagree	14	3.6
my vehicle"		Neutral	89	23.1
		Agree	221	57.4
		Strongly Agree	60	15.6
Responsibility2 (N=389)	3.71 (.97)	Strongly Disagree	11	2.8
"Acknowledge my use has negative"		Disagree	34	8.7
Impacts"		Neutral	86	22.1
		Agree	182	46.8
		Strongly Agree	76	19.5

with the exception of support for government involvement to encourage bicycling and walking which were highly correlated (.70 $p < .01$).

Description of Predictor Variables

Subjective factors. Table 10 provides a summary of the subjective factors used in the study. Overall, responses tended to lie just to the positive side of neutral, with an overall average score of 3.60 out of a possible 5, with 5 indicating strong agreement with the statement. The most common response in almost all subjective factors was 4 out of 5 indicating a general agreement with each statement, with the exception of the subjective norm variable relating to employers, of which the most common response was neutral. Thus, respondents were generally knowledgeable and felt responsible about the impact of their car use and were receptive to suggestions that they change their transportation habits. They also perceived that friends and employers support reductions in car use in commuting and in general.

Intercorrelations of subjective factors are presented in Table 11. Factor analysis of attitude variables reduced these three items to one common attitudinal score that accounts for 76% of the intercorrelation variance (Table 12). One subscale was created by summing the three attitude items. The two subjective norm items were moderately correlated (.490 $p<.01$) and were therefore summed to produce a single score ($\alpha=.84$). The two responsibility items were weakly correlated (.385 $p<.01$) and were therefore left intact.

Objective factors. Table 13 provides a summary of the objective predictors used in the study. A total of 95.2% of respondents owned at least one automobile with 32.3% owning one, 45.0% owning two, and 18.2% owning three or more. The mean number of

Table 11

Intercorrelations Among Variables for Subjective Predictors of Proenvironmental Transportation Behaviours, Intentions, and Support for Government Involvement

Variable	1	2	3	4	5	6
Attitudes						
1. Important to decrease use						
2. Like idea of alternatives	.570**					
3. Would like to reduce use	.742**	.611**				
Norms						
4. employer support	.498**	.463**	.468**			
5. friends	.519**	.499**	.542**	.490**		
Responsibility						
6. "knowledge"	.402**	.360**	.378**	.318**	.386**	
7. "awareness"	.525**	.476**	.456**	.342**	.482**	.389**

Note. ** $p < 0.01$ (2-tailed), Ns varied between 348 and 390, response categories were 1="Strongly disagree" to 5="Strongly agree"

Table 12

Factor Analysis of Variables for Proenvironmental Attitudes in Car Use

Variable	Factor I
	Attitude toward Alternative Transportation
Important to decrease use	.886
Like idea of Alternatives	.824
Would like to reduce use	.902
Eigenvalue	2.28
% of total variance	75.99
Internal consistency (α)	.84

Note. Varimax-rotated factor loadings above |.50| presented

vehicles per household was 2.84. Only 74.4% of respondents reported owning at least one bicycle, with 17.3% owning one, 25.4% owning two, and 31.7% owning three or more (two respondents did not report number of bicycles owned). The mean number of bicycles per household was 3.40. The majority of residents lived within five minutes of the nearest transit stop (56.4%), the remaining were split between 6-10 minutes (15.9%), 11-15 minutes (7.6%), and more than 15 minutes (20.1%). Finally, most respondents had a large commuting distance, with 41.1% reporting travel distance to their most frequent destination greater than 10 km, 31.6 % travelling 6-10 km, 18.2% traveling 2-5 km, and only 8.8% travelling less than 2 km.

Table 13

Descriptive Statistics of Variables for Objective Predictors of Proenvironmental Transportation Behaviours, Intentions, and Support for Government Involvement

Variable		N	%
Number of Household Vehicles (N=400)	None	19	4.8
	1	129	32.3
	2	180	45.0
	3	51	12.8
	4	13	3.3
	5	5	1.3
	>/= 6	3	0.8
Number of Household Bicycles (N=398)	None	102	25.6
	1	69	17.3
	2	101	25.4
	3	58	14.6
	4	42	10.6
	>/= 5	26	6.5
Time to Nearest Transit Stop (N=353)	0-5 minutes	199	56.4
	6-10 minutes	56	15.9
	11-15 minutes	27	7.6
	> 15 minutes	71	20.1
Distance to most frequent destination (N=396)	< 2 km	35	8.8
	2-5 km	72	18.2
	6-10 km	125	31.6
	> 10 km	164	41.4

Correlations among objective predictors were low (see Table 14). Number of insured vehicles and useable bicycles were most highly intercorrelated ($r = .32$, $p < .01$). Other relationships included number of insured vehicles and distance to most frequent destination ($r=.21$, $p < .01$) (possibly related to people the typical urban pattern of higher income brackets residing in suburbs further removed from the economic centre of the city), and time to transit stop and distance to most frequent destination ($r = .32$, $p < .01$), suggesting that suburbs have more dispersed bus stops.

Table 14

Intercorrelations among Variables for Objective Predictors of Proenvironmental Transportation Behaviours, Intentions, and Support for Government Involvement

Variable	1	2	3
1. Number of Household Vehicles			
2. Number of Household Bicycles	.32**		
3. Time to Nearest Transit Stop	.10	.04	
4. Distance to most frequent destination	.21**	.05	.32**

Note. ** $p < 0.01$ (2-tailed), Ns varied between 353 and 398

Hypothesis Testing

Hypothesis 1. Recall that hypothesis 1 predicts a positive relationship between intentions to adopt proenvironmental modes of transportation, and behavioural outcomes. Intention items (i.e. the 3 scales identified in the factor analysis of the proenvironmental intention items) were regressed onto each of the behavioural items, and the results are presented in Table 15. In all cases, predictions were consistent with expectations, as each of the four proenvironmental behaviours were reliably predicted by its corresponding intention scale. For example, use of public transit and carpooling were each predicted by

intentions to use prosocial transportation and inversely associated with engaging in trip planning with one's own car (public transit $\Delta R^2 = .11$, $F(3, 351) = 13.73$; carpooling $\Delta R^2 = .09$, $F(3, 332) = 10.58$; all p's $< .001$). Similarly, bicycling and walking/rollerblading were each predicted by intentions to use exercise-mediated forms of transportation (bicycling: $\Delta R^2 = .17$, $F(3, 339) = 22.60$; walking/rollerblading: $\Delta R^2 = .09$, $F(3, 335) = 11.00$; all p's $< .001$).

Inspection of the beta weights further clarify the relationships between proenvironmental intentions and behaviour. For use of public transit, intentions to plan around one's vehicle use was inversely related to public transit use ($\beta = -.22$, $p < .001$), whereas intentions to adopt prosocial means of transportation (i.e. carpooling and public transit) were positively related to public transit use ($\beta = .29$, $p < .001$). For exercise-mediated modes of transportation (i.e. bicycling and walking/rollerblading), the corresponding exercise intention items were positively related ($\beta = .42$ and $\beta = .26$ respectively, $p < .001$). It should be noted that the exercise intention scale predicts bicycling by nearly double that of walking/rollerblading.

The Theory of Reasoned Action. Given that proenvironmental intentions predicted transportation behaviour, the next step in the analysis examined subjective predictors of intentions using variables from the Theory of Reasoned Action. To accomplish this, each of the three intention variables was regressed onto the attitude, subjective norm and responsibility scales after controlling for the sociodemographic variables. As shown in Table 16, all three proenvironmental intentions were predicted by subjective factors (exercise: $\Delta R^2 = .12$, $F(5, 267) = 8.11$; trip planning: $\Delta R^2 = .09$, $F(5, 267) = 5.34$; prosocial: $\Delta R^2 = .32$, $F(5, 265) = 26.19$; all p's $< .001$). In each regression,

Table 15

Multiple Regression of Proenvironmental Intentions on Transportation Behaviour: Use of Transportation in the Last 12 Months

	Public Transit			Bicycling			Walking/Rlblading			Carpooling		
Intention	ΔR^2	F	β	ΔR^2	F	β	ΔR^2	F	β	ΔR^2	F	β
All	.11	13.73***		.17	22.60***		.09	11.00***		.09	10.58***	
Variables												
Exercise			-.02			.42***			.26***			.07
Planning			-.22***			.02			.00			-.11*
Prosocial			.29***			-.06			.08			.27***

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

Table 16

Multiple Regression of Subjective Predictors of Attitudes, Subjective Norms, and Responsibility on Proenvironmental Transportation Intentions: The Theory of Reasoned Action.

	Exercise Intention			Planning Intention			Prosocial Intention		
	ΔR^2	F	β	ΔR^2	F	β	ΔR^2	F	β
Step 1: Demographics	.08	4.57**		.04	2.27		.02	1.19	
Gender			-.02						
Age			-.27***						
# Residents			-.08						
Education			.01						
Income			.06						
Step 2: Subjective Factors	.12	8.11***		.09	5.34***		.32	26.19***	
Attitudes			.36***			.22**			.59***
SubjNorm1			-.08			.02			-.08
SubjNorm2			.06			-.01			.07
Resp1			-.14*			.05			-.19**
Resp2			.07			.08			.09

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

the combined attitude scale strongly predicted proenvironmental intentions (exercise: β = .36, $p < .001$; trip planning: β = .22, $p < .01$; prosocial: β = .59, $p < .001$). Interestingly, the subjective norms scales were not significant predictors of intentions in any case. Finally, one of the responsibility scales ("responsibility 1") predicted proenvironmental intentions in the opposite direction than expected, reaching significance for exercise and prosocial intentions (β = -.14, $p < .05$; β = -.19, $p < .01$), but not for trip planning. Thus, these results show that it is attitude that contributes the most to subjective decision-making in the formation of proenvironmental intentions, with responsibility contributing only to those intentions that related to non-automobile types of transportation.

Hypotheses 2 and 3. Hierarchical multiple regression analysis was also used to test the relative impact of subjective and objective factors on proenvironmental transportation behaviour. Because correlations among the proenvironmental behaviour items were low, separate regressions were run for public transit, bicycling, walking/rollerblading, and carpooling. To more fully assess the potential of personal and social factors as predictors of proenvironmental transportation behaviour, sociodemographic (gender, age, number of household residents, education, income) scales were included in the first step. On the second step, all subjective factors were included (total scores on the three attitude scales, total scores on the two subjective norms scales, the two proenvironmental responsibility scales, and intentions to increase exercise-related modes of transportation, intentions to engage in better trip planning, and intentions to use prosocial modes of transportation). In the third step, objective factors were regressed onto the outcome behaviours (number of vehicles, number of bicycles, time to public transit stop, distance to most common destination). This procedure

evaluates the impact of objective factors on proenvironmental transportation after controlling for demographics, attitudes, norms, responsibility, and intentions. It is a conservative test of the idea that objective factors in the environment either facilitate or inhibit proenvironmental transportation, over and above the impact of subjective factors. Results of these analyses are displayed in Table 17.

Results from the multiple regression indicate that demographic variables do significantly predict the respondents' use of public transit ($\Delta R^2 = .05$, $F(5, 217) = 2.33$, $p<.05$) and bicycling ($\Delta R^2 = .09$, $F(5, 214) = 4.37$, $p<.01$), but do not predict walking/rollerblading and carpooling. Inspection of the beta weights show that income is inversely related to public transit use ($\beta = -.19$, $p<.01$) and walking/rollerblading ($\beta = -.17$, $p<.05$). Also, gender and age were inversely related to bicycle use ($\beta=-.14$, $p<.05$ and $\beta=.20$, $p<.01$ respectively) thus indicating that younger males are most likely to use their bicycles often. Finally, results show that females are more likely to carpool ($\beta=-.18$, $p<.05$). Consistent with hypothesis 2, subjective factors predicted proenvironmental behaviours across all four modes of transportation, (public transit: $\Delta R^2 = .16$, $F(7, 210) = 5.97$, $p < .01$; bicycling: $\Delta R^2 = .15$, $F(7, 207) = 5.97$; walking/rollerblading: $\Delta R^2 = .15$, $F(7, 204) = 5.53$; carpooling: $\Delta R^2 = .10$, $F(7, 202) = 3.29$; all p's $< .01$). Inspection of the beta weights across all four modes of transportation show little consistency among the subjective factors. As expected, intentions to use prosocial transportation were positively associated with public transit behaviour ($\beta=.31$, $p<.001$), indicating that people with higher intentions toward prosocial transportation are more likely to have used public transit in the past year. In addition, intentions to engage in trip planning ($\beta=-.22$, $p<.01$) was inversely associated with public transit use, suggesting that

Table 17

Multiple Regression of Sociodemographic, Subjective, and Objective Variables on Proenvironmental Transportation Behaviour: Use of Transportation in the Last 12 Months

	Public Transit			Bicycling			Walking/Rlblading			Carpooling		
	ΔR^2	F	β	ΔR^2	F	β	ΔR^2	F	β	ΔR^2	F	β
Step 1: Demo	.051	2.328*		.093	4.373**		.032	1.403		.049	2.157	
Gender[1]			.022			-.144*			.020			.183**
Age			-.087			-.197**			-.010			-.075
# Residents			-.032			.035			-.019			.032
Education			-.034			.104			.090			-.008
Income			-.188**			.080			-.166*			.115
Step 2: Subj	.158	5.974**		.152	5.968**		.154	5.532**		.097	3.285**	
Attitudes			.005			.137			.021			-.011
Norms			.118			-.021			-.062			-.049
Resp1			-.018			.079			-.054			-.104
Resp2			-.193*			.047			-.087			-.019
Exercise			-.055			.369***			.373***			-.031
Planning			-.220**			-.039			-.043			-.070
Prosocial			.308***			-.212**			.115			.313***
Step 3: Obj	.048	3.314*		.093	7.134**		.077	5.227**		.013	.758	
# Vehicles			-.168*			-.059			-.117			-.019
# Bicycles			-.035			.408***			.051			.108
Time to bus			-.182**			.077			-.121			-.099
Distance			.059			.046			-.205**			.026

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. [1]Gender coded as 1 = Male, 2 = Female

people who are willing to adapt their vehicle use patterns do so instead of taking the bus.

Again, proenvironmental responsibility ("awareness" only; β=-.19, $p<.05$) was inversely associated with public transit use. This result seems surprising, as it seems to be the case that higher sense of environmental responsibility have a negative impact on public transit use. However, on closer inspection of the variables, we can see that the responsibility items include elements of personal vehicle usage within them. That is, the responsibility scale pertains to the knowledge and awareness of the impact of one's personal vehicle. Analysis of carpooling behaviour shows a positive association with intentions to use prosocial modes of transportation (β=.31, $p<.001$). Analysis of bicycling behaviour indicates that intentions to use exercise-mediated transportation are most related to this outcome behaviour (β=.37, $p<.001$), and that intentions to use prosocial transportation were inversely related (β=-.21, $p<.01$). Finally, analysis of walking/rollerblading behaviour indicates that only intentions to use exercise-mediated transportation were related to this outcome behaviour (β=.37, $p<.001$).

Examination of the objective factors leading to proenvironmental transportation behaviour demonstrates support for Hypothesis 3 for use of public transit ($\Delta R^2 = .05$, $F(4, 206) = 3.31$, $p<.05$), bicycling($\Delta R^2 = .09$, $F(4, 203) = 7.13$, $p<.01$), and walking/rollerblading ($\Delta R^2 = .08$, $F(4, 200) = 5.23$, $p<.01$), but not for carpooling. Inspection of beta weights showed distance from the nearest public transit stop and the number of household vehicles owned were both inversely related to public transit use ($\beta = -.18$, $p < .01$; $\beta = -.17$, $p < .05$ respectively), that the number of bicycles owned was positively related to bicycle use ($\beta = .41$, $p < .001$), and that distance to the most frequent destination was inversely related to walking/rollerblading ($\beta = -.21$, $p < .01$).

In order to shed more light on the determinants of behaviour change towards increased proenvironmental transportation use, a sub-sample including only respondents who reported either a recent (i.e. over the past year) increase or decrease in each mode of transportation were analyzed by stepwise logistic regression (see Table 18). The dependent variable that measures the behaviour change was recoded as YES. YES equals 1 if the respondent reported a somewhat or substantially increased use over the past twelve months and NO equals 0 if the responded reported a somewhat or substantially decreased use over the same period. In general, the results are largely consistent with the multiple regression analysis on transportation use, however, some significant unique contributions to behaviour change should be noted. First, the logistic regression eliminates any of the associations between sociodemographic and objective factors with the dependent variable. Although this may be attributable to the lower N's associated with this analysis (N = 196 to 202), this cannot be confirmed. An alternative explanation may be that behaviour change is entirely dictated by subjective factors and that objective factors such as number of household vehicles are in fact outcomes of transportation behaviour.

Three other outcomes of the logistic regression point to additional contributions of subjective factors toward proenvironmental transportation use in public transit (χ^2 = 19.50, $p < .01$), walking/rollerblading ((χ^2 = 13.02, $p < .01$), and carpooling (χ^2 = 16.01, $p < .05$). Inspection of the Wald statistics reveals several relationships. First, increased public transit use in the last 12 months was associated with a 31% lower score on the proenvironmental attitudes scale (Wald = 4.60, $p < .05$, Odds Ratio = .69). Although this seems contradictory to expectations, closer examination of two of the attitude scales

Table 18

Logistic Regressions of Sociodemographic, Subjective, and Objective Variables on Proenvironmental Transportation Behaviour: Change in Transportation Patterns in the Last 12 Months

	Public Transit			Bicycle
	χ^2	Wald	Odds	χ^2
Step 1:Demographics	7.23			6.56
Step 2:Subjective Factors	19.50**			13.02
Attitudes		4.60*	.69 (.50-.97)	
Norms		3.38		
Resp1		.97		
Resp2		.05		
Exercise		2.56		
Planning		3.98*	.73 (.51-1.00)	
Prosocial		6.19*	1.5 (1.09-2.09)	
Step 3:Objective Factors	4.83			9.49

	Walking/Rollerblading			Carpooling		
	χ^2	Wald	Odds	χ^2	Wald	Odds
Step 1:Demographics	12.80			14.50		
Step 2:Subjective Factors	28.65***			16.01*		
Attitudes		.01				
Norms		10.23**	.63 (.47-.83)			
Resp1		.25				
Resp2		1.48				
Exercise		11.74**	1.45 (1.17-1.80)			
Planning		.93				
Prosocial		.75			5.56*	1.48 (1.07-2.04)
Step 3:Objective Factors	7.84			1.64		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$.

suggests that they may have been perceived as irrelevant to respondents. In other words, when asked if it was important or if they would like to reduce car usage, respondents would have answered negatively since they had already done so. Second, increased walking and rollerblading was associated with a 37% lower score on the subjective norms scale (Wald = 10.23, $p < .01$, Odds Ratio = .63), suggesting that these respondents felt that they had accomplished this behaviour on their own, rather than by pressure from friends or employers. Not surprisingly, and consistent with results from the multiple regression analysis, respondents who had increased their proenvironmental transportation behaviour also reported higher scores on the corresponding intention scales. Those who increased: (1) walking and rollerblading reported 45% higher on the intention to exercise scale (Wald = 11.74, $p < .01$, Odds Ratio 1.45), and likewise, those who increased public transit and carpooling reported 50% (Wald = 6.19, $p < .05$, Odds Ratio = 1.5) and 48% (Wald = 5.56, $p < .05$, Odds Ratio = 1.48) higher prosocial intentions respectively. One result not obtained in the multiple regression analysis was that respondents who had increased their use in public transit reported 27% lower scores in planning around vehicle use (Wald = 3.98, $p < .05$, Odds Ratio = .73), which generally implies that those who recently increased public transit use felt that they could "leave their vehicles behind" and not be so concerned with off-peak hour driving, maintenance, or trip scheduling. Finally, the logistic regression showed no significant contribution of any variable toward increased bicycle use.

Hypothesis 4. A stepwise logistic regression was conducted to assess respondents' support for proenvironmental government involvement (Table 19). Recall that, similar to the predictions of Hypotheses 2 and 3, Hypothesis 4 predicts that

Table 19

Logistic Regression of Sociodemographic, Subjective, and Objective Variables on Public Transit and Bicycling Support for Government Involvement

	Public Transit			Bicycling		
	χ^2	Wald	Odds	χ^2	Wald	Odds
Step 1:Demographics	11.16			5.82		
Step 2:Subjective factors	16.45*			53.86***		
Attitudes		3.92*	1.41 (1.00-1.97)		4.11*	1.42 (1.01-2.00)
Norms		2.06			.00	
Resp1		1.29			.72	
Resp2		.04			.30	
Exercise		.79			13.81***	2.04 (1.40-2.97)
Planning		1.10			4.77*	1.39 (1.04-1.88)
Prosocial		.57				
Step 3:Objective factors	3.60			2.02		

	Walking/Rollerblading			Carpooling		
	χ^2	Wald	Odds	χ^2	Wald	Odds
Step 1:Demographics	5.82			9.61		
Step 2:Subjective factors	40.92***			20.86**		
Attitudes		2.64			.00	
Norms		.39			7.02**	1.65 (1.14-2.39)
Resp1		.16			.15	
Resp2		.85			.01	
Exercise		7.30**	1.41 (1.10-1.81)		3.36	
Planning		3.09			.85	
Prosocial		.02			.38	
Step 3:Objective factors	7.71			5.06		

Note. * $p < .05$, ** $p < .01$, *** $p < .001$. Response categories recoded as No=0, Yes=1, "Uncertain" category excluded

subjective and objective factors will each predict support for government involvement in relation to the four modes of proenvironmental transportation. The dependent variable that measures support for government involvement was recoded as YES. YES is equal to 1 if the respondent supports government involvement. Those who responded as "uncertain" were excluded from the analysis. Sociodemographic variables entered in step 1 showed no significant relationship between support for government involvement and gender, age, number of household members, education, or income. In step 2, subjective factors showed consistent relationships to the support for government involvement across all four modes of transportation (public transit: $\chi^2 = 16.45$, $p < .05$; bicycling: $\chi^2 = 53.86$, $p < .001$; walking/rollerblading: $\chi^2 = 40.92$, $p < .001$; carpooling: $\chi^2 = 20.86$, $p<.01$). Inspection of the Wald statistics showed that different combinations of subjective factors predict support for each type of government involvement. Support for government involvement in public transit was predicted exclusively by respondents' attitudes toward the negative environmental impacts of car usage (Wald = 3.92, $p < .05$, Odds Ratio = 1.41). In contrast, support for carpooling (the other "prosocial" mode of transportation) was predicted by higher scores on subjective norms)Wald = 7.02, $p < .01$). Both exercise-mediated forms of transportation (bicycling and walking/rollerblading) were predicted to the greatest extent by respondents' intentions to exercise (Bicycling: Wald = 13.81, $p < .001$, Odds Ratio = 2.04; Walking: Wald = 7.30, $p < .01$, Odds Ratio = 1.41), however, bicycling was also predicted by both attitudes (Wald = 4.11, $p < .05$, Odds Ratio = 1.42) and intentions to engage in trip planning in one's car (Wald = 4.77, $p < .05$, Odds Ratio = 1.39). These results suggest that bicycling may be considered as an alternative to car usage in commuting situations. Objective

factors did not predict support for government involvement in proenvironmental transportation in any form.

Chapter 5

Discussion

Since 1990, public transit usage in Canada has decreased 13 %, while at the same time there has been a steady increase in light duty vehicles, both in number (9% between 1990 and 1995) and average distance traveled (6%) (Pucher, 1998). This trend runs contrary to the efforts of urban transportation planners to encourage a modal shift among the public toward more environmentally-friendly modes of transportation. The goal of this study was to provide insights about the complex interplay of factors involved in a population's proenvironmental decision-making processes. Specifically, I examined decisions related to the use of less polluting forms of transportation. The study looked at both individual behaviour change and individuals' support for government involvement in proenvironmental transportation. It sought to identify the impact of subjective, objective, and sociodemographic factors on decisions to use proenvironmental modes of transportation and support government involvement to encourage higher rates of proenvironmental transportation usage. It was proposed that transportation behaviours and support for proenvironmental involvement reflect both subjective factors (attitudes, subjective norms, responsibility, behavioural intentions) and objective factors (distance, accessibility, automobile/bicycle ownership, and sociodemographics). On the subjective side, the study incorporated Ajzen and Fishbein's (1985) Theory of Reasoned Action as a baseline model to predict these outcomes. Attitudes toward the environment, subjective norms, and sense of personal responsibility were measured for their ability to predict proenvironmental intentions, behaviour, and government strategy support.

This study also expanded the scope of prediction by determining whether a series of objective environmental factors accounted for unique variance in proenvironmental behaviour and support for government involvement, after taking into account the impact of demographics and subjective factors. With regard to proenvironmental transportation behaviour, it was hypothesized that these objective factors stem from the impact of geographical constraints inherent in city planning, as well as on transportation habits and reliance on the car that is engrained into Canadian culture. The inclusion of objective factors in environmental behaviour was also supported by emerging evidence in the environmental psychology literature (Frey, 1988; Tanner, 1999).

Hypotheses

Hypothesis 1. The first step in the analysis confirmed that intentions to adopt proenvironmental behaviour predicted the actual use of proenvironmental transportation in the sample. Proenvironmental intentions consistently predicted transportation use, accounting for 9% to 17% of the observed variance in each proenvironmental behaviour. Although the direction of these associations are consistent with theory, their slightly lower magnitude relative to results of 19% to 38% typically seen in the literature on TRA (Sutton, 1998) suggests either methodological limitation (see below) or that proenvironmental intentions may be inhibited by an unidentified intervening variable. In other words, if people state that they are willing to increase the amount that they take the bus, bicycle, walk, or carpool, but there is no corresponding action, then additional barriers must exist that prevents the adoption of the intended behaviour. In other words, there is little volitional control over these types of behaviour.

Theory of Reasoned Action. Attitudes, subjective norms, and sense of responsibility were shown to predict between 9% and 32% of behavioural intentions. These results are well below the values of 40% to 50% typically achieved in other TRA studies (Sutton, 1998). Additionally, subjective norms failed to contribute to intentions in all three behavioural domains. This suggests that proenvironmental behaviour is generally not subject to external pressures placed on an individual's decision-making, but rather, is internally constructed, as evidenced by the contribution of sense of responsibility found in the results.

Hypotheses 2 and 3. Testing the effects of subjective (Hypothesis 2) and objective (Hypothesis 3) factors on proenvironmental transportation behaviour yielded mixed results among the four types of transportation. Analyses were conducted in such a way as to control for the effects of sociodemographics and subjective factors in a stepwise manner, allowing for analysis of the effects of each step on the dependent variable. In this regard, sociodemographics accounted for 3% to 9% of variance in transportation behaviour.

After controlling for sociodemographics, analysis of subjective factors accounted for 15% to 16% of the variance in transportation behaviour in public transit, bicycling, and walking, but not carpooling, which yielded slightly lower results at 10%. In almost all instances, these effects were limited to proenvironmental intentions, with the exception of public transit, which was explained in part by a sense of responsibility toward an awareness of the negative impact of one's own vehicle use on the community. That the remaining subjective factors failed to reach significance suggests two things. First, in line with TRA, behavioural intentions is a better predictor than other subjective

factors, as it is a more proximal predictor of behaviour, therefore yielding more easily detectable results than the more theoretically distal subjective factors. Related to this, a second possibility may be a sampling limitation, in both size, and more importantly the heterogeneity of the sample in terms of transportation patterns. Possible solutions to this would involve a modification in sampling method, and are discussed below. Further resolution of these relationships was attempted through logistic regression analysis of respondents who had changed their proenvironmental behaviours significantly in the past 12 months. Although largely consistent with the multiple regression, results support the inclusion of proenvironmental attitudes as predictors of recent behaviour change in public transit and subjective norms as predictors of recent behaviour change in walking/rollerblading. This trend toward significance of these more distal subjective factors thus provides more certainty to the relationships posited by the TRA.

In terms of their ability to predict behaviour, objective factors accounted for a 5% to 9% improvement in explained variance across three of the four modes of transportation after controlling for sociodemographics and subjective factors. Concerning the geographic variables, results show that longer distance from the nearest bus stop is associated with lower use of public transit, and that longer commuting distances are associated with fewer people walking or rollerblading as a viable means of transportation. With regard to the personal ownership variables, results indicate that the more vehicles a person has in their household, the less likely they are to take the bus, and that owning more bicycles in the household is associated with bicycling as a preferred means of transportation. In terms of the logistic regression of recent behaviour change, no further

evidence was found among the sociodemographic or objective factors, probably due to the smaller sample sizes achieved in the data collection.

Hypothesis 4. With regard to support for government involvement in transportation, results from a logistic regression measuring support as YES or NO suggest that subjective factors played an exclusive role in their association with personal opinions (however, the lack of influence of sociodemographic and objective factors on support for government involvement cannot be entirely ruled out, as it may again be due to the smaller sample sizes obtained). It should be noted that the strongest support for government involvement was in the area of bicycling. This suggests that bicycling in the study city is the most underutilized, yet viable form of proenvironmental transportation, and that given a more pro-active government involvement in supporting bicycling infrastructure, more people would be willing to switch to bicycling use over vehicles. The following vignette was provided to the author courtesy of a member of his committee who resides in the study city. It highlights the difficulties that he encounters when faced with commuting by bicycle in the study city.

Vignette

I take my bike to main work and to other areas of town when I have meetings. The trip from home is 14-16 km and takes 45-65 minutes by bike depending on the weather which dictates the route and rate of travel. I have the option to take bike to bus part way, then ride downtown but, with all things considered, it is usually easier just to take bike all the way. Overall, I do about 2500 km commuting per year

If I didn't bike to work, I would have to buy a third vehicle if he didn't use bike. Several times I've come pretty close to doing this, but creative thought, flexibility and assistance from others has helped out. The big advantage is the major cost savings of bike use, because I don't have to buy a third car. My work schedule is too erratic for carpooling, I feel that the bus is too inconvenient, and I live too far from work to walk. I believe in active living and need to exercise to keep my weight down. As well, I am doing my part to improve air quality, so need to "walk/ride my talk"! IT helps that there is a shower facility at work and that most people accept my bike wear as normal now--it took

over a year, though! I am the sort that doesn't care a lot about what other people think about apparel, and I can get away with that in many (but not all) cases because of my credential, my work, humour, etc. Finally, I see advantages to riding time – I do significant problem solving while on route, I can debrief myself in the afternoon which lets me unload from the day so I can be fully present with kids. Some things that prevent me from biking include the weather – rain makes it pretty messy at times. Also, I'm usually somewhat messy when I arrive to meetings, and some meeting mates still don't accept bike wear. I try doing creative alternative and packing wrinkle resistant clothes, but with the computer in backpack too, it is tough to have the right clothes at the right place.

Results indicate that support was mediated by different combinations of subjective factors, depending on which type of transportation was concerned. For example, attitudes played a significant role in support for both public transit and bicycling, showing a 40% higher score on attitudes among those who support government involvement versus those who do not, but had no effect on support for walking/rollerblading or carpooling. This suggests that public transit and bicycling may be considered as satisfactory alternatives to those who realize that their vehicle use has adverse environmental effects. It could be argued that neither walking nor carpooling was seen as viable, possibly due to a perceived inappropriateness of walking as a form of commuting, or to carpooling as an ineffective replacement for personal car use with regard to reducing effects on the environment. To build on this argument, the results show that those who support government involvement involving bicycling also showed a corresponding 40% higher intention to plan their trips more.

Also of note is that intentions to commute via exercise-mediated transportation played a very significant role in determining support for government involvement in bicycling and walking/rollerblading as a means of transportation, showing a 40% higher association with walking intentions and 100% higher value in bicycling intentions. This

could mean that those who were willing to bicycle or walk saw a necessary role of government in facilitating a means to do so. In contrast, public transit may have been considered as "fine the way it is" and government involvement was perceived as irrelevant to respondent's intentions to carpool. Finally, subjective norms were a major factor associated with support for government involvement in strategies related to carpooling. Those who were strongly influenced by the opinions of their employers and friends with regard to finding alternatives to car use were 65% more likely to support government involvement toward carpooling. This implies that people believe if their friends and employers favour reductions in car use, they may be willing to "tow-the-party line" even if their personal willingness is low.

Overall, the results of this study have shown that both individual (subjective) and structural (objective) factors, as well as certain sociodemographic factors affect proenvironmental transportation, and may lead to potential recommendations for transportation planners.

Limitations of the Study

Methodology. It is important to give some attention to the cross-sectional nature of this study. Of main concern is the effect that this has on the ability to accurately assess the relationships between the various subjective factors and their influence on behaviour. For example, Sutton (1998) notes that for maximal prediction of the measurement, intentions should be measured at a point in time just prior to the observation of the behaviour. Because it was not feasible to do this in this study, we were forced to measure these two items concurrently, thus not allowing time for people who may have high intentions to take action on them. In addition, results obtained of attitudes, subjective

norms, and responsibility may in fact be outcomes of behavioural change, rather than predisposing factors. Thus, although the present results reveal several interesting *associations* between subjective factors and behaviour, they are limited in their actual *predictive* ability, and only suggest possible predictive patterns among the study variables.

Sampling. The sampling method was a major obstacle in this study. Ideally, researchers of transportation and behaviour access a relatively homogeneous sample of people who commute by personal vehicle in order to gauge future intentions to adopt other modes of transportation. This allows for a broad array of intention levels to be evaluated against factors that are predicted to influence them, thereby facilitating stronger associations. In this study, because of budgetary and time limitations, the approach used was a household telephone survey which, while producing a relatively cheap and unbiased sample of respondents, does not serve to isolate the target respondent, namely the commuter. The resulting heterogeneity in the sample may have led to a loss in ability to detect the more subtle influences on behaviour. On the positive side however, this heterogeneous sample did allow us to draw comparisons across a wide spectrum of behaviours, albeit with limited results. A larger sample size may have provided a clearer picture of the more subtle influences of factors leading to proenvironmental transportation. Alternatively, a more rigorous selection procedure might have been adopted to isolate the target group (i.e. single-passenger vehicle commuters). This has been accomplished in other studies by sampling transportation association members, or by administering questionnaires at major stops (i.e. gas stations) on commuter routes (Tanner, 1999; Van Lange, *et al*, 1998).

Another concern relates to the representativeness of the sample. Outsourcing of the survey made it difficult to access information about the sampling procedure, thus the study lacks in its ability to analyze the potential impacts of refusal rates as a source of potential bias in the findings. The sample tended toward middle-aged respondents, which although making claims of representativeness to the entire population difficult, does suggest a broader interest among the segment of the population that is more likely to be in the workforce and more prone to commute. Also, it was not possible to obtain some specific information about the data collection, including the total number of respondents called before the sample size of 400 was reached and the refusal rate. This makes it particularly difficult to accurately assess the validity of the results.

Measures. The most limiting aspect to the study design was the inability of the researcher to achieve final control of questionnaire content. Due in part to impending deadlines and to the difficulties in doing research at a long geographical distance (see below), there was no collaboration in the piloting and subsequent revising of the questionnaire. One representative example of the manifestation of this problem was in the anomalous results of the "responsibility" items. The results suggest that as sense of responsibility toward environmental pollution and community impact increased, proenvironmental transportation usage decreased. A more logical result may have been obtained by rewording the questions to eliminate the use of "my vehicle" and "my use" which may have mislead those do not own or use vehicles to respond with an answer suggesting that they do not feel responsible. If these questions had been restated in generic hypothetical terms (i.e. "if I were an average driver..."), then sense of responsibility may have been more in line with proenvironmental behaviour.

Another problem encountered in the analysis was the low association of subjective factors with proenvironmental intentions and behaviours. This may have been due in part by the fact that several of the scales used were incongruent with the dependent variables. For example, two of the three attitude items, one of the two subjective norm items, and both of the responsibility items dealt exclusively with "reduction in car use", while most of the intention items and all of the dependent variables contained no reference to car usage at all. There may be a perceptual difference to the individual in car reduction behaviour versus using public transit, bicycling, walking or carpooling.

Other limitations. This study focused exclusively on individual perceptions of environmental impacts in transportation decision-making. Certainly, there are other factors that may influence a persons' decision-making to use the modes of transportation examined here. Indeed, many of these factors have been studied and found to be significant contributors to decision-making, including cost, comfort, active lifestyle, to name but a few (see Go For Green, 1998). The decision to limit the present analysis to environmental variables was two-fold. First, budgetary constraints prevented an exhaustive questionnaire, due to the high expense of administering a telephone survey. Second, and more importantly, the purpose of this study was not to attempt to account for complete variance in transportation behaviour, but to determine the relative *extent* to which perceptions of environmental impacts influence individual decision-making and to demonstrate that environmental concern is a common underlying theme across very divergent behaviours, thereby directing planners toward a common target on which to aim transportation strategies. The study was fundamentally targeted at answering the question, "Do people interpret alternative modes of transportation to their personal

vehicles as an environmental issue". The results have demonstrated that the answer is a qualified "Yes".

Regarding research at a distance, a few comments are warranted that may serve to overcome communication difficulties inherent in the spatial separation of researcher and study site. The main problem encountered in this study was the incompatible timelines of researcher and local stakeholders. The onset of collaboration did not take place far enough in advance for this author to contribute to the pre-planning stages of the survey and thus negotiate a timeline that served mutual needs. As it was, this thesis was completed on a part-time basis over the course of several months, whereas local planners had only a few months to proceed with, analyze, and report their findings of the survey to stakeholders. A related problem that is inherent in part-time work was the difficulty in maintaining regular communication with local partners. This could be overcome by ensuring mutual awareness of each others' time constraints, as well as committing to regular contact and reporting of progress, for example, on a biweekly basis. One possible means of ensuring that collaboration at a distance can be mutually productive and beneficial would be to draw up a memorandum of understanding early in negotiations to ensure that all parties are aware of each others' intentions, timelines, and contributions to the project. Part of this might involve drafting a project management "critical path" that would include important dates and deadlines for essential matters, checkpoints for re-affirming mutual commitments, and individual roles and responsibilities to the project. In addition, finding opportunities for face-to-face contact between researcher and the community would be very beneficial to the process. This would require actively seeking out additional funds to support transportation, accommodation, and other expenses. In

this project, only one brief trip by the researcher was possible (as it coincided with a vacation taken by the researcher). It is often too easy for the researcher to become caught up in his or her own analysis without involving the community partners throughout the research process. This could be overcome with a commitment to regular conversation to establish stronger working relationships and commitment to each other's goals.

Conclusions and Recommendations

Recalling Brown's (1991) conceptualization of health promotion, the findings of this study have implications for policies toward directly changing personal behaviours, changing environmental influences on personal behaviours, and changing environmental conditions that directly influence health status. Social norms in Canada that have led to an over-reliance on cars, on sprawling urban landscapes, and inadequate funding to provide effective transportation alternatives have contributed to a now pressing environmental and human health issue in communities across the country. Effective solutions to the problem of increasing urban air pollution caused by vehicle emissions can only be achieved through careful attention to the factors contributing to these three levels of change.

At the first level, this study has shed light onto the "black box" of behaviour change in proenvironmental transportation through successful use of the Theory of Reasoned Action to understand this particular behaviour. Typically, strategies that target changing transportation patterns are outcome-oriented (i.e. "Save the environment, Take the bus!") and do not reflect a thorough understanding of the complexity of behaviour change. For example, a recent report by the David Suzuki Foundation and Pembina Institute call for (Hornung, 1998) call for billions of dollars in federal monies toward

improving the "attractiveness, frequency, and convenience of transit services", building bicycle routes and commuter ride matching services, and creating tax subsidies for employees who are public transit users. However, these broad proposals for infrastructure and policy changes make no mention of the predisposing attitudes and intentions of people and the personal barriers they experience in their lives. This failure to create a modal shift in Canadians is clear by statistics of the 1996 Census that indicate that 73% of the workforce commute by personal vehicle, while only 10% used public transit, 7% carpooled, 7% walked, and 1% bicycled (Statistics Canada, 1996). In order to change these numbers, proenvironmental transportation advocates and planners need to address the underlying mechanisms by which people change their behaviour. This study has revealed several of these mechanisms that contribute to behaviour change in individuals, thus providing transportation planners with a more accurate set of assumptions on which to build their strategies. Although the "brick and mortar" approach outlined by the David Suzuki Foundation may be necessary in terms of an identified need in proenvironmental transportation infrastructure, people must also be convinced that their personal contribution to environmental pollution matters, and that each individual is morally accountable for his or her actions.

This study has also identified geographic and personal ownership-related objective factors as an integral part of the decision-making process in adopting proenvironmental transportation choices. While subjective factors were shown to be the predominant influence on individual decision-making, a more comprehensive understanding of the psychological processes of behaviour change can only be achieved by placing the individual into the structural context in which he/she lives. Results of this

study confirm that environmental influences such as distance, accessibility, and number of cars and bicycles are all related to the decision to adopt new transportation behaviours.

Finally, where the environment has direct impacts on human health, this study has given governments the mandate to take action. Indeed, results show broad support for a government role in fostering proenvironmental transportation. An average of 88% of respondents were in favour of government involvement to promote proenvironmental transportation. In addition, the lack of predictability of objective factors toward this support suggest that those who own several cars, live long distances from their workplace, and have poor access to public transit are just as likely to support government involvement as those who have fewer barriers to proenvironmental modes of transportation.

Future directions. This thesis has contributed to the theoretical understanding of the determinants of behaviour change in environmental psychology. Results have shown that the factors that underlie decisions to adopt new behaviours are complex and inconsistent across different modes of transportation. Although people are generally receptive to the concept of proenvironmental transportation, there is a lack of corresponding behaviour to adopt proenvironmental transportation. This implies that the factors presented in this study represent only part of the behaviour-change equation, and that people's reluctance or inability to act in accordance with their beliefs may be prevented by deeper, yet unknown barriers. Certainly there are other elements within the psychological level of analysis that can be explored, many of which were mentioned earlier. Perceived control, trust, and other subjective factors have been shown to play a role in determining environmental behaviour, and indeed, the list of candidates is

seemingly endless. Perhaps more important to a fuller understanding of environmental behaviour than the pursuit of variables may lie in furthering the linkages of psychology with the contributions of geography and other social sciences. The results of this study provide tentative evidence that spatial patterns play a significant role in determining transportation behaviour. Other promising areas of research include the role of social value orientation (see Cameron, Brown, and Chapman, 1998; Van Vugt, Meertens, and Van Lange, 1995; Van Vugt, Van Lange, and Meertens, 1996; Van Lange, Van Vugt, Meertens, *et al*, 1998) in determining which segments of the population are predisposed to placing societal values ahead of personal interests. Future advances in transportation decision-making may also benefit from further exploration of the contribution of internally constructed sense of responsibility in proenvironmental decision-making. Indeed, Schwarz's Norm Activation Model (Blamey, 1998) ascribes sense of responsibility as a central determinant of proenvironmental helping behaviour.

From a practical standpoint, this study contributes to a community's ability to fully understand the nature of decision-making when it comes to adopting more proenvironmental transportation practices. It sheds light on the "black-box" that often exists in local planning between planning intents and outcomes. It has shown that there are several consistent attributes of people that use proenvironmental transportation. For example, the association between people with positive attitudes and their use of proenvironmental transportation may facilitate more directed campaigns to target that segment of the population who acknowledge the negative impacts of their vehicles on the environment but are not currently using alternatives to their personal vehicles.

This study has provided several interesting insights into transportation decision-making based on a popular rational choice theory. It provides a first step towards gaining a broader understanding of the interplay between subjective and objective factors and their combined influence on behaviour. Future research would benefit by including a comprehensive evaluation of specific objective factors that exist within a community prior to conducting quantitative research to ascertain their relative impacts. Thus, there is a role to play for qualitative methods to be included within future study designs of this type. Focus groups could be conducted in order to gauge resident's specific experiences with the transportations system. As is alluded to from the vignette above, there is potential for uncovering a wide variety of specific insights from residents that would otherwise not be considered in typical studies using survey-methodology. In addition, the results of surveys of this type can benefit by follow-up study using focus groups of residents in order to contextualize results. Participants might be able to shed light on the underlying reasons for the relationships that are ascertained through quantitative methods. For example, in this study, it was shown that a the majority of residents lived in close proximity to transit stops, but there may be additional factors such as inconvenient times, cost, or comfort that pose additional objective constraints to their use. Finally, future surveys could be structured in a longitudinal fashion, so as to facilitate measurement of more accurate relationships between hypothesized predisposing factors and behaviour by giving respondents time to act upon their attitudes, intentions, and the like. It would also be useful to ascertain the stability of such factors, to see whether they change with time, or remain constant in the population. Certainly, there is a great opportunity to conduct future research in this area. This study has shown that

transportation decision-making is a complicated, yet very approachable area for the study of environmental behaviour. The fundamental argument, therefore, is that the best approach to resolving the complexity of proenvironmental behaviour change is an integrative one.

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Appendix 1

A Review of the Literature on Transportation and Air Quality

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Introduction

Over 90% of Canadians believe that our air, water, and land are more contaminated now than ever before (Kindra and Chynoweth, 1993). Linking these effects to health has also been increasingly brought to light, with 33% of Canadians feeling that environmental problems *very much* affect their health and that of their families (Kindra and Chynoweth, 1993), and that one in two Canadians believes that his or her long-term health is affected by the environment (James and Eyles, 1999). Referring specifically to pollution, a 1991 survey revealed that 92% of Canadians believe that the health of our population is affected by pollution (Kindra and Chynoweth, 1993). In addition, 51% stated that their own health is affected by pollution. By 1996, this number increased to almost two thirds saying that their health has likely or has definitely been affected by pollution (Health Canada, 1997). In fact, 44% Canadians perceive environmental pollution to be a greater health risk factor than exercise and diet or smoking and drinking (Go for Green, 1998). Referring specifically to transportation, 40% of Canadians believe that the greatest improvement to municipal transportation would be expanding or improving transit services (Environics, 1999; In David Suzuki Foundation, 1999). This review highlights the relationship between human behaviour and the physical environment., although it is recognized that transportation choices are influenced by a variety of factors, such as lifestyle, culture, and socioeconomic status, all of which can be considered interdependent and important predictors in the overall decision-making processes of people.

Kelowna

The population of Kelowna has doubled since 1986 and will surpass 120,000 within the next few years. This rapid growth rate is resulting in increased pressure on the local environment, due mainly to increased traffic volumes. Urban air pollution in Kelowna is becoming a pressing problem to local citizens, as certain contaminants have reached levels that can have adverse effects on the health of vulnerable groups such as seniors and children. Community-level action to prevent these problems from worsening is already underway. The municipal government has responded to public concern and is currently developing new initiatives to address urban air pollution. Part of its strategy is a Transportation Demand Management proposal intended to shift Kelowna toward a more sustainable transportation system over the next 20 years. This review provides a general summary of the environmental psychology literature on factors that influence transportation decision-making and those that are most amenable to change by targeted community-level campaigns.

In general, the issue is a social dilemma connected with the choice between using personal vehicles and alternative modes of transportation in a population. The dilemma lies in balancing individual versus collective outcomes. By choosing a personal vehicle, the obvious advantages are to the individual in terms of travel time, flexibility, and comfort. In contrast, the disadvantages of car travel are diffused among the whole population in terms of pollution, noise, and energy consumption. By choosing an

alternative mode of transportation, the advantages and disadvantages are reversed (Figure 1).

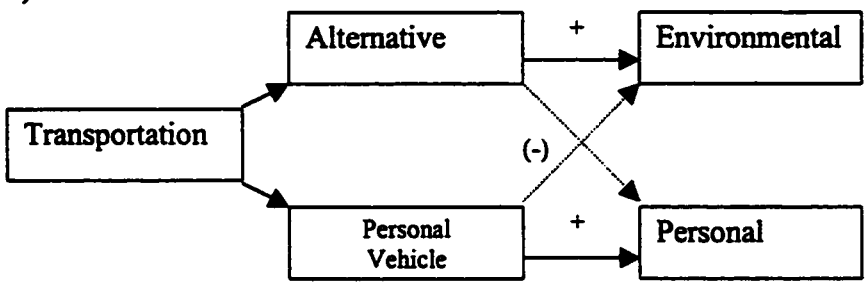

Fig. 1. The social dilemma faced by individuals making transportation choices between car and alternative transportation.

Finding Solutions

There are generally two levels on which to base strategies toward more environmentally sustainable transportation practices.

1. *Elementary solutions* are focused at the individual level on attitudes and beliefs that people have toward their transportation use. Solutions are sought that will influence an individuals' judgments about choosing cooperation versus non-cooperation toward environmentally friendly transportation. These include campaigns that provide information to promote awareness and concern toward urban air pollution.

2. *Structural solutions* focus on eliminating the environmental problem altogether by changing the structure of interdependence between people and environmentally harmful transportation choices. Solutions of this form look to introduce structural constraints that will redirect individual behaviour toward the desired end. These include regulatory measures that restrict noncooperative behaviour (i.e. higher taxes) or encourage cooperative behaviour (i.e. incentives).

Questions of relevance to developing community-level include:

- What are the specific elementary and structural solutions?
- Which solutions are most effective?
- How can these solutions be integrated into an overall strategy?

The next section of this review will identify those elementary and structural solutions that have been studied in the psychological literature. Factors that may lead to elementary solutions include threat perception, control (James and Eyles, 1999), concern (Fransson and Gärling, 1999), knowledge (Fransson and Gärling, 1999), attitudes (Kaiser *et al*, 1999; Axelrod and Lehman, 1993; Grob, 1995; Schultz and Zelezny, 1999), vulnerability (Skov *et al*, 1991), general and personal awareness, values, efficacy (Axelrod and Lehman, 1993), trust, responsibility (Kaiser and Shimoda, 1999; James and

Eyles, 1999), and outcome desires (Axelrod and Lehman, 1993). Factors that may lead to structural solutions include demographic, political, economic, social, or physical barriers or facilitators of environmentally sound transportation use.

Literature Review

Air Pollution and Mental Health

1. Bullinger, M. (1989). Psychological effects of air pollution on healthy residents--a time-series approach. Journal of Environmental Psychology 9:103-118.

   Overview: Examined the effects of air pollution on psychological state, mental functioning, and physiological arousal in 22 healthy female volunteers residing in a polluted and a non-polluted region of Bavaria. For two months, daily assessments of mood, perceived stress, air quality, and annoyance reactions were obtained together with daily recordings of pollutant concentrations and weather variables. Ability to concentrate, reaction time, urinary cortisol and catecholamines, blood-pressure, and bodily complaints were assessed at weekly intervals.

   Results: Impairments in reaction time to visual stimuli were associated with increased pollutant concentrations. Mood and stress were synchronously as well as 1-4 days delay associated with higher SO_2 levels. A higher proportion of pollutant-sensitive persons in terms of psychological state were reported in the polluted area.

2. Rotton, J., and Frey, J. (1984). Psychological costs of air pollution: atmospheric conditions, seasonal trends, and psychiatric emergencies.

   Overview: Examined archival data on the relationship between psychiatric emergencies and levels of air pollution to validate a model which predicts that adverse environmental conditions elicit unpleasant emotions (e.g. annoyance and irritability) which, in turn, reinforce avoidance behaviour and negative evaluations of social objects.

   Results: More psychiatric emergencies occurred on days when levels of air pollution, especially photochemical oxidants, and temperatures were high.

   Implications: As of 1984, it was estimated that the annual cost of air pollution in the U.S. was $16.1 billion. However, this estimate takes only lost productivity and medical costs into account. This study shows that mental health should be incorporated into the overall burden of air pollution to society.

Environmental Psychology Surveys

3. Cameron, L.D., Brown, P.M., and Chapman, J.G. (1998). Social value orientation and decisions to take proenvironmental action. Journal of Applied Social Psychology 28(8): 675-697.

   Overview: This study examines whether social value orientations predict decisions to engage in actual environmental behaviour. 135 undergraduates at a university in Pennsylvania were given a description of a program aimed at reducing ozone emissions by 15% that would require all companies with 100 or more employees to increase their average vehicle occupancies by 25%, thereby requiring car commuters to either carpool with at least one other person or else use public transportation. Advantages to this program included reduction of adverse health effects, reduction of acid rain, and increased protection against global warming. Disadvantages included compliance costs of up to $200/employee/year resulting in higher tuition or reduction in future employment opportunities, as well as commuting difficulties. Students were then given the option of sending a letter in support or opposition to the program. Measures of social value orientation, perceived environmental benefits of the program, perceived personal costs of the program, extent of support for the program, other environmental practices, and general environmental beliefs regarding one's personal ability to have a positive impact on the environment.

   Findings: 46% of respondents were categorized as prosocial. Males tended to be more prosocial (63.9%) than females (41.3%). Individuals with prosocial and proself value orientations differ in their perceptions of the program and their propensity to actively support or oppose it.
   - Proselfs reported higher perceived costs associated with the program
   - Proselfs were more likely to send letters opposing the program
   - Prosocials were more likely to send letters supporting the program
   - Support for the program is influenced by perceptions of both personal cost and environmental benefits, although perceptions of personal cost appear to have a greater impact.

   Implicatons: These findings suggest that environmental programs may profit from using persuasion messages that reduce perceptions of the personal costs induced by environmental actions, rather than focus primarily on the expected environmental benefits. Examples are given below:
   - Personal benefits of carpooling such as reduced transportation costs and extra personal time during commutes
   - Personal costs of not engaging in environmental behaviour such as the cost of wasteful energy use

- Reduce personal costs of public transportation by improving accessibility and convenience, providing parking benefits to carpoolers, and offering monetary rewards for those adhering to the programs.

4. Flannelly, K.J., McLeod, M.S., Jr., Behnke, R.W., and Flannelly, L. (1990). Assessing consumers' interest in using alternative transportation modes of commuting. Psychological Reports 67: 875-878.

Overview: Studied commuters' interest in paratransit use when variables of comfort (measured as service availability) and cost are manipulated. A survey of 666 residents of a Honolulu suburb measured commuter's preference compared to current conditions if bus fare was $1, $2, or $3, when a guaranteed seat was available, and when the nearest bus stop was door-to-door, a 5-minute walk, or a 10-minute walk.

Findings: Table 1 lists the results of the study. The ideal scenario was obviously a door-to-door service with a guaranteed seat at a $1 cost. Cost had the strongest main effect on interest, followed by access, and guaranteed seating.

- A guaranteed seat significantly increases interest in paratransit, regardless of commuting distance.
- Interactions between interest in seating and access and seating and fare show that a guaranteed seat can counter the negative effects of fare and access substantially.
- Interaction between fare and access shows that closer bus stops can partially compensate for increases in fare.
- Even with superior service, consumer interest drops sharply with higher fares and quickly becomes negative (i.e. more than $2)
- The highest percentage of interest was found among commuters traveling between 11 and 20 minutes.

Seating	Access	One-way Fare		
		$1	$2	$3
No seat	Door/Door	62.3	19.6	-5.1
	5 Minutes	44.1	3.9	-14.7
	10 Minutes	21.3	-5.4	-16.6
Seat	Door/Door	88.2	40.6	5.5
	5 Minutes	72.4	23.3	-4.9
	10 Minutes	43.0	10.5	-10.3

Table 1. Relative interest of automobile commuters in using paratransit as a function of fare, access, and seat availability.

Authors note that it is difficult to translate this interest into actual demand for service, since the association between attitudes and behaviour has not been established. One proposed approach is as follows:

%Commuters currently using cars X % Commuters interested in using each alternative

For example, in the neighbourhood studied, 10% of commuters already used the bus. Given a door-to-door transit without a guaranteed seat at a $1 fare (62.5% according to the statistics given) = 6.23% increase in demand for this type of service, thus increasing commuting by bus to 16.2%.

5. Kaiser, F.G., Ranney, M., Hartig, T., and Bowler. (1999). Ecological behaviour, environmental attitude, and feelings of responsibility for the environment. European Psychologist 4(2): 59-74.

Overview: Studied the inclusion of a moral component in a rational choice theory to further explain variance in ecological behaviour intention. Surveyed 436 Swiss adults belonging to two ideologically different transportation associations (one is pro-automobile, the other is pro-environment) to examine environmental knowledge, environmental values, and responsibility feelings (the moral component) as they relate to general environmental behaviour and intention:

1. I support raising parking fees in cities
2. I am ready to pay environmental taxes (e.g. raising fuel or automobile taxes)
3. I support speed limits on freeways
4. I support efforts to create automobile free inner cities
5. I would prefer to drive only if absolutely necessary (i.e. no other mode of transportation is available)
6. I would prefer not to drive to work any longer
7. I would prefer to be able to go shopping without my automobile
8. I will stop the engine at red lights in the future
9. I will still need my automobile in the future
10. My next automobile will be small and as ecologically sound as possible
11. I will travel by automobile or by airplane during my vacations

Findings: All three components together (knowledge, values, responsibility) predicted 45% of variance in ecological behaviour intentions, which, in turn, predicted 76% of explainable variance in ecological behaviour. Responsibility increased the variance in intention by 5%.

Implications: Subsequent inquiry to the author yielded further evidence that "changing attitudes is definitely a worthwhile enterprise" (Kaiser, 2000; personal communication). This author made two general recommendations regarding the role of attitude in behaviour change: (1) When it comes to attitude changes, note that the target behaviour should actually be a range of or an array of ecological behaviours (strictly speaking, people are free to convert their changed attitude in different behaviours), and (2) If one is interested in affecting a particular behaviour, they had better shoot for changing situational constraints rather than modifying attitudes.

6. Skov, T. et al. Modifications of Health Behaviour in Response to Air Pollution Notifications in Copenhagen.

   Overview: Studied the knowledge and beliefs about air pollution and modifications of behaviour brought about by information to the public about projected levels of pollution, with special emphasis on reduction of outdoor activity and avoidance of car driving. Surveyed 668 residents of Copenhagen and 255 lung diseased patients.

   Findings: Respondents were almost universally knowledgeable about the prime emission source being automobiles (over 80% reported that cars and buses "very much" affected air pollution in the city) and were concerned about the possible health effects of air pollution in the area.
   - Avoidance of outdoor activity was associated with personal experiences of symptoms ascribed to air pollution, with employment status, and with female gender, but not with knowledge or beliefs about the degree or health implications of air pollution.
   - Willingness to reduce car use was associated with the belief that one can oneself influence one's health and with female gender.
   - Lung diseased individuals were generally more prone to protect themselves than the healthy in both behaviour modifications.

   Implications: These authors note that "It should be kept in mind that preventive behaviours which clash with other daily activities stand a poor chance of being carried out. 'The preventive behaviour must be the easy behaviour'. As long as people need a car to perform the job and/or it is very unhandy to use public transportation, they are not likely to adopt an altruistic attitude. In view of these considerations, it is questionable whether policies which rely on modification of individual health behaviour will have any great effect on the emission from motor vehicles."

7. Tanner, C. (1999). Constraints on environmental behaviour. Journal of Environmental Psychology 19: 145-157.

Overview: This research examines the crucial predictors of driving frequency with the perspective that behaviour is generally prevented by a host of constraints. The author identifies subjective factors that are assumed to affect the preference for proenvironmental behaviour and objective factors that inhibit the performance of proenvironmental action. The Ipsative Theory of Behaviour is employed to further explain the relationship between the types of constraints, adding an ipsative constraint element to the subjective and objective factors. That is: There are three presuppositions for human behaviour—(1) The action must be objectively possible (i.e. time, income, legal, political, technology, infrastructure, etc.), (2) The behavioural option must be salient for the individual in the situation—under certain circumstances, an individual's action is constrained by the fact that a particular alternative did not occur to him or her in the situation, (3) Provided that there are at least two options, a choice must be made.

A survey was administered to a random sample of 153 Swiss adults containing questions about (1) Subjective factors including personal and general problem awareness, perceived efficacy, sense of responsibility, and perceived behavioural barriers, (2) Objective factors including car ownership and extent of car use, and other demographic variables.

Findings: Both subjective and objective factors independently contributed to variance in behavioural reports. The findings support the idea that attitudinal factors should not be conceived as direct predictors of environmental behaviour.

Implications: The authors conclude that "Overall, the investigation of subjective and objective constraints has the potential to make a significant contribution to knowledge about behaviour. As this study suggests, not only variables that affect people's evaluation of alternatives but also variables that inhibit individuals' ability to participate in particular activities must be taken into account to ensure an appropriate understanding of human behaviour. In subsequent communication, the author informed that further analysis was conducted to find groups which are described by their specific constraints. One group in particular was described as "wanting" to behave in an ecological manner but who "could not". This group consisted primarily of settled families with children. These people viewed their cars as a necessary tool, in particular for purchases (in constrast, this same group did not use their cars for leisure purposes). These findings resulted in two applied implications: (1) the public transportation company has recently started to offer car rentals for passengers at train stations, and (2) supermarkets have started offering food deliveries by telephone.

8. Van Vugt, M., Meertens, R.M., and Van Lange, P.A.M. (1995). Car versus public transportation? The role of social value orientations in a real-life social dilemma. Journal of Applied Social Psychology 25(3):258-278.

Overview: This research evaluates the role of social value orientations in decisions as to how to commute. These authors assess commuting as a decision that can be viewed as either an environmental or an accessibility problem. The assumption is that these decisions are affected by structural variables such as scarcity of parking space, the likelihood of traffic jams, and differences in the quality or costs of cars versus the quality or costs of public transportation. The study used an experimental approach where 31 female and 25 male subjects were exposed to computer-mediated decision-making tasks.

Findings: 39% of respondents were categorized as prosocial. First, people who are primarily concerned with collective welfare (prosocials) will have higher preference for public transportation when other people are traveling the same way (i.e. cooperative behaviour toward the environment) and that people who are primarily concerned with their own wellbeing (proself) will prefer public transportation only when others are traveling by car (i.e. avoidance of congestion). In addition, a greater percentage of prosocials indicated that they were ready to stop driving their cars in case of a serious environmental threat. Secondly, it was found that prosocials exhibited greater preference for public transportation when led to believe that the majority of others preferred the same, whereas proselves would prefer to commute by car. Thus it was concluded that prosocials transform the problem into an environmental issue, whereas proselves transform it into an accessibility issue (knowing that given higher public transportation rates, traffic would decrease resulting in faster commutes by car). The authors conclude that, "In light of the current results, it is plausible that proself individuals are particularly sensitive to arguments that emphasize the personal benefits of commuting by public transportation or the personal costs of commuting by car, such as travel time or travel convenience. It goes without saying that such messages are only effective to the extent that they are persuasive, which may require some structural changes in public transportation, such as extension of networks, an increase in transport frequency, or an improvement in travel convenience and flexibility."

9. Van Vugt, M., Van Lange, P.A.M., and Meertens, R.M. (1996). Commuting by car or public transportation? A social dilemma analysis of travel mode judgements. European Journal of Social Psychology 26:373-395.

Overview: This research surveys 300 employees of a publishing company in Deventer, a medium-sized city of the Netherlands to examine the conflict between self-interest and long-term collective interest in transportation decision-making. Respondents were asked to rate the preferences for car versus public transportation in a variety of scenarios that manipulated level of pollution (very little impact of cars on pollution versus cars as main source of pollution in 10 years), relative time of commuting by car versus bus (40 versus 60 minutes), and variability/control over travel time (2 minutes versus 16 minute range above the average travel time).

Findings: 73% of respondents were categorized as prosocial. Individuals preferred options yielding shorter travel times as well as smaller variabilities in travel time. Overall, prosocial individuals' greater preferences for commuting by public transportation than did proself individuals. In both groups, preferences for public transportation were greater when individuals perceived that excessive car use was detrimental to the environment, with proself individuals being more sensitive to this perception. Finally, it was shown that elimination of both obstacles (time and variability) promoted preferences for public transportation more strongly than the sum of their separate influences. The authors comments that "Setting theoretical issues aside, this finding (that preferences for public transportation were much greater when individuals believed that car use had a large impact on the environment) may be relevant for educational purposes because there appears to be a growing consensus among environmental experts that excessive car use is among the main causes of environmental pollution, and that technological improvements of cars may not be sufficient to reduce these problems significantly."(p. 390-391).

10. Van Lange, P.A.M., Van Vugt, M., Meertens, R.M., and Ruiter, R.A.C. (1998). A social dilemma analysis of commuting preferences: The roles of social value orientation and trust. Journal of Applied Social Psychology 28(9): 796-820.

Overview: This research examines the relationship between social value orientation and trust (i.e. a general belief in the honesty and cooperative intentions of others) in determining preferences for collectively desirable commuting options (public transportation and replicated with carpooling). 140 daily commuters in the Netherlands were recruited at gas stations and administered a questionnaire measuring social value orientation and trust relative to hypothetical commuting situations where the efficiency of commuting and beliefs about pollution levels were manipulated.

Findings:
68% of respondents were categorized as prosocial, 27% as proself, and 6% unclassifiable. Both groups were approximately the same with regard to high (~72%) and low (~28%) trust.

- Proselfs were more strongly associated with beliefs about the relative efficiency of cars (Figure 2)
- Prosocials with high trust exceeded prosocials with low trust as well as proselfs with high or low trust in exhibiting preferences for collectively desirable actions.

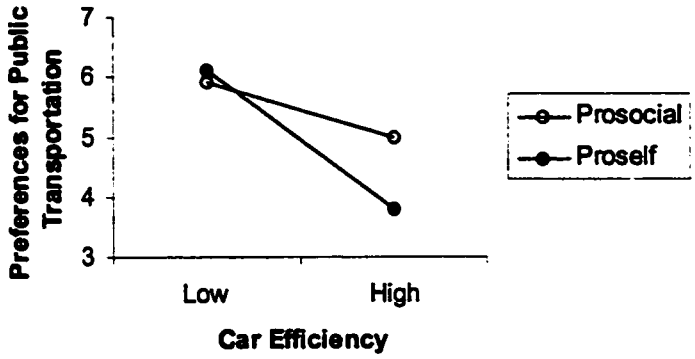

Fig. 2. Preferences for public transportation as a function of social value orientation and perceived efficiency of commuting by car (vs. public transportation) (Van Lange *et al*, 1998).

11. Zeidner, M. & Shechter, M. (1988). Psychological responses to air pollution: Some personality and demographic correlates. Journal of Environmental Psychology 8: 191-208.

Overview: Examined the impact of air pollution on anger, anxiety, and perceptions and attitudes toward air pollution. A survey of 900 residents of Haifa, Israel showed :

- There is a strong correlation between perceived severity of air pollution with actual neighbourhood pollution, thus residents of polluted neighbourhoods were more aware of air pollution in their immediate surroundings.
- The higher peoples' perceptions of the severity of pollution are, the stronger their affective responses (i.e. anxiety, anger) are.
- There is a significant association between low socioeconomic status and affective reactions to air pollution.
- Perceived severity of pollution is alone sufficient to incite anger and anxiety in the public, regardless of whether the air is polluted.
- Older respondents expressed less concern than younger individuals toward the effects of air pollution.
- 52% of respondents report adopting passive techniques in coping with air pollution (i.e. ignoring the problem). The majority of others merely reported shutting windows. Only a few responded by talking to others or complaining to authorities. This reflects a phenomenon called "dissonance reduction"—being exposed to ambient pollution over time results in habituation to air pollution.
- Respondents reported that they were willing to incur an increase of almost 10% of their municipal tax to improve air quality. They were also willing to incur a 10% increase to prevent air quality from deteriorating from the level it was already at. Upper class individuals were willing to pay more than lower classes.

Implications: These authors note that "systemic information with respect to psychological, economic, demographic, and health correlates of air pollution may be regarded as an essential input in decisions on environmental management".

Conclusions and Recommendations

Subjective Solutions

Overall, subjective factors were found to be very significant predictors of environmental behaviour or intentions. Unfortunately, despite the considerable amount of research that has been done to demonstrate the value of psychological solutions to transportation systems, there has been little effort to disseminate these contributions to community planners. Personal communication with many of the researchers reviewed in this paper has shown that practical implementation of their findings has not occurred. One author took a very pessimistic stand on this issue, saying:

> Unfortunately, finding empirical results and transforming them into real programs are two different things. Specifically in the case of mobility, it appears that a lot of additional 'constraints' are working, limiting the potential that anything can really change. I did not find any other ecologically relevant theme, where so many powerful lobbies (in this case the automobile industry) are contradicting any change and where politicians are so afraid to support sustainable development. (Tanner, 2000; personal communication)

Despite this pessimistic outlook, the author does mention one psychological strategy that has been used in Switzerland:

> The car is not only an instrumental tool, but also has symbolic qualities fostered by advertisement of the automobile industry (such as giving freedom, independency, allowing privacy, and so on). Those aspects must also be considered in understanding regulation activities. Changing the "meaning" of the car means investing in alternative advertisements showing positive consequences of alternative transportation and negative consequences of cars. For example, Swiss public transportation companies try to send the message by advertisement showing that usage of public transportation such as the train allows passengers to have no stress, you can sleep, discuss, eat and drink, work, and enjoy the surroundings. (Tanner, 2000; personal communication)

Other key recommendations can be derived directly from the studies outlined in this review. Foremost among these in terms of community planning is that knowledge of the problem is not the issue. Research has shown many times that people are generally aware of the problems, their sources, and solutions. Unfortunately, far too many campaigns are limited to just that—telling people what they already know!

Second, social value orientation must be recognized as a significant factor when planning mass media campaigns. An effective approach would recognize the differences in persuasion techniques between the two groups. Importantly, there is no fixed percentage of the population that is either one or the other. The proportion between prosocials and proselfs varies (between 39% and 73% prosocial) with age, culture, and homogeneity of the population. Ideally, planners would identify these percentages for

their target population prior to implementation of strategies in order to prioritize their campaign to suit local circumstances.

Third, an important theme that emerged across the studies is the need to personalize messages. Campaigns should be individualized such that the recipient of the information is made to realize how their behaviour affects them personally, especially with regard to personal cost in terms of both money and health. In other words, a message that reads "yours and others driving behaviour will affect you by causing such symptoms and health effects as ..." is better than "pollution caused by driving is bad for people's health". Similarly, demonstrating that individual behaviour can have significant positive results is also important. For example, "Reducing your driving frequency will save you $X per year".

Objective Solutions

It must be recognized that objective solutions are very situation specific. Each community faces unique barriers to ideal transportation circumstances. These barriers may result from a complexity of interdependent factors such as local economy, geography, culture, and infrastructure to name but a few. That said, several general principles derived from the studies reviewed here may be applied in a given context.

1. Make the desired behaviour as easy as possible to adopt. If possible, marketing the desired behaviour as *easier* than the non-desired behaviour would be ideal. Be specific—include testimonies and statistical support to claims of time, convenience, or cost saving.
2. Between cost, accessibility, and comfort, cost has the strongest impact on interest in alternative transportation.
3. People are generally in favour of absorbing a certain degree personal financial cost to improve air quality (10% in the case cited here).

Specific examples of objective solutions are recommended by Tanner (2000; personal communication). She notes that:
Since people who own a car are also apt to use it, interventions should also focus on reducing structural constraints, that is, supporting development of infrastructures facilitating use of alternative transportation systems and supporting strategies which make automobile use more difficult.
In Switzerland, current strategies include:

1. Fostering a quite modern, convenient, comfortable public transportation system for rural and urban areas.
2. In cities, reducing the number of parking spaces for automobiles. There is a trend in several Swiss cities to prohibit people from going by car into city centres.
3. Increasing areas for pedestrians.

Appendix 2

Box 1. Six major segments of the Canadian Population by attitudes, interest, and opinions regarding the environment and related issues (Kindra and Chynoweth, 1993)

Activists (20%)	These people tend to be young, well educated, and knowledgeable; they feel "empowered" to take action on environmental problems. This group has increased by 4 percent since 1991 and will continue to grow in size. Activists are eager to protest publicly and to fight for environmental causes. They are also less apt to believe that government and business can initiate change. This group is very interested in ecological issues and represents influential opinion leaders and innovators. They are also less susceptible to mass-advertising efforts, partly because of their general distrust of government and the media.
Environmental Enthusiasts (17%)	These Canadians are more optimistic than *Activist* in their belief that solutions can be found without radical changes. Their behaviour vis-à-vis environmental protection is exemplary. They also possess a strong faith in science and technology, as well as the efforts of government and business. This is the fastest growing group, expanding from 9% in 1989 to 17% in 1992. This group is most susceptible to mass media efforts originating from government agencies.
Anxious (18%)	This group feels both scared and guilty about the environmental problems. Their sense of "helplessness" reduces their proclivity to take personal action. This group does not believe strongly that their actions "count", but supports strong measures by the government (including additional regulations), and possesses a strong faith in others, such as scientists and legislators. While they would probably be open to mass media efforts (in terms of increasing their levels of eco-literacy), they will require more personal, one-on-one effort to generate behaviour change.
Apathetic Mainstreamers (18%)	Members of this group tend to be older and less educated. Many of them live in small cities and in rural areas. Feeling neither alienated from nor in particular sync with the social forces around them, they show concern, but no alarm, over the state of the environment. They lend support to environmental protection measures, but they do not support radical initiatives. Like the *Anxious*, they too are open to mass media efforts, but are much more susceptible to personal efforts directed at attitude and behaviour change.
Fatalistic Bystanders (14%)	This segment is depressed and cynical and possesses the lowest education and income levels. Its members are basically concerned with survival; issues such as the environment and health are largely not on their minds.
Hostiles (13%)	They are primarily middle aged, prosperous, and conservative. They believe that the environmental issues was invented by leftists in the media and that there is no real problem. They are resistant to environmental protection messages, and counter argue and/or ignore mass media appeals.

Appendix 3

Transportation Survey (2000) – Help Us Help You!

Transportation is one of the main issues affecting everyone in the Central Okanagan.In order to improve the efficiency and effectiveness of our transportation system, we are asking you and your household to please take 10-15 minutes to share your thoughts with the City of Kelowna and the Central Okanagan Regional District. We highly value your opinion and you input will help us make important decisions about future spending!
Try to answer all questions by reading each question carefully and checking the box that best represents your opinion.

Thank-you! .

Various Modes of Transportation

1. How many insured motor vehicles (excluding RV.s) are regularly used by your household ?

1. None ☐ 1
2. One ☐ 2
3. Two ☐ 3
4. Three ☐ 4
5. Four ☐ 5
6. Five ☐ 6
7. Six or more ☐ 7

2. How many usable bicycles are in your household?

1. One ☐ 1
2. Two ☐ 2
3. Three ☐ 3
4. Four ☐ 4
5. Five or more ☐ 5
6. None ☐ 6

Household Trip Profile

3. In a typical week, <u>how many trips</u> (beyond your block) does your household make using each of the following modes of transportation?
(a trip to and from a location counts as two trips)

1. Personal Vehicle (car, truck, van etc.) ____
2. Car pooling (with people from outside household) ____
3. Bike ____
4. Bus ____
5. Walking/Rollerblading ____
6. Other (please specify) ____

4. In a typical week, how many trips do members of your household take to the following destinations?
(a trip to and from a location counts as two trips)

1. Leisure/Recreation ____
2. Shopping/Errands ____
3. Medical/Dental Appointment ____
4. School/College/University ____
5. Visiting/Volunteering/Church ____
6. Work ____

5. Please provide the following information on the main motor vehicles used by your household.

Vehicle	Years Owned/ leased	Original Mileage (Km)	Current Mileage (Km)
1.			
2.			
3.			
4.			

Personal Trip Profile

6. How long of a walk is it to your nearest public transit stop?

1. 0-5 minutes ☐1
2. 6-10 minutes ☐2
3. 11-15 minutes ☐3
4. More than 15 minutes ☐4
5. Don't know ☐5

7. Which of the following do you personally travel to most frequently? *(check only one!)*

1. Leisure/Recreation ☐1
2. Shopping/Errands ☐2
3. Medical/Dental Appointment ☐3
4. School/College/University ☐4
5. Visiting/Volunteering/Church ☐5
6. Work ☐6

8. How do you typically get to the place you travel to most frequently? *(check only one!)*

1. Personal Vehicle ☐1
2. Car pooling ☐2
3. Bicycle ☐3
4. Bus ☐4
5. Walking/Rollerblading ☐5

9. How far away from your home is the place you travel to most frequently? *(check only one!)*

1. Less than 2 km ☐1
2. 2-5 km ☐2
3. 6-10 km ☐3
4. More than 10 km ☐4

10. Are you currently employed?

Yes 1☐ No 2☐ (Skip next question if no!)

11. What part of the Region do work in ?

1. Airport/OUC north area 1☐
2. Highway 97/Reid's Corner area 2☐
3. Rutland area 3☐
4. Orchard Park/Enterprise area 4☐
5. Spall/ Gordon Road area 5☐
6. KGH/ Pandosy/ KLO area 6☐
7. Glenmore area 7☐
8. Downtown/North area 8☐
9. Westbank area 9☐
10. Don't work in the region 0☐
11. Other 11☐

Use of Alternative Transportation

12. How frequently have you used the following means of alternative transportation in the Central Okanagan over the past twelve months?

	Never	Rarely	Sometimes	Frequently	Almost Always
1. Public transit	1☐	2☐	3☐	4☐	5☐
2. Bicycle	1☐	2☐	3☐	4☐	5☐
3. Walking/Rollerblading	1☐	2☐	3☐	4☐	5☐
4. Car pooling [others outside family]	1☐	2☐	3☐	4☐	5☐

13. Over the past year, how have you changed the number of times you use the following types of alternative transportation?

	Increased Substantially	Increased Somewhat	Same	Decreased Somewhat	Decreased Substantially
1. Public transit	1☐	2☐	3☐	4☐	5☐
2. Bicycle	1☐	2☐	3☐	4☐	5☐
3. Walking/ Rollerblading	1☐	2☐	3☐	4☐	5☐
4. Car Pooled [others outside famil y	1☐	2☐	3☐	4☐	5☐

Environmental Barriers to More Extensive Use of Alternative Transportation [for motor vehicle users]

14. If you could change three things the local governments could do to help you use your car less often, what would they be?

1. _____
2. _____
3. _____
4. _____

Support for Government Actions

15. There are various social costs associated with reliance on automobiles. Which two of the following social costs are of greatest concern to you? ***[Choose only two!]***

1. Road construction/maintenance costs ☐1
2. Land use/space costs for roads/parking ☐2
3. Environmental pollution/health costs ☐3
4. Accident/safety costs ☐4
5. Community disruption/social costs ☐5
6. Traffic congestion/City Image costs ☐6

16. Do you think governments should be working towards increasing the public's use of the following alternative forms of transportation?

	Yes	No	Uncertain
1. Public transit	☐1	☐2	☐3
2. Cycling	☐1	☐2	☐3
3. Walking/rollerbladding	☐1	☐2	☐3
4. Car Pooling	☐1	☐2	☐3

17. If you had the power to make decisions for local governments and wanted to reduce automobile reliance, which of the following options would you pursue?

	Yes	No	Uncertain
1. Provide incentives for vehicle owners to reduce use	☐1	☐2	☐3
2. Increase the promotion of alternative transportation	☐1	☐2	☐3
3. Focus on approving more compact urban development	☐1	☐2	☐3
4. Increase parking prices	☐1	☐2	☐3
5. Implement road pricing (tolls) for certain areas at certain times	☐1	☐2	☐3
6. Introduce more on-road cycling lanes	☐1	☐2	☐3
7. Introduce more cycling paths separate from road traffic	☐1	☐2	☐3
8. Introduce new transit-only lanes on roads experiencing congestion	☐1	☐2	☐3
9. Improve transit services	☐1	☐2	☐3
10. Add more sidewalks	☐1	☐2	☐3
11. Encourage car pooling	☐1	☐2	☐3

Attitudes towards Transportation Alternatives

18. Please indicate how you feel about the following:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. I think it is important that I use my vehicle less often.	☐1	☐2	☐3	☐4	☐5
2. I like the idea of using alternatives to car transportation.	☐1	☐2	☐3	☐4	☐5
3. I, personally, would like to reduce the number of times I use my vehicles.	☐1	☐2	☐3	☐4	☐5
4. I think my employer would support my using alternative transportation to get to work.	☐1	☐2	☐3	☐4	☐5
5. I believe that my friends think it is a good idea for people to reduce car usage.	☐1	☐2	☐3	☐4	☐5
6. I feel knowledgeable about the impact my vehicle has on the community.	☐1	☐2	☐3	☐4	☐5
7. I acknowledge that my use of a motor vehicle has negative impacts on the community.	☐1	☐2	☐3	☐4	☐5

Willingness to Change

19. How willing would <u>you</u> be to changing your actions *<u>in the next year</u>* to reduce the overall impact of vehicles traffic?

	Very willing	Somewhat Willing	Neutral	Somewhat Unwilling	Very Unwilling
1. Use public transit twice a week more than you currently do?	1☐	2☐	3☐	4☐	5☐
2. Cycling instead of driving for two or more of your shorter trips each week?	1☐	2☐	3☐	4☐	5☐
3. Walk instead of driving for two or more of your shorter trips each week?	1☐	2☐	3☐	4☐	5☐
4. Share a ride with others twice a week more than you do now?	1☐	2☐	3☐	4☐	5☐
5. Plan your trips so that you can accomplish more than one task on any given trip?	1☐	2☐	3☐	4☐	5☐
6. Reschedule two or more of my peak hour [6-9 AM, 3-6PM] trips in a week to Off-Peak hours?	1☐	2☐	3☐	4☐	5☐
7. Ensure your vehicle is checked/ maintained twice yearly to operate at optimum levels	1☐	2☐	3☐	4☐	5☐

[Please continue over to the last page!]

Respondent information

*** Please note that all information is strictly confidential and will only be used to get an overall profile of all respondents.**

20. What is your gender? Male 1☐ Female 2☐

21. Please indicate your age.

1. 18 - 29 years 1☐
2. 30 - 39 years 2☐
3. 40 - 49 years 3☐
4. 50 - 59 years 4☐
5. 60 - 69 years 5☐
6. 70+ years 6☐

22. <u>Including yourself</u>, how many people live in your household?

1. One person 1☐
2. Two people 2☐
3. Three people 3☐
4. Four people 4☐
5. Five people 5☐
6. Six or more 6☐

23. How many <u>children under the age of 18</u> live in your household?

1. One person 1☐
2. Two people 2☐
3. Three people 3☐
4. Four or more 4☐

24. What Neighborhood do you live in?

McKinley Landing 1☐
Ellison/Joe Rich 13☐
Quail Ridge 2☐
Black Mountain 14☐
Dilworth 3☐
Rutland (North 33) 15☐
N. Glenmore 4☐
Rutland (South 33) 16☐
S. Glenmore 5☐
S.E. Kelowna 17☐
Magic Estates/Clifton 6☐
Upper Mission 18☐
Central Kelowna 7☐
Lower Mission 19☐
South Pandosy 8☐
Lakeview Heights 9☐
West Kelowna Estates 10☐
Shannon Lake 11☐
Westbank 12☐

25. What type of housing do you live in?

1.Single detached house[includes strata/gated communities] ☐
2. Semi-detached house[Duplex - Fourplexes/Suites] ☐
3. Townhouse ☐
4. Apartment ☐
5. Modular Home ☐

26. What is the highest level of education you have completed?

1. Elementary ☐
2. Junior High ☐
3. High school ☐
4. College ☐
5. Undergraduate Degree ☐
6. Graduate Degree ☐

27. What is your current Annual Household Income?

1. Less than $ 20,000 ☐
2. $20,000 to $40,000 ☐
3. $40,000 to $60,000 ☐
4. $60,000 to $80,000 ☐
5. $80,000 to $100,000 ☐
6. Over $100,000 ☐

28. How much <u>on average</u> would your household spend/month on the following:

1. Gasoline $_____
2. Parking (Include fines) $_____
3. Transit fares $_____

Thank-you for your time in completing the survey!