Anticipated Changes to Quality of Life and the Impact of Divergent Social Normative Information: A Field Experiment on Sustainable Transportation Behaviour

by

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Bachelor of Science (Honours) in Psychology, Queen's University, 2004
Bachelor of Science in Biology, Queen's University, 2003

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Supervisory Committee

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Abstract

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This study evaluated anticipated changes to quality of life (QoL) from a reduction in private vehicle use, and the impact of social normative information on willingness to change transportation behaviour. Staff and students at the University of Victoria completed transport journals for a month, and participants in the low or high social norm condition received divergent information about the percentage of others who had switched to sustainable commuting. Unexpectedly, message content did not predict behavioural change, but mere receipt of a message, versus the control condition, did predict change. The results suggest that sustainable transport campaigns should highlight others' cooperation, regardless of their rate of cooperation, and target commuting behavior. Also, participants expected decreases to individually relevant QoL items and improvements to collectively relevant QoL items under a hypothetical reduction in private vehicle use. The findings may be employed by policy-makers to increase acceptance of transportation policies.

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Acknowledgments

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Dedication

I dedicate this thesis to other applied social psychology researchers, scientists, engineers, government officials, and practitioners who work towards the mitigation of climate change, unfazed by the daunting nature of their task. Their optimism is inspiring.

Chapter 1: Introduction

Climate change is now widely acknowledged to be underway, and there is unprecedented consensus that it is largely the result of human activity. And yet, according to The Intergovernmental Panel on Climate Change (2007), human behaviour remains the least-understood aspect of the climate change system. Thus, as debate over the existence and causes of climate change turns to a search for mitigation solutions, it becomes increasingly apparent that a sound understanding of the psychological factors that influence carbon-relevant behaviours, such as vehicle use, is a requisite piece of the broader puzzle. In an effort to better-understand two of the factors thought to play a role in transportation choices, this study evaluates which changes to quality of life (QoL) individuals anticipate to result from a reduction in private vehicle use, as well as whether or not social normative information can be used to increase sustainable transport behaviour.

Transportation and Greenhouse Gas Emissions

At the Kyoto Protocol to the United Nations Framework Convention on Climate Change, Canada pledged to reduce its annual greenhouse gas (GHG) emissions to 6% below 1990 levels by 2008-2012. Contrary to this pledge, however, annual emissions had risen to roughly 26% above the base level by 2005 (Environment Canada, 2007). The transportation sector is the most GHG-intensive sector, per unit of energy consumed in Canada, and personal passenger vehicles comprise about half of all transportation-related emissions (Transport Canada, 2006). In 2004, these vehicles accounted for about 20% of our annual national GHG emissions (Torrie, 2002). In British Columbia, personal cars, trucks, and SUVs constitute the largest source of individual emissions for the average resident

(Livesmart BC), and they contribute to 27% of the Province's yearly GHG emissions (Greater Vancouver Regional District, 2003).

The passenger vehicle sector is not only an important source of Canadian GHG emissions, but it is also a growing source. Passenger travel has increased by 31% since 1990 and, although this is partly due to a 16.5% national population growth, per capita travel has also risen over this time. The average annual distance traveled per Canadian increased by 11% between 1990 and 2005 (Steenhof & McInnish, 2008). Thus, passenger-related carbon dioxide emissions have grown at a faster rate since 1990 (i.e., a 40% increase) relative to the rate of increase in total domestic emissions (i.e., 26%) (Steenhof & McInnish). The increase in per capita travel is a function of both structural factors, such as landmass size and low density urban design, as well as psychological factors, such as the intrinsic appeal of automobiles (Jensen, 1999; Sandqvist & Kriström, 2001; Steg, 2005).

Indeed, many people love to drive. Studies show that most individuals evaluate car use positively along various psychological dimensions, whereas only a few individuals report such positive evaluations of public transport (Jensen, 1999). This is not surprising given that compared to alternative modes of transport, individuals associate private car use with greater safety, independence, and convenience, among other advantages (Steg & Gifford, 2005). Even commuting, a seemingly highly functional purpose of car use, has been shown to be related to non-instrumental motives (e.g., expressions of status and feelings of power) but not to instrumental or practical motives (Steg, 2005). Therefore, policy-makers who strive to enact sustainable transport strategies must confront powerful forces in their attempts to alter driving behaviour.

Defining sustainable transportation. The current transportation system is thought to be largely unsustainable (OECD, 1996). Although various definitions of sustainability have been put forth since sustainability became an issue of international discussion during the United Nations Conference on the Human Environment (1972), all stress the importance of ecological limits as well as the need to maintain citizens' current and future QoL (e.g., Beatley, 1995; WCED, 1987). Therefore, issues of sustainable transport are inextricable from those of human needs and values.

Litman (2005) discerns three dimensions of sustainable transportation: social (e.g., community cohesion), economic (e.g., reduction in non-renewable resources), and environmental (e.g., particulate emissions). Of several proposed indicator lists (e.g., Gilbert & Tanguay, 2000; Gudmundsson, 2001; Litman, 2005), most include objective economic or environmental indicators, whereas social indicators are often excluded or underrepresented (see Geurs & Van Wee, 2003). Steg and Gifford (2005) suggest that a dearth of appropriate methods and instruments for measuring the social effects of transport changes may be to blame, and they propose QoL as a means to assess these effects (De Groot & Steg, 2006a).

Acceptability of sustainable transportation policies. Sustainability goals are achievable through major technological advancements, extreme changes to human behaviour, or some combination of the two (Geurs & Van Wee, 2000). In general, individuals tend to prefer technological improvements over behavioural changes (e.g., see Gifford, 2007; Poortinga et al., 2003). Gardner and Stern (1996) suggest that this preference arises from a reluctance to make major lifestyle adjustments that are perceived to threaten individual QoL. In addition, individuals tend to view change as especially undesirable if they are uncertain about the future consequences of the change (Kahneman & Tversky, 1984). In some cases,

however, new technologies are used more often than the older technology, in a phenomenon termed the rebound effect (Berkhout, Muskens, & Velthuijsen, 2000). This can ultimately negate the benefits of the technological advancement; for example, improved car efficiency can lead to more vehicle use through reduced usage costs and decreased guilt over the vehicle's environmental impact (Litman, 2005). The rebound effect, along with the tendency for people to resist behavioural change, supposedly to maintain their current QoL, suggests that technological solutions are not solely sufficient to solve sustainability problems (Geurs & Van Wee; OECD, 1996; Steg & Sievers, 2000). Ideally, insights into the psychological factors underlying human behaviour and processes of behavioural change are required to supplement technological advances.

Quality of Life

The construct. Well-being, or QoL, is the degree to which individuals perceive that important values and needs are fulfilled in different aspects of their lives (Diener, 1995; Diener et al., 1999). This broad construct has two main conceptualizations: individuals' objective living conditions and individuals' subjective judgments of their lives (Cummins, 2000; Diener, 2000). Although scholars typically agree that both of these indicators should be studied (e.g., Ormel et al., 1997), research on well-being in relation to sustainable transport has mostly considered objective indicators (e.g., Geurs & Van Wee, 2003; Gilbert & Tanguay, 2000). To compensate for this, the present study will focus on subjective QoL.

Measuring quality of life with respect to environmental behaviour. Human needs relate to internal forces that guide individuals' behaviours (Maslow, 1954), and values act as governing principals in people's lives (Schwartz, 1992). The value scales of Schwartz (1994) and Rokeach (1973) are commonly used to examine the influence of values on environmental

behaviour. However, these measures were not initially developed for this purpose, and, as a result, some researchers believe that environmental values are often underrepresented in such research. To rectify this, Poortinga et al. (1994) conducted an extensive literature review on values, needs, and human well-being in relation to sustainable development and, subsequently, developed a list of 22 QoL indicators intended to assess barriers to sustainable household consumption. Respondents typically state that these indicators are important in their lives (Poortinga et al., 2001, 2004). Because major life goals are similar to values (Rokeach), these importance judgments are thought to be indicative of basic human needs and values (Poortinga et al., 2004). When participants assess the extent to which each aspect is satisfied in their lives, this scale can be transformed from a measure of needs and values into a measure of QoL (see Gifford & Steg, 2007). This instrument offers an advantage over previous QoL scales because it includes environmental aspects.

Quality of life and environmental scenarios. Poortinga et al.'s (1994) list has since been used to measure anticipated and experienced changes to QoL resulting from environmental policies or conditions. Specifically, Steg and Gifford (2005) report that these QoL indicators have been employed in multiple projects on household consumption at the University of Groningen (De Groot & Steg, 2006; Gatersleben, 2000; Pootinga et al., 2001; Poortinga et al., 2004; Skolnik, 1997; Slotegraaf & Vlek, 1996; Steg et al., 2002; Vlek et al., 1998; Vlek et al., 1999), although many of these studies are currently unpublished. Given that this list is intended to reflect what consumers' value, and that people value mobility, this scale can also be used to measure the impact of transport conditions on well-being. The expected impact of proposed sustainable transport scenarios on QoL can be measured when

participants estimate the manner, and degree, to which different scenarios would affect their QoL.

Quality of life and energy use. In a study on household energy consumption, importance judgments from the above scale were found to cluster into seven value dimensions (i.e., self-enhancement, environmental quality, self-direction, openness to change, maturity, family/health/safety, and achievement) that predicted acceptance of home and transport energy-saving measures (Poortinga, Steg, & Vlek, 2004). These two main categories of household energy consumption, home energy use and transport energy use, are related to different underlying values and motivations (Gatersleben, 2000; Poortinga et al., 2004). Home energy-saving measures are often perceived to be more acceptable than transport energy-saving measures (Poortinga et al., 2003). Because the car has been shown to contribute more to QoL than any other household appliance (Gatersleben, 2000), this discrepancy may stem from differences in the perceived impact of such measures on QoL.

When participants stated the QoL changes that they expected from adopting energy-saving measures to meet a hypothetical sustainable consumption level, they anticipated improvements in environmental resources, quality of nature, income, safety, and recognition, whereas they anticipated decreases in comfort, pleasure, freedom, social relations, work, and leisure time (Gatersleben, 2000). Steg et al. (2002), on the other hand, asked participants to voluntarily reduce their household energy consumption by at least 5% and to state the impact on their anticipated and experienced QoL. Each household was given information about how to decrease their energy use, as well as feedback on how much energy they had saved. Participants anticipated improvements in nature and biodiversity, as well as environmental qualities, and they indicated actual improvements to these two QoL indicators one month

later. In short, research into sustainable household energy use has yielded varied findings in terms of the positive and negative influences of such conservation behaviour on each of the 22 QoL indicators (e.g., Gatersleben, 2000; Steg et al., 2002). Observed discrepancies may result from differences between anticipated and experienced QoL changes.

Quality of life and sustainable transportation behaviour. Other researchers, who have explicitly studied QoL in relation to hypothetical sustainable transport scenarios, have found little overall impact on QoL. For instance, even a stringent measure like the hypothetical doubling of car cost only had a minimal negative effect on overall expected changes to QoL; anticipated decreases in comfort, money or income, freedom, change or variation, leisure time, and work, were offset by anticipated improvements in environmental quality, nature and biodiversity, and safety (De Groot & Steg, 2006a,b). In addition, Poortinga et al. (2001) examined respondents' anticipated QoL affects under sustainable household consumption scenarios that varied in focus (home versus transport), means (technological, behavioural, or a combination of both), and amount (20% versus 30% energy decrease). With the transport scenarios, respondents expected decreases in privacy, money, work, freedom, and comfort, but improvements in environmental qualities as well as nature and biodiversity. Again, overall QoL was not greatly affected. Steg and Gifford (2005), among others, propose that this lack of negative impact on overall QoL suggests that participants use a compensatory decision-making model, in which QoL improvements to some aspects offset QoL decrements to others (De Groot & Steg, 2006a; Greenwald & Leavitt, 1984).

In summary, although expected effects on QoL indicators differ somewhat among studies, participants typically anticipate decrements to individual qualities, such as freedom, comfort, and privacy, and improvements to collective qualities, such as environmental

quality and nature and biodiversity (Steg & Gifford, 2005; see Gärling & Steg, 2007). Other than an unpublished manuscript by Steg et al. (2002) on home energy use, little research has addressed QoL changes experienced in response to actual increases in sustainable transport behaviour. Experienced changes may differ from anticipated changes because studies have demonstrated a shift in attitudes following the implementation of sustainable transport policies (Heath & Gifford, 2002). Or, conversely, they may not differ because Steg et al. found no difference between anticipated and experienced QoL effects. Furthermore, because the majority of related studies are either unpublished and/or have been conducted in Europe, Steg (2005) suggests that research should be conducted in North American countries where greater car dependency might affect QoL consequences differently.

Policies intended to reduce car use are often thought to be unpopular among the public because of the perception that they threaten QoL (Jakobsson et al., 2000), and yet little evidence exists to suggest that this is true (e.g., De Groot & Steg, 2006a). If, as research indicates, overall QoL is only marginally affected by sustainable transport strategies, then perhaps policy-makers may be more willing to consider enacting such measures. An understanding of the QoL indicators that are most affected will allow policy-makers to consider possible compensation for perceived losses associated with sustainable transport strategies, to increase the overall positive evaluation of the strategy (De Groot & Steg, 2006a; Steg, 2005; Steg & Gifford, 2005).

Examining Social Norms from the Social Dilemma Perspective

Defining social dilemmas. A social dilemma is a situation in which individual self-interest is pitted against that of the group. In a social dilemma each individual benefits the most by acting in self-interest (termed "defection") as opposed to public interest (termed

"cooperation"), assuming that few others also choose to defect. The individual benefits the second-most if all harvesters cooperate to preserve the commons, and the individual loses the most if everyone defects, thus exhausting the resource (Dawes, 1980). Hardin's (1968) tragedy of the commons suggested that the tendency for individuals to act out of self-interest when they harvest from a jointly controlled resource often leads to resource extinction. The term "commons dilemma" refers to this conflict between self-interest and public-interest when multiple individuals or organizations have access to a desirable resource that can be harvested faster than it can be replenished (Dawes, 1980; see Gifford, 2007). More specifically, a "social trap" occurs when harvesters repeatedly opt in favour of short-term benefits such that the associated costs of self-interest behaviour compound over time to result in a large cost to the group (Platt, 1973). Thus, at their core, social dilemmas relate individual resource use to others' resource use (see Gifford, 2007).

Transportation behaviour as a social dilemma. Because energy comes from natural resources, energy conservation can be thought of as a social dilemma. Fossil fuels regenerate so slowly that they are considered a non-renewable resource (see Gifford, 2007). Although most individuals agree that increased sustainable transport is desirable, sacrificing the individual benefits of private car use is not nearly as desirable. Therefore, like many other types of behaviour, car use exemplifies a social dilemma in that it pits the interests of the individual against that of the group (e.g., Dawes, 1980; Hardin, 1968). Because of their emissions, car use is classified as a "give some" type of social dilemma (see Gifford, 2007). In this case, private car use is seen as defection because of its associated environmental effects, whereas sustainable transport use is considered cooperation because of its association with less adverse effects.

Studies indicate that harvesters tend to act more out of self-interest as group size increases (Dawes, 1980). Some research even suggests that a group size of 150 is the maximum number of harvesters for a cooperative commons (Edney, 1981). With millions of drivers on the road in Canada alone, one can see how transport behaviour is indeed a social dilemma that requires attention. Cooperation in such large-scale dilemmas, where harvesters make relatively anonymous decisions, is influenced mostly by values such as equality (e.g., Schwartz, 2005). In these dilemmas, feedback mechanisms are weak or lacking, such that individuals are often unaware of the environmental effects of their transport choices. Previous research has examined the factors that influence the likelihood that an individual will behave in self- versus public-interest.

The influence of normative information in social dilemmas. Many factors (e.g., individual, interpersonal, governance, and technological) influence the tendency for a decision-maker to behave in individual- or group-interest (see Gifford for framework, 2007). Biel and Thøgersen's (2007) review concluded that normative information is another factor that can influence behaviour in social dilemmas, even in large-scale environmental dilemmas, although these authors note that the role of social norms within social dilemmas has been understudied.

One way to behave in a dilemma situation, especially when one is new to a commons, is to conform to others' behaviour (Fleishman, 1988). However, individuals are often uncertain about whether or not others are cooperating, and for many it does not make sense to sacrifice the benefits of private vehicle use given this uncertainty (see Gifford & Steg, 2007). Environmental problems can be solved only through the cooperation of many citizens, and it has been suggested that one way to increase such cooperation is to use communication

strategies that elicit social norms about others cooperation (e.g., Bicchieri, 2002; Dawes, McTavish, & Shaklee, 1977). Indeed, a strong association has been detected between individuals' anticipation about others' cooperation and their own cooperation (Dawes et al., 1977; Messick et al., 1983).

According to equity theory (Adams, 1965), individuals desire an equitable distribution of final outcomes; therefore, those who engage in sustainable commuting may cease to do so if they perceive that the individual costs of acting pro-environmentally are not being shared among all commuters. These equity, or fairness, norms affect behaviour because individuals evaluate them with respect to their perception of others' behaviour and, depending on the perceived fairness, decide whether or not to cooperate (see Biel & Thøgersen, 2007). Individuals who perceive an inequitable distribution of costs and benefits may choose to defect based on a desire for equity, even if cooperation is the more rational choice (Fehr & Fischbacher, 2004). In addition, a related reciprocity norm may be also elicited. This norm may reinforce cooperation if individuals perceive that others are cooperative, or it may encourage defection if individuals perceive that others are uncooperative and thus lead people to defect even when they would rather cooperate (see Biel & Thøgersen, 2007).

Defining social normative beliefs. Research on social norms has gone by many different names, including social validation, social proof, and consensus effects (Schultz, 2009). Various types of norms have been proposed and defined, and this variation can give rise to confusion when examining the effect of social norms on behaviour. A general, sociological definition of social norms is that they are, "rules and standards that are understood by members of a group, and that guide and/or constrain social behaviour without

the force of laws" (Cialdini & Trost, 1998, p. 152) that are thought to have "evolve[d] to regulate social life" (Biel & Thøgersen, 2007, p. 94). Most generally, social norms refer to an individual's beliefs about what is the typical and condoned behaviour in a given situation. Because they exist within the head of the individual, these beliefs may not necessarily be an accurate representation of reality. Nevertheless, they exert a powerful influence on behaviour, especially in novel situations (Schultz, 2009). These norms result from perceived expectations of reference groups, as well as individuals motivations to comply with these expectations, and they can become personal norms if they are internalized.

Despite the fact that all social norms are based on external references, because they result from the attitudes and actions that individuals perceive in themselves and others, Deutsch and Gerard (1955) propose that social norms should be divided into two categories according to their motivational sources. First, descriptive social norms, which reflect individuals' beliefs about how the majority of others typically behave in given situations (i.e., what is normal), convey information about which behaviour is likely to be effective (Cialdini, 1988). Second, injunctive social norms, which reflect individuals' beliefs about what is the accepted behaviour in a given situation, pertain to beliefs about how others think that people should behave (Reno, Cialdini, & Kallgren, 1993). Here, individuals are motivated to comply to either receive social rewards or avoid social punishments. The present study will focus on the former type of normative beliefs, descriptive social norms.

In sum, given the typical anonymity of large-scale environmental dilemmas, it seems beneficial to share information about others' cooperative behaviour (Aronson & O'Leary, 1983; Schultz, 1999), so as to elicit equity and reciprocity norms that facilitate cooperation. Although the activation of social norms is mostly unconscious, once a norm has been

activated individuals typically adhere to it as though it were a habitual behaviour (Bicchieri, 2002). Several key models exist to explain the association between normative beliefs and environmental behaviour.

Theoretical frameworks to explain pro-environmental behaviour. Three theoretical frameworks include social normative beliefs as one of the key determinants of social behaviour: the theory of planned behaviour (TPB, Ajzen, 1991) and the norm activation model (NAM, Schwartz, 1977), along with the closely-related value-belief-norm (VBN) theory (Stern et al., 1999).

The TPB is an extension of Fishbein and Ajzen's (1975) theory of reasoned action, and both endeavour to explain how attitudes and behaviours are connected. The TPB has received empirical support in a variety of behavioural domains. Most recently it has been successfully used to explain environmental behaviours, such as recycling (Boldero, 1995) and public transport use (Heath & Gifford, 2002). This theory assumes that intention is the most proximal psychological determinant of behaviour. It suggests that intention is composed of, and causally determined by, three factors: individuals' attitudes about the specific behaviour (as determined by beliefs and values concerning the consequences of the behaviour); individuals' perceptions of the social norms regarding the behaviour (i.e., perceived expectations of reference individuals or groups as well as motivation to meet those expectations); and finally, the degree to which individuals perceive the behaviour to be under their control.

The remaining two theoretical frameworks are the NAM (Schwartz, 1977) and its spin-off, the VBN theory (Stern, 2000; Stern et al., 1999). The NAM was originally developed to explain altruistic behaviour, a domain in which it has since demonstrated its

usefulness. The NAM is based on the premise that moral (i.e., personal) norms determine pro-social behaviour, whereby the belief that certain behaviour is right or wrong motivates individuals to perform the behaviour to reduce feelings of guilt (Schwartz, 1977). According to this model, an individual first perceives a problem (i.e., potential negative consequences to others or to the environment), understands the consequences of action or inaction, and then weighs the benefits or costs to the self of action or inaction. The NAM has been applied to explain pro-environmental behaviour (e.g., Van Liere & Dunlap, 1978).

Stern and his colleagues modified the NAM, and developed the VBN theory specifically to explain environmental behaviour (Stern, 2000; Stern, Dietz, Abel, Guagnano, & Kalof, 1999). The VBN theory adds to Ajzen's causal process by suggesting that personal values precede environmental beliefs. Specifically, this theory proposes that several variables are linked to influence environmental behaviour through a causal chain. Like the NAM, the VBN theory asserts that behaviour results from personal norms (i.e., a sense of moral obligation to behave a certain way). As a specific pathway of effect, the VBN suggests that norms are activated by a belief that environmental conditions will threaten something valued by the individual (e.g., nature), as well as the belief that the individual can act to reduce this threat and thus preserve the related things of value. Furthermore, the VBN theory suggests that these two beliefs stem from one's general conception of human-environment interactions and, thus, combines the NAM with the New Ecological Paradigm (NEP, Dunlap & Van Liere, 1978).

The VBN theory has been successfully applied to explain the acceptability of household energy-saving policies (Steg, Dreijerink, & Abrahamse, 2005) as well as willingness to reduce car use (Stern et al., 1999). These frameworks refer mostly to personal

norms (i.e., moral obligation) or injunctive social norms; however, as noted earlier, descriptive social norms have also been shown to influence environmental behaviour.

Social-norms marketing campaigns and pro-environmental behaviour. Researchers have long sought to discover the most effective means to alter behaviour – a goal shared by those who develop and implement public service campaigns. Although information-based campaigns (e.g., pamphlets) have traditionally enjoyed much popularity because of their cost-effectiveness and ease of implementation, they have not been overly effective (e.g., Gardner & Stern, 1996; Schultz, 1999; see Abrahamse, Steg, Vlek, & Rothengatter, 2005 for review). As a result, persuasive communications using social normative information, such as guilt appeals, responsibility appeals, modeling, community-based social marketing, and social norms marketing, have gained popularity in recent years (Thøgersen, 2009). Social norm marketing assumes that people's behaviour is guided by perceptions of their peer's attitudes and actions (Thøgersen, 2009). Such descriptive normative beliefs have been shown to be correlated with a variety of behaviours, including littering (Cialdini et al., 1990), alcohol consumption (Prentice & Miller, 1993), recycling (Hornik et al., 1995), water conservation (Corral-Verdugo, Frías, Pérez, Orduño, & Espinoza, 2002), and energy conservation (Schultz et al., 2006).

However, individuals tend to overestimate the frequency at which their peers engage in undesirable behaviours and underestimate the frequency at which they engage in desirable behaviours. As such, these normative perceptions are often inaccurate. This pluralistic ignorance, as it has been termed, can be corrected through the provision of accurate information via social norms marketing campaigns. It is this disconnect between normative

beliefs and reality that provides the leverage by which social norms theory may be used to promote pro-environmental behaviour.

The correction of these misperceptions has proven to be successful when applied to decrease a variety of behaviours, such as tobacco use and drinking and driving. Several intervention studies have also illustrated the usefulness of social normative feedback in eliciting change to environmentally relevant behaviours. In a study on recycling behaviour, Schultz (1999) found that recycling behaviour increased when individuals were provided with information about their personal recycling efforts and about group efforts. Presumably, individuals were motivated to reduce any discrepancies between their behaviour and that of the group, possibly because of psychological conflict or guilt (Allen, 1965). Furthermore, in a study on energy conservation, residents who were informed that their neighbours had taken steps to curb energy consumption significantly reduced their household energy use, even though, when interviewed later, participants reported that the descriptive norm message was not motivational in terms of promoting conservation behaviour (Nolan, Schultz, Cialdini, Goldstein, & Griskevicius, 2008). Thus, despite the lack of awareness of the strong influence of normative beliefs, they have been shown to be powerful predictors of some environmental behaviours.

Furthermore, a study on the reuse of hotel towels showed that a message that included both a descriptive norm message (i.e., that others at the hotel typically reused their towels) and an injunctive norm message (i.e., reusing hotel towels is a “good” thing to do) resulted in a significant reduction in the number of towels removed from the hotel room for cleaning, compared to the control condition (Schultz, Khazian, & Zaleski, 2008). A similar study found that the effectiveness of these social norm communications could be increased when

they emphasized the typical behaviour of previous guests in that specific hotel room (Goldstein, Griskevicius, & Cialdini, 2007). This finding is consistent with Festinger's (1954) theory of social comparison, which states that individuals compare themselves most to those who they feel are similar.

Taken together, these studies demonstrate that normative messages can cause a change in both private and public behaviour. However, although normative messages have received fairly consistent support for their effect on behaviour in laboratory settings, results from field studies have been more mixed, with some research showing a phenomenon termed the "boomerang effect" in which the social norms message increases the behaviour that it is intended to decrease (Perkins, Haines, & Rice, 2005). For example, a study at the Petrified Forest National Park revealed that messages intended to deter visitors from stealing petrified wood actually increased the incidence of theft when they mentioned that the theft was a common occurrence (Cialdini, 2003). In another study on household energy conservation, a descriptive normative message about neighbours' energy use resulted in either an energy reduction or the boomerang effect, depending on participants' initial energy consumption rates (Schultz, Nolan, Cialdini, Goldstein, & Griskevicius, 2007); for both high and low energy-use participants, there was a movement towards the mean. Seemingly, the normative message can leave those who engage in the target behaviour at a rate that is better than the norm feeling taken advantage of and as if they have 'room to move.' In this sense, norms function as a guide to behaviour, but the same message can either increase or decrease the target behaviour, depending on one's initial place relative to the norm.

Other research has shown that the addition of an injunctive social norm message can eliminate this boomerang effect. For instance, messages about stealing petrified wood were

more successful at dissuading theft when they emphasized the injunctive norm, or social stigma, against stealing (Cialdini, 2003). Schultz et al. (2007) also found that this effect could be eliminated through the addition of an emoticon which conveyed the injunctive norm of the social approval of energy conservation. Specifically, for high consumers the message produced a reduction in consumption, and an even larger effect was created by the addition of the injunctive norm. Low energy users, however, increased consumption rates when they were solely provided with the descriptive feedback message - an effect which disappeared once the injunctive norm message was added.

Despite the above findings, the extent and degree to which social normative information will affect large-scale, high carbon-impact behaviours, such as driving, is presently unclear. Values and beliefs, like those about others' behaviour, typically have the greatest influence on lower-impact behaviours and, as such, they may be most successfully employed in persuasive communications aimed at altering those behaviours. In contrast, the behaviours that have the most potential to reduce emissions are typically more influenced by technological and financial aspects. Therefore, the present study may not yield results that are consistent with previous literature.

The Present Study

This study employed a field-intervention design to evaluate how divergent social normative information is related to willingness to decrease private vehicle use. Social-norms marketing campaigns have shown promise to encourage various types of pro-social behaviour, but little research has examined whether or not their usefulness extends to high-impact, pro-environmental behaviours, such as vehicle use. Regardless, previous literature in other domains informs the first hypothesis; namely, that those in the high social norm

condition will exhibit a greater reduction in private vehicle use as compared to those in the low social norm condition. Second, this study maintained a null hypothesis as to whether or not initial social normative beliefs would interact with the social norm condition to influence subsequent behaviour change.

This study also examined which aspects of QoL participants' anticipated would change as a result of a hypothetical 25% decrease in private car use. The third hypothesis, based on previous literature, is that participants will anticipate reductions to individually-relevant QoL aspects and improvements to collectively-relevant QoL aspects. Fourth, those who expected more adverse QoL effects are predicted to be less likely to reduce their private vehicle use compared to those who expect less adverse QoL effects. Fifth, as suggested by Gifford and Steg (2007), this study also aimed to explore which changes participants reported to their experienced QoL as a result of their personal decrease in private vehicle use. A null hypothesis was maintained in this regard, although these observed changes could be expected to correspond to the anticipated QoL changes reported by Poortinga et al. (2001).

Importance of research. Social norm research can inform efforts to create effective environmental public service campaigns. Given the anonymity inherent in many large-scale environmental dilemmas, dissemination of information about others' cooperative behaviour may be useful in eliciting norms that facilitate cooperation (Schultz, 1999). In addition, an understanding of the QoL indicators that are most affected will allow policy-makers to consider possible compensation for any perceived losses associated with these strategies, so as to increase the overall positive evaluation of such strategies (De Groot & Steg, 2006a; Steg, 2005; Steg & Gifford, 2005). Last, as noted by Stern et al. (1999), knowledge about behavioural influences is only useful, from an environmental perspective, insofar as that

behaviour contributes to climate change. Transportation use is thought to be a valid indicator of the environmental impact of human behaviour (e.g., Dürr, 1994), and therefore it is a measure of environmental behaviour with much potential to affect environmental outcomes.

Chapter 2: Method

Participants

Eighty-one participants were recruited from the University of Victoria and randomly assigned to the control (n = 29), low social norm (n = 26), or high social norm condition (n = 26). This sample size was based on Cohen's (1992) recommendation that 85 participants are needed to detect a medium effect size, when $\alpha = .05$, $\beta = .2$, and power = .8. To be eligible to participate, individuals had to be over 18 and possess a vehicle that they could use to commute to campus.

The mean age of participants was 32.80 years (SD = 15.31), and the sample consisted of 50 (61.73%) females and 31 (38.27%) males. Approximately half the participants were students (n = 46 or 56.79%), and the rest (n = 35 or 43.21%) were faculty or staff members. The mean age of the student participants (M = 20.96, SD = 2.39) was less than that of the faculty and staff participants (M = 48.37, SD = 10.24). Within the faculty and staff subset of the sample, 12 individuals were instructors, eight were administrative assistants, five were managers, one was in the trades, and nine reported that they held other positions. The average income of participants who provided this information (n = 27), the majority of whom were faculty or staff members, was C$85 666.81 ($SD$ = 50 266.72).

More than half the participants (n = 46 or 56.79%) reported living in a suburban neighbourhood more than 2 km from Victoria's downtown core. The second-most common residence location, reported by 20 participants (24.69%), was suburban within 2 km of the downtown core. Another eight participants (9.88%) reported living in the downtown core, and six (7.41%) indicated that they live in a rural neighbourhood.

The most common vehicle type was the car (*n* = 59 or 72.84%). Vans and SUVs were the second-most common vehicles (*n* = 8 or 9.88%, each). Three participants reported driving a truck (3.70%), and one participant each (1.23%) stated that they drive a hybrid, motorcycle, or other type of vehicle. Average vehicle age was listed as 10.01 years (*SD* = 6.22).

The majority of participants (*n* = 47 or 58%) had completed some university, 15 participants (18.5%) had completed graduate school, 13 (16%) had an undergraduate degree, and the rest had completed some graduate school or some college (*n* = 2 or 2.5%, respectively).

Materials

Transport behaviour measures. Two types of transport measures were employed in this study: (1) the two-week transport habits measure and (2) the Week 1, 2, 3, and 4 transport record. For the former measure, an estimation of transport behaviour over the two weeks preceding the study was adapted from Loukopoulos, Jakobsson, Gärling, Meland, and Fujii's (2006) measure of car use and alternative transportation behaviour. In the original measure, respondents were asked to approximate the number of car trips they took for work, shopping, and leisure purposes over the past week, along the following scale: 1 (*0 trips*), 2 (*1-2 trips*)… to 7 (*More than 10 trips*). The modified scale, used in this study, assessed participants' private vehicle use for "School/Work" purposes and "Other (i.e., shopping, leisure, and appointments)" purposes (Appendix A). Participants were asked to estimate the total number of private vehicle trips that they took in the past two weeks, as well as the average time per trip, for each of the two trip purpose categories. In addition, in the revised measure, the word "car" was replaced with "vehicle" to include the other types of transport.

The alternative transport measure in this two-week transport habits measure was also modified from Loukopoulos et al. (2006). In the scale's original form, participants were asked to indicate how often they would perform each of 10 transport adaptation alternatives in the future (e.g., "*Use public transport instead of car*" and "*Conduct the activity less frequently*") compared to now, given various hypothetical car-use reduction goals. Original response options ranged from 1 ("*Not more than today*") to 5 ("*A great deal more than today*"). For present purposes, the generalized scale items were rephrased to assess recollected alternative transport behaviour, rather than intended future behavioural change. In general, this two-week pre-study behaviour measure was included to reduce the Heisenberg effect: when a change in behaviour results from the mere action of recording that behaviour. Thus, the current version of this scale required participants to reflect on their "other" transport trip behaviour (e.g., bus, carpool, rideshare, cycle, or walk) over the previous two weeks and to estimate the total number of trips taken, as well as the average time per trip, for "School/Work" purposes and "Other" purposes.

When they had completed the two-week transport habits measure, participants were asked to indicate how typical this two-week period was of their usual transport behaviour, from 1 (*Not at all typical*) to 7 (*Extremely typical*). Space was provided at the bottom of this revised scale for participants to include comments. Additional changes to Loukopoulos et al.'s (2006) measure included changing the word "sustainable" to "alternative," adding the word "single-occupant vehicle use" to the instructions, and merging table data to reduce cognitive load on participants.

The scale used for the Week 1, 2, 3, and 4 transport records differed from the above measure in that the term "over the past two weeks" was replaced with "today," so that

participants were asked to record the number of trips and the total amount of time that they engaged in private vehicle use and other types of transport behaviour each day, rather than the average time per trip (Appendix B). Again, participants were provided with a space to include comments about their daily transport activities. The only difference among the Week 1 – 4 transport records was that the Week 1 record, which was intended to serve as a baseline assessment of behaviour, included a question that asked about how typical their behaviour during the previous week was of their usual transport behaviour, from 1 ("*Not at all typical*") to 7 ("*Extremely typical*").

Quality-of-life indicators. Two slightly adapted versions of Poortinga et al.'s (2004) list of 22 QoL indicators were administered to measure participants' current QoL, as well as their anticipated change to QoL in response to decreased private vehicle use. Pootinga et al. generated this list based on a literature review (see Gatersleben, 2000; Vlek et al., 1999). In the scale's original form, participants were asked to evaluate the importance of each aspect in their lives on a Likert-type scale from 1 ("*Unimportant*") to 5 ("*Very important*"). Gifford and Steg (2007) suggest that this scale can be modified to evaluate participants' current QoL, or the extent to which values are fulfilled. Thus, to assess experienced QoL scale items were reworded to reflect ratings of experience rather than importance. Despite this subtle rephrasing, the scale items remained relatively unchanged. For example, the identity and self-respect item was changed from "*Having sufficient self-respect and being able to develop one's own identity*" to "*I have sufficient self-respect and feel that I am able to develop my identity*." Additionally, response options were increased to a seven-point scale, ranging from 1 ("*Not at all*") to 7 ("*Very much so*"), to match the anticipated QoL scale and to be more sensitive to subtle changes in QoL.

Of the original 22 QoL aspects, two items explicitly refer to the environment: the environmental quality aspect ("*I have access to clean air, water and soil. I enjoy, and will be able to maintain, a good environmental quality*") and the nature and biodiversity aspect ("*I am able to enjoy natural landscapes, parks and forests. I feel assured of the continued existence of plants and animals and the maintenance of biodiversity*"). These items, along with several other items, were double-barrelled and so both were separated into two items. An additional item, related to the extent to which participants believed that their status is accurately portrayed to others, was also included in the scale. One final question was added to assess overall current QoL. Therefore, the resulting experienced QoL scale contained 29 items (Appendix C).

To measure anticipated changes to QoL, De Groot and Steg (2006) used Poortinga et al.'s (2004) original wording of QoL items; for example, the environmental quality aspect reads as follows: "*Having access to clean air, water, and soil. Having and maintaining a good environmental quality*." De Groot and Steg did, however, alter the response options to reflect expected changes to each of the QoL indicators along a scale from -3 (*Would decrease dramatically*) to 3 (*Would increase dramatically*). The scale instructions were re-worded for present purposes, so that participants were asked to imagine that they were going to reduce their private vehicle use by at least 25 percent over the next three weeks and to indicate how they expected that this change would affect each of their 29 QoL indicators described above (Appendix D). Along the same seven-point response scale, participants also indicated their anticipated change to overall QoL using a question slightly adapted from one of De Groot and Steg's: "*All things considered, to what extent would [decreasing your single-occupant vehicle use by at least 25%] affect your overall QoL*?"

Descriptive social norm measure. A four-item measure of descriptive normative beliefs was created for this study. Participants were asked to estimate "What percent of students [do you] think engage in some form of sustainable commuting to campus (i.e., ride the bus, walk, bike, carpool, etc.) on a fairly regular basis," from 0% to 100%. Participants also estimated "What percent of students [do you] think commute to campus using single-occupant vehicle use on a fairly regular basis." The final two questions were identical in their phrasing and response scale, except that "students" was replaced with "staff." Participants were asked to ensure that their responses for these two items totalled 100% for both staff and students (Appendix E).

Sociodemographic measure. A brief questionnaire was included to assess key participant demographics, such as age, gender, occupation (i.e., student versus employee), vehicle age, and distance between their residences and campus (Appendix F).

Information page. This page contained information about options for sustainable commuting to campus, as well as varying fictitious social norm information for the two experimental conditions. Those in the high social norm condition were informed that, "Since 1993, 26% of UVic commuters have switched to more sustainable modes of transport to campus," whereas those in the low social norm condition were told that since that time, "only 4% of UVic commuters have switched to more sustainable modes of transport to campus." These values were chosen to deviate enough from one another to cause a social norm effect, if one exists. Social norm information was absent from the control condition version of this page. According to the University of Victoria, since 1993 a 7% decrease in private vehicle use as a form of commuting to campus has occurred. Other than the differing social norm information, the contents of these pages were the same (Appendix G).

The participants were then asked to "please make every attempt to reduce your single-occupant vehicle use over the next three weeks by however much you can, with the goal of a 25% reduction." Steg et al. (2002) asked participants to reduce their household energy consumption by at least 5%. This was increased to 25% in this study because a higher goal was thought to be more likely to result in behaviour change, and also it carried a higher likelihood that QoL effects would emerge (De Groot & Steg, 2006b). Thus, a goal of reducing by 25% was thought to be sufficiently large, yet feasible. The goal was specified, rather than allowing participants to choose their own goal, for the sake of standardization. Alternative transport options, as well as contact information for purchasing a rideshare or carpool permit through Campus Security Services and the campus rideshare website were also included.

Reminder emails. An email was sent to participants at the beginning of Week 2 (Appendix H) to remind them to submit Transport Booklet #1. Similar emails were sent to participants at the beginning of Week 3 and Week 4 (Appendix I and J). These emails served several functions. First, participants were thereby reminded to submit their booklets, if they had not already done so. Second, participants in the two experimental conditions received normative information consistent with their condition; specifically, those in the low social norm condition were told that, "In general, participants in previous phases of the study have reduced their private vehicle use by approximately 5%," whereas those in the high social norm condition were told that, "In general, participants in previous phases of the study have reduced their private vehicle use by approximately 19%." Last, the emails repeated the goal of reducing by 25% and they reiterated alternative transport options. A final email was sent

to participants at the end of Week 4 (Appendix K) as a reminder to submit Transport Booklet #2.

Procedure

Pilot testing. Initially, 12 participants were recruited for a pre-test phase of the procedure. Of these, most individuals were recruited through a third-year psychology class, although several were recruited through campus parking lots. Unfortunately, only four individuals submitted both Transport Booklet #1 and #2. Based on this low participation rate and feedback from those who did participate, study materials were slightly revised (e.g., the seven-point scale from the two-week transport habit measure was added to the Week 1 baseline measure) and several improvements were made to the methodology. Specifically, the number of emails was increased from two to five because participants mentioned that a greater frequency of contact may reduce the attrition rate. Also, participants were subsequently addressed by name in emails. These modifications increased the response rate considerably for subsequent participants. Because of the changes that were made to the materials and the methodology, data from these pilot test participants were not included in study analyses.

Recruitment. Participant recruitment for the study took place between August 2008 and March 2009. It was carried out through a variety of means, depending on whether the prospective participant was a student or faculty/staff member. Recruitment for the student subset of the sample was conducted through the Psychology Research Participation System. The study was advertised on this system and interested students could sign up to participate as a means to gain course credit in their undergraduate psychology classes.

The faculty and staff participants were more difficult to recruit, likely because the compensation offered had an element of chance (i.e., the possibility of winning one of four prizes of $100 in a lottery draw), compared to the student participants who all received course credit. In one method of recruitment for these participants, representative staff members from various campus departments were asked to forward a recruitment email to their department listserv. Second, where possible, recruitment flyers were posted in common areas (e.g., lunch rooms). Third, participants were also recruited through information sessions at the beginning of staff meetings. Because it is unknown how many individuals were exposed to the above methods of recruitment, an associated response rate is unavailable. Fourth, personalized study invitation letters were sent through campus mail to 282 faculty/staff members, representing 26 departments, at the University. In total, 17 faculty or staff participants were recruited via this means, a response rate of 6.03%.

Study period. The study procedure was loosely based on that employed by Steg et al. (2002) in their analysis of household energy consumption. Participants were given a package that contained the study instructions, the letter of information for implied consent (Appendix L), Transport Booklet #1, Transport Booklet #2, two self-addressed, stamped envelopes, and a lottery information form (Appendix M). In the study instructions, participants were asked to begin the study on a specified date. On that date, they commenced the study by reading the letter of information. Their consent was implied by their continuation in the study and their submission of data. Participants then began to complete Transport Booklet #1. In it, they first completed the two-week transport habits measure as an indicator of their transport behaviour prior to commencing the study. Next, they recorded their daily transport behaviour for one week, using the Week 1 transport record, as a baseline measure of behaviour. Following this

week, they completed Questionnaire #1, which included the 29-item experienced QoL scale, the descriptive social norm scale, and the sociodemographic scale. Next, participants were asked to submit their booklet by mail using the envelope provided.

The following day, participants began to complete Transport Booklet #2, which consisted of Questionnaire #2, the Week 2 - 4 transport records, and Questionnaire #3. In this booklet, participants were initially presented with one of three versions of the information page, in which they were asked to attempt to reduce their private vehicle use by 25% over the next three weeks and were provided with information about alternative transport options. Depending on their assigned condition, some participants received falsely inflated or deflated statistics about others' sustainable commuting behaviour to campus, whereas others did not receive any information about others' transport behaviour. All then completed Questionnaire #2 in which they recorded their anticipations about how a 25% decrease in private vehicle use would affect the 29 aspects of their QoL. At the beginning of Week 2, participants received an email reminder to submit their Transport Booklet #1. They were then presented again with the instructions for completing the transport records and, on the same day, began to complete the Week 2 transport record. Participants continued to record their daily transport behaviour, plus any reasons for their transport choices, for seven days using the Week 2 transport record.

As in Steg et al.'s (2002) methodology, another email was sent to all participants at the beginning of Week 3 to remind them to continue to attempt to reduce their private vehicle use as much as possible and to submit their Transport Booklet #1, if they had not already done so. This email was also used to reiterate the transport alternatives and to strengthen the divisions between the norm conditions by repeating the divergent normative information,

except to those in the control condition. Another important purpose of this email was to reduce attrition by maintaining contact with participants.

Participants then completed the daily transport records for Week 3. At the beginning of Week 4, participants received yet another email, similar to that described above. Next, individuals completed the daily transport records for Week 4, again recording any comments. At the end of Week 4, participants completed Questionnaire #3, wherein they once again responded to the experienced QoL scale and the descriptive social norm scale. They were then prompted to complete a lottery information form if they wished to be included in the draw to win one of four prizes of $100. Finally, participants were thanked for their time and urged to return the Transport Booklet #2, along with the lottery information form if they chose, using the envelope provided. Also at the end of Week 4, participants received a final email reminding them to submit the second transport booklet. Once this booklet was received, participants were emailed a debriefing form, specific to their condition, in which they were informed of the study's purposes and applications, and encouraged to voice any questions, comments, or concerns (Appendix N).

Pre-analysis Variable Computations

Prior to conducting the analyses, variable indices were created and several other changes were made to the dataset. First, average index values were computed for the pre- and post-manipulation experienced QoL scale and for the anticipated change to QoL scale, according to the number of items in each scale. Second, pre-manipulation descriptive social normative belief values about the percentage of staff and student commuters who engage in alternative transportation were averaged for each participant to yield a mean percentage of campus commuters who engage in this mode of transport. The mean percentage of pre-

manipulation beliefs about private vehicle use commuting was also computed for each participant.

Third, the social norm condition variable was recoded into the Contrast 1 variable (i.e., control condition = 0, the low social norm condition = 1, and the high social norm condition = -1). In addition, a social norm condition manipulation check variable, termed Contrast 2, was created (i.e., the control condition = 2, and the low and high conditions = -1) for use in the analyses, and it was coded to ensure that these two variables were orthogonal.

Fourth, before an interaction term could be created between the social norm condition variable (i.e., Contrast 1) and the pre-manipulation variable concerning average descriptive social normative beliefs about others' alternative transportation behaviour, it was necessary to center the continuous component variable. As such, the pre-existing normative beliefs variable was centered (i.e., the grand mean of 50.71 was subtracted from each data point), so that it had a new mean of zero (Aiken & West, 1991). This centering ensured that the component independent variables were not too highly correlated with their interaction product term, and therefore reduced potential problems with multicollinearity (Tabachnick & Fidell, 2007). The interaction term was then computed by multiplying the social norm condition variable by the centered normative beliefs variable.

Fifth, several changes were made to the transportation behaviour data prior to analysis. The majority of the faculty/staff participants began the study on a Sunday, whereas, for reasons related to the Psychology Research Participation System, the majority of the student participants began the study on a Thursday. As a result, eight weekend data points were omitted for all participants to standardize the meaning of observations. Therefore, the remaining 20 data observations pertained only to transportation during the workweek.

Sixth, two transportation indices were then computed: one for school/work transport trip purposes and one for other transport trip purposes (e.g., errands, appointments, and social outings). For each index, the number of alternative transport trips was subtracted from the number of private vehicle use trips, so that positive values represent more private vehicle use, relative to alternative transportation use, and negative values represent more alternative transportation use, relative to private vehicle use. For each trip purpose index, average weekly values were computed for the Week 1 (baseline), Week 2, Week 3, and Week 4.

Last, these mean weekly transport indices were then averaged to yield total transportation index values for each type of trip purpose for each week.

Chapter 3: Results

Prior to analysis, basic data cleaning procedures were performed on all variables.

Univariate Outliers

Data were first assessed for univariate outliers, using approaches that differed according to whether they were fixed-response, semi-fixed response, or non-fixed response data. Several data entry errors were identified and corrected, and several responses that exceeded the scale range were changed to missing.

Values on the four behavioural measures (i.e., the number of private vehicle use trips for school/work and for other purposes, as well as the number of alternative transport trips for school/work purposes and for other purposes) were also assessed. They were converted into standardized residuals, and *z*-score values in excess of 3.29 ($p < .001$, two-tailed test) were considered to be outliers. These values were not omitted because they were thought to be from the target population; rather, they were winsorized to reduce their impact. Specifically, each outlier was replaced with a value that was one standard deviation higher than the next highest score across participants for that observation day (see Field, 2005). Twenty-five data observations (or 1.11%) were winsorized for the number of private vehicle use trips for other purposes, 14 (or 0.63%) for the number of alternative transport trips for school/work purposes, and 17 (or 0.76%) for the number of alternative transport trips for other purposes.

Missing Data

Of the 81 participants who submitted their Transport Booklet #1, 29 were in the control condition (35.80%), and 26 were from each of the low and high social norm condition (32.09% for each). One participant from each condition neglected to submit their

Transport Booklet #2, for an attrition rate of 3.70%. Thus, 78 participants submitted both booklets: 28 from the control condition (35.89%), and 25 from each of the two social norm conditions (32.05% for each).

Three participants who did not submit their second transport booklet were omitted from the missing data calculation because they were each missing 70.80% of their data. The average percentage of missing data for each of the remaining participants from the response scale data (i.e., excluding the demographic variables and the transportation behaviour data) was low (M = 1.21%, SD = 2.79%). Three of these remaining participants were missing more than 10% of their data, with the maximum percentage of 12.68%. There was little difference between the percentage of missing data for student participants (M = 1.06%, SD = 2.21%) and for faculty/staff participants (M = 1.39%, SD = 3.42%). The percentage of missing data for the four transportation behaviour measures across the 28 observation days of the study was also low. Not including those who failed to submit Transport Booklet #2, 0.5% of the data observation points (i.e., 45 out of 8988) were missing.

Scale Reliability

The internal consistency of each scale was assessed using reliability analysis. The pre- and post-manipulation 29-item experienced QoL scales both had an excellent reliability (α = .92 and α = .95, respectively), and all corrected item-total correlation values were adequately high. The 29-item anticipated change to QoL scale also had a high reliability (α = .93).

Mean Replacement

Given the low percentage of overall missing data, a mean replacement was deemed appropriate to perform, and it was carried out on all variables for all participants (except for

the three participants). To compute the mean replacement values for the QoL and social normative belief scales, variable means were computed separately for each social norm condition, and these values were entered in lieu of the missing data on a per-variable basis according to each participant's assigned condition. Furthermore, missing data for the four behavioural measures were replaced with the social norm condition mean for the day that the data were missing.

Normality

The normality of all variable distributions was evaluated. The majority of the variables were normally distributed, although potential problems were identified with the skewness and kurtosis of some variables. Square root and log transformations were performed in an effort to normalize these distributions; however, despite the fact that the transformations marginally improved the normality in some cases, modeling with and without the transformed variable resulted in largely identical regression results. Therefore, as suggested by Tabachnick and Fidell (2007), the untransformed variables were retained for ease of interpretation.

Descriptives

Means and standard deviations were calculated for all study indices (Table 1). In general, participants reported high levels of pre-manipulation experienced QoL (M = 5.72, SD = .65) and post-manipulation experienced QoL (M = 5.73, SD = .73), given the maximum scale value of 7. The index value for the anticipated change to QoL scale indicates that, in general, participants expected no change to their QoL under a hypothetical reduction in private vehicle use by 25% (M = -.06, SD = .53).

Participants reported pre-manipulation normative beliefs that a greater percentage of students commute to campus via alternative forms of transport (*M* = 65.14%, *SD* = 14.16%), than private vehicle use (*M* = 35.05%, *SD* = 14.52%). Conversely, participants reported pre-manipulation beliefs that fewer staff members commute to campus via alternative forms of transport (*M* = 36.44%, *SD* = 17.87%), than private vehicle use (*M* = 63.54%, *SD* = 17.83%). Post-manipulation normative beliefs, shown in Table 1, were largely the same.

The descriptive statistics for the average weekly transportation indices are shown in Table 2. The negative valence of all index values indicates that participants generally engaged in alternative transportation more frequently than private vehicle use. In addition, a trend for decreasing index scores from Week 1 (*M* = -.06, *SD* = 1.24) to Week 3 (*M* = -.46, *SD* = 1.09) appears, but then a slight increase between Week 3 and Week 4 (*M* = -.37, *SD* = .90) appears. Furthermore, the weekly index values for school/work trip purposes typically are more negative than are those for other trip purposes, which suggests that participants engaged in more alternative transport use, relative to private vehicle use, for commuting than for errands and appointments.

Table 1: Descriptive Statistics for Pre-manipulation (*N* = 81) and Post-manipulation (*N* = 78) Variables and Indices

	Mean	SD
Pre-manipulation		
Experienced QoL	5.72	.65
Beliefs about students' alternative commuting	65.14%	14.16%
Beliefs about staff members' alternative commuting	36.44%	17.87%
Mean beliefs about alternative commuting	50.71%	12.79%
Beliefs about students' private vehicle use commuting	35.05%	14.52%
Beliefs about staff members' private vehicle use commuting	63.54%	17.83%
Mean beliefs about private vehicle use commuting	49.38%	12.95%
Post-manipulation		
Anticipated changes to QoL	-.06	.53
Experienced QoL	5.73	.73
Beliefs about students' alternative commuting	63.74%	14.48%
Beliefs about staff members' alternative commuting	38.48%	19.28%
Mean beliefs about alternative commuting	51.11%	13.11%
Beliefs about students' private vehicle use commuting	36.19%	14.54%
Beliefs about staff members' private vehicle use commuting	61.52%	19.28%
Mean beliefs about private vehicle use commuting	48.86%	13.19%

Note: Response options for the pre- and post-manipulation experienced QoL scale ranged from 1 (*Not at all*) to 7 (*Very much so*). Response options for the anticipated change to QoL scale ranged from -3 (*Decrease dramatically*) to 3 (*Increase dramatically*). Social normative beliefs refer to percentage of campus commuters who engage in that form of transportation.

Table 2: Descriptive Statistics for Total Transportation Indices, School/work Trip Purpose Indices, and Other Trip Purpose Indices for Week 1 (*N* = 80), and Week 2, 3, and 4 (*N* = 78)

	Mean	SD	Minimum	Maximum
Total transportation indices				
Week 1	-.06	1.24	-3.00	4.94
Week 2	-.27	1.16	-2.38	4.23
Week 3	-.46	1.09	-3.05	3.27
Week 4	-.37	.90	-2.30	1.86
School/work trip purpose indices				
Week 1	-.11	1.70	-4.50	4.23
Week 2	-.24	1.73	-5.36	5.03
Week 3	-.60	1.67	-4.50	4.32
Week 4	-.54	1.35	-3.20	2.40
Other trips purpose indices				
Week 1	-.02	1.31	-4.00	5.65
Week 2	-.30	1.00	-2.51	3.42
Week 3	-.33	.99	-2.40	2.22
Week 4	-.21	.92	-2.00	3.31

Note: Index values reflect the number of private vehicle use trips minus the number of alternative transport trips, averaged across each week. Thus, negative values represent more alternative transport trips, relative to private vehicle use trips, and vice versa for positive index values.

Associations among the study indices and demographic variables were examined. Gender was not related to any of the demographic variables (Table 3), nor was participants' level of education (Table 4). However, participant type (i.e., student or faculty/staff) was related to post-manipulation experienced QoL (Table 5). Students reported a higher QoL rating (M = 5.89, SD = .56) than faculty/staff (M = 5.50, SD = .88). In addition, as shown in Table 6, younger participants reported higher levels of experienced QoL for both pre-manipulation (r = -.25, p = .02) and post-manipulation ratings (r = -.27, p = .02). Finally, those with newer vehicles also reported higher levels of this QoL measure (r = .23, p = .04).

Table 3: Gender Differences in Key Variables

	t	*p*	Mean difference
Week 1 total index	-.13	.90	-.04
Week 1 school/work trip index	-1.13	.26	-.45
Week 1 other trip index	1.23	.22	.37
Pre-manipulation experienced QoL	1.46	.15	.22
Anticipated change to QoL	1.68	.10	.21
Normative private vehicle use beliefs	.73	.47	2.19
Normative alternative transport beliefs	-.79	.43	-2.33
Post-manipulation experienced QoL	1.99	.05	.33

Note: * $p < .05$. Male = 1 and female = 2.

Table 4: Differences in Key Variables According to Participants' Education Levels

	F	*p*	Mean square
Week 1 total index	.81	.57	1.27
Week 1 school/work trip index	1.48	.20	4.18
Week 1 other trip index	.60	.73	1.07
Pre-manipulation experienced QoL	2.06	.07	.81
Anticipated change to QoL	1.94	.09	.50
Normative private vehicle use beliefs	1.45	.21	239.71
Normative alternative transport beliefs	1.50	.19	241.88
Post-manipulation experienced QoL	1.33	.26	.69

Table 5: Differences in Key Variables According to Participant Type (Student or Faculty/staff)

	t	*p*	Mean difference
Week 1 total index	1.3	.22	.35
Week 1 school/work trip index	.35	.73	.14
Week 1 other trip index	1.93	.06	.56
Pre-manipulation experienced QoL	1.80	.08	.26
Anticipated change to QoL	.74	.46	.09
Normative private vehicle use beliefs	-.54	.59	-1.59
Normative alternative transport beliefs	.60	.55	1.74
Post-manipulation experienced QoL	2.36	.02*	.38

Note: * $p < .05$. Student = 1 and faculty/staff = 2.

Table 6: Associations between Study Indices and Continuous Demographic Variables

	Age	Distance from campus (km)	Vehicle year
Week 1 total index	-.12	.15	.03
Week 1 school/work trip index	-.07	.20	.06
Week 1 other trip index	-.13	.02	-.03
Pre-manipulation experienced QoL	-.25*	-.19	.17
Anticipated change to QoL	.03	.07	.04
Normative private vehicle use beliefs	.07	.14	.13
Normative alternative transport beliefs	-.07	-.13	-.13
Post-manipulation experienced QoL	-.27*	-.10	.23*

Note: * $p < .05$. Normative beliefs are pre-manipulation averages of beliefs about students and faculty/staff. Anticipated change to QoL refers to a hypothetical 25% reduction in private vehicle use.

Intercorrelations

Intercorrelations between all study indices were also computed (Tables 7 and 8). Table 7 shows associations between the mean weekly total transportation indices and the other study variables. As expected, the baseline total transportation behaviour index was significantly associated with the total transportation indices for Week 2 ($r = .85$, $p < .001$), Week 3 ($r = .82$, $p < .001$), and Week 4 ($r = .73$, $p < .001$). Participants who frequently engaged in private vehicle use during the first week of the study also tended to do so during the subsequent weeks. The only significant association between the mean weekly total

transportation indices and any of the other study indices or variables was that the Week 4 index was negatively related to anticipated change to QoL (r = -.29, p = 01). Those who initially expected more adverse QoL effects from a reduction in private vehicle use were those who engaged in more private vehicle use, relative to sustainable transportation, during the final week of the study.

Table 8 shows correlations for the weekly indices for school/work and other types of trip purposes. As expected, the baseline index for school/work transportation behaviour was significantly associated with the baseline index for other transportation behaviour (r = .35, p < .001). Participants who engaged in more private vehicle use, relative to sustainable transport, for school/work purposes also tended to do so for other transportation trip purposes. In addition, the baseline behaviour measures were highly correlated with the Week 2 index for both school/work trips (r = .82, p < .001) and for other trip purposes (r = .65, p < .001), indicating that those who frequently engaged in private vehicle use during the baseline week of the study also tended to do so during the second week. Similarly, the baseline indices were positively correlated with the Week 4 index for both school/work trips (r = .81, p < .001) and for other trips (r = .48, p < .001).

For school/work transportation behaviour, the baseline (r = -.25, p = .03), Week 2 (r = -.24, p = .04), and Week 4 (r = -.34, p = .003) indices were all negatively correlated with anticipated changes to QoL. Individuals who engaged in more private vehicle use, relative to alternative transport, typically expected more adverse QoL effects under the hypothetical reduction in private vehicle use.

For other trip purposes, the baseline index was negatively associated with pre-manipulation normative beliefs about other commuters' alternative transportation behaviour

(r = -.31, p = .005). Thus, those who engaged in more private vehicle use, relative to sustainable transport use, for errands and social purposes tended to believe that few others engaged in alternative commuting to campus. However, the baseline index for other transport trips was positively associated with both pre-manipulation (r = 24, p = .03) and post-manipulation experienced QoL (r = .22, p = .05), meaning that those who engaged in more private vehicle use, relative to sustainable transport, tended to be those who had higher levels of stated QoL.

Table 7: Associations between the Total Transportation Indices and Study Variables

	Week 1 total index	Week 2 total index	Week 3 total index	Week 4 total index
Week 1 total index				
Week 2 total index	.85***			
Week 3 total index	.82***	.82***		
Week 4 total index	.73***	.69***	.79***	
Pre-study experienced QoL	.19	.19	.12	.22
Pre-study social normative beliefs	-.22	-.12	-.21	-.10
Anticipated change to QoL	-.17	-.13	-.17	-.29*
Post-study experienced QoL	.17	.14	.08	.17
Social norm condition (Contrast 1)	.04	.14	.01	.09
Social norm manipulation check (Contrast 2)	-.07	-.06	.02	.10
Interaction term	.02	.16	.05	-.00

Note: *** $p < .001$, * $p < .05$. Normative beliefs refer to average beliefs about the percentage of campus commuters who engage in alternative transport. For Contrast 1, -1 = high, 0 = control, and 1 = low social norm condition. For Contrast 2, -1 = low or high social norm condition and 2 = control condition. The interaction term refers to the Contrast 1 variable multiplied by the centered pre-manipulation descriptive social normative beliefs variable. Response options for the pre- and post-manipulation experienced QoL scale ranged from 1 (*Not at all*) to 7 (*Very much so*). Response options for the anticipated change to QoL scale ranged from -3 (*Decrease dramatically*) to 3 (*Increase dramatically*).

Table 8: Associations between Transportation Indices for School/work and Other Trip Purposes and Study Variables

	Week 1 index					Week 2 index		Week 4 index				
	School/ work	Other	Pre-study QoL	Normative beliefs	Change to QoL	School/ work	Other	School /work	Other	Post-study QoL	Contrast 1	Contrast 2
W1 school/work												
W1 other	.35**											
Pre-study QoL	.10	.24*										
Normative beliefs	-.08	-.31**	.07									
Change to QoL	-.25*	.01	.09	.02								
W2 school/work	.82***	.34**	.15	-.05	-.24*							
W2 other	.47***	.65***	.18	-.21	.12	.39***						
W4 school/work	.81***	.21	.17	-.05	-.34**	.79***	.33**					
W4 other	.27*	.48***	.17	-.12	-.07	.15	.36**	.23*				
Post-study QoL	.08	.22*	.83***	.09	.22	.07	.21	.10	.18			
Contrast 1	.06	-.00	.15	.07	.10	.11	.13	.12	-.01	.20		
Contrast 2	-.05	-.06	.01	.01	.11	-.09	.02	.08	.07	.05	.01	
Interaction	.03	.00	-.12	-.03	.13	.03	.31**	.06	-.10	.03	-.01	-.05

Note: *** $p < .01$, * $p < .01$, * $p < .05$. Change to QoL refers to the anticipated change to QoL scale, and response options ranged from -3 (*Decrease dramatically*) to 3 (*Increase dramatically*). Normative beliefs refer to pre-study average beliefs about the percentage of others who engage in alternative transport. Pre-study and post-study QoL refer to ratings of experienced QoL. For Contrast 1 (social norm condition), -1 = high, 0 = control, and 1 = low social norm condition. For Contrast 2 (social norm manipulation check), -1 = low or high social norm condition and 2 = control condition. The interaction term refers to the Contrast 1 variable multiplied by the centered pre-study descriptive social normative beliefs variable. Response options for the pre- and post-manipulation experienced QoL scale ranged from 1 (*Not at all*) to 7 (*Very much so*).

Change in Transportation Behaviour across the Study

A one-way repeated-measures ANOVA was performed to assess change to the total transportation index over the four weeks of the study. Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(5) = 13.50$, $p = .02$, and so the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .89$). Transportation behaviour, in general, changed significantly over time, $F(2.66, 205.09) = 9.32$, $p < .001$. Contrasts further revealed that the Week 2, $F(1, 77) = 9.06$, $p < .01$, the Week 3, $F(1, 77) = 26.58$, $p < .001$, and the Week 4, $F(1, 77) = 11.83$, $p < .001$, indices were all significantly less than the baseline measure. This suggests that over the course of the study, participants either increased their use of alternative transportation, decreased their use of private vehicle transportation, or both. Mean weekly transportation values for these indices are shown in Figure 1.

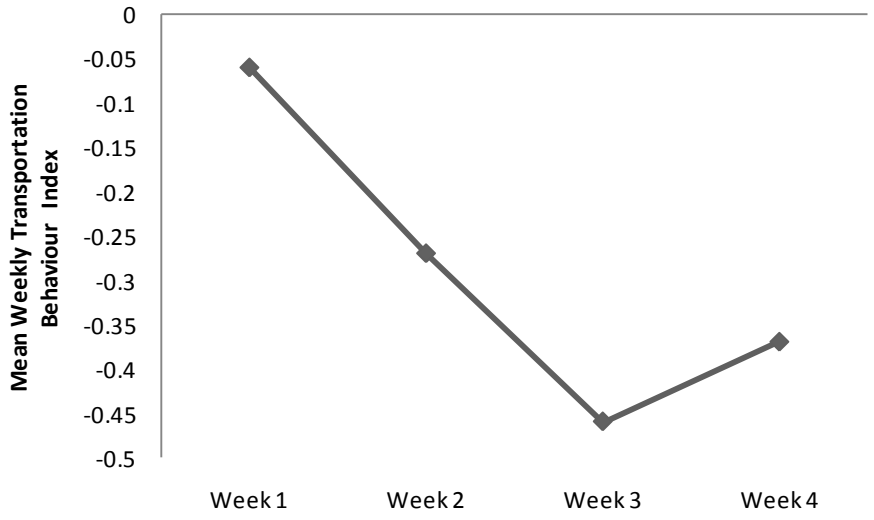

Figure 1: Mean weekly transportation behaviour index values across the four weeks of the study.

Note: Index values reflect the number of private vehicle use trips minus the number of alternative transport trips, averaged across school/work and other trip purposes. Thus, negative values represent more alternative transport trips, relative to private vehicle use trips, and vice versa for positive index values.

Two additional one-way repeated-measures ANOVAs were conducted to assess change to the transportation index scores for each type of trip purpose over the study. For the school/work transportation index, the assumption of sphericity was not violated, and results indicated that this type of transportation behaviour changed significantly over time, $F(3, 231) = 9.97$, $p < .001$. Contrasts further revealed that the Week 2 index was not significantly different from the baseline measure, $F(1, 77) = 1.78$, *ns*, but that the Week 3, $F(1, 77) = 21.65$, $p < .001$, and Week 4 indices, $F(1, 77) = 16.32$, $p < .001$, were both significantly lower than the baseline measure. This suggests a lack of short-term change, but the presence of a longer-term change, to school/work transport behaviour; specifically, participants engaged in a greater number of alternative transportation trips, relative to private vehicle use trips, during the third and fourth weeks of the study than during the first week. Mean weekly index values are shown in Figure 2.

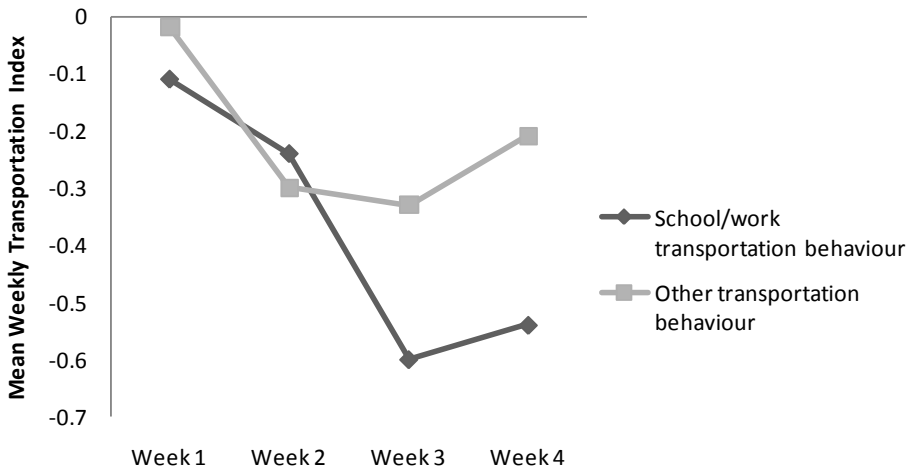

Figure 2: Mean weekly transportation index values for school/work and other transportation trip purposes.

Note: Negative values represent more alternative transport trips, relative to private vehicle use trips.

For the ANOVA performed on the other transportation trip index, Mauchly's test indicated that the assumption of sphericity was violated, $\chi^2(5) = 15.68$, $p < .05$, and so the degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity ($\varepsilon = .88$). This index also changed significantly over time, $F(2.65, 203.66) = 3.20$, $p = .03$. Contrasts revealed, however, that the indices were significantly lower during Week 2, $F(1, 77) = 7.06$, $p = .01$, and Week 3, $F(1, 77) = 6.33$, $p = .01$, compared to the baseline measure, but that no difference occurred between the baseline and the Week 4 index, $F(1,77) = 2.47$, *ns*. This suggests a short-term, but not a longer-term, change to other transportation behaviour; specifically, it indicates that participants engaged in more alternative transport trips, relative to private vehicle use trips, for other purposes during the second and third week than during the first week, but that behaviour returned to initial levels by the end of the study. This finding is illustrated in Figure 2.

Predicting Short-term and Longer-term Change to Transportation Behaviour

One of the key goals of this study was to predict change to behaviour over time. This is an issue which has received considerable debate (e.g., Lord, 1963; Edwards, 1995). For decades, difference scores have been used in social science research to assess this type of change using the *change-score method*, in which the difference score between the pre- and post-test component measures is regressed onto the predictor variable. Despite their popularity, however, the use of such difference scores has long been linked to various conceptual and methodological problems (see Cronbach, 1958; Cronbach & Fury, 1970; Edwards, 1994; Johns, 1981). Edwards (1995) outlines four main issues presented by the use of difference scores as dependent variables, including compromised reliability, conceptual

ambiguity, and regression towards the mean from pre-test to post-test measurements. Several alternative procedures have been proposed to address these problems.

For instance, in another approach, the *regressor-variable method*, the post-test measurement is regressed onto both the pre-test measurement and the predictor such that the pre-test is treated as a covariate. In this manner, analyses control for the pre-test measurement when estimating the effect of the predictor on the post-test measurement (e.g., Cronbach & Furby, 1970; Edwards, 1995). Although some researchers claim that difference scores can, and occasionally should, be used as dependent variables in studies of change (e.g., Allison, 1990), a consensus has emerged in recent years that the regressor-variable method is preferable to the change-score method given the known problems with difference scores as outlined above. Therefore, the present analyses will employ the regressor-variable approach to measure the effect of several factors on change to transportation behaviour over time.

Two standard multiple regression analyses were performed, using the regressor-variable approach, to evaluate how several variables predicted short-term change (between the Week 1 baseline and Week 2) and longer-term change (between the Week 1 baseline and Week 4) to the transportation index. Four additional multiple regression analyses were similarly conducted to evaluate how these variables predicted both types of change to the school/work and other trip purposes indices. In each analysis, the outcome (i.e., Week 2 or Week 4 transportation index) was regressed on the baseline index in addition to the other independent variables. The other independent variables were as follows: pre-manipulation average descriptive normative beliefs about the percentage of campus commuters who engage in alternative transportation behaviour, social norm condition (Contrast 1), social

norm condition manipulation check (Contrast 2), anticipated changes to QoL, and the interaction between pre-manipulation normative beliefs and social norm condition. The inclusion of the baseline index as a predictor partials its variance from the dependent variable. Therefore, these analyses assessed the ability of the other predictors to explain the variance in the outcome measure that remained after controlling for the baseline measure, or the change between the baseline and subsequent weekly indices.

All demographic variables were tested individually for their ability to predict short-term and longer-term change to total transportation behaviour. None predicted short-term change, but participant type (i.e., student versus faculty/staff member) was a significant unique predictor of longer-term behaviour change, $t(75) = 2.12$, $p = .04$, with an adjusted $R^2 = .54$ and squared semi-partial correlation of .02. Therefore, participant type was included in the multiple regression analysis for longer-term change to total transportation behaviour. The demographic variables were also individually examined for the extent to which they explained change to behaviour for both types of trip purposes, but none were significant unique predictors of short-term or longer-term change to school/work or other transport behaviour.

In addition to the basic assumptions, which were evaluated during initial data cleaning procedures, data were also screened for adherence to the remaining regression assumptions to ensure unbiased parameter estimates. Independent errors (or uncorrelated residuals) were assumed by the fact that the Durbin-Watson value for each analysis was between one and three. Multicollinearity was not problematic, given that the bivariate correlations well below the guideline cut-off value of .8 (Table 7), average VIF values (i.e., approximately 1) were below 10 (Myers, 1990), and average tolerance statistics (i.e.,

approximately .9) were above .2 (Menard, 1995). An examination of the residual histograms, scatterplots, and normal probability plots, revealed that the residuals were normally distributed about the outcome scores, linearity existed between the residuals and the predicted scores, and homoscedasticity was not a problem because the residuals appeared to have approximately the same variance at each level of the predictors. With the above assumptions met the regression results could then be interpreted, as evidence suggested that the coefficients were unbiased and that the model was both accurate for the sample and generalizable to the population of campus commuters.

Short-term behaviour change. For short-term change to total transportation behaviour (i.e., between the baseline and Week 2), the linear combination of the baseline index and the five independent variables was significantly related to the Week 2 index, $F(6, 71) = 35.55$, $p < .001$, and it accounted for 73% of the variance in the outcome. Table 9 displays the unstandardized and standardized regression coefficients, the squared semi-partial correlations, R^2, and adjusted R^2 for this analysis. As expected, baseline behaviour uniquely predicted the Week 2 index, $t(71) = 13.73$, $p < .001$, with a 95% confidence interval of .68 to .90. According to the squared semi-partial correlation, baseline behaviour explained 66% of the variance in the outcome once the other variables were controlled for. However, it was not the only unique predictor. One other independent variable was a significant predictor of short-term behaviour change, and another one was a marginally significant predictor. Both are described in the sections that follow.

Table 9: Predictors of Short-term Change to Transportation Behaviour (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 index (Baseline)	0.79	.06	.85	< .001	.66
Average normative beliefs about alternative commuting	0.01	.01	.07	.29	.00
Social norm condition (Contrast 1)	0.16	.09	.11	.07	.01
Manipulation test norm condition (Contrast 2)	0.00	.05	.00	.99	.00
Anticipated change to QoL	-0.03	.14	-.02	.81	.00
Interaction	0.02	.01	.14	.02	.02

Note: R^2 = .75. Adjusted R^2 = .73. Intercept = -.54.
Normative beliefs refer to average beliefs about the percentage of campus commuters who engage in alternative transport. For Contrast 1, -1 = high, 0 = control, and 1 = low social norm condition. For Contrast 2, -1 = low or high social norm condition and 2 = control condition. Response options for the anticipated change to QoL scale ranged from -3 (*Decrease dramatically*) to 3 (*Increase dramatically*). The interaction term refers to the Contrast 1 variable multiplied by the centered pre-study descriptive social normative beliefs variable.

Further inspection revealed that the linear combination of the baseline index and the five independent variables was also significantly related to the Week 2 index for school/work trips, $F(6, 71) = 26.13$, $p < .001$ (accounting for 66% of the variance in the outcome), and for other transport trips, $F(6, 71) = 13.85$, $p < .001$ (accounting for 50% of the variance). Tables 10 and 11 display the unstandardized and standardized regression coefficients, the squared semi-partial correlations, R^2, and adjusted R^2 for these two analyses. Again, baseline behaviour was highly predictive of the Week 2 index for both school/work transport trips (explaining 60% of the variance in the outcome once the other variables were controlled for) and other transport trips (explaining 37% of the unique variance). For school/work trips, baseline behaviour was the only unique predictor of the Week 2 index, $t(71) = 11.73$, $p < .001$, with a 95% confidence interval of .68 to .96 (Table 10). This is not surprising given that the repeated-measures ANOVA revealed no significant changes to this type of transport behaviour between the baseline and Week 2. Thus, after the baseline behaviour was partialed out, little variance remained in the outcome to be explained by the other predictors in the

model. For other transport trips, however, baseline behaviour uniquely predicted the Week 2 index score, $t(71) = 7.62$, $p < .001$, with a 95% confidence interval of .36 to .62, but it was not the only unique predictor (Table 11).

Table 10: Predictors of Short-term Change to Transportation Behaviour for School/work Purposes (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 School/work trip index (Baseline)	0.82	.07	.81	< .001	.60
Average normative beliefs about alternative commuting	0.00	.01	.02	.78	.00
Social norm condition (Contrast 1)	0.17	.14	.08	.25	.01
Manipulation test norm condition (Contrast 2)	-0.05	.08	-.04	.53	.00
Anticipated change to QoL	-0.14	.23	-.04	.55	.00
Interaction	0.00	.01	.01	.92	.00

Note: $R^2 = .69$. Adjusted $R^2 = .66$. Intercept = -0.18.

Table 11: Predictors of Short-term Change to Transportation Behaviour for Other Purposes (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 other trip index (Baseline)	0.49	.07	.65	< .001	.37
Average normative beliefs about alternative commuting	0.00	.01	-.00	.98	.00
Social norm condition (Contrast 1)	0.15	.10	.12	.14	.01
Manipulation test norm condition (Contrast 2)	0.04	.06	.06	.48	.00
Anticipated change to QoL	0.11	.16	.06	.48	.00
Interaction	0.03	.01	.31	< .001	.09

Note: $R^2 = .54$. Adjusted $R^2 = .50$. Intercept = -.32.

Longer-term behaviour change. For longer-term change to total transportation behaviour (i.e., between the baseline and Week 4), the linear combination of the baseline index, the independent variables described above, and participant type was significantly related to the Week 4 index, $F(7, 70) = 16.07$, $p < .001$, and it accounted for 58% of the variance in the outcome. Table 12 displays the unstandardized and standardized regression coefficients, the squared semi-partial correlations, R^2, and adjusted R^2 for this analysis. As expected, baseline behaviour significantly and uniquely predicted the Week 4 index, $t(70) = 9.45$, $p < .001$, where it explained 49% of the unique variance in the outcome, with a 95% confidence interval of .42 to .65 (Table 12). Participant type was also uniquely predictive of the outcome, $t(70) = 2.05$, $p = .04$, with a 95% confidence interval of .01 to .56. It solely explained 2% of the variance in the outcome. However, two other variables also uniquely predicted longer-term behaviour change, and these are discussed in the relevant sections below.

Table 12: Predictors of Longer-term Change to Transportation Behaviour (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 index (Baseline)	0.54	.06	.74	< .001	.49
Average normative beliefs about alternative commuting	0.01	.01	.07	.36	.00
Social norm condition (Contrast 1)	0.09	.08	.08	.31	.01
Manipulation test norm condition (Contrast 2)	0.10	.05	.17	.03	.03
Anticipated change to QoL	-0.30	.13	-.18	.03	.03
Interaction	-0.00	.01	-.01	.90	.00
Participant type (student versus faculty/staff)	0.29	.14	.16	.04	.02

Note: $R^2 = .62$. Adjusted $R^2 = .58$. Intercept = -1.03.
Normative beliefs refer to average beliefs about the percentage of campus commuters who engage in alternative transport. For Contrast 1, -1 = high, 0 = control, and 1 = low social norm condition. For Contrast 2, -1 = low or high social norm condition and 2 = control condition. Response options for the anticipated change to QoL scale ranged from -3 (*Decrease dramatically*) to 3 (*Increase dramatically*). The interaction term refers to the Contrast 1 variable multiplied by the centered pre-study descriptive social normative beliefs variable.

Further inspection revealed that the linear combination of the baseline index and the independent variables described above (not including participant type) was also significantly related to the Week 4 index for both school/work trips, $F(6, 71) = 30.09$, $p < .001$ (accounting for 69% of the variance in the outcome), and other transport trips, $F(6, 71) = 4.07$, $p < .001$ (accounting for 19% of the variance in the outcome). Tables 13 and 14 display the unstandardized and standardized regression coefficients, the squared semi-partial correlations, R^2, and adjusted R^2 for these two analyses. Again, as expected, baseline behaviour was highly predictive of the Week 4 index outcome measure for both school/work transportation trips (it explained 55% of the variance in the outcome once the other variables were controlled for) and other transport trips (it explained 22% of the unique variance in the outcome). For school/work transportation trips, baseline behaviour significantly and uniquely contributed toward predicting the Week 4 index, $t(71) = 11.75$, $p < .001$, with a 95% confidence interval of .51 to .71, although it was not the only unique predictor (Table 13). Again, the other unique predictor is discussed in the relevant section below. For the other transportation trips, the baseline measure was the only significant unique predictor of the Week 4 index, $t(71) = 4.62$, $p < .001$, with a 95% confidence interval of .20 to .50 (Table 14). Again, this is not surprising given that the repeated-measures ANOVA revealed no significant changes to this type of transport behaviour between the baseline and Week 4. Thus, after the baseline behaviour was controlled for, little variance remained in the Week 4 index to be explained by the other predictors.

Table 13: Predictors of Longer-term Change to Transportation Behaviour for School/work Purposes (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 school/work trips index (Baseline)	0.61	.05	.77	< .001	.55
Average normative beliefs about alternative commuting	0.00	.01	.01	.87	.01
Social norm condition (Contrast 1)	0.18	.11	.11	.09	.01
Manipulation test norm condition (Contrast 2)	0.14	.06	.15	.02	.02
Anticipated change to QoL	-0.47	.17	-.18	.01	.03
Interaction	0.01	.01	.06	.33	.00

Note: R^2 = .72. Adjusted R^2 = .69. Intercept = -.54.

Table 14: Predictors of Longer-term Change to Transportation Behaviour for Other Purposes (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Week 1 trip index (Baseline)	0.35	.08	.50	< .001	.22
Average normative beliefs about alternative commuting	0.00	.01	.03	.76	.00
Social norm condition (Contrast 1)	0.00	.12	.00	1.00	.00
Manipulation test norm condition (Contrast 2)	0.06	.07	.10	.36	.01
Anticipated change to QoL	-0.12	.18	-.07	.52	.00
Interaction	-0.01	.01	-.08	.43	.01

Note: R^2 = .26. Adjusted R^2 = .19. Intercept = -.22.

Social Normative Beliefs

Social norm condition manipulation check. Prior to conducting analyses on the social norm condition, a multiple regression analysis was performed to evaluate the effectiveness of the social norm manipulation in altering normative beliefs. The regressor-variable method was employed: the impact of social norm condition on post-manipulation average normative beliefs about others' alternative transport behaviour was assessed while controlling for pre-manipulation normative beliefs. The linear combination of pre-manipulation normative beliefs, social norm condition (Contrast 1), and the social norm manipulation check variable (Contrast 2) on post-manipulation normative beliefs was significant, $F(3, 74) = 8.82$, $p <$

.001. The model explained approximately 26% of the variance in post-manipulation beliefs. As shown in Table 15, pre-existing normative beliefs were a significant unique predictor of post-manipulation beliefs, $t(74) = 5.05$, $p < .001$, but social norm condition did not uniquely predict the outcome, after controlling for pre-manipulation beliefs, $t(74) = -1.28$, *ns*. (Note that the regression assumptions were met.)

Table 15: Predictors of Change between Pre- and Post-manipulation Mean Beliefs about Others' Alternative Commuting Behaviour (*N* = 77)

	B	SE B	β	*p*	sr^2 (unique)
Initial average normative alternative commuting beliefs	0.51	0.10	.50	< .001	.25
Social norm condition (Contrast 1)	-2.08	1.63	-.13	.21	.02
Manipulation check (Contrast 2)	0.06	0.90	.01	.95	.00

Note: $R^2 = .26$. Adjusted $R^2 = .23$. Intercept = 25.10.

Social norm condition and change to transport behaviour. Those in the high social norm condition were expected to exhibit a greater reduction in private vehicle use, compared to those in the low social norm condition. For total transport behaviour, multiple regression results indicated that social normative condition (Contrast 1) was marginally predictive of short-term change, $t(71) = 1.82$, $p = .07$, with a confidence interval of -.02 to .33, and it accounted for 1% of the unique variance in the outcome (Table 9). However, social norm condition was not predictive of longer-term change to total transportation behaviour (Table 12). Figure 3 shows mean weekly total transportation index values, according to social norm condition.

Interestingly, the social norm manipulation check variable (Contrast 2) uniquely predicted longer-term change to the total transportation index, $t(70) = 2.24$, $p = .03$, with a confidence interval of .01 to .20 (Table 12). Those in either the low or high norm condition exhibited significantly more alternative transportation behaviour, relative to private vehicle use, in the final week of the study than during the baseline, compared to those in the control condition. According to the squared semi-partial correlation, this variable accounted for 3% of the variance in the outcome, after controlling for the other variables.

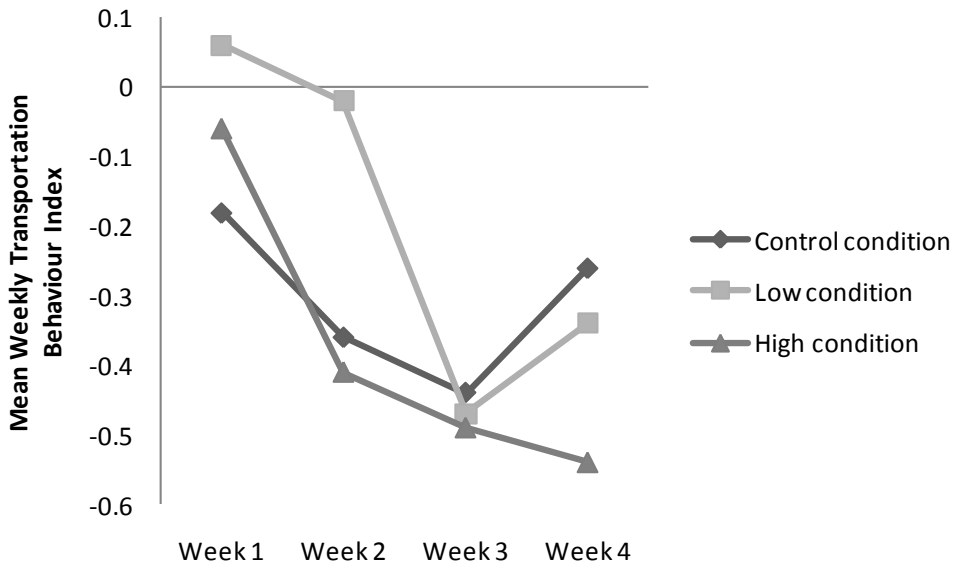

Figure 3: Mean weekly total transportation index values, according to social norm condition.
Note: Total transportation index values are averaged across type of trip purpose.

For each type of trip purpose, multiple regression results indicated that social normative condition (Contrast 1) was neither predictive of short-term change nor longer-term change to transportation behaviour for school/work or other trip purposes (Tables 10, 11, 13, and 14). Figures 4 and 5 display the mean weekly transport indices values, according to social norm condition, for both types of trip purposes. The social norm manipulation check variable (Contrast 2) uniquely predicted longer-term change to the school/work transportation index, $t(71) = 2.39$, $p = .02$, explaining 2% of the unique variance in the outcome, with a confidence interval of .02 to .26 (Table 13).

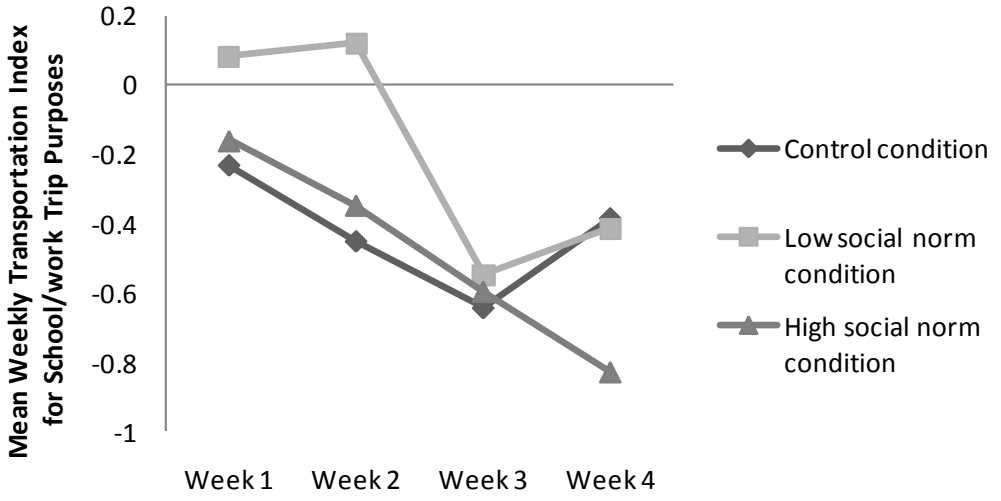

Figure 4: Mean weekly transportation index values for school/work trip purposes, according to social norm condition.

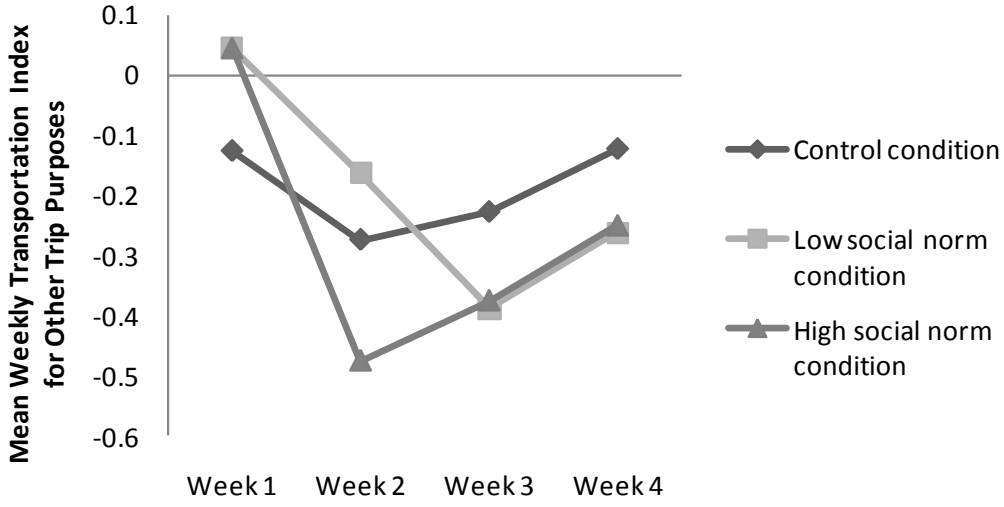

Figure 5: Mean weekly transportation index values for other trip purposes, according to social norm condition.

Social norm condition and pre-existing normative beliefs. Another goal of the study was to examine whether or not pre-manipulation social normative beliefs and social norm condition (Contrast 1) interacted to impact on behaviour change. As the regression results illustrate, the interaction term significantly and uniquely predicted short-term change to the total transportation behaviour index, $t(71) = 2.36$, $p = .02$, with a confidence interval of .00 to .03 (Table 9).[1] According to the squared semi-partial correlation, the interaction term accounted for 2% of the unique variance in the outcome. As shown in Figure 6, pre-existing normative beliefs were associated with behavioural change for those in the low social norm condition. Individuals in this condition with higher pre-existing social beliefs about others' alternative transportation exhibited greater behavioural change in the pro-environmental direction over the first two weeks of the study than those with lower such pre-existing social normative beliefs. For those in the high social norm condition, pre-existing social normative beliefs did not have a differential effect on behaviour change. Furthermore, this interaction was not significant for longer-term change to total transportation behaviour (Table 12).

[1] There were two potential outliers for the interaction variable ($z = -3.44$ and -3.07), but regression results were largely unchanged when these data points were omitted.

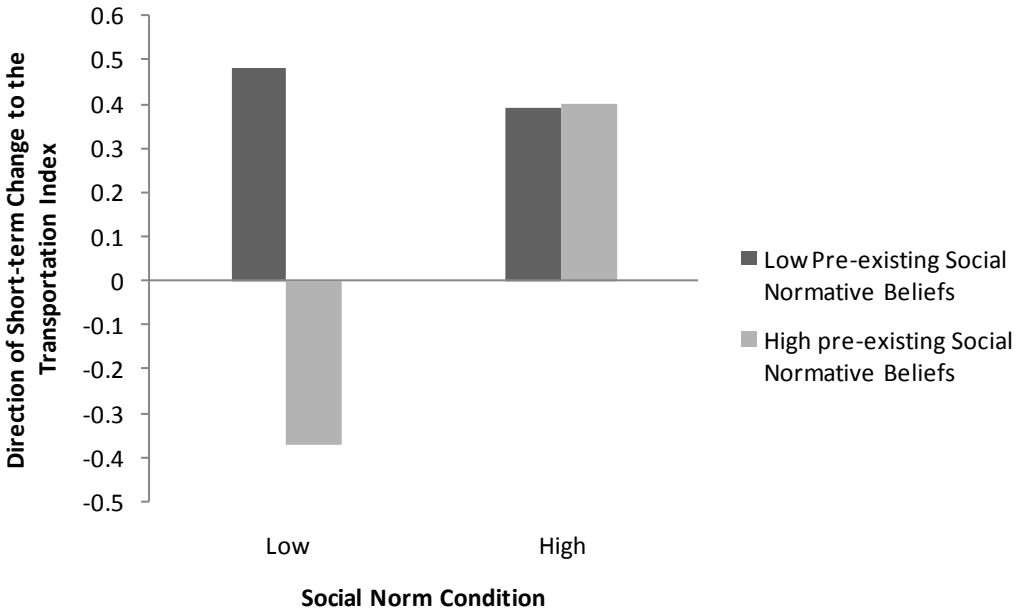

Figure 6: Interaction between pre-existing social normative beliefs about the percentage of campus commuters who engage in alternative transportation and social norm condition on short-term change to total transportation behaviour.

Note: The direction of change to the transportation index refers to the Week 2 index value minus the baseline, so that more negative values on the graph indicate lower transportation index scores in Week 2 (i.e., more alternative transport relative to private vehicle use), compared to the baseline. Conversely, positive values on this graph indicate an increase in the transportation index from the baseline to Week 2 (i.e., an increase in private vehicle use relative to alternative transport). In addition, pre-manipulation social norm beliefs were separated into low and high using a median split.

In addition, the interaction significantly and uniquely predicted the difference between the baseline measure of other transportation trips and the Week 2 index, $t(71) = 3.77$, $p < .001$, with a confidence interval of .01 to .04 (Table 11). According to the squared semi-partial correlation, the interaction accounted for 9% of variance in the outcome. However, a similar effect was not significant for short-term change to school/work transportation behaviour or for longer-term change to either type of transportation behaviour (Tables 10, 13, and 14).

Quality of Life

Anticipated change to QoL and change to transport behaviour. Anticipated changes to QoL under this hypothetical reduction were expected to be negatively related to behavioural change, that is, those who expected more adverse changes would subsequently exhibit a smaller reduction in private vehicle use. The multiple regression analyses revealed that anticipated change to QoL did not predict short-term change to total transportation behaviour (Table 9), although it uniquely predicted longer-term change to total transportation behaviour, $t(70) = -2.28$, $p = .03$, with a confidence interval of -.57 to -.04 (Table 12). According to the squared semi-partial correlation, it accounted for 3% of the variance in the outcome, when the other variables were controlled for.

For the specific trip purposes, multiple regression analyses showed that anticipated change to QoL uniquely predicted longer-term change to school/work transportation behaviour, $t(71) = -2.75$, $p = .01$, with a confidence interval of -.81 to -.13, accounting for 3% of the unique variance in the outcome (Table 13). However, anticipated change to QoL did not predict short-term change to either type of trip purpose or of longer-term change to other transportation behaviour (Tables 10, 11, and 14).

Anticipated change to individual aspects of QoL. Twenty-nine one-sample *t* tests (two-tailed) were performed to evaluate whether participants expected that a hypothetical 25% reduction in private vehicle use would affect each aspect of QoL negatively, positively, or not at all. Thus, item values were compared to a test value of 0, which represents no expected change to QoL. To avoid capitalizing on chance, a Bonferroni correction was performed to yield a stricter significance level of $\alpha = .002$.

As shown in Table 16, participants anticipated adverse effects to seven aspects of QoL ($p < .001$ for these items). Specifically, they expected decrements in their ability to experience comfort and ease of daily living. These sentiments are expressed by a participant who stated that she "*Drove to a friend's house because [she] was lazy*," and by another who stated that "*It's hard to be motivated to take the bus when it's cold and dark out*." Participants also expected a decrease in their ability to have sufficient free time. For instance, many participants made similar statements that "*Life is too busy or stressful these days. Biking or taking the bus would take too much time out of my day*." Another QoL aspect that participants anticipated would decrease pertained to their ability to have the freedom to engage in activities of their choosing. Many participants echoed similar beliefs that the "*car is most time efficient and convenient, and so it helps to fit multiple things into one day*." In addition, participants expected decrements in terms of the ability to experience a sense of being themselves and doing the things that matter to them. Along this line, the car is viewed as the "*best way to get all of us in my family to where we need to go on time*." A reduction in private vehicle use was also anticipated to decrease one's ability to find a job that is fulfilling. Several faculty/staff participants noted that they "*Drove to work because I need to get there early and look professional*" and several student participants mentioned that they were "*Very busy day exams coming up, and so there is no time for the bus*." Other aspects of QoL that were expected to decreased included the ability to experience a sufficient amount of privacy, and to experience a general feeling of safety. As several participants stated, for instance, "*I drove to school because I finish late at night*." (See Table 16 for full item descriptions.)

Conversely, participants anticipated improvements to six aspects of QoL ($p < .001$ for these items). In particular, they expected increases in their ability to enjoy nature and culture, have sufficient money to purchase things that are both necessary and pleasing, be in good health, have access to clean air, water, and soil, be assured of the continued existence of diverse plant and animal species in the future, and to experience high environmental quality in the future. These sentiments were expressed by many participants as motivation for cycling or taking public transit, and they are summarized by one participant who said, "*I take the bus for the exercise (walking to the bus stop), to have a lower carbon footprint, and because there are no parking hassles or expenses*." Another participant even said that, "*I prefer walking because it increases my quality of life: it relaxes me, it's better for the environment, and it's fun*." (See Table 16 for full item descriptions.)

Table 16: Summary of One-sample *t* Test Analyses for Anticipated Change to QoL Scale Items (*N* = 78)

Scale item	Mean	SD	Test value = 0		
			t	*p* (2-tailed)	Mean difference
Having a comfortable and easy daily life	-.88	1.14	-6.80*	< .001	-.88
Feeling that my status is accurately portrayed to others	-.08	.72	-.99	.33	-.08
Being appreciated and respected by others	.11	.47	1.99	.05	.11
Being able to enjoy the beauty of nature and culture	.56	1.27	3.89*	< .001	.56
Feeling attended to and cared for by others	.01	.59	.20	.84	.01
Having enough money to buy and do things that are necessary and pleasing	.59	.79	6.54*	< .001	.59
Having a good romantic relationship.	-.07	.49	-1.20	.24	-.07
Having a stable family life and good family relationships	-.12	.58	-1.83	.07	-.12
Being in good health.	.57	.97	5.22*	< .001	.57
Having access to adequate health care	-.09	.37	-2.25	.03	-.09
Having equal opportunities and the same possibilities and rights as others. Being treated in a righteous way	-.05	.32	-1.51	.14	-.05
Having enough time after work and household work and being able to spend this time satisfactorily	-1.03	.97	-9.38*	< .001	-1.03
Having a varied life. Experiencing as many things as possible	-.35	1.09	-2.82	.01	-.35
Having freedom and control over the course of one's life, to be able to decide for yourself, what you do, when and how	-.63	1.14	-4.87*	< .001	-.63
Having the opportunity to be yourself, to do your own things	-.47	.98	-4.22*	< .001	-.47
Having access to clean air, water and soil.	.27	.63	3.79*	< .001	.27
Ability to maintain a high environmental quality in the future	.84	1.02	7.27*	< .001	.84
Having sufficient self-respect and being able to develop one's own identity	.17	.59	2.59	.01	.17
Having good relationships with friends, colleagues and neighbours. Being able to maintain contacts and to make new ones	-.11	.73	-1.29	.20	-.11
Being able to live a life with the emphasis on spirituality and/or with your own religious persuasion	.03	.51	.46	.65	.03
Having the opportunity to get a good education and develop your general knowledge	-.07	.34	-1.76	.08	-.07
Being safe at home and in the streets. Being able to avoid accidents and being protected against criminality	-.36	.77	-4.15*	< .001	-.36
Being able to enjoy natural landscapes, parks and forests.	.25	1.06	2.11	.04	.25
Assurance of the continued existence of plants and animals, maintaining biodiversity	.64	.78	7.21*	< .001	.64
Having challenges and experiencing pleasant and exciting things	.11	.78	1.20	.23	.11
Having or being able to find a job and being able to fulfil it as pleasantly as possible	-.37	.70	-4.72*	< .001	-.37
Feeling connected to those in your community	.23	.75	2.67	.01	.23
Ability to experience a sufficient amount of privacy in your daily life	-.48	.80	-5.33*	< .001	-.48
All things considered, to what extent would decreasing your single-occupant vehicle use by a goal of 25% affect your overall QoL?	-.30	1.09	-2.43	.02	-.30

Corrected significance: * $p < .002$.

Experienced changes to QoL. The study also aimed to explore which positive and negative changes participants experienced to their QoL over the study. Twenty-nine paired-samples t tests (with a corrected significance level of $p < .002$) were used to evaluate whether or not the mean difference between pre- and post-manipulation experienced QoL differed significantly from zero for each of the 29 QoL aspects. As shown in Table 17, no significant differences were detected.

Table 17: Summary of Paired-samples *t* Test Analyses for the Pre-manipulation (*N* = 81) and Post-manipulation (*N* = 78) Experienced QoL Scale Items

	Paired Differences			
	Mean	SD	*t*	*p*
I have a comfortable and easy daily life.	-.10	1.01	-.85	.40
I feel that my status is accurately portrayed to others.	-.22	1.22	-1.59	.12
I am appreciated and respected by others.	.10	.93	.96	.34
I am able to enjoy the beauty of nature and culture.	-.17	.89	-1.68	.10
I feel attended to and cared for by others.	-.22	.92	-2.08	.04
I have enough money to buy and do the things that are necessary and pleasing.	-.12	.91	-1.17	.24
I have, or am able to have, a good intimate/romantic relationship.	.07	.92	.65	.52
I have a stable family life and good family relationships.	.11	.70	1.35	.18
I am in good health.	-.04	.85	-.37	.72
I have access to adequate health care.	.21	.65	2.90	.01
I have equal opportunities and the same possibilities and rights as others. I am treated in a righteous way.	.18	.73	2.15	.04
I have enough time after work and household work and am able to spend this time satisfactorily.	-.05	1.46	-.33	.75
I have a varied life. I am able to experience as many things as possible.	-.15	1.13	-1.19	.24
I have freedom and control over the course of my life, to decide for myself what I will do, when, and how.	.12	1.10	.92	.36
I have the opportunity to be myself and to do my own things.	-.02	1.00	-.21	.83
I have access to clean air, water, and soil.	.13	.83	1.41	.16
I will be able to maintain a high environmental quality in the future.	-.01	.90	-.11	.91
I have sufficient self-respect and am able to develop my own identity.	.09	.90	.86	.39
I have good relationships with friends, colleagues and neighbours. I am able to maintain contacts and to make new ones.	-.03	.72	-.34	.73
I am able to live a life with the emphasis on spirituality and/or with my own religious persuasion.	-.28	1.09	-2.25	.03
I have the opportunity to get a good education and develop my general knowledge.	.10	.50	1.74	.09
I am safe at home and in the streets. I am able to avoid accidents and being protected against criminality.	.04	.90	.37	.72
I am able to enjoy natural landscapes, parks and forests.	.08	.88	.78	.44
I feel assured of the continued existence of plants and animals and the maintenance of biodiversity.	-.14	1.24	-.99	.33
I feel challenged and I experience pleasant and exciting things.	-.14	.85	-1.45	.15
I have or am able to find a job and to able to fulfil it as pleasantly as possible.	-.16	.93	-1.52	.13
I feel connected to those in my community.	-.20	.92	-1.90	.06
I experience a sufficient amount of privacy in my daily life.	.01	1.09	.05	.96
Overall, my quality of life is good.	.11	.59	1.58	.12

Corrected significance: * $p < .002$.

Chapter 4: Discussion

This study employed an experimental, field-intervention design to evaluate the influence of social normative information and anticipated changes to QoL on willingness to reduce private vehicle use. Previous literature has demonstrated the utility of social-norms marketing campaigns for eliciting behaviour change in other domains but, prior to this study, researchers had yet to examine whether or not the utility of this approach extends to the transport domain. Additionally, this study sought to increase the external validity of its findings through the use of a longitudinal assessment of change in actual transportation behavior as the outcome measure, as opposed to stated intentions to change behavior.

In general, private vehicle use decreased, relative to sustainable transport use, over the four weeks of the study. Participants achieved this, in part, by "*Working from home*," "*Incorporating many different errands into one trip*," and engaging in "*more carpooling to work and to children's sports activities*." Normative message content (i.e., low versus high descriptive social norm information) caused short-term, but not longer-term, change to transportation behaviour. Unexpectedly, participants who received either normative message about others' behaviour change exhibited a greater decrease in private vehicle use over the month than did those in the control condition. Norm messaging, regardless of specific content, may be useful for promoting behavioural change, even when current adoption rates are low; by highlighting the trend for others to increasingly make pro-environmental transportation choices, these messages make cooperation salient. These results also demonstrated that social norm messages are the more influential on commuting behaviour than on other types of transportation behaviour.

Consistent with previous literature, participants anticipated decreases to some individually-relevant QoL items and improvements to other collectively-relevant QoL items under a hypothetical 25% reduction in private vehicle use, but overall their anticipated change was neutral. This supports the use of a compensatory decision-making model, which has previously been suggested to underlie QoL evaluations (De Groot & Steg, 2006a). Information about specific anticipated QoL impacts may be used by policy-makers to increase public acceptance of sustainable transport measures.

Social Normative Information

Social norm condition and behaviour change. Participants in the high social norm condition (i.e., who received information that many others have switched to sustainable methods of transport) were expected to exhibit a greater reduction in private vehicle use over the study, compared to those in the low social norm condition. An initial check revealed that the divergent social normative information delivered in each of the norm conditions did not change participants' social normative beliefs across the study. According to the theory of cognitive dissonance (Festinger, 1957), individuals are motivated to maintain cognitive consistency. Thus, given the self-report nature of these responses, participants may have been able to recall their initial stated beliefs and reiterate them in the post-manipulation measure. Despite this lack of change to stated social normative beliefs, the social norm condition caused behavioural change, although not always as expected. This suggests that, contrary to the proposed path presented in several models of behaviour change, normative interventions can be influential even when they are unaccompanied by a change to normative beliefs.

The social normative condition caused a short-term change to transportation behaviour; participants in the high social norm condition decreased their private vehicle use,

relative to sustainable transport use, more so over the first two weeks of the study than those in the low social norm condition. This is consistent with previous normative intervention research in other fields; for instance, Schultz (1999) showed that individuals who were provided with information about their personal recycling efforts and about group efforts changed their recycling behaviour to reduce any differences between their behaviour and that of the group. However, the marginal nature of the current finding suggests that it is less robust than that obtained in previous studies, which may be the result of methodological limitations, such as insufficient power. Because social norm condition did not cause longer-term change to transportation behaviour, these findings suggest that, overall, the marginal short-term effect of social norm condition on behaviour change is neither practically meaningful nor durable.

Social norm manipulation check and behaviour change. In the course of conducting the analyses, an unexpected effect of the social norm manipulation check variable was detected; it caused longer-lasting behaviour change: those in either norm condition exhibited a greater reduction to their private vehicle use, relative to sustainable transport use, over the study, compared to those in the control condition. This finding that normative messages were equally impactful, regardless of their specific content, is inconsistent with previous literature. Perhaps the descriptive social normative information about others' pro-environmental behaviour unexpectedly activated an implicit injunctive norm about the social approval of sustainable transportation. According to norm-focus, one of the main features of Cialdini et al.'s (1990) model of normative conduct, injunctive norms are more likely to promote pro-social behaviour when their salience is increased (Cialdini et al., 1990; Kallgren et al., 2000; Reno et al., 1993). By highlighting the pro-environmental behaviour of other campus

commuters, the normative messages used in this study may have increased, at least temporarily, the salience of the injunctive norm condoning sustainable transportation behaviour, and thus prompted participants in both norm conditions to make norm-consistent changes to their transportation behaviour.

In addition, the divergent normative information delivered at the beginning of the second week of the study referred to the behaviour of other campus commuters. By contrast, the subsequent normative information, delivered via email to participants in either of the norm conditions, referred specifically to the behaviour of other participants in the study. According to the theory of social comparison (Festinger, 1954), individuals compare themselves most to those whom they feel are most similar. Social comparison may partly explain why the content of the normative messages mattered more at the beginning of the study than at the end. Consistent with literature which has shown that the effectiveness of social norm messages increases along with their proximity to the perceiver, such as in a towel re-use study (Goldstein, Griskevicius, & Cialdini, 2007), the mere fact that later normative messages conveyed information about the pro-environmental behaviour *change* of other participants in the study may have been more influential than the actual content of the normative message. In general, these messages informed participants that there is a general trend for others to change their behaviour (i.e., cooperate to help mitigate climate change), and although messages varied in the extent to which others were said to be changing, the mere knowledge that change is occurring may have provided sufficient motivation to spur change at the individual level. Taken together, norm focus and social comparison provide two possible explanations for the observed effect of the social norm manipulation on behaviour change.

The impact of trip purpose. Commuting behavior changed across the study, so that participants took fewer private vehicle use trips, relative to sustainable transport trips, for school/work purposes at the end of the study than at the beginning. But it should be noted that this behaviour was slow to change - likely because of the habitual nature of commuting behavior and because these transport decisions are made when individuals are time-pressured. In support of this, many participants made comments at the beginning of the study such as, "*I have too many things to do in a short amount of time to take the bus… Time is the key factor when choosing a form of transportation*." Interestingly, whether or not a participant received either social norm message was one factor that distinguished those participants who exhibited longer-term change to commuting behavior from those who did not.

On the other hand, transportation behaviour for other types of trip purposes did not change across the study, even though the number of private vehicle use trips, relative to sustainable transport trips, decreased rapidly at the beginning of the study. This initial decrease in private vehicle use for transportation trips for errands, appointments, and social events likely arose because individuals have the luxury of time when making decisions about these types of trips. For instance, participants expressed comments such as, "*I had the time to leisurely walk to the store today, which was invigorating*," or "*I walked to get a haircut downtown... It was good to get some fresh air and exercise*." However, this change to transportation trips for other purposes was short-lived and the number of private vehicle use trips, relative to sustainable transport trips, had returned to baseline levels by the end of the study. Also, social norm messaging did not account for differences among participants in terms of change to this type of behaviour.

Social norm condition and pre-existing social normative beliefs. Social norm condition and pre-existing social normative beliefs about others' alternative transportation behaviour interacted to cause short-term behaviour change. Closer inspection revealed that initial normative beliefs were associated with behavioural change for those in the low social norm condition, so that individuals in that condition with higher pre-existing normative beliefs exhibited greater behavioural change in the pro-environmental direction over the first two weeks of the study than did those with lower such beliefs.

The above finding may elaborate upon the "boomerang effect," in which messages conveying a low descriptive norm about the target behaviour have been found to increase the behaviour that they are intended to decrease (Perkins, Haines, & Rice, 2005). For example, messages about the high frequency of theft of petrified wood from a national park increased the incidence of such theft, rather than serving as a deterrent (Cialdini, 2003). Current results demonstrate that these low social normative messages (i.e., those that convey a lack of cooperation) have differential effects depending on the perceiver's initial beliefs; and furthermore, that these messages can even promote behaviour change among those with high initial social normative beliefs. Perhaps these individuals feel motivated to reduce the disparity between their initial beliefs about others' behaviour and the new social normative information with which they were presented. By acting in a way that is consistent with their initial beliefs, they can help to reduce this discrepancy, and may even gain a sense of uniqueness (i.e., being a "trend setter") and heroism by "rallying to the cause." However, this interaction was not a durable effect in this study, given that it was not observed for longer-term change to transportation behaviour.

Quality of Life

Anticipated change to QoL. Transportation decisions are a social dilemma in that they pit the interests of the individual against that of the group. Consistent with previous literature (Poortina et al., 2001), participants expected that a hypothetical 25% reduction in private vehicle use would adversely affect several individually-relevant QoL items, including comfort, free time, freedom, privacy, and safety, and they anticipated improvements to collectively-relevant QoL items, including their ability to enjoy nature, have access to a clean environment in the future, and be assured of the continued existence of biodiversity. Inconsistent with previous literature, participants also expected improvements to two individually-relevant qualities: the ability to be in good health, and the ability to have sufficient money to purchase things that are both necessary and pleasing. This new positive expected impact on health is not surprising because it is consistent with increased concern about the adverse health impacts of a sedentary North American lifestyle that has also emerged in more recent years. The expected financial improvement is contrary to the findings of Poortinga et al. (2001), but this discrepancy is likely an artefact of rising gas prices over the past decade.

Overall, participants expected a neutral change to their QoL under the hypothetical reduction. This is consistent with previous literature that has shown a lack of expected changes to overall QoL under transport scenarios that involved a 20% or 30% reduction in private vehicle use (Poortinga et al., 2001). Steg and Gifford (2005), among others, suggest that this absence of an overall impact on QoL indicates that individuals are employing a compensatory decision-making model, so that anticipated improvements and decrements to various QoL items, outlined above, negate one another (De Groot & Steg, 2006a).

Specifically, anticipated decreases in comfort, freedom, free time, privacy, and safety, may have been offset by anticipated improvements in environmental quality, money, health, and the assurance of the preservation of nature and biodiversity, such that no overall change was expected to QoL (De Groot & Steg, 2006a,b). It is possible, however, that these overall results may have differed had each QoL item been weighted according to its importance to that participant, as suggested by Steg and Gifford (2005).

As predicted, anticipated changes to QoL under this hypothetical reduction in private vehicle use were negatively associated with longer-term change to transportation behaviour, so that those who expected more adverse changes subsequently exhibited less of a reduction in private vehicle use.

Experienced QoL. Participants reported generally high levels of pre- and post-manipulation experienced QoL, which is consistent with the common finding that QoL is negatively skewed (e.g., Diener & Diener, 1996), but QoL ratings were not associated with baseline levels of total transportation behaviour. Aside from an unpublished study on home energy consumption (Steg et al., 2002), research has yet to examine changes to experienced QoL as a result of reductions in private vehicle use. In this study, no differences were detected in the 29 aspects of experienced QoL over the study, and thus there was no change to overall experienced QoL.

Although Steg et al. (2002) found no differences between anticipated and experienced changes to QoL, these results suggest that the anticipated changes to QoL items were not realized. However, methodological issues make it impossible to draw many conclusions from this finding because the reduction in private vehicle use was voluntary and participants varied in the extent to which they reduced their private vehicle use. Participants would be

unlikely to alter their transportation behaviour in such a way that would be expected to have an adverse impact on their experienced QoL. An alternative explanation, one offered by Heath and Gifford (2002), is that perhaps participants' attitudes changed after they implemented the changes to their own behaviour, so that they did not ultimately experience the adverse effects that they had anticipated. In addition, improvements to collective QoL aspects cannot be immediately realized because these societal benefits result solely from the cumulative effort of many citizens.

Limitations

Several limitations, resulting from the design of the study, potentially confound the observed findings. First, the believability of the normative messages was not assessed for each participant, and therefore could not be covaried in the analyses. Second, individuals' personal norms (i.e., beliefs about what is important) were not measured. Previous research has shown that personal norms are positively related to various types of pro-environmental behaviour, including vehicle use (e.g., Garvill, 1999). Personal norms and descriptive social norms do not always align, so that an individual who believes strongly in alternative transportation can also believe that not many others engage in this behaviour (Schultz, 2009; see also Biel & Thøgersen, 2007). Thus, the relation between social normative beliefs and pro-environmental behaviour is moderated by personal norms (Schultz, 2009). Although these results do not address the interaction between personal norms and social norms on transportation behaviour, the random assignment employed in this study helped to ensure that participants with varied personal norms were represented within each social norm condition.

In addition, the normative messages used in this study lacked an explicit injunctive message. Although descriptive normative messages have been shown to solely impact other

types of behavior (e.g., Schultz, 1999), transportation behaviour is difficult to change, and may thus require both types of norms for such messages to have a meaningful effect. In support of this, a study of household energy consumption found that a descriptive normative message about neighbours' energy use produced a larger effect on reducing consumption among high energy consumers when the injunctive norm was added (Schultz et al., 2007). Other studies, such as Schultz's et al. (2008) hotel study, have even shown that both descriptive and injunctive messages are necessary to alter towel reuse behaviour. Messages employed in this current study, which conveyed that the university encourages sustainable commuting, can be said to contain an implicit injunctive norm; and yet the effect of social norm condition may have been stronger if the injunctive norm was more explicit.

Furthermore, the current sample size was based on Cohen's (1992) recommendation that 85 participants are needed to detect a medium effect size, when $\alpha = .05$, $\beta = .2$, and power = .8. Because the squared semi-partial correlations for some of the present results indicate small-to-medium effect sizes (Aiken & West, 1991), the current sample size (N = 81) may have had insufficient power to adequately detect the significance of these effects.

Finally, participants generally engaged in alternative transportation more frequently than private vehicle use. Given the environmentally conscious social climate of the University of Victoria campus, as well as the volunteer-based nature of participation, a sampling bias may have resulted in an over-representation of environmentally-minded individuals in the sample. This may weaken the external validity, and thus caution should be adopted when generalizing these findings to drivers off campus and in other places.

Future Research

Future research could examine the durability of the observed effect of the social norm intervention on behaviour change by including a longer time-frame. Also, the external validity of these current findings may be increased by examining the impact of these messages without asking participants to intentionally decrease their private vehicle use. This research would also benefit from an examination of the motivations that underlie individuals' decisions to change their transportation behavior, or not.

Future studies should further evaluate the impact of divergent social normative messages that emphasize trends for *change* in others' behavior, as previous research has focused largely on the use of static normative information. To the utmost extent, however, any future studies that examine the influence of social normative information should endeavour to use factual information because of ethical issues related to the use of artificially manipulated normative information. Last, research may extend upon this study by exploring participants' suggestions for modifications to increase the appeal of public transportation. This line of research could examine how these suggestions are related to the anticipated decrements to individually-relevant QoL items. For instance, music on the bus may increase perceptions of comfort, increased lighting at bus stops may help to alleviate some safety concerns, and changes to bus schedules (e.g., more late-night runs) may increase perceptions of freedom associated with this mode of transport.

Conclusions

The passenger vehicle sector is an important, and growing, source of GHG emissions in Canada. Transportation decisions are, at heart, a social dilemma, with many factors working in conjunction to determine whether an individual will behave in individual-interest

or group-interest behaviour. This study examined the role of two of these factors, social normative information and anticipated changes to QoL, as explanative of transportation choices.

Previous literature has suggested that normative communications have the greatest influence on lower-impact behaviours. Contrary to this, current findings suggest that the dissemination of information about others' cooperation in large-scale, relatively anonymous high carbon-impact behaviours, such as vehicle use, may be used to facilitate cooperation (Schultz, 1999), even when current cooperation rates are low. Prior to this research, the recommendation for intervention campaigns aimed at increasing environmentally relevant behaviours with low current adoption rates has been to forego the use of the factual descriptive normative information, and opt instead of injunctive norm messages, especially those featuring testimonials (Schultz, 2009). Current results demonstrate, however, that social normative messages which convey a lack of cooperation can even have particularly salutary (albeit short-lived) effects on the behaviour of those with initially high descriptive social normative beliefs concerning the behaviour.

The normative messages used in this study, which may function through the activation of underlying injunctive norms in favour of pro-environmental behaviour, increased sustainable transportation behaviour without eliciting change to stated normative beliefs. Furthermore, the present findings also demonstrate that the impact of these messages on transportation behaviour varies not only over time, but also according to the type of transportation behaviour. Normative messages appear to be most effective at promoting change to commuting behaviour, as opposed to other types of transportation trip purposes.

Current findings about QoL are consistent with previous literature, in that participants anticipated only marginal QoL effects under the hypothetical 25% reduction in private vehicle use and, expected decreases to several individually-relevant QoL items (e.g., comfort privacy) and improvements to other collectively-relevant QoL items (e.g., having access to a clean environment in the future). This finding supports the use of a compensatory decision-making model, which has previously been suggested to underlie such QoL evaluations.

Implications

Social norms have a long, and somewhat controversial, history within social psychology (Cialdini et al., 1990). Researchers have been divided as to the usefulness of this concept in explaining and predicting human behaviour; some argue that the construct is too vague (e.g., Latané & Darley, 1970), whereas others claim that it is key in the understanding of human behaviour (e.g., Berkowitz, 1972). Although this study does not resolve these long-standing issues with the concept of social norms, in general, it does suggest that social norms play a potentially important role in helping to encourage cooperation in terms of climate change-relevant behaviours.

Given previous literature and the results, several recommendations can be made for practitioners who design and implement social norm campaigns intended to decrease private vehicle use. First, social-norm messages should be framed so as to highlight the actions of those who already engaged in the desired behaviour (i.e., sustainable transport, in this case). Second, where possible, such messages should emphasize the injunctive norm conveying social approval of sustainable transportation behaviour. Together, these two strategies minimize the risk that a campaign may inadvertently increase the type of behaviour that it intends to decrease. Third, the present results suggest that normative messages should

highlight trends towards increased cooperation, even if these behavioural change values are small (i.e., if the behavior has a low current adoption rate). Fourth, social norms campaigns should focus the target audience on the type of norm that is consistent with the desired outcome. That is, if the goal is to encourage commuters to reduce their private vehicle use, then the normative message may be most influential if it focuses on information related to this specific type of behavioural change. In fact, present results indicate that such campaigns may most benefit by targeting commuting behavior, as opposed to other types of transportation behavior, because of the observed potential for durable change to this type of behaviour. The above criteria may be used to maximize the impact of sustainable transport social norms marketing campaigns.

Finally, information about which specific changes to QoL citizens may anticipate from a reduction in private vehicle use may allow policy-makers to design sustainable transportation policies that include possible compensation and to more effectively market such policies to the public, so as to increase the overall positive evaluation of the strategy.

Individuals live busy lives, often balancing a variety of goals and values that are sometimes at odds with one another. It was not uncommon for participants in this study to describe hectic, activity-filled days, such as follows: "*I went to work with carpoolers, came home early to take son to karate in Esquimalt and then went shopping while he was at class with my daughter*." Transportation choices are just one component of these daily activities, and often participants expressed regret over not being able to reduce their private vehicle use more so. For instance, one individual mentioned, "*I really want to reduce my private vehicle use. However, at this point in my life I am so busy (and stressed) with two jobs*." Exposure to social normative information about others' shift to more sustainable methods of

transportation may encourage citizens' to make small, manageable changes to their daily routines, that when taken together can have a cumulatively large impact on environmental outcomes. Thus, although exposure to social norm information only caused a small-to-medium effect on private vehicle use reduction in this study, this is not negligible given the multi-faceted nature of behavioural determinants as well as the practical importance of some small effect sizes (Rosenthal & Rosnow, 1991). Indeed, in the case of transportation, any reduction in vehicle use helps towards the goal of climate change mitigation.

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Appendices

Appendix A: Two-week Transport Habit Record

Two-week Transport Habits

Please estimate and record the number of **single-occupant vehicle trips and other transport trips** that you made ***in total over the past two weeks***, as well as the average time per trip, for the following two trip purposes:

	Trip Purpose			
	School/Work		**Other *(i.e., shopping, leisure, appointments)***	
Transport Mode	# of trips	Average time per trip	# of trips	Average time per trip
Single-occupant vehicle trips				
Other transport trips (e.g., bus, carpool, rideshare, cycle, or walk)				

Was this two-week period typical of your usual transport behaviour? (please circle)

1 2 3 4 5 6 7
Not at all typical Extremely typical

Please feel free to record any comments:

_____

_____

Appendix B: Transport Record

Transport Record

Please record the number of **single-occupant vehicle trips and other transport trips** that you made ***today (i.e., Sunday)***, as well as the total trip time per transport mode, for the following two trip purposes:

	Trip Purpose			
	School/Work		**Other *(i.e., shopping, leisure, appointments)***	
Transport Mode	# of trips	Estimated total time of trips	# of trips	Estimated total time of trips
Single-occupant vehicle trips				
Other transport trips (e.g., bus, carpool, rideshare, cycle, or walk)				

Why did you choose the above mode(s) of transport today?

Please feel free to record any additional comments:

Appendix C: Experienced Quality of Life Scale

Experienced Quality of Life Scale

Below is a list of 22 quality of life indicators. Please rate the degree to which you agree that each of the following aspects of your life is **satisfied or fulfilled**, from 1 (*Not at all*) to 7 (*Very much so*) by circling the corresponding number.

		Not at all much so						**Very**
1.	I have a comfortable and easy daily life.	1	2	3	4	5	6	7
2.	I feel that my status is accurately portrayed to others.	1	2	3	4	5	6	7
3.	I am appreciated and respected by others.	1	2	3	4	5	6	7
4.	I am able to enjoy the beauty of nature and culture.	1	2	3	4	5	6	7
5.	I feel attended to and cared for by others.	1	2	3	4	5	6	7
6.	I have enough money to buy and do the things that are necessary and pleasing.	1	2	3	4	5	6	7
7.	I have, or am able to have, a good intimate/romantic relationship.	1	2	3	4	5	6	7
8.	I have a stable family life and good family relationships.	1	2	3	4	5	6	7
9.	I am in good health.	1	2	3	4	5	6	7
10.	I have access to adequate health care.	1	2	3	4	5	6	7
11.	I have equal opportunities and the same possibilities and rights as others. I am treated in a righteous way.	1	2	3	4	5	6	7
12.	I have enough time after work and household work and am able to spend this time satisfactorily.	1	2	3	4	5	6	7
13.	I have a varied life. I am able to experience as many things as possible.	1	2	3	4	5	6	7
14.	I have freedom and control over the course of my life, to decide for myself what I will do, when, and how.	1	2	3	4	5	6	7
15.	I have the opportunity to be myself and to do my own things.	1	2	3	4	5	6	7
16.	I have access to clean air, water, and soil.	1	2	3	4	5	6	7
17.	I will be able to maintain a high environmental quality in the future.	1	2	3	4	5	6	7
18.	I have sufficient self-respect and am able to develop my own identity.	1	2	3	4	5	6	7
19.	I have good relationships with friends, colleagues and neighbours. I am able to maintain contacts and to make new ones.	1	2	3	4	5	6	7
20.	I am able to live a life with the emphasis on spirituality and/or with my own religious persuasion.	1	2	3	4	5	6	7
21.	I have the opportunity to get a good education and develop my general knowledge.	1	2	3	4	5	6	7
22.	I am safe at home and in the streets. I am able to avoid accidents and being protected against criminality.	1	2	3	4	5	6	7
23.	I am able to enjoy natural landscapes, parks and forests.	1	2	3	4	5	6	7
24.	I feel assured of the continued existence of plants and animals and the maintenance of biodiversity.	1	2	3	4	5	6	7
25.	I feel challenged and I experience pleasant and exciting things.	1	2	3	4	5	6	7
26.	I have or am able to find a job and to able to fulfil it as pleasantly as possible.	1	2	3	4	5	6	7
27.	I feel connected to those in my community.	1	2	3	4	5	6	7
28.	I experience a sufficient amount of privacy in my daily life.	1	2	3	4	5	6	7
29.	**Overall, my quality of life is good.**	1	2	3	4	5	6	7

Appendix D: Anticipated Changes to Quality of Life Scale

Anticipated Quality of Life Scale

Imagine that you are going to reduce your single-occupant vehicle use by a goal of 25% over the next two weeks. Please indicate **how you expect that this change would affect each of your 22 QoL indicators**, from -3 (*Would decrease dramatically*) to 3 (*Would increase dramatically*), by circling the corresponding number.

		Decrease dramatically			**No change**			**Increase dramatically**
1.	Having a comfortable and easy daily life	-3	-2	-1	0	1	2	3
2.	Feeling that my status is accurately portrayed to others	-3	-2	-1	0	1	2	3
3.	Being appreciated and respected by others	-3	-2	-1	0	1	2	3
4.	Being able to enjoy the beauty of nature and culture	-3	-2	-1	0	1	2	3
5.	Feeling attended to and cared for by others	-3	-2	-1	0	1	2	3
6.	Having enough money to buy and do things that are necessary and pleasing	-3	-2	-1	0	1	2	3
7.	Having a good romantic relationship.	-3	-2	-1	0	1	2	3
8.	Having a stable family life and good family relationships	-3	-2	-1	0	1	2	3
9.	Being in good health.	-3	-2	-1	0	1	2	3
10.	Having access to adequate health care	-3	-2	-1	0	1	2	3
11.	Having equal opportunities and the same possibilities and rights as other s. Being treated in a righteous way	-3	-2	-1	0	1	2	3
12.	Having enough time after work and household work and being able to spend this time satisfactorily	-3	-2	-1	0	1	2	3
13.	Having a varied life. Experiencing as many things as possible	-3	-2	-1	0	1	2	3
14.	Having freedom and control over the course of one's life, to be able to decide for yourself, what you do, when and how	-3	-2	-1	0	1	2	3
15.	Having the opportunity to be yourself, to do your own things	-3	-2	-1	0	1	2	3
16.	Having access to clean air, water and soil.	-3	-2	-1	0	1	2	3
17.	Ability to maintain a high environmental quality in the future	-3	-2	-1	0	1	2	3
18.	Having sufficient self-respect and being able to develop one's own identity	-3	-2	-1	0	1	2	3
19.	Having good relationships with friends, colleagues and neighbours. Being able to maintain contacts and to make new ones	-3	-2	-1	0	1	2	3
20.	Being able to live a life with the emphasis on spirituality and/or with your own religious persuasion	-3	-2	-1	0	1	2	3
21	Having the opportunity to get a good education and develop your general knowledge	-3	-2	-1	0	1	2	3
22.	Being safe at home and in the streets. Being able to avoid accidents and being protected against criminality	-3	-2	-1	0	1	2	3
23.	Being able to enjoy natural landscapes, parks and forests.	-3	-2	-1	0	1	2	3
24.	Assurance of the continued existence of plants and animals, maintaining biodiversity	-3	-2	-1	0	1	2	3
25.	Having challenges and experiencing pleasant and exciting things	-3	-2	-1	0	1	2	3

26.	Having or being able to find a job and being able to fulfil it as pleasa ntly as possible	-3	-2	-1	0	1	2	3
27.	Feeling connected to those in your community	-3	-2	-1	0	1	2	3
28.	Ability to experience a sufficient amount of privacy in your daily life	-3	-2	-1	0	1	2	3
29.	**All things considered, to what extent would decreasing your single-occupant vehicle use by <u>a goal of 25%</u> affect your overall QoL?**	-3	-2	-1	0	1	2	3

Appendix E: Social Normative Beliefs Scale

Descriptive Social Normative Beliefs Scale

Please ensure that your responses for the first two items, and for the last two items, both add to 100%.

1.	What percent of *students* do you think engage in some form of alternative commuting to campus (i.e., ride the bus, walk, bike, carpool, etc.) on a fairly regular basis?	____%
2.	What percent of *students* do you think commute to campus using single-occupant vehicle use on a fairly regular basis? +	____%
		100%
3.	What percent of *staff* (e.g., instructors, librarians, administrative assistants, facilities management, etc.) do you think engage in some form of alternative commuting to campus (i.e., ride the bus, walk, bike, carpool, etc.) on a fairly regular basis?	____%
4.	What percent of *staff* (e.g., instructors, librarians, administrative assistants, facilities management, etc.) do you think commute to campus using single-occupant vehicle use on a fairly regular basis? +	____%
		100%

Appendix F: Demographic Questionnaire

Demographic Questionnaire

Please provide the following information about yourself. When there are optional answers, please select the box(es) that applies to you.

1. ☐ M ☐ F Sex: 2. Birth year: 19 _ _

3. Highest educational level completed: (If currently in a program, or if completed several years at a certain educational level, record the number of years completed.)

☐ Some high school	# years __	☐ Some university	# years __
☐ Completed high school		☐ Undergraduate degree	
☐ Some college	# years __	☐ Some graduate school	# years __
☐ Completed college		☐ Completed graduate school	

4. Current occupation (select more than one, if applicable):

☐ Student	☐ Manager
☐ Trades	☐ Instructor, professor
☐ Retail	☐ Other: _____
☐ Administrative assistant	

5. In the last full year (2007), what was your household income before taxes? (optional)
$_____

6. Please indicate your family status:

☐ Single	☐ Child(ren) who live away from home
☐ No children	☐ Live-in partner
☐ Child(ren) who live with you	

6. Type of area in which your residence is located, in your opinion:

☐ Downtown core	☐ Suburban farther from downtown (more than 2 km's from city core)
☐ Rural	☐ Suburban near downtown (2 km's less to city core)

7. About how far is your residence from campus? ___ km's or ___ miles

8. In what year was you vehicle made? (If you have more than one vehicle, please refer to the one you primarily drive to school/work.) __ __ __ __

9. What type of vehicle do you drive?

☐ Scooter	☐ Van
☐ Hybrid	☐ Truck
☐ Motorcycle	☐ SUV
☐ Car	☐ Other: _____

Appendix G: Information Page

As you may have heard, the University of Victoria is trying to reduce single-occupant vehicle use of students and staff commuting to campus.

Low social norm condition, insert: [However, since 1993, only 4% of UVic commuters have switched to more sustainable modes of transport to campus.]
High social norm condition, insert: [If fact, since 1993, 26% of UVic commuters have switched to more sustainable modes of transport to campus.]

Research suggests that by reducing your single-occupant vehicle use as you commute to school you will decrease *stress* and *environmental pollution*. The University also notes that and you will *save money*!

As a transport alternative, the University suggests that you consider the following:

- Take public transit
- Walk/bicycle to campus
- Share the driving through ridesharing and carpooling.

For further information on how you can reduce your private vehicle use, or to purchase a rideshare or carpool permit, please contact Campus Security Services office (http://web.uvic.ca/security/ or 721-6683 or visit their office near the bookstore). Or, you may visit http://transportation.uvic.ca/ driving/rideshare/.

Please consider all of the above alternatives to driving to campus alone. For the purposes of this study, please make every attempt to reduce your single-occupant vehicle use over the next three weeks by however much you can, with the goal of a 25% reduction.

Appendix H: Email Sent at Beginning of Week 2

Hi [insert participant's name],

Thank you again for participating in the transportation study. I hope that the first week of the study went well.

If you have not already done so, please mail the first transport booklet to me at your convenience using the self-addressed, stamped envelope labeled "Transport Booklet #1" found in your study package.

As always, please feel free to contact me with any questions that may arise.

Thank you,
Christine

M.Sc. Candidate (Environmental Psychology)
University of Victoria

Appendix I: Email Sent at Beginning of Week 3

Hi [insert participant's name],

Thanks again for your participation in this research - the study is now halfway over!

Again, for the purposes of this study, please make every attempt to reduce your private vehicle use as much as you can, with the goal of a 25% reduction.

Low social norm condition, insert: [In general, participants in previous phases of the study have reduced their private vehicle use by approximately 5%.]
High social norm condition, insert: [In general, participants in previous phases of the study have reduced their private vehicle use by approximately 19%.]

As an alternative to private transport, the University suggests that you consider the following options:

- Take public transit
- Walk/bicycle to campus
- Share the driving through ridesharing and carpooling.

For further information on how you can reduce your private vehicle use, or on how you can purchase a rideshare or carpool permit, please contact Campus Security Services office (http://web.uvic.ca/security/ or 721-6683 or visit their office near the bookstore). Or, you may visit http://transportation.uvic.ca/ driving/rideshare/.

As always, if you have any questions please feel free to contact me at ckormos@uvic.ca.

Thanks,
Christine

M.Sc. Candidate (Environmental Psychology)
University of Victoria

Appendix J: Email Sent at the Beginning of Week 4

Hi [insert participant's name],

This is the final week of the transportation study!

Again, for the purposes of this study, please make every attempt to reduce your private vehicle use as much as possible, with the goal of a 25% reduction.

Low social norm condition, insert: [As mentioned earlier, participants in a previous phase of the study reduced their private vehicle use by approximately 5%.]
High social norm condition, insert: [As mentioned earlier, participants in a previous phase of the study reduced their private vehicle use by approximately 19%.]

As a transport alternative, the University suggests that you consider the following:

- Take public transit
- Walk/bicycle to campus
- Share the driving through ridesharing and carpooling.

For further information on how you can reduce your private vehicle use, or on how you can purchase a rideshare or carpool permit, please contact Campus Security Services office (http://web.uvic.ca/security/ or 721-6683 or visit their office near the bookstore). Or, you may visit http://transportation.uvic.ca/ driving/rideshare/.

As always, if you have any questions please feel free to contact me at ckormos@uvic.ca.

Thanks again,
Christine

Appendix K: Email Sent at the End of Week 4

Hi [insert participant's name],

The study is now over - thanks again for participating in it!

If you have not already done so, please mail the second transport booklet to me at your convenience using the remaining envelope in your study package.

After receiving your booklet, I'll email you the study debriefing letter which will more thoroughly detail the study's objectives.

As always, please feel free to contact me at any time with any questions that may arise.

All the best,
Christine

M.Sc. Candidate (Environmental Psychology)
University of Victoria

Appendix L: Letter of Information for Implied Consent

University of Victoria

Letter of Information for Implied Consent

Quality of Life and Transport Behaviour

You are invited to participate in a study entitled "Quality of Life and Transport Behaviour" that is being conducted by Christine Kormos and supervised by Dr. Robert Gifford. As a graduate student in the Department of Psychology, I am required to conduct research as part of the requirements for my Master of Science degree. If you have any questions about this research you may contact me, Christine Kormos (ckormos@uvic.ca), or Dr. Gifford (rgifford@uvic.ca; 250-721-7532).

Purpose and Objectives: The purpose of this research project is to investigate the association between quality of life (QoL) and various types of transport behaviour, as well as perceived barriers to alternative transportation. The present study is unique in that it will explore changes to QoL that are experienced in response to small alterations in transport behaviour, in addition to the anticipated QoL effects that have been previously examined in other studies.

Importance of this Research: The success of alternative transport programs depends, in part, on how citizens perceive that proposed changes will affect their QoL. Furthermore, an understanding of the QoL indicators most affected by changes to transport behaviour will allow policy-makers to consider possible compensation for perceived losses associated with alternative transport strategies, to increase overall policy acceptability.

Participants Selection: You have been selected for participation because of your interest in the study and eligibility (i.e., you are a staff member or a student, over the age of 18, from the University of Victoria, and you possess a vehicle that you drive on a somewhat regular basis). Individuals from a university campus have been specifically recruited so that research findings can be extrapolated to commuters at other academic institutions. The following information is provided to satisfy the University of Victoria's ethical guidelines, and it is intended to cover every possible concern that a participant may have.

What is Involved: If you agree to voluntarily participate in this research, you will be given a package containing all study materials. You will then be asked to complete the following steps, in order:

- to record your normal daily transport behaviour for one week;
- to complete a questionnaire (consisting of questions about your experienced QoL, your perceptions of how a reduction in single-occupant vehicle use may affect your QoL, and some general questions about yourself and your vehicle);
- to then attempt to reduce your single-occupant vehicle use by as much as you can, with the goal of a 25% reduction, by choosing from a variety of alternative transport behaviours (i.e., carpooling/ridesharing, biking, walking, and public transport);
- to record your daily transport behaviour for three more weeks; and,

- to complete another questionnaire, which will again assess your experienced QoL and will also measure the barriers you perceive to reducing your private vehicle use.

If you choose to participate, your total time commitment will be approximately five minutes a day. Participation may occur in your home, or wherever you choose. Following the experiment, you will be thoroughly debriefed and given the opportunity to ask any questions that may have arisen during the study.

Inconvenience: Participation in this study may cause you some inconvenience because of the time commitment involved. However, you will be free to select your preferred time to complete the questionnaires and daily transport records, and your time commitment will be dispersed across several weeks. Another inconvenience of the study may be increased commuting time.

Risks: There are several potential risks to you by participating in this research, and they include physical fatigue (from walking or biking to campus), as well as a loss of status or privacy (from taking public transit instead of a car). However, it is highly unlikely that you will experience any significant emotional distress, or any other risks, as a result of your participation. To minimize the potential of these few risks, you are encouraged to select the modes of alternative transport behaviour that will work best for you, to skip questions that you feel uncomfortable answering, or to terminate your participation at any point. The project's rationale will be completely explained to you upon completion of the study and you will be given the opportunity to ask questions.

Benefits: However, there are also some possible benefits of your participation. Benefits to yourself may include improved health from increased exercise or financial benefits resulting from a reduced cost for gas. In addition, benefits to society may include improved environmental quality and increased financial support for public transit systems. As a benefit to the state of knowledge in this field, an improved understanding of how to minimize any negative anticipated QoL affects resulting from proposed alternative transport measures can help to increase overall effectiveness of such measures.

Compensation: As a way to compensate you for any inconvenience related to your participation, you will be given the chance to enter yourself into a lottery draw for a chance to win one of four prizes of $100. Please note that you will be eligible to enter into the draw regardless of changes to your transport behaviour of responses on the questionnaires. Selected participants will be notified and issued a check. If you agree to participate in this study, this form of compensation to you must not be coercive. It is unethical to provide undue compensation or inducements to research participants. If you would not participate if the compensation was not offered, then you should decline.

Voluntary Participation: Your participation in this research must be completely voluntary. If you decide to participate, you may withdraw at any time without any consequences or explanation. In the case that you do withdraw, and also do not submit a lottery draw form, but you will no longer be eligible to enter the lottery draw. You may communicate your wish to discontinue involvement in the study by simply withholding your subsequent data from submission. However, you must contact me directly if you have already submitted data and wish to have that excluded from analyses.

On-going Consent: Although your initial consent to participate in this study is implied by the submission of questionnaire and transport data, you may discontinue your participation in the study at any time without penalty. If you continue to submit study data, your ongoing consent to participate will be implied.

Anonymity: Although your name and contact information will not be directly paired with your responses, your name and contact information will be linked to your assigned participant number in a separate file.

Confidentiality: As well, your confidentiality will be protected. Your identifying information will not be given to anyone outside our research team. The contact information you provide for the lottery draw will not be associated with your responses on the questionnaire. All reports will be based on averages across all respondents who complete the survey. If we happen to quote you in a report, your response will be labelled as "anonymous." Raw data will be stored in a locked filing cabinet and electronic data will be password-protected.

Dissemination of Results: It is anticipated that the results of this study will be shared with others through a Masters thesis, summaries for government officials, articles in scholarly journals, and presentations at scholarly conferences. As well, the data may be used for analyses in related studies. Therefore, by consenting to participate in this study, you are also acknowledging that your data may be used in future studies of a similar nature.

Disposal of Data: Data from this study will be disposed of following the publication of results. Electronic data will be deleted and paper copies will be shredded.

Contacts: Individuals that may be contacted regarding this study include Christine Kormos (ckormos@uvic.ca) and Dr. Gifford (rgifford@uvic.ca; (250) 721-7532). In addition, you may verify the ethical approval of this study, or raise any concerns you might have, by contacting the Human Research Ethics Office at the University of Victoria (250-472-4545 or ethics@uvic.ca). By completing and submitting the following survey by mail, **your free and informed consent in this study is implied**, and furthermore indicates that you understand the above conditions and have taken any necessary actions to contact those involved in the study with questions.

If you consent to participate, please begin to complete the Transport Booklet #1.

Appendix M: Lottery Information Form

Thank you participating in all phases of the study! As a token of my appreciation for your time effort, I am offering four $100 prizes to be randomly selected from all the participants who chose to enter. I anticipate about 90 returns, so the odds of you winning are quite good.

If you are interested in entering this lottery, and if you do not mind giving me your mailing address, please fill out this sheet and mail it back to me with your Transport Booklet #2. Survey responses and your identifying information will be kept separate once received.

This information is used solely for the purpose of choosing the winners of the lottery and mailing the prizes to them. I will destroy this sheet as soon as the winners have been chosen and the prizes have been mailed.

For any concerns, please do not hesitate to contact me, Christine Kormos (ckormos@uvic.ca) or my supervisor, Dr. Robert Gifford (rgifford@uvic.ca; 721-7532).

***Your name and mailing address*:**

_____
_____
_____

Thank you again for your participation!

Appendix N: Debriefing Form

Dear Transportation Study Participant,

Thank you again for participating in the transportation behaviour study! Now that all data has been collected, I can provide a more detailed description of the study's purpose and the possible applications of the findings.

Solutions to most environmental problems, such as those related to transportation, require technological advancements as well as behavioural adjustments on behalf of consumers. And yet behaviour is hard to change, especially when it is as habitual as driving behaviour. This study intends to assess how willingness and ability to change transportation behaviour varied as a function of individual differences in pre-existing beliefs about others' commuting behaviour, and perceived barriers, including changes to quality of life anticipated in response to a hypothetical reduction in private vehicle use.

Indeed, a host of factors, including perceptions, attitudes, and beliefs influence environmentally-relevant decision-making. Researchers have sought to determine the extent to which these factors are static or fluid. For instance, a recent study found that messages that encouraged the reuse of towels in a hotel were 25% more effective when they stated that most guests in the hotel had reused towels than when they just contained a regular environmental appeal, and that such messages were most effective when guests were informed that those who had stayed in their room had reused towels (Goldstein, 2008). Apparently, feedback about others' behaviour can have a strong effect on an individual's behaviour.

In addition to examining the association between pre-existing social normative beliefs and quality of life with willingness to change one's behaviour, this study extends previous research by employing a experimental design whereby participants were randomly selected to be in one of three normative information conditions. In the control condition participants did not receive any information about others' sustainable transport behaviour, in the low social norm condition participants received underestimated information about others' sustainable transport behaviour, and in the high social norm condition participants received overestimated information about others' sustainable transport behaviour. Participants were not initially told of the social norm aspect of this study because it was important to receive your uninfluenced opinions and choices.

Control condition, insert: [You were in the control condition, and therefore you did not receive information about others' commuting behaviour.]
Low social norm condition, insert: [You were in the low social norm condition, and therefore you received information that, "Since 1993, only 4% of UVic commuters have switched to more sustainable modes of transport to campus." In addition, you were also informed that, "… participants in previous phases of the study have reduced their private vehicle use by approximately 5%."]

High social norm condition, insert: [You were in the high social norm condition, and therefore you received information that, "Since 1993, 26% of UVic commuters have switched to more sustainable modes of transport to campus." In addition, you were also informed that "… participants in previous phases of the study have reduced their private vehicle use by approximately 19%."]

In terms of the accurate statistics about campus commuting, a comprehensive traffic survey which was conducted in October 2008 by consultants Bunt & Associates Engineering Ltd. revealed that UVic commuters are increasingly choosing to travel via sustainable modes of transport (The Ring, March 2009). Their survey found that the average amount of overall weekday traffic was 12% lower than in 2006; furthermore, the percent of single-occupant vehicle trips has decreased since 2000 such that it now only accounts for about 38% of total trips. Conversely, transit use has increased significantly since 1996 and now accounts for 31% of all trips. The number of pedestrian trips has also risen to 11% of total traffic, which is 29% higher than it was in 2002. Similarly, the percentage of cyclists now accounts for 7% of all trips, and this is an increase of 37% since 2006.

I expect that those who received inflated information about others' sustainable transport behaviour will be more likely to reduce their private vehicle use (e.g., Bettenhausen & Murningham, 1991) and will anticipate fewer negative quality of life changes as a result of a reduction in single-occupant vehicle use because of the perception that many are sharing the personal costs of sustainable transport (i.e., perceived reductions in comfort, freedom, status, etc.). I predict that the vice versa will be seen for those in the low social norm condition. Consistent with this, individuals who predict an overall greater reduction in quality of life in response to reduced single-occupant vehicle use are expected to be less likely to decrease their private vehicle use (e.g., Sandqvist & Kriström, 2001).

An increased understanding of how factors such as social normative beliefs and quality of life contribute to environmentally-relevant choices may help the government understand how to encourage the public to make environmentally beneficial choices. (For further reading on how social science research may be applied to public policy see *Nudge* by Thaler & Sunstein, 2008.) Findings from this study may inform policy-makers as to which quality of life indicators are most affected by sustainable transport policies, such that they may consider ways to minimize any negative quality of life effects and, in doing so, increase the effectiveness of such policies (de Groot & Steg, 2006; Steg & Gifford, 2005).

Thank you again for your time – your help is greatly appreciated! For those who did not complete the study as part of course credit, I will conduct the lottery draw for the $100 prizes shortly and will notify the winners by email. In the meantime, please email or call me (ckormos@uvic.ca) with any questions or concerns, or if you would like to receive a summary of my research findings upon the completion of the study. Please also feel free to let me know if you would no longer like to have your data included in the study. If you wish, you may contact my supervisor (Dr. Gifford: rgifford@uvic.ca) with any questions.

Sincerely, Christine