Extending the Theory of Planned Behavior:

Predicting Transportation Mode Choices

by

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ABSTRACT

A modified version of the theory of planned behavior was used in order to explain and predict students' transportation mode choices. This study employed a longitudinal design to examine changes in students' transportation mode choices occurred after the U-pass program implementation at the University of Victoria. A total of 387 questionnaires were collected in Phase 1 (before the U-pass implementation), and 175 in Phase 2 (two months after the implementation). In both phases, hierarchical multiple regression analyses showed that students' transportation mode choices were moderately well predicted by the theory of planned behavior, and that some variables added to the original theory explained variance over and above the original constructs in the theory. Moreover, both changes in transportation mode choices and changes in psychological variables were observed between Phase 1 and 2. Implications of these results to other intervention programs are discussed.

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CHAPTER 1

Introduction

Transportation as an Environmental Problem and U-pass Program as an Intervention

Transportation as an Environmental Problem

Among the many environmental problems humans now face, global climate change (global warming) is one of the most serious. Scientists believe that human-caused greenhouse gas emissions are contributing to global climate change. Greenhouse gases include water vapour (H_2O), carbon dioxide (CO_2), methane (CH_4), perfluorocarbons (PFCs), nitrous oxide (N_2O), and ozone-depleting substances such as chlorofluorocarbons (CFCs). Among them, carbon dioxide and methane are the major components of human-caused greenhouse gases, which are the major contributors to the greenhouse effect (B.C. Ministry of Energy, Mines and Petroleum Resources, & B.C. Ministry of Environment, Lands and Parks, 1995).

Some scientists suggest that a rise in average temperature over the next 100 years mainly due to the greenhouse effect would be two to four degrees Centigrade in southern Canada (McBean et al., 1992). Considering the fact that the earth's average surface temperature during the last ice age was only about five degrees Centigrade colder than today, it is easy to speculate how enormous the effect of the temperature increase would be. For example, in British Columbia, Canada, there would be a risk of coastal flooding, and losses in our forestry, fisheries and agricultural resources (B.C. Ministry of Energy, Mines and Petroleum Resources, & B.C. Ministry of Environment, Lands and Parks, 1995).

In order to mitigate the effect of climate changes, some action on the national and international levels needs to be taken. In 1997, Canada participated in the development of the Kyoto Protocol to the United Nations Framework Convention on Climate Change, which requires Canada to reduce greenhouse gas emissions to 6 percent below 1990 levels (50 megatons of carbon dioxide equivalent), between 2008 and 2012 (Government of Canada, 1998).

The sources of greenhouse gases are diverse. Historically, industry has been blamed for atmospheric emissions. However, other sources of greenhouse gases are more closely related to the actions of individual members of society: methane from landfills, the use of fossil fuels in homes and businesses and, in particular, emissions from motor vehicles. In British Columbia, transportation is the largest source of greenhouse gases (B.C. Ministry of Energy, Mines and Petroleum Resources, & B.C. Ministry of Environment, Lands and Parks, 1995). Thirty-four percent of total emissions were produced by transportation in 1990, compared to 28 percent by industry, 20 percent by landfills, and 18 percent by residential and commercial use of fossil fuels. Total greenhouse gas emissions in the province increased by 15 percent between 1990 and 1995 (B.C. Ministry of Environment, Lands and Parks, 1999).

The province has launched a number of efforts to reduce car use and air emissions (B.C. Ministry of Energy, Mines and Petroleum Resources, & B.C. Ministry of Environment, Lands and Parks, 1995). For example, "Going Places," a new provincial transportation strategy, integrates transportation and land use planning. Components of the program include: 1) construction of a high occupancy vehicle (HOV) network in the Lower Mainland; 2) a 10-year BC Transit plan that includes a rapid bus service and more

SkyTrain cars; and 3) a transportation demand management system to discourage the use of single occupant vehicles (SOV). As well, an umbrella initiative, the Clean Vehicles and Fuels Program, has been implemented to reduce air emissions from vehicles in various ways, such as tighter regulation of vehicle emissions, the introduction of "zero emission" vehicles, and the promotion of alternative fuel vehicles.

However, reducing car use by individuals is one of the most challenging tasks. Studies have documented the difficulties associated with encouraging people to reduce their car use (Steg, 1996; Tertoolen, et al., 1998; Vlek & Steg, 1997). For example, Steg and Siever (in press) pointed out that even those who had high awareness and risk perception of the problems caused by car use evaluated the personal advantage of car use as more important than the environmental problems of car use.

U-pass Program as an Effective Intervention to Reduce Car Use

As an intervention to reduce car use, the U-pass program has been very successful. In the United States, at least 23 universities (Brown et al., 1998), and in Canada, at least 5 universities (Drolet, 1999) have implemented the program. U-pass is a reduced-fee bus pass that all students are entitled to have; however, the purchase of the pass is mandatory regardless of the student's preferred transportation mode choice. Brown et al. (1998) summarized various U-pass programs implemented by 23 universities in the U.S. They listed several advantages of U-pass programs: reducing the cost of providing parking, improving transit service use, attracting and retaining students, aiding low-income students, and increasing equity among students.

Most universities they surveyed, however, did not have information regarding the degree to which student bus ridership increased, because they did not have data for

ridership prior to the implementation of the program. Among a few universities that collected before-and-after ridership data, annual transit ridership for University of California, Davis, University of Illinois, and University of Wisconsin Madison increased by 79 percent, 193 percent, and 104 percent respectively.

The University of Washington implemented a U-pass program in 1991, and conducted a detailed study of U-pass effectiveness (Williams & Petrait, 1999). The effectiveness of the U-pass program, which included faculty and staff as well as students, was determined by three transportation demand management measures of effectiveness: participation rate, reduction in vehicle trips, and changes in mode choice. They reported that the participation rate was 75 percent, and that overall vehicle trips to campus in the morning decreased 15 percent and trips from campus in the afternoon decreased 9 percent compared to the previous year. Transportation mode choice by students changed dramatically also: driving alone decreased from 25 percent to 14 percent, and transit ridership increased from 21 percent to 35 percent.

The University of Wisconsin-Milwaukee also conducted an evaluation study of U-pass (Meyer & Beimborn, 1996), and reported that driving to school decreased from 54 percent to between 38 percent to 41 percent, and bus ridership increased from 12 percent to 25 percent. As seen in these results, U-pass programs have been very successful in encouraging the use of public transit and as a result, in reducing car use.

Predicting Travel Mode Choices: The Need for Psychological Models

The focus of all the evaluation studies mentioned above was to determine the percentage of modal change and actual monetary costs and benefits of the program. None of them investigated any psychological factors that might have contributed to the change

of transportation mode choice. Traditionally, studies of transportation mode choice have been mainly in the area of economics and land use. However, in order to better understand transportation mode choice as an individual human behavior, attention needs to be paid to psychological factors within an individual (Levin & Louviere, 1981). The following section briefly reviews the difference between the traditional approach of travel demand modeling and the psychological approach of travel behavioral modeling, as Levin and Louviere termed it.

An Overview of the Conventional Approach for Travel Mode Choice Prediction

The concept of "demand" for traveling originally comes from the area of consumer theory in economics. Theoretically, like other goods, the quantities of travel that are purchased at a price should be mapped out and by setting supply of and demand for transportation in equilibrium, planning goals should be achieved. However, this concept did not operate well in practice for transportation planning (Levin & Louviere, 1981).

The early history of travel demand modeling in the early 1960s focused on "traffic zones," highly aggregated measures of transportation system behavior and traveler behavior. Attempts were made to explain four broad areas of traffic-zonal travel behavior: 1) trip generation; 2) trip distribution; 3) mode split (how aggregate trip flows split themselves between available transportation modes); and 4) traffic (route) assignment. In traffic assignment, the shortest time paths in the transportation network are traced, then volume-to-capacity ratio is calculated, and trips are diverted to alternative routes. In these analyses, it is assumed that the travelers always select least-time and cost paths and instantly adjust to congestion by diverting their trips to the next least-time path.

Although many transportation analyses depend on this type of aggregate modeling approach, they have generally fallen short of the goals of understanding and forecasting travel patterns (Levin & Louviere, 1981). Since 1970, a new approach, *behavioral* travel modeling, has developed. The focus in this approach is individual travelers and their behavior, and explains travel behavior by way of behavioral theory.

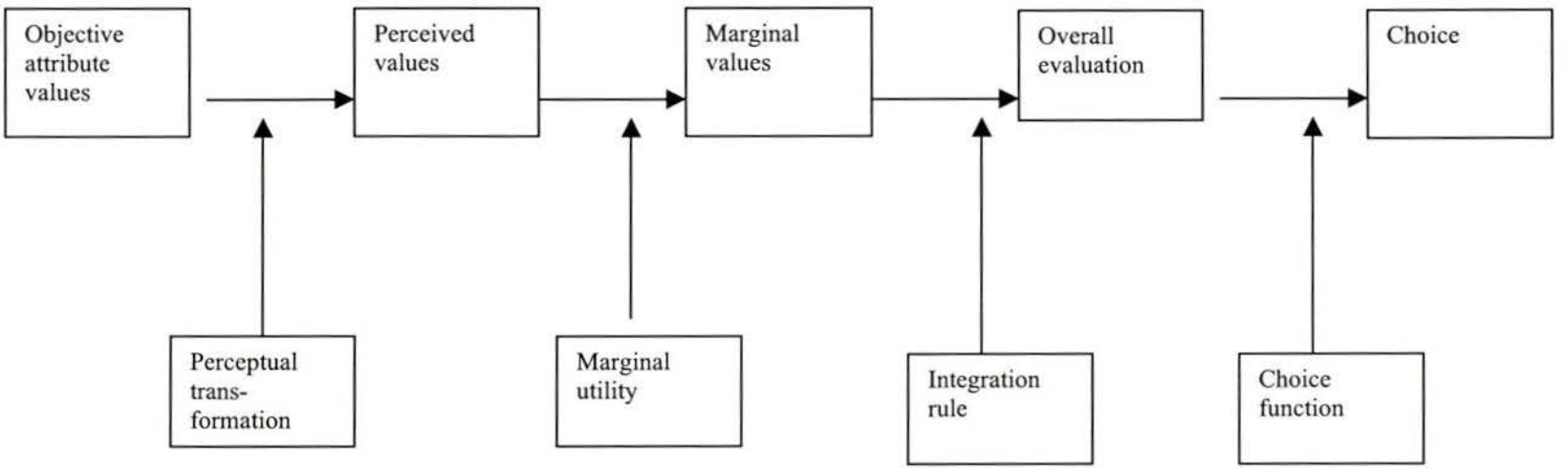
Models that Incorporate Psychological Attributes for Prediction of Transportation Mode Choice

Travel mode decisions, like any other choice behavior, are conceptually viewed as composed of four processes or relations, as follows (Levin & Louviere, 1981) : (a) Perceptual transformation, a process whereby objective, observable attributes are mapped into individual subjective beliefs and perceptions; (b) valuation or marginal utility, a process that maps the subjective perceived values into some psychologically meaningful dimension, such as "good" or "desirable"; (c) integration rule, a process where the marginal values above of several attributes are integrated into a single, overall value; and (d) choice function, where overall values are used to make decisions. These relations are depicted in Figure 1. These relations are very similar to Brunswik's (1952) lens model and also are very similar to models that are used in consumer choice behavior (Tybout & Hauser, 1981).

In order to explain the relation between an individual's perception and overall evaluation (process (c) above), psychological approaches are needed. Fenwich et al. (1983) pointed out, in a study of transit ridership, that the perception of physical characteristics of each transit mode may vary considerably across individuals, whereas the perception of physical characteristics of most consumer goods are approximately the

Figure 1

Processes in individual mode choice behavior (Modified from Figure 1. "Component processes in individual mode choice behavior", in Levin and Louviere (1981).



same for each individual. They proposed that a method of measuring consumers' values and perceptions at the individual level (micro level) is important. Bronner (1982) also argued that travel demand analysis should pay more attention to findings in cognitive psychology, especially to rules for decision making. In his brief review of developments in travel demand analysis, Bronner (1982) states that during the mid-1970s, explanatory variables other than socio-demographics, such as attitudes towards the specific transportation mode, began to receive attention.

In transportation research, attitude is usually measured by asking respondents to rate the importance of each attribute and aggregating the evaluations across attributes (Levin & Louviere, 1981). Although aggregation processes may be represented by a variety of forms, such as linear, conjunctive and disjunctive, linear models are often used.

Dawes and Corrigan (1974, as cited in Tybout & Hauser, 1981) suggested that linear models generally provide a good approximation of the process. Bronner (1982) also supported the linear model, emphasizing the parsimoniousness of, and easy data collection for, the model. Fishbein (1972), and Fishbein and Ajzen (1975), in the area of social psychology, also use the linear model approach as the aggregation process to measure attitudes toward objects.

There is some empirical support in the early studies for including attitude as a psychological factor to predict and explain transportation mode choice. Meyer et al. (1978) related mode choice to measures of preference for bus and car users. They reported that an attitude measure (preference for bus or car across situations) accounted for over 70 percent of the variance in the actual mode split to commute to and from work. Fenwick et al. (1983) found that users and non-users of transit evaluated the attributes in

a similar way, but that the two groups differed substantially in their perception and general preference towards transit and car use. Dobson and Tischer (1978) examined the perception of each attribute for different transportation mode choices and found that the differences in perception of attributes were highly correlated with mode choice patterns.

Theory of Planned Behavior

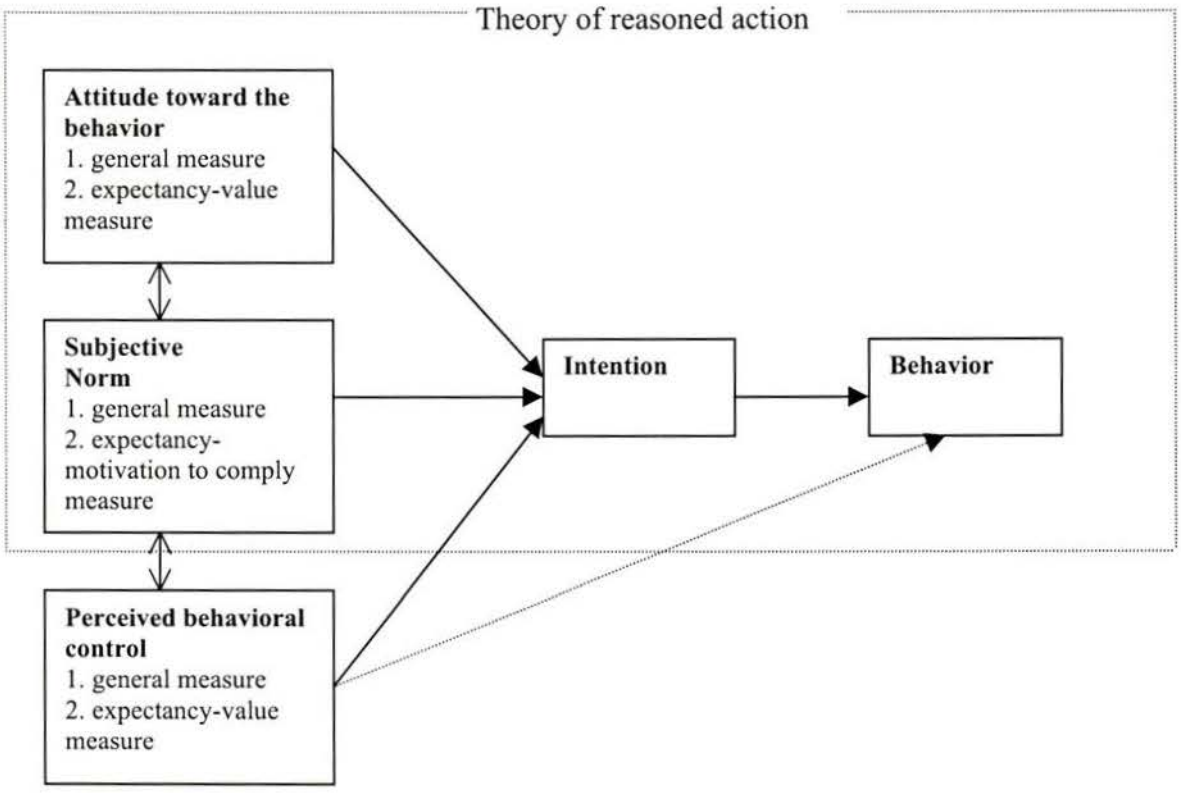
To incorporate attitudes and other psychological mediators to predict and explain a behavior, the theory of planned behavior (Ajzen, 1985; Schifter & Ajzen, 1985) has been a favorite choice among researchers (see Conner & Armitage, 1998 for a review). It provides a parsimonious theoretical framework to integrate various constructs, as well as a clear operational definition of each construct within the theory. The theory of planned behavior is an extended version of the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), in which attitudes and social norms are said to predict behavioral intentions, which in turn predict actual behaviors. The theory of reasoned action (see Figure 2) is designed to predict volitional behavior. The assumption of this theory is that "human beings usually behave in a sensible manner; that they take account of available information and implicitly or explicitly consider the implications of their actions" (Ajzen, 1988, p. 117). On the other hand, the theory of planned behavior deals with behavior over which people do not have full volitional control. In this situation, the execution of actual behavior depends on the availability of opportunities and resources to perform the behavior, which probably more closely applies to most real-life situations.

Components of the Theory

Ajzen (1988) claims that intentions are close antecedents of overt actions; a behavior can be predicted with a high degree of accuracy by knowing one's intention to

Figure 2

The theory of planned behavior by Ajzen (1988). (Modified from Figure 6.2, p. 133.)



perform the behavior. Hence, intentions should correlate more strongly with the target behavior than with other antecedents, such as attitudes (Ajzen et al., 1982; Manstead et al., 1983). The accuracy of prediction of behavior from behavioral intention is assumed as long as the behavioral intention remains stable before the observation of behavior. When the interval between the measurement of intention and observation of behavior increases, the accuracy of prediction by intention tends to decrease (Fishbein & Coombs, 1974; Sejwacz et al., 1980).

Although intentions may predict behavior accurately, they do not provide the reasons for a behavior. In order to understand and explain why one performs a certain behavior, the determinants of behavioral intentions need to be identified. The theory of reasoned action attempts to provide the causal antecedents of volitional behavior, namely, attitudes and subjective norms.

Ajzen and Fishbein (1980) proposed that intentions are a function of two determinants. One is the attitude toward the behavior; the other is the perception of social pressure. Attitudes are defined as one's positive or negative evaluation of performing a specific behavior. Social pressure to perform or not to perform a specific behavior is perceived by each individual, and is called "subjective norm." According to the theory, the more positive attitude toward a behavior that a person has, and the more the person thinks significant others approve of the behavior, the more likely he or she will intend to perform the behavior. Also, the theory assumes that the relative importance of attitude and subjective norm varies across behaviors and persons.

The theory of planned behavior (TPB), as previously mentioned, addresses the problem of incomplete volitional control over a behavior by adding a concept of

"perceived behavioral control" (PBC) as another determinant of behavioral intentions and behavior (see Figure 2). The TPB acknowledges that many factors, external and internal, can disrupt the intention-behavior relations. The PBC "refers to the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles" (Ajzen, 1988, p. 132). This refers to perceived control over a behavior, not the objective, actual amount of control a person has in a certain situation. Therefore, perceived control over a certain behavior in the same situation may differ, depending on the person's perception of the control.

Two features of the PBC need to be mentioned. First, the PBC is expected to be directly associated with behavioral intentions. Second, the PBC can be directly linked to behavior in some situations (see Figure 2); that is, behavior can be predicted from the PBC independent of behavioral intention, to the extent to which one's perception of control over a situation is realistic.

Operationalization of Each Construct: Expectancy-value Models

Fishbein (1967) conceptualized the structure of attitudes as a composite of the evaluation (value) of attributes related to the object or behavior in question and expectancy (the subjective probability that the behavior brings out the attributes). This type of model is called an "expectancy-value model." He proposed that attitudes are a function of beliefs about the behavior and the evaluative aspects of these beliefs.

Applying this concept, the components of the TPB, attitudes, social norms, and PBC are determined by salient beliefs for each component and evaluations of the beliefs by each person. The beliefs for each component are: behavioral beliefs for attitudes, normative beliefs for social norms, and control beliefs for the PBC.

Behavioral beliefs are beliefs about attributes of a certain behavior, or specific beliefs about outcomes of performing the behavior. For example, one might believe that "driving a car to school" will "be quicker than taking the bus" or "be more likely to take longer than taking the bus as I will be caught in a traffic jam" (outcomes). According to Ajzen (1988), "the attitude toward the behavior is determined by the person's evaluation of the outcomes associated with the behavior and by the strength of these associations" (p. 120). The following are examples of the questions used to measure the behavioral belief and the evaluation of it.

Driving is quicker to get to school than taking the bus (behavioral belief).

Likely: ---------- : Unlikely

Getting to school more quickly is (evaluation)

Very important: ---------- : Completely unimportant

Several behavioral beliefs are usually chosen for a target behavior and an estimate of the attitude toward the behavior is obtained by multiplying the strength of the belief and evaluation of the outcome, and summing the resulting products across the beliefs for the behavior. This is expressed by the following equation:

$$A_B \propto \Sigma b_i e_i$$

Where b is the belief (subjective probability) of the outcome, e is the evaluation of the outcome, and A_B is the attitude toward the behavior.

Normative beliefs, used to derive subjective norms, are the beliefs that one's significant others disapprove or approve a certain behavior. For subjective norms, motivation to comply with the significant other's wishes is used instead of evaluation of the outcome of a behavior. Subjective norms are derived by multiplying the strength of

normative beliefs and degree to which one is motivated to comply with the significant other's wishes. Therefore, the more a person believes that his or her significant others approve the behavior, and the more the person is motivated to comply, the more he or she will perceive social pressure to perform the behavior. The relation between normative beliefs and subjective norms are expressed by the following equation:

$$SN \propto \Sigma b_j m_j$$

where b is the normative belief about the significant others, and m is the person's motivation to comply with them.

Control beliefs are the beliefs that a certain factor will either facilitate or interfere with the performance of a behavior. Several control beliefs (c) are chosen and the each control belief is multiplied by the perceived power (p) of the facilitating or interfering factors. The PBC is derived by summing the resulting products across all the control beliefs, expressed by the following equation:

$$PBC \propto \Sigma c_j p_j$$

In addition to these expectancy-value measures for each construct, general measures of attitude, subjective norms and perceived behavioral control are obtained, using semantic differential items (see Ajzen & Fishbein, 1980). The semantic differential consists of a set of bipolar evaluative adjective pairs, such as good-bad, desirable-undesirable and harmful-beneficial, placed on opposite ends of a 7-point scale. Direct measures are derived by summing over the adjective scales.

Modifying the Theory of Planned Behavior

The theory of planned behavior is one of the most frequently used models for the prediction of behavior, especially in certain areas of applied social psychology (Parker et

al., 1996). However, in the environmental psychology literature, the use of theory of planned behavior has been much less common. Among the few that have used the theory are studies of composting behavior (Taylor & Todd, 1997), water-saving technology adoption (Lynne et al., 1995), and transportation mode choice (Parker et al., 1992; Verplanken et al., 1998). In the environmental psychology literature, various variables tend to be studied separately, without an integrating theoretical framework (Forward, 1997; Taylor & Todd, 1997). The merit of using the theory of planned behavior is that it provides a parsimonious theoretical framework to integrate various variables found in the previous studies, and it is flexible enough to add new constructs to the model. Ajzen himself suggested the following (1991):

> Perhaps of greater importance is the possibility of making further distinctions among additional kinds of beliefs and related dispositions. The theory of planned behavior is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behavior after the theory's current variables have been taken into account (p. 199).

The following section will discuss ways to modify the theory of planned behavior in order to improve its predictive ability by a) extending the concept of existing constructs and b) adding new constructs.

Extending the Concept of Constructs

In this section, the original constructs of the theory of planned behavior will be extended by making further distinctions within each construct: Attitudes will be divided

into two parts, namely evaluative and affective judgements, and subjective norms will be expanded by adding moral (personal) norms and descriptive norms.

Attitudes. Some investigators have suggested that not only perceived costs and benefits for a certain behavior (evaluative attitudes), but also positive or negative feelings toward the behavior (affective judgements) should be included to explain a behavior (e.g., Abelson et al., 1982). In a study of university students, Richard et al. (1996) showed that anticipated affect (i.e., pleasant, nice, good) of performing four selected behaviors, namely eating junk food, using soft drugs, drinking a lot, and studying hard, predicted the behavior over and above the original components of theory of planned behavior. Lawton et al. (1997) investigated the role of affective judgements within the context of road traffic violations. The results revealed that the more positive the feelings the respondents had about performing the behavior, the more likely they intended to perform the behavior.

The present study includes both original evaluative attitudes and affective judgements for explaining transportation mode choice.

Social norms. The original concept of subjective norms deals with approval or disapproval of a behavior by significant others. In a situation where the target behavior is smoking or drinking-and-driving, it is obvious that the behavior would be perceived as socially undesirable and approval or disapproval from significant others becomes important. However, if the target behavior is not socially perceived as obviously bad, as in transportation mode choice, this type of norm might not have much power to predict the behavior. Instead of completely ruling out the influence of social pressure by

excluding the concept, this study intends to expand the concept of social norms to include additional norms, namely, descriptive norms and moral norms.

Cialdini et al. (1990) distinguished between "descriptive norms" and "injunctive norms." Injunctive norms refer to rules as to what is morally approved or disapproved, or in other words, what ought to be done, which is equivalent to Ajzen's subjective norm. In contrast, descriptive norms describe what is typical or normal, or in other words, what most people do in a given situation. The notion that the perception of what most others are doing influences one's choice of behavior (Milgram, Bickman, & Berkowitz, 1969) is a well-established concept in social psychology.

Some researchers argued that not only the external pressure that one feels in performing a behavior, but also personal feelings of obligation or moral responsibility must be added to explain a behavior (Gorsuch & Ortberg, 1983; Schwartz & Tessler, 1972). Beck and Ajzen (1991) added perceived moral obligation to the model in a study of university students on unethical behavior, such as cheating during exams and shoplifting. Results showed that perceived moral obligation increased the explained variance further, over and above the original constructs of the theory of planned behavior. Schwartz's norm-activation model of altruism (1977) also emphasizes the role of personal feelings of moral obligation to perform pro-environmental behaviors. Parker et al. (1995) showed that the addition of moral norm substantially improved prediction of intention to commit driving violations. Thus, moral norms and descriptive norms were added to subjective norms in this study's model.

Adding New Constructs to the Model

In order to incorporate some of the variables that researchers have shown to explain environmental behaviors, the following new constructs were added: Schwartz's value priorities, awareness of and perceived responsibility for the problems caused by car use, and past negative experience concerning transit use.

Schwartz's value priorities. Schwartz and Bilsky (1990, as cited in Schwartz, 1992) defined values as follows, incorporating five features of values often mentioned in the literature: " Values 1) are concepts, 2) pertain to desirable end states or behaviors, 3) transcend specific situations, 4) guide selection or evaluation of behavior and events, and 5) are ordered by relative importance" (p. 4), and emphasized that values differ from attitudes. Schwartz (1992, pp. 6-7) listed 56 values that are partly derived from the Rokeach Value Survey (1973), and classified them into either "terminal goals (end states)" or "instrumental goals (modes of behavior that helps to achieve the end states)."

Schwartz categorized the 56 values into 11 motivational concerns (types) that each value expresses: self-direction, stimulation, hedonism, achievement, power, security, conformity, tradition, spirituality, benevolence and universalism. Schwartz included "protecting the environment," "world of beauty" and "unity with nature" in the last category, universalism, which represents "understanding, appreciation, tolerance, and protection for the welfare of all people and for nature" (p. 12). These motivational types are further categorized into four higher-order value types: openness to change, self-enhancement, conservation, and self-transcendence.

Schwartz also postulated the norm-activation model of altruism (1977), which has been often used in order to provide a theoretical framework to explain environmental

attitudes and behavior (Black et al., 1985; Stern et al., 1986). The Schwartz's norm-activation model of altruism suggests that pro-environmental actions are a special case of altruism. It also assumes that people have a general value orientation toward the welfare of others. Under the assumption, pro-environmental behavior is more likely to happen when an individual is aware of harmful consequences to others and when the person perceives responsibility for solving environmental problems. The theory reasons that, under these conditions, an individual will feel obligated to undertake pro-environmental behaviors; hence, it is called the norm-activation model.

Stern et al. (1995) expanded Schwartz's norm-activation model of altruism to provide an integrative theoretical model of environmental concern by linking it to measures of underlying values derived from studies by Rokeach (1973) and Schwartz (1992). Using 34 value items selected to represent Schwartz's list, the results showed that two of the Schwartz's value types, self-transcendent and self-enhancement, had explanatory power for one's beliefs about environmental conditions and one's willingness to take pro-environmental actions, and that the values had both direct and indirect effects on behavioral intentions.

Awareness of and perceived responsibility for the problems caused by car use. As mentioned previously, Schwartz's norm-activation theory (1977) was developed originally to explain altruistically motivated helping behavior. The theory proposes that two conditions are necessary for one to perform altruistic behavior: awareness of harmful consequences of (not performing) the behavior to others, and a feeling of responsibility for performing the behavior. Under these two conditions, an individual experiences a sense of obligation to act to prevent harm to others.

Much research has successfully applied Schwartz's theory to predict pro-environmental behaviors, using a measure of awareness of consequences (AC) and ascription of responsibility (AR). These pro-environmental behaviors include: recycling (Hopper & Nielsen, 1991; Guagnano et al., 1995); energy conservation (Stern, Black, & Elworth, 1983); willingness to take political action for environmental protection (Stern, Dietz, & Kalof, 1993); and yard burning (Van Liere & Dunlap, 1978).

Steg and Vlek (1997) investigated the role of awareness of and perceived responsibility for the problems caused by car use in the study of psychological factors in relation to car use in the Netherlands. Their results revealed that the greater the awareness of the problems, the more individuals felt responsible for the problems caused by car use, and they actually used their car less. Steg et al. (1999) also showed that the awareness of the problems caused by car use explained further variance in actual car use over and above demographic variables (age, gender, educational level and income).

In the present study, awareness of and perceived responsibility for the problems caused by car use were used as close approximates for awareness of consequences and ascription of responsibility. My interest was to investigate whether or not these two variables would make any contribution for the prediction of transportation mode choice.

Past experience. Ajzen (1988) suggested that PBC is "assumed to reflect past experience as well as anticipated impediments and obstacles" (p. 132). Intuitively, past experience could also affect attitudes toward behavior; it is natural that if one had a negative experience when using public transit, one would form a negative attitude toward it. Thus, measures of past experience about bus use was included to investigate whether

or not it would be correlated with any construct in the theory of planned behavior, and whether or not it would predict behavior and behavioral intention.

Summary of the Modified Theory of Planned Behavior

The original model was expanded considerably both by extending each component of the original model and by adding new constructs. Attitudes included both evaluative and affective judgements of the behavior. Social norms had three distinctive components: injunctive, descriptive, and moral (personal). As well, the following new constructs were added: (a) Schwartz's value priorities, (b) perceived responsibility for and awareness of the problems caused by car use, and (c) past negative experience regarding bus use. The main goal is to explain more variance in travel mode choice and intention to choose one, over and above the original constructs of the theory of planned behavior.

A Study of a U-pass Program Using the Theory of Planned Behavior

As mentioned previously, most studies on transportation mode choice focus on economic factors, and only a few investigate psychological factors that might affect the mode choice. Among those few, Bamberg and Schmidt (1998) investigated the effect of a U-pass program implemented at a university in Germany using the theory of planned behavior. The major purpose of their study of the U-pass intervention was to explain the underlying processes that caused empirically observed effects (shifts in modal split).

They proposed differentiating between two types of theories, conceptual theory and action theory, in intervention or evaluation research. They suggest that a social intervention program usually consists of an implicit or explicit causal theory. Such a theory suggests that a set of causal variables has a specific effect on a desired set of

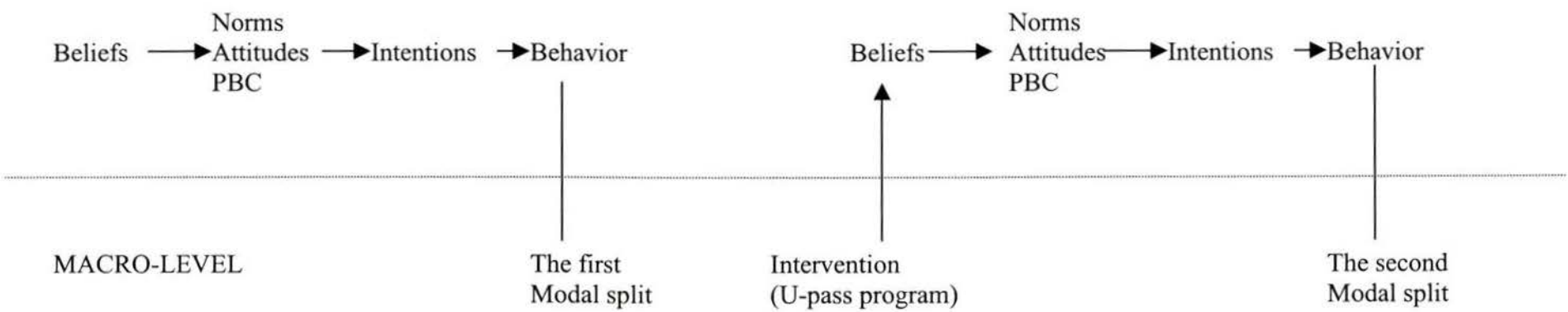
outcome variables and that the intervention influences those causal variables. The former is a "conceptual theory", and the latter, an "action theory." An evaluation of an intervention involves two kinds of tests: A test of a conceptual theory, to examine whether the causal variables have expected impact on the outcome variables; and a test of an "action theory," to examine whether the intervention successfully influenced the causal variables of the conceptual theory. They argued that, although an action theory is generally proposed by decision makers or program planners, the success or failure of an action theory is normally not tested or documented.

To illustrate the relations between conceptual and action theory, their longitudinal study design is depicted below (Figure 3). Data were collected twice, before and after the U-pass program implementation. At both times, the same constructs (attitudes, social norms, and PBC) were used to predict and explain transportation mode choice. They called this a test of "conceptual theory." In addition, they examined whether the intervention caused any changes in the constructs of the theory (a test of "action theory"), which in turn, predicted transportation mode choice at the second data collection. In most conventional evaluation studies, only the macro-level outcomes (modal split) before and after the intervention are compared without taking into consideration the underlying processes in micro-level.

Bamberg and Schmidt (1998) formulated a set of hypotheses concerning action theory. The key element of the action theory is derived from the reciprocal nature of psychological variables and behavior; psychological factors influence behavior, and performing the behavior will influence the psychological factors. Bamberg (1995, as cited in Bamberg & Schmidt, 1998) found that car users who had no direct experience

Figure 3

Interrelation between Micro- and Macro- Processes of the Intervention



with public transportation were likely to have negatively biased beliefs about the outcomes of using public transportation. They reasoned from this result that once car users start to use transit as a result of a U-pass program, they will develop more unbiased, realistic perceptions of public transportation, and that the beliefs about the outcomes of using public transportation will positively change.

They also hypothesized that, as a result of increased transit use, former non-bus-users would acquire more information on a transit system, which would cause positive changes in their perceived behavioral control over transit use. They further assumed that increased transit use by a majority of students would influence the social norm. They called these hypotheses "bridge assumptions," because they link macro-level and micro-level explanations of changes concerning the intervention.

As a result of a questionnaire survey of 705 students, Bamberg and Schmidt reported the macro-level change as follows: The percentage of car use decreased from 43.5 percent to 30.6 percent after the U-pass implementation, and the use of transit increased by nearly the same amount, from 15.7 percent to 30.1 percent.

The results also revealed changes at the micro level. Comparing the means and standard deviation of the indicators of TPB, they showed that changes occurred in TPB constructs, attitudes, subjective norms, PBC, and intention. For example, after the U-pass implementation, the evaluation of the control belief, "knowledge of timetable" decreased significantly, whereas the subjective probability of the control belief (i.e., the probability that respondents thought they would know the timetable well) increased significantly. The evaluation of another control belief, "the existence of good bus connections" showed a significant increase, whereas the subjective probability of it (i.e., the probability that

respondents thought good bus connections would exist) decreased significantly. From this Bamberg and Schmidt concluded that as a result of direct experience of frequent transit use, students' timetable knowledge increased, hence, the importance of timetable knowledge as a facilitating factor decreased; at the same time, the existence of good bus connections became a more crucial facilitating factor for the use of transit. In this way, they managed to explain the underlying processes (changes at the micro-level) that caused changes in modal split (macro level changes).

Hypotheses

This study follows Bamberg and Schmidt's (1998) study closely. One major difference, however, is that this model includes additional constructs that were reported to improve the predictive validity of the theory of planned behavior.

The purposes of this study are to investigate (a) whether or not the original constructs of the theory of planned behavior would significantly explain and predict the transportation mode choice; (b) whether or not the added variables would account for more variance over and above the original constructs of the theory of planned behavior; (c) whether or not there would be changes in the constructs of the model (i.e., attitudes, social norms, PBC, etc.) before and after the U-pass implementation; and (d) whether or not there would be differences in any of the constructs in the model between those who changed to bus use from car use and those who did not change after the U-pass implementation.

Several hypotheses concerning these purposes were formulated:

1. Concerning the predictive validity of psychological constructs in TPB in predicting transportation mode choice:

(a) The TPB constructs, attitudes, social norm, PBC and behavioral intention, will explain considerable variance in transportation mode choice; and

(b) The new variables added to extend the original constructs, namely affect, descriptive norm and moral norm, will explain a significant amount of variance over and above the original construct.

2. Concerning the predictive ability of new constructs:

New constructs added in the theory of planned behavior, value priority, awareness of and perceived responsibility for the problems caused by car use, and past experience will account for significantly more variance over and above the original constructs of the theory of planned behavior.

3. Concerning changes in beliefs and psychological constructs before and after the U-pass implementation:

(a) There will be changes in behavioral and control beliefs in both subjective probability and evaluation of them; and

(b) Changes in other variables will be also explored.

4. Concerning differences among different transportation mode users:

(a) There will be differences in the beliefs and constructs of the model among different transportation mode users, i.e., bus users, car users, and bicyclists; and

(b) The differences between those who have started to use the bus more often and those who continue to use a car all the time after the implementation of the U-pass program will be explored in the constructs measured in the model.

CHAPTER 2

Method

Site

This study took place on the University of Victoria campus. Victoria is the capital city of British Columbia, Canada, with a population of 250,000, and it is located on Vancouver Island in the extreme southwest of the country.

U-pass was implemented in September 1999, at the beginning of the fall semester, as a result of a successful referendum in February 1999, of undergraduate and graduate students. All students who have student identification cards are entitled to use U-pass. Fee payment of $11 CDN per month ($44 per semester) is mandatory regardless of students' preferred transportation mode choice. The U-pass enables them to travel throughout the Capital Regional District by bus (the only form of public transportation). Compared to the usual price of $36 for a monthly student pass, U-pass offers a considerable price reduction.

Design and procedure

This study employed a longitudinal approach to measure possible changes associated with the U-pass implementation. Two surveys took place: one during summer 1999 prior to the U-pass implementation, and one afterward, in late October 1999.

In the first data collection (Phase 1), questionnaires were distributed to students in a variety of undergraduate classes in many departments besides Psychology (English, History, Anthropology, Geography, Sociology, Education, Business, Economics, Mathematics, Physics, and Astronomy). Students were asked to complete the questionnaires at home and to bring them at the next class. All participation was

voluntary. On the questionnaire, students were asked to provide information such that the researcher could contact them in October for the second data collection.

The Phase 2 data collection took place in late October, three months after the Phase 1 data collection, and took approximately one month. The same questionnaires (exclusive of demographic information, such as age and gender) were mailed to 26 participants of Phase 1 who left only mailing addresses as contact information. The questionnaire was also set up on a Web page established for this purpose, and those who left only email addresses were notified by email to answer the Phase 2 questionnaire on-line.[1]

Questionnaires

A questionnaire (see Appendix 1) was designed to measure all the constructs described in the previous section. Most questions had a 5-point bipolar scale response format, ranging from 2 (strongly agree) to –2 (strongly disagree).

For the original constructs of Theory of Planned Behavior (TPB), the operationalization suggested by Ajzen (1988) was followed. Both evaluation of the beliefs and subjective probability of the beliefs were measured, except for the subjective norms. The selection of salient beliefs was made from previous studies or on an intuitive basis.

The dependent variable was the percentage of time that students took the bus to and from the university, among other modes of transportation, during the previous 10 school days that each student came to school. Although it was asked retrospectively, it was assumed that this measure represented an accurate measure of the present transportation mode choice of students for the following two reasons: (a) it covers a

recent time period and (b) it is relatively easy to remember, compared to other specific things that vary greatly on a daily basis.

Intention. One item on the questionnaire asked students directly about their intentions to use transit, using the bipolar scale described above.

Attitudes. Attitudes in this model had three variables: two from the original TPB model, namely general measure and expectancy-value measure, and one added to extend the original model, namely an affective judgement measure. General attitude was measured using one direct question about the student's general preference for bus use. For the expectancy-value measure, behavioral beliefs (namely costs, convenience, travel time, comfort, and flexible schedule) were selected from previous studies (e.g., Fenwich et al., 1983). As well, the need for protection from bad weather and for having control over one's time were added on an intuitive basis. These behavioral beliefs and general attitudes were asked also regarding car use for comparison with those concerning bus use.[2] Both evaluations and subjective probabilities of the beliefs were requested, using the bipolar scales described above. The calculation of the expectancy-value measure followed Ajzen (1988), by multiplying evaluation and subjective probability for each item and totalling the products across all the items. Affective judgement about driving and taking the bus was measured with three items: "driving makes me feel good," "driving gives me a thrill," and "traveling by bus is fun." A general affect measure was calculated by taking the average of the three items after recoding two items for car use.

Subjective norms. The role of subjective norms as a useful explanatory and predictive device has been controversial among researchers. Forward (1997) examined this variable in detail and reported that the two components used to derive subjective

norms, normative belief and motivation to comply, were not related significantly and that the effect on intention was due to normative belief alone. These findings are consistent with other studies, and often motivation to comply is omitted from studies (Ajzen & Driver, 1991; Beck & Ajzen, 1991; Doll & Orth, 1993). Based on these findings, this study used only a general measure for subjective probability.

The general subjective norm was measured using two items that asked respondents to rate the extent to which most people who are important to them think that they should take the bus to and from school, using bipolar scales. The descriptive norm was measured by asking respondents to estimate what percentage of their friends use transit to commute to and from school. The moral norm was measured using two items directly asking whether or not respondents would have any sense of guilt driving to school, using the same bipolar scale.

Perceived behavioral control. For the expectancy-value measure, two control beliefs, namely, living near a good bus route and knowing the bus schedule well, were used, which followed Bamberg and Schmidt's (1988) study. Again, the expectancy-value measure was calculated according to Ajzen (1988). A general measure of PBC using a bipolar scale was assessed using one item that asked respondents to rate how difficult it is to take the bus to commute to and from school.

Value orientation. Schwartz's value priorities (1992) were used to measure value orientations. The rank order that participants assigned to the value of "protecting the environment," among six other values (true friendship, equality, family security, social power, wealth and authority), was used as a measure of the importance of environmental values.

Awareness of and responsibility for the problems caused by car use. First, problems caused by car use were categorized into three areas: environmental, economic, and problems concerning urban quality of life. Awareness of these problems was measured by asking respondents to rate the extent to which they agreed with the statement of each problem in a bipolar scale response format. The average of these eight items was calculated as a "problem awareness" measure. Perceived responsibility for the problems was queried using one item that directly asked respondents how much they would feel responsible for solving the problems caused by car use.

Past experience. Respondents were asked whether or not they had had negative experiences with transit use on a 4-point scale ranging from 1 (none) to 4 (many).

Analyses

After constructing composite variables from the original items for some constructs, hierarchical multiple regression analyses were performed in order to test whether the additional variables would explain variance over and above the original TPB variables in the prediction of behavioral intention and behavior (percentage of time participants took the bus to and from the university). These regressions were performed also in order to examine which variables uniquely predict the dependent variables.

In addition, an attempt was made to test the structure of the original TPB model, in which the effect of attitude, subjective norm and PBC are mediated by behavioral intention to influence behavior, and PBC can be also directly linked to behavior, independent of behavioral intention (see Figure 2). Baron and Kenny (1986) suggested that three regression equations are necessary to test a mediating relation: (a) regression of the dependent variable on the predictor, (b) regression of the mediator on the predictor,

and (c) regression of the dependent variable on the mediator and predictor. When regression in equations (a) and (b) is significant, and the candidate for the mediator is significant while the predictor is not in equation (c), the mediating relation is supported. Using this method, a set of three regression models described above was performed to examine the mediating relation.

Also, multivariate analysis of variance was performed to investigate whether or not significant differences exist in psychological constructs among three different transportation mode groups (i.e., bus users, car users, and bicyclists).

All of the above analyses were performed for both Phase 1 and Phase 2 data. In addition, whether or not any changes had occurred in the variables since Phase 1 was examined using the paired-sample t test. Furthermore, an attempt was made to predict the changes in actual behavior between Phase 1 and Phase 2 using the same predictors in multiple regression analyses.

CHAPTER 3

Results

Phase 1

Participants. Approximately 1,020 questionnaires were distributed in the first data collection in a variety of undergraduate classes encompassing several departments besides psychology as described before. The total number of completed questionnaires collected was 431. The average return rate was 42.3 percent. Out of 431, those who either lived on campus or very close to school and did not have to choose any transportation mode (those who always walk to school) were excluded, as were disabled students. This resulted in 387 valid completed questionnaires (56.8 percent females and 41.8 percent males, average age 24.5 years). Among them, 309 questionnaires (79.8 percent) included some form of contact information (mailing address and/or email address) for the Phase 2 survey.

Descriptive statistics. On average, 41 percent of all the trips made by the participants to commute to and from school were by driving alone, 26.8 percent were by bus, 17.8 percent by bike, 8.6 percent by carpooling (drive with at least one more person) and 5.5 percent by walking. For the question "I'm happy that U-pass will be introduced," 24.3 percent answered "disagree" or "strongly disagree," 19.1 percent "neutral," and 56.7 percent answered "agree" or "strongly agree."

Table 1 lists the means and standard deviations for the variables in Phase 1. Internal consistency is also listed for the composite variables. The construct for affect was originally measured by three items, but its internal consistency was poor among the 3 items (alpha = .42). Examination of the correlations of each separate item with other

Table 1

Means and Standard Deviations for Variables in Phase 1

	Mean	S.D.	alpha
For bus use			
Percentage of bus use	26.81	40.57	
Intention to take the bus	-.07	1.45	
General attitude	-.07	1.17	
Belief-based attitude	-.65	9.8	
Affect	-.45	1.04	
Subjective norm	.04	0.92	0.69
Descriptive norm	1.82	1.01	
Moral norm	-.43	1.12	0.81
General control	.36	1.39	
Belief-based control	1.53	4.23	
For car use			
General attitude	.69	1.25	
Belief-based attitude	12.39	8.06	
Affect	.28	1.13	
Value ranking of environmental concern	4.15	1.55	
Awareness of environmental problems	.41	.67	0.78
Responsibility for environmental problems	-.08	1.12	
Past negative experiences with buses	1.68	.96	

Notes. Most variables were measured in 5-point scale from 2 (strongly agree) to –2 (strongly disagree). Descriptive norm was measured on a scale ranging from 1 to 4.

Larger values indicate more perceived descriptive norm. The value measure was assessed by the rank participants assigned to "protecting the environment" among other 6 values. The value ranges from 1 (highest) to 7 (lowest).

Past negative experience with bus was measured with scale ranging from 1 to 4. Larger values indicate more negative experiences.

variables revealed that one of the three items ("driving gives me a sense of thrill") was not significantly related to any other variable, except for one of the three affect items (the other item for car use, "driving makes me feel good"). Therefore, the item was dropped and two other items were used separately: One item asked about the feeling toward a bus ride ("traveling by bus is fun"), and the other asked the same thing about a car ride.[3]

Means of all three measures for attitudes toward taking the bus (general, expectancy-value and affect) were negative on the bi-polar scale, which indicates that participants on average did not have positive attitudes toward taking the bus. As well, means for moral obligation and perceived responsibility for problems caused by car use were negative, which indicates participants on average did not feel a moral obligation for not using a car, or perceive responsibility for the problems caused by car use.

Table 2 lists the correlations among variables. Past negative experience with the bus was significantly negatively correlated with affective judgement for bus use ($r = -.15$, $p < .01$), although the size of the correlations was small. It was also significantly correlated with actual behavior ($r = .19$, $p < .01$), although it was not a negative correlation as expected (see Discussion). Awareness of the problems caused by car use, perceived responsibility for the same problems, and moral norm inter-correlated moderately with each other. Affective judgement was relatively highly correlated with the general attitude toward bus use ($r = .59$, $p < .01$). The subjective norm was moderately correlated with both the descriptive ($r = .37$, $p < .01$) and the moral norm ($r = .40$, $p < .01$), while descriptive norm and moral norm were much less correlated ($r = .24$, $p < .01$). Correlations between newly added variables (value, awareness of and perceived responsibility for the problems caused by car use, and past negative experience with the

Table 2

Correlations Among Variables in Phase 1

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Percentage of bus use																
2. Intention to take the bus	.69															
3. General attitude for bus use	.39	.63														
4. Belief-based attitude for bus use	.39	.48	.48													
5. Affect for bus use	.14	.33	.59	.36												
6. General attitude for car use	-.22	-.31	-.39	-.30	-.22											
7. Belief-based attitude for car use	-.21	-.30	-.35	-.20	-.27	.53										
8. Affect for car use	-.13	-.19	-.26	-.14	-.11	.61	.38									
9. Subjective norm for bus use	.41	.65	.57	.41	.33	-.36	-.27	-.25								
10. Moral norm for bus use	.16	.36	.38	.28	.16	-.61	-.39	-.45	.40							
11. Descriptive norm for car use	.44	.44	.36	.29	.23	-.23	-.13	-.17	.37	.24						
12. General control over bus use	.49	.58	.45	.47	.22	-.31	-.27	-.15	.45	.30	.30					
13. Belief-based control over bus use	.44	.49	.38	.41	.21	-.24	-.21	-.12	.35	.18	.23	.55				
14. Value ranking of environmental concern	-.06	-.18	-.21	-.18	-.11	.33	21	.29	-.17	-.28	-.03	-.12	-.03			
15. Awareness of environmental problems	.27	.41	.27	.24	.12	-.42	-.29	-.32	.36	.48	.21	.28	.26	-.31		
16. Responsibility for environmental problems	.09	.23	.30	.20	.18	-.39	-.22	-.30	.31	.48	.16	.16	.11	-35	.51	
17. Past negative experiences with buses	.19	.13	-.07	-.09	-.15	.01	.13	.09	-.07	-.06	.03	-.01	.05	.09	-.03	-.08

Note. Values larger than .13 are all significant at $p < .01$.

bus), actual behavior, and behavioral intention were relatively small, except for the correlation between awareness of the problems and behavioral intention.

For the sake of comparison, correlations of three measures for car use (general attitudes, expectancy-value measure for attitude and affect toward car use) with other variables were also examined. All the three measures for car use were negatively and moderately correlated with perceived moral obligation for not using cars. In particular, the general attitude for car use was relatively highly correlated with the moral measure ($r = -.61$, $p < .01$) and the awareness of the problems caused by car use ($r = -.42$, $p < .01$). Correlations of the three measures for car use with dependent variables (behavioral intention and behavior) were relatively small compared to those of measures for bus use (general attitudes, expectancy-value measure for attitude and affect toward bus use).

Comparison of user groups. The means for variables were compared among car users (defined as those who reported that they drove to the university more than 80 percent of the time), bus users (defined as those who reported that they took the bus more than 80 percent of the time), and bicyclists (defined as those who reported that they biked more than 80 percent of the time). Table 3 lists the means and standard deviations of the variables for each group.

The result of the multivariate analysis of variance showed that the overall group difference was statistically significant, $F (24, 406) = 9.87$, $p < .001$. Most of the univariate means were significantly different ($p < .01$) between groups, except for affective judgement for bus use ($p = .052$) and perceived responsibility for the problems caused by car use ($p = .049$). Table 3 also lists the result of univariate analysis of variance for each variable. In order to further investigate the group differences, Tukey HSD tests

Table 3

Mean Comparison Among User Groups in Phase 1

		car user	bus user	bicyclist	MS	F	p
General attitude	M	-0.51	0.56	-0.19	24.98	21.34	0.000
	S.D.	1.15	1.04	0.95			
Belief-based attitude	M	-4.17	4.46	-1.06	1610.71	17.78	0.000
	S.D.	10.51	8.04	8.99			
Affect	M	-0.64	-0.24	-0.44	3.42	3.01	0.052
	S.D.	1.08	1.05	1.05			
Subjective norm	M	-0.35	0.61	0.04	19.52	27.94	0.000
	S.D.	0.82	0.91	0.72			
Descriptive norm	M	1.56	2.54	1.64	21.77	23.89	0.000
	S.D.	0.88	1.09	0.87			
Moral norm	M	-0.81	-0.23	0.00	12.40	11.33	0.000
	S.D.	1.10	0.94	1.08			
General control	M	-0.45	1.44	0.36	76.49	54.03	0.000
	S.D.	1.30	0.87	1.36			
Belief-based control	M	-0.15	4.52	0.00	514.01	35.85	0.000
	S.D.	3.87	3.63	3.83			
Value ranking of environmental concern	M	4.53	4.17	3.72	9.40	4.69	0.010
	S.D.	1.25	1.37	1.91			
Awareness of environmental problems	M	0.09	0.66	0.69	9.38	24.40	0.000
	S.D.	0.62	0.58	0.70			
Responsibility for environmental problems	M	-0.30	0.00	0.17	3.77	3.06	0.049
	S.D.	1.07	1.12	1.21			
Past negative experience with bus uses	M	1.71	2.17	1.86	4.58	5.35	0.005
	S.D.	0.92	0.91	0.96			

were performed as a post-hoc test on each variable. Generally, bus user attitudes were different from those of the other two groups, namely the car users and bicyclists. For example, general attitudes toward bus use were the most positive among bus users compared to the other two groups, and the general PBC measure was also highest for bus users. For perceived moral obligation (to not use a car) and value, bicyclists had the highest score among the three groups, although the differences between bus users were not statistically significant. Awareness of environmental problems was not significantly different between bus users and bicyclists, although both had significantly higher scores than car users.

Regression analyses with behavioral intention. Hierarchical multiple regressions with behavioral intention as the dependent variable were performed to investigate the increases in variance (if any) when new variables (affective judgement measure for attitudes toward bus use, descriptive norm, moral norm, measure for value, awareness of and perceived responsibility for the problems caused by car use, and past negative experience with bus use) were added to the original theory of planned behavior constructs (i.e., general and expectancy-value measures for attitude for bus use, subjective norm, general and expectancy-value measures for perceived behavioral control). The regression model also included two covariates, financial status and the self-reported time it took respondents to come to the university by bus, as a distance measure (the latter will be referred to as "distance" hereafter).

Table 4 lists variables added in each step, corresponding R^2 changes, and standardized regression coefficients for each variable, with t and p values. In the first step, only covariates (financial status and distance) were included. The second step

Table 4

Hierarchical Regression of Behavioral Intention for Phase 1 (n = 387)

	Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
1	distance	-0.25	-0.25	0.99	-4.15	0.001			
	finance	-0.14	-0.15	0.99	-2.36	0.05	0.08	0.05	0.001
2	distance	0.03	0.04	0.78	0.59				
	finance	-0.04	-0.07	0.96	-1.1				
	General attitude	0.27	0.31	0.57	5.21	0.001			
	Belief-based attitude	0.03	0.04	0.67	0.7				
	Subjective norm	0.36	0.43	0.65	7.5	0.001			
	General control	0.22	0.24	0.47	3.9	0.001			
	Belief-based control	0.13	0.17	0.66	2.74	0.01	0.61	0.53	0.001
3	distance	0	0	0.76	0.07				
	finance	-0.04	-0.06	0.93	-0.91				
	General attitude	0.29	0.29	0.41	4.93	0.001			
	Belief-based attitude	0.04	0.05	0.63	0.83				
	Subjective norm	0.34	0.39	0.59	6.89	0.001			
	General control	0.21	0.24	0.47	3.84	0.001			
	Belief-based control	0.12	0.16	0.65	2.59	0.01			
	Affect	-0.06	-0.08	0.60	-1.29				
	Descriptive norm	0.15	0.22	0.83	3.61	0.001			
	Moral norm	-0.05	-0.07	0.72	-1.16		0.63	0.02	0.01

Table continues.

	Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
4	distance	-0.02	-0.03	0.73	-0.54				
	finance	0.01	0.01	0.88	0.14				
	General attitude	0.27	0.29	0.40	4.82	0.001			
	Belief-based attitude	0.08	0.11	0.61	1.79				
	Subjective norm	0.32	0.39	0.57	6.74	0.001			
	General control	0.19	0.23	0.46	3.69	0.001			
	Belief-based control	0.09	0.12	0.62	1.89				
	Affect	-0.04	-0.05	0.59	-0.84				
	Descriptive norm	0.13	0.21	0.81	3.38	0.001			
	Moral norm	-0.05	-0.07	0.59	-1.15				
	Value ranking of environmental concern	-0.02	-0.03	0.78	-0.44				
	Awareness of environmental problems	0.16	0.21	0.59	3.42	0.001			
	Responsibility for environmental problems	-0.07	-0.09	0.62	-1.51				
	Past negative experience with buses	0.19	0.32	0.89	5.3	0.001	0.67	0.05	0.001

Notes. All the variables are regarding bus use.

Only significant p values are shown.

included all of the original TPB constructs. In the third step, the new variables (affective judgement measure for attitude, descriptive norm and moral obligation) that were expected to extend the original construct, attitudes and social norms, were added. In the fourth and last step, the other new variables (value measure, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience the with bus) were added, resulting in the full model.

At each step, $\underline{R}^2$ changes were significant, although they were small after the second step. In the second step, $\underline{R}^2$ change was .53, $\underline{F}$ change (5, 256) = 71.79, $\underline{p} < .001$, for the third step, $\underline{R}^2$ change was .02, $\underline{F}$ change (3, 253) = 5.03, $\underline{p} < .01$, and for the fourth step, $\underline{R}^2$ change was .05, $\underline{F}$ change (4, 249) = 10.1, $\underline{p} < .001$. Total $\underline{R}^2$ for the full model was .67, $\underline{F}$ (14, 249) = 39.69, $\underline{p} < .001$. In the final model, in which all the 14 variables (including covariates) were included, the following variables were significant: general attitude ($\underline{t} = 4.8$, $\underline{p} < .001$), subjective norm ($\underline{t} = 6.74$, $\underline{p} < .001$), general perceived behavioral control (PBC) ($\underline{t} = 3.69$, $\underline{p} < .001$), descriptive norm ($\underline{t} = 3.38$ $\underline{p} < .001$), problem awareness ($\underline{t} = 3.42$, $\underline{p} < .001$), and past negative experience with the bus ($\underline{t} = 5.3$, $\underline{p} < .001$).

Although the main purpose was to investigate whether or not the new variables would add further variance over and above the original TPB variables, it was also investigated how much variance would be explained only by the new variables. Controlling for financial status and distance, the seven new variables (affective judgement measure for attitude, descriptive norm, moral obligation, value measure, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience with bus use) were added together in the first

step, which explained 35 percent of the variance, $F(9, 254) = 21.79$, $p < .001$. The original TPB variables were added in the second step. R^2 change for the second step was significant, explaining a further 25.5 percent of variance, F change $(5, 249) = 41.01$, $p < .001$. In the first step, where only new variables were entered, affective judgement toward bus use (beta = .24, $t = 4.74$, $p < .001$), descriptive norm (beta = .28, $t = 5.64$, $p < .001$), awareness of the problems caused by car use (beta = .25, $t = 4.28$, $p < .001$) and past negative experience with bus use (beta = .25, $t = 5.18$, $p < .001$) were significant.

Regression analysis with actual behavior. Actual behavior (percentage of times that the respondents took the bus to and from the university) was regressed on the same predictors and behavioral intention (see Table 5), using hierarchical regressions again, in order to examine the R^2 changes for each step. First, two covariates, namely financial status and distance measure, were entered. Next, behavioral intention was entered, followed by the original TPB variables, and new variables. Controlling for the covariates, the full model explained 55 percent of the variance, $F(15, 248) = 22.55$, $p < .001$. Behavioral intention explained most of the variance (R^2-change = .46), and subsequent steps added only slightly more variance. In the second step where behavioral intention was added, R^2 change was .46, F change $(1, 260) = 233.52$, $p < .001$; for the third step, R^2 change was .05, F change $(5, 255) = 5.46$, $p < .001$; for the fourth step, R^2 change was .04, F change $(3, 252) = 6.98$, $p < .001$; and for the last step, R^2 change was .004, F change $(4, 248) = .55$, $p = .7$ (n.s.). Total R^2 for the full model was .55, F $(15, 248) = 22.55$, $p < .001$. Four new variables (value measure, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience with the bus) added in the last step did not significantly explain more variance. In the full

Table 5

Hierarchical Regression of Behavior for Phase 1 (n = 387)

Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
1 distance	-0.15	-0.15	0.99	-2.43	0.05			
finance	-0.07	-0.07	0.99	-1.19		0.02	0.03	0.05
2 distance	0.03	0.04	0.93	0.57				
finance	0.03	0.04	0.98	0.58				
Intention								
to take the bus	0.71	0.69	0.92	15.28	0.001	0.48	0.46	0.001
3 distance	0.07	0.09	0.78	1.5				
finance	0.04	0.06	0.96	1.01				
Intention								
to take the bus	0.68	0.53	0.38	9.86	0.001			
General attitude	-0.1	-0.11	0.51	-1.7				
Belief-based attitude	0.04	0.04	0.66	0.66				
Subjective norm	-0.1	-0.11	0.53	-1.74				
General control	0.15	0.15	0.45	2.34	0.05			
Belief-based control	0.14	0.17	0.64	2.69	0.01	0.52	0.05	0.001
4 distance	0.05	0.06	0.76	0.95				
finance	0.05	0.08	0.92	1.27				
Intention								
to take the bus	0.61	0.49	0.36	8.85	0.001			
General attitude	-0.03	-0.03	0.38	-0.46				
Belief-based attitude	0.05	0.06	0.63	1.01				
Subjective norm	-0.09	-0.1	0.49	-1.61				
General control	0.15	0.15	0.44	2.39	0.05			

Table continues.

	Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
	Belief-based control	0.14	0.17	0.63	2.67	0.01			
	Affect	-0.12	-0.14	0.59	-2.16	0.05			
	Descriptive norm	0.19	0.24	0.79	3.97	0.001			
	Moral norm	-0.08	-0.1	0.72	-1.67		0.56	0.04	0.001
5	distance	0.03	0.04	0.73	0.69				
	finance	0.06	0.09	0.88	1.46				
	Intention								
	to take the bus	0.58	0.44	0.31	7.77	0.001			
	General attitude	-0.03	-0.03	0.36	-0.49				
	Belief-based attitude	0.06	0.07	0.61	1.13				
	Subjective norm	-0.09	-0.09	0.48	-1.44				
	General control	0.15	0.15	0.44	2.33	0.05			
	Belief-based control	0.14	0.17	0.61	2.71	0.01			
	Affect	-0.11	-0.13	0.59	-2.03	0.05			
	Descriptive norm	0.19	0.25	0.77	4.07	0.001			
	Moral norm	-0.08	-0.09	0.59	-1.55				
	Value ranking of environmental concern	-0.05	-0.07	0.78	-1.04				
	Awareness of environmental problems	0.01	0.02	0.56	0.25				
	Responsibility for environmental problems	-0.02	-0.03	0.61	-0.39				
	Past negative experience with buses	0.05	0.07	0.8	1.04		0.55	0.004	n.s.

Notes. All the variables are regarding bus use. Only significant p values are shown.

model, besides intention (t = 7.76, p < .001), general PBC measure (t = 2.33, p < .05), expectancy-value measure for PBC (t = 2.71, p < .01), affective judgement for bus use (t = -2.02, p < .05) and descriptive norm (t = 4.07, p < .001) were significant.

Again, it was also examined how much variance would be explained by the new variables alone. When seven new variables (affective judgement measure for attitude, descriptive norm, moral obligation, value measure, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience with the bus) were added in the first step, they explained 24.4 percent of the variance, controlling for financial status and distance, F change (7, 254) = 12.18, p < .001. Behavioral intention still added another 25.8 percent of the variance in the next step, F change (1, 253) = 139.34, p < .001, and the five TPB variables in the last step added only 4.6 percent, F change (5, 248) = 5.39, p < .001.

In the first step in which only new variables were entered, descriptive norm (beta = .38, t = 6.57, p < .001), awareness of the problems caused by car use (beta = .2, t = 2.97, p < .01) and past negative experience with bus use (beta = .2, t = 3.64, p < .001) were significant.

Mediating relation. Following Baron and Kenny's (1986) method, a set of 3 regression equations was performed as described above (in the analysis section) for the full model with 14 predictors (including two covariates). Table 6 summarizes the procedure. The purpose of this analysis was to investigate whether or not behavioral intention operated as a mediator of behavior for attitude, subjective norm and PBC, with PBC also directly linked to behavior, as described in the original TPB model. As well, I

Table 6

Mediator Analysis

variable	1st regression (DV = B) beta	zero-order	partial	p <	2nd regession (DV = IN) p <	3rd regression p <	mediated by intention	direct link with B
Intention						0.001		x
General attitude	0.12	0.40	0.11		0.001			
Belief-based attitude	0.11	0.36	0.11					
Subjective norm	0.01	0.39	0.10		0.001			
General control	0.26	0.52	0.23	0.001	0.001	0.05	x	x
Belief-based control	0.19	0.48	0.20	0.01	marginal	0.01		
Affect	-0.13	0.14	-0.14	0.05		0.05		
Descriptive norm	0.27	0.42	0.32	0.001	0.01	0.001	x	x
Moral norm	-0.11	0.16	-0.12	marginal				
Awareness of the problems					0.01			
Past negative experience	0.16	0.18	0.21	0.01	0.001		x	
model				0.001	0.001	0.001		

Notes. In the first regression, behavior is regressed on the predictors, excluding behavioral intention. In the second regression, behavioral intention is regressed on the same predictors (the same as Table 4). In the third regression, behavior is regressed on the predictors and behavioral intention (the same as Table 5). p values are listed only for significant predictors. p values for MO and EC were .058, .059, respectively.

was also interested in examining how newly added variables would fit into this original model.

When the dependent variable (actual behavior) was regressed on the 14 predictors (including covariates), the model was significant ($p < .001$), and general PBC measure, expectancy-value PBC measure, affective judgement for bus use, descriptive norm, and past negative experience with bus use were significant. Next, the mediator variable (behavioral intention) was regressed on the same variables. The model was significant ($p < .001$), and general measure of attitude toward bus use, subjective norm, general PBC measure, descriptive norm, awareness of the problems caused by car use and past negative experience with bus use were significant. Third, the dependent variable was regressed on the behavioral intention and the same predictors. Among those predictors that were significant in both first and second regression models, general PBC measure and descriptive norm were still significant when the effect of behavioral intention was controlled for. This result indicates that the general measure of PBC and descriptive norm were not only mediated by behavioral intention to predict actual behavior, but also directly predicted it, independent of the behavioral intention. As well, past negative experience was mediated by behavioral intention to influence the behavior. General attitude and subjective norm were not significant predictors in the regression of behavior; hence, the mediating relation with behavioral intention was not supported, although they were significantly correlated with behavior at the zero-order level.

Phase 2

Participants. Fifteen out of 26 Phase 1 participants who received the Phase 2 questionnaire by mail returned a completed questionnaire by mail (return rate 57.7

percent). Among 246 participants who received the email notice,[4] 160 returned the answers on-line,[5] resulting in a return rate of 65.0 percent. Participants were contacted up to four times for a reply. This resulted in a total of 175 participants among 272 who received email or letter notices. The overall return rate was 64.3 percent (male 40.2 percent, female 59.8 percent, average age 24.4 years).

In order to test for selection effects among the returned surveys, it was examined whether or not the distribution of various transportation mode users (those who reported using one type of transportation mode more than 80 percent of the time at the time of Phase 1) in the Phase 1 sample was different in the Phase 2 sample. The distribution for Phase 1 was 36.2 percent car users, 23.0 percent bus users, 13.2 percent bicyclists, 3.9 percent car poolers and 23.8 un-categorized. For Phase 2, the distribution was 26.9 percent, 27.4 percent, 14.9 percent, 4.0 percent and 26.9 percent, respectively. Chi-square test was performed, using the distribution at the time of Phase 1 as expected values. The result of the test showed that the two distributions were not significantly different, χ^2 (4) = 3.86, $p > .05$.

Further, following Bamberg and Schmidt's (1998) analysis, a logistic regression with dependent variable for participation mortality (participated or not) was performed on predictor variables and demographics (age and gender). None of them were reliable predictors of participation mortality. Thus, although not everyone returned the survey, those who did do not seem different than those who did not, in terms of their Phase 1 transportation mode choice.

Descriptive statistics. Table 7 lists means and standard deviations of the variables for Phase 2. Values for the attitude measures (general attitude and expectancy-value

Table 7

Means and Standard Deviations of the Variables in Phase 2

	Mean	S.D.	alpha
For bus use			
Percentage of bus use	42.64	43.82	
Intention to take the bus	0.37	1.56	
General attitude	0.13	1.07	
Belief-based attitude	1.49	8.71	
Affect	-0.45	0.97	
Subjective norm	0.26	0.87	0.66
Descriptive norm	2.09	0.99	
Moral norm	-0.19	1.09	0.85
General control	0.53	1.24	
Belief-based control	2.07	4.23	
For car use			
General attitude	0.37	1.27	
Belief-based attitude	10.7	7.89	
Affect	-0.07	1.08	
Value ranking of environmental concer	3.8	1.64	
Awareness of environmental problems	0.44	0.62	0.82
Responsibility for environmental probl	0.05	1.03	
Past negative experiences with buses	1.95	0.98	

measure for bus use) increased substantially, indicating that participants on average had a relatively more positive attitude for bus use at the time of Phase 2 compared to Phase 1.

The pattern of correlations among variables was very similar to that of Phase 1 (see Table 8). Some of the few differences were as follows: All variables were slightly more strongly correlated with actual behavior; past negative experience with the bus was no longer significantly correlated with behavior as it was in Phase 1, although it was still significantly negatively correlated with affective judgement for bus use. The table also lists the correlations of the same variables between Phase 1 and 2. Ranging from .45 to .81, all were relatively highly correlated.

On average, 26.4 percent of all the trips made by the participants commuting to and from the university were by driving alone, 42.6 percent were by bus, 14 percent by bike, 11.2 percent by carpool and 5.8 percent by walking. Figure 4 depicts the modal splits, for both Phase 1 and 2, which are based on the answers from students who participated in both Phase 1 and 2 ($n = 175$). Compared to the Phase 1 result, driving alone significantly decreased by 6.7 percent ($t = 2.89$, $p < .01$) and taking the bus significantly increased by 11.1 percent ($t = -4.37$, $p < .001$). Biking also significantly decreased by 5.7 percent ($t = 2.81$, $p < .01$), probably due to the weather change, while carpooling and walking were almost unchanged (see Table 9).

The following analysis was also performed. Employing the criterion of reported use of one type of transportation mode more than 80 percent of time at the time of Phase 2 for commuting to and from the university, participants were categorized into five groups: car users, bus users, bicyclists, car poolers, and un-categorized (defined as those who did not use any one transportation mode more than 80 percent of the time). There

Table 8

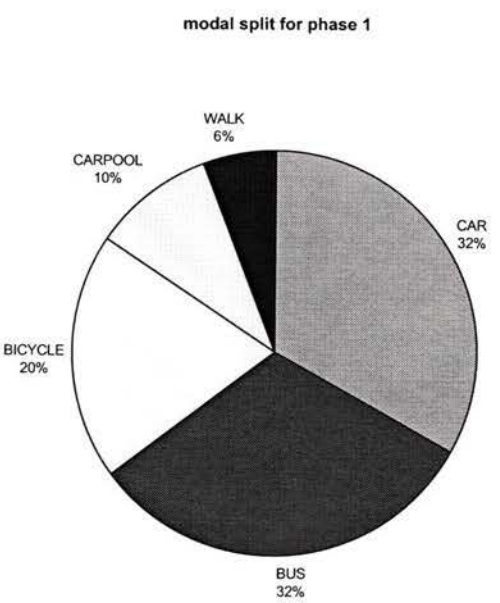
Correlations among Variables in Phase 2

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Percentage of bus use																
2. Intention to take the bus	.79*															
3. General attitude for bus use	.42*	.52*														
4. Belief-based attitude for bus use	.42*	.46*	.48*													
5. Affect for bus use	.19*	.32*	.57*	.29*												
6. General attitude for car use	-.3*	-.33*	-.48*	-.4*	-.27*											
7. Belief-based attitude for car use	-.3*	-.37*	-.42*	-.21*	-.18	.55*										
8. Affect for car use	-.18	-.21*	-.27*	-.2	-.11	.59*	.37*									
9. Subjective norm for bus use	.48*	.56*	.54*	.46*	.28*	-.47*	-.35*	-.21*								
10. Moral norm for bus use	.57*	.47*	.41*	.37*	.26*	-.32*	-.28*	-.36*	.38*							
11. Descriptive norm for car use	.27*	.36*	.41*	.36*	.16	-.64*	-.5*	-.40*	.48*	.33*						
12. General control over bus use	.64*	.66*	.42*	.51*	.22*	-.31*	-.33*	-.17*	.47*	.37*	.30*					
13. Belief-based control over bus use	.44*	.45*	.36*	.42*	.25*	.19	-.07	-.06	.32*	.31*	.17*	.51*				
14. Value ranking of environmental concern	.10	.08	-.15	.01	.02	.24*	.18	.20*	-.05	.06	-.25*	.03	.02			
15. Awareness of environmental problems	.30*	.36*	.31*	.34*	.13	-.45*	-.35*	-.32*	.49*	.28*	.55*	.27*	.16	-.15		
16. Responsibility for environmental problems	.10	.12	.23*	.13	.10	-.36*	-.27*	-.30*	.27*	.27*	.52*	.07	.12	-.37*	.40*	
17. Past negative experiences with buses	.15	.08	-.14	-.12	-.23*	.29*	.12	.09	-.14	.04	-.18	-.05	.06	-.16	-.02	-.07
between-study	.70*	.74*	.66*	.64*	.65*	.73*	.62*	.68*	.64*	.59*	.75*	.67*	.55*	.45*	.81*	.65*	.54*

Note. * indicates $p < .01$.

Figure 4

Comparison of Modal Splits



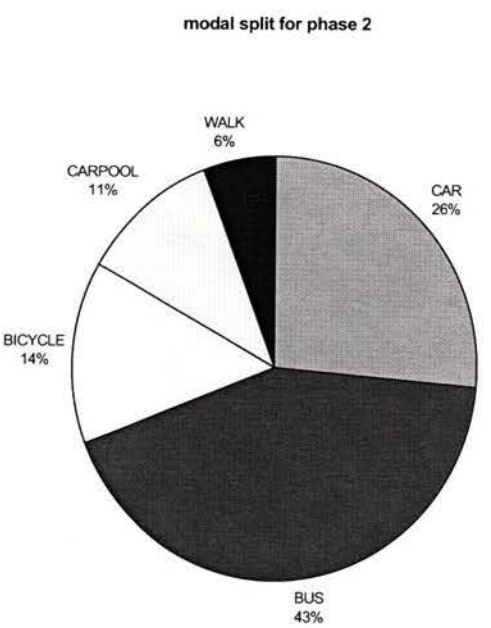


Table 9

Mean Percentages for Each Transportation Mode for Phase 1 and 2

	Phase 1		Phase 2		
	Mean	S.D.	Mean	S.D.	$p <$
CAR	33.08	42.61	26.43	39.48	0.01
BUS	31.58	42.49	42.64	43.82	0.001
BICYCLE	19.69	35.71	13.99	29.70	0.01
CARPOOL	9.90	22.68	11.17	22.53	n.s.
WALK	5.76	17.27	5.77	19.22	n.s.

Table 10

Distributions of Various Transportation Mode Users for Phase 1 and 2

	Phase 1	Phase 2
caruser	26.9	22.3
bususer	27.4	37.7
biker	14.9	9.1
carpooler	4	3.4
un-categorized	26.9	27.4
Total	100	100

Note. n = 175 for both phases.

were 22.3 percent car users, 37.7 percent bus users, 9.1 percent bicyclists, 3.4 percent car poolers and 27.4 percent un-categorized. V At the time of Phase 1, using the same criterion, the percentages of the participants for each category was 26.9 percent, 27.4 percent, 14.9 percent, 4 percent and 26.9 percent, respectively (see Table 10). Using the distribution for Phase 1 as expected values again, a chi-square test of fit revealed that these distributions were significantly different, χ^2 (4) = 12.25, $p < 0.05$, which indicates that there were more bus users and fewer car users at the time of Phase 2 compared to Phase 1.

For the question, "I'm happy that U-pass has been introduced," 66.9 percent answered "agree" (20.6 percent agree, 46.3 percent strongly agree), 14.3 percent were neutral, and 18.8 percent answered "disagree" (9.7 percent disagree and 9.1 percent strongly disagree). Comparing the percentages between Phase 1[6] and 2 only among those who participated in both studies (n = 175), there were only very slight changes. In Phase 1, 62.1 percent answered "agree" (17.8 percent agree, 44.3 percent strongly agree), 19 percent was neutral, and 19 percent answered disagree (4.6 percent disagree, 14.4 percent strongly disagree).

Comparison of different transportation mode user groups. As in Phase 1, participants were categorized into groups according to their reported major transportation mode choice (use of one kind of transportation mode more than 80 percent of time to commute to and from the university). Table 11 summarizes the differences among the groups in terms of variables.

The result was very similar to that of Phase 1. Multivariate analysis of variance showed that the overall group difference was statistically significant, F (24, 210) = 8.94,

Table 11

Mean Comparison among Various Transportation Mode Users in Phase 2

		car user	bus user	bicyclist	MS	F	p
General attitude	M	-0.56	0.59	0.25	16.31	17.84	0.000
	S.D.	1.05	0.90	0.93			
Belief-based attitude	M	-3.90	4.95	1.75	949.27	17.15	0.000
	S.D.	10.07	6.12	3.73			
Affect	M	-0.85	-0.23	-0.44	4.54	5.46	0.005
	S.D.	1.04	0.87	0.73			
Subjective norm	M	-0.33	0.73	0.47	13.75	23.68	0.000
	S.D.	0.75	0.83	0.43			
Descriptive norm	M	1.62	2.78	1.81	18.39	25.83	0.000
	S.D.	0.63	0.92	0.98			
Moral norm	M	-0.87	0.13	0.44	15.33	15.98	0.000
	S.D.	1.02	0.96	0.98			
General control	M	-0.56	1.33	0.13	45.02	58.39	0.000
	S.D.	1.02	0.74	1.02			
Belief-based control	M	-0.72	4.02	0.63	289.18	18.84	0.000
	S.D.	4.75	3.22	4.26			
Value ranking of environmental concern	M	4.00	3.91	2.69			
	S.D.	1.36	1.79	1.78	11.00	4.00	0.021
Awareness of environmental problems	M	-0.02	0.61	0.84			
	S.D.	0.51	0.56	0.41	6.29	22.62	0.000
Responsibility for environmental problems	M	-0.31	0.20	0.88			
	S.D.	0.92	1.09	1.02	8.35	7.91	0.001
Past negative experience with buses	M	1.92	2.17	1.56			
	S.D.	1.04	0.95	0.81	2.59	2.78	0.066

Notes. Sample size for each group: car users, n = 39; bus users, n = 64; bicyclists, n = 16.

All the variables are concerning bus use.

$p < .001$. Most of the univariate means were significantly different among groups ($p < .01$), except for environmental value ($p = .021$) and past negative experience with the bus ($p = .066$). Table 11 lists the result of univariate analysis of variance. For all three attitude measures for bus use, car users had the lowest scores among the three groups, although differences between bus users and bicyclists were not significant. Bus users had the highest score for descriptive norm, and car users and bicyclists did not differ significantly. As in Phase 1, bicyclists had the highest score among the three groups, for environmental value, perceived moral obligation for not using the car, awareness of and perceived responsibility for the problems caused by car use, although bus users and bicyclists were not significantly different for the last three variables.

Regression analysis with behavioral intention. Hierarchical multiple regressions were performed again to investigate whether or not newly added variables further explain variance over and above the original TPB variables. Table 12 shows each step of the hierarchical regressions with corresponding R^2, R^2 changes, p values and standardized coefficients for each variable. Total R^2 for the full model was .55, F (14, 139) = 14.19, $p < .001$. The order of the hierarchical regression is the same as in Phase 1.

First, as in Phase 1, the TPB variables were entered, followed by new variables, controlling for financial status[7] and the distance measure. R^2 change in each step was significant, although they were very small after the second step. The five TPB variables entered in the second step explained most of the variance (46.6 percent), F change (5, 146) = 28.8, $p < .001$. For the third step, R^2 change was .03, F change (3, 143) = 2.68, $p < .05$, and for the fourth step, R^2 change was .04, F change (4, 139) = 3.03, $p < .05$.

Table 12

Hierarchical Regression of Behavioral Intention for Phase 2

	Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
1	distance	-0.15	-0.16	0.99	-1.97				
	finance	-0.2	-0.2	0.99	-2.54	0.01	0.05	0.06	0.01
2	distance	0.09	0.13	0.84	1.59				
	finance	-0.06	-0.08	0.91	-0.96				
	General attitude	0.17	0.19	0.61	2.33	0.05			
	Belief-based attitude	0.04	0.04	0.63	0.48				
	Subjective norm	0.23	0.26	0.63	3.26	0.01			
	General control	0.42	0.42	0.58	5.58	0.001			
	Belief-based control	0.09	0.11	0.71	1.33		0.51	0.47	0.001
3	distance	0.09	0.12	0.82	1.48				
	finance	-0.06	-0.08	0.86	-0.91				
	General attitude	0.08	0.08	0.42	0.94				
	Belief-based attitude	0.005	0.01	0.61	0.07				
	Subjective norm	0.21	0.23	0.57	2.79	0.01			
	General control	0.4	0.41	0.57	5.39	0.001			
	Belief-based control	0.08	0.09	0.7	1.14				
	Affect	0.08	0.09	0.59	1.08				
	Descriptive norm	0.16	0.19	0.74	2.43	0.05			
	Moral norm	0.04	0.05	0.68	0.57		0.52	0.03	0.05

Table continues.

	Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
4	distance	0.05	0.07	0.78	0.87				
	finance	-0.05	-0.07	0.84	-0.87				
	General attitude	0.12	0.11	0.39	1.36				
	Belief-based attitude	0.0	-0.01	0.59	-0.09				
	Subjective norm	0.19	0.21	0.52	2.54	0.05			
	General control	0.38	0.4	0.54	5.14	0.001			
	Belief-based control	0.06	0.08	0.67	0.97				
	Affect	0.09	0.11	0.55	1.29				
	Descriptive norm	0.13	0.16	0.69	1.94	marginal			
	Moral norm	0.08	0.09	0.48	1.02				
	Value ranking of environmental concern	0.09	0.12	0.78	1.47				
	Awareness of environmental problems	0.07	0.09	0.59	1.05				
	Responsibility for environmental problems	-0.06	-0.07	0.63	-0.83				
	Past negative experience with buses	0.15	0.2	0.82	2.42	0.05	0.55	0.04	0.05

Notes. p value for DE is .055. Only significant p values are shown.

In the final model, in which all the 14 variables (including covariates) were included, fewer predictors were significant compared to Phase 1, which was not surprising given the reduction in the sample size: subjective norm ($t = 2.54$, $p < .05$), general PBC measure ($t = 5.14$, $p < .001$) and past negative experience with the bus ($t = 2.42$, $p < .05$). Descriptive norm was marginally significant ($t = 1.94$, $p = .055$).

Second, as in Phase 1, it was also examined how much variance the new variables (affective judgement measure for attitude, descriptive norm, moral obligation, environmental value, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience with the bus) would explain when entered first, although that was not the main purpose. The new variables explained 32.8 percent of the variance, F change (7, 144) = 11.04, $p < .001$, and the five TPB variables added a further 19.9 percent, F change (5, 139) = 13.46, $p < .001$.

In the first step in which only the new variables were entered (controlling for financial status and distance measure), the following variables were significant: affective judgement toward bus use (beta = .21, $t = 3.00$, $p < .01$), descriptive norm (beta = .30, $t = 4.04$, $p < .001$), perceived moral obligation for not using the car (beta = .21, $t = 2.34$, $p < .05$) and awareness of the problems caused by car use (beta = .19, $t = 2.32$, $p < .05$). Past negative experience with the bus were marginally significant (beta = .14, $t = 1.96$, $p = .052$).

Regression analysis with actual behavior. Next, actual behavior (percentage of the time participants took the bus to and from the university) was regressed on the same predictor variables and the behavioral intention (see Table 13). Total R^2 was .7, F (15,

Table 13

Hierarchical Regression of Behavior for Phase 2

Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
1 distance	-0.08	-0.09	1.00	-1.05	0.30			
finance	-0.16	-0.16	1.00	-1.94	0.05	0.02	0.03	0.1
2 distance	0.04	0.07	0.97	0.80	0.42			
finance	0.01	0.01	0.96	0.11	0.92			
Intention								
to take the bus	0.80	0.79	0.94	15.65	0.00	0.62	0.60	0.001
3 distance	0.13	0.20	0.83	2.39	0.02			
finance	0.03	0.05	0.90	0.58	0.56			
Intention								
to take the bus	0.62	0.60	0.47	8.92	0.00			
General attitude	-0.04	-0.05	0.59	-0.62	0.54			
Belief-based attitude	0.04	0.06	0.62	0.69	0.49			
Subjective norm	0.08	0.10	0.59	1.22	0.22			
General control	0.22	0.26	0.48	3.27	0.00			
Belief-based control	0.05	0.07	0.70	0.90	0.37	0.66	0.04	0.003
4 distance	0.10	0.16	0.81	1.94	0.05			
finance	0.03	0.05	0.85	0.64	0.52			
Intention								
to take the bus	0.57	0.59	0.45	8.65	0.00			
General attitude	0.01	0.01	0.41	0.14	0.89			
Belief-based attitude	0.03	0.04	0.61	0.45	0.65			
Subjective norm	0.07	0.10	0.54	1.19	0.24			
General control	0.20	0.25	0.47	3.10	0.00			

Table continues.

Variables	beta	partial r	tolerance	t	p <	adjusted R square	R square change	p for R square change
Belief-based control	0.03	0.05	0.69	0.64	0.52			
Affect	-0.12	-0.18	0.59	-2.16	0.03			
Descriptive norm	0.25	0.37	0.71	4.77	0.00			
Moral norm	-0.07	-0.11	0.68	-1.31	0.19	0.71	0.05	0.001
5 distance	0.09	0.15	0.78	1.78	0.08			
finance	0.04	0.06	0.84	0.74	0.46			
Intention								
to take the bus	0.55	0.57	0.41	8.06	0.00			
General attitude	0.00	0.00	0.38	-0.04	0.97			
Belief-based attitude	0.04	0.05	0.59	0.64	0.52			
Subjective norm	0.08	0.11	0.50	1.30	0.20			
General control	0.21	0.27	0.46	3.24	0.00			
Belief-based control	0.02	0.03	0.67	0.38	0.70			
Affect	-0.10	-0.14	0.55	-1.64	0.10			
Descriptive norm	0.25	0.36	0.67	4.55	0.00			
Moral norm	-0.08	-0.11	0.48	-1.25	0.21			
Value ranking of environmental concern	-0.04	-0.07	0.77	-0.84	0.40			
Awareness of environmental problems	0.01	0.02	0.58	0.23	0.82			
Responsibility for environmental problems	0.01	0.01	0.62	0.13	0.90			
Past negative experience with buses	0.08	0.13	0.79	1.55	0.12	0.70	0.01	0.513

Note. Only significant p values are shown.

138) = 25.15, $p < .001$. Again, as in Phase 1, behavioral intention explains most of the variance (60 percent out of 70 percent), F change (1, 150) = 244.97, $p < .001$.

In the third step, in which the 5 TPB variables were added, R^2 change was .04, F change (5, 145) = 3.73, $p < .01$, for the fourth step, R^2 change was .05, F change (3, 142) = 9.02, $p < .001$. The last step, in which four new variables (value measure, awareness of problems caused by car use, perceived responsibility for problems caused by car use and past negative experience with the bus) were added, did not add further variance significantly, R^2 change = .01, F change (4, 138) = .82, $p = .51$.

In the final model with all the 14 predictors (including covariates) and behavioral intention included, the general PBC measure ($t = 3.24$, $p < .01$) and descriptive norm ($t = 4.55$, $p < .001$) were significant predictors of actual behavior, besides intention ($t = 8.06$, $p < .001$).

Next, as in the previous analyses, it was also examined how much variance new variables would explain when entered first, even though it was not the main purpose of this study. When the seven new variables were added before the original TPB variables, they explained 36.1 percent of the variance, F change (7, 144) = 12.21, $p < .001$. Behavioral intention added another 30.7 percent, F change (1, 143) = 145.98, $p < .001$, and the five TPB variables added a further 3.3 percent, F change (5, 138) = 3.44, $p < .01$.

In the first step, in which only new variables were entered, descriptive norm (beta = .49, $t = 6.69$, $p < .001$), awareness of the problems caused by car use (beta = .18, $t = 2.21$, $p < .05$) and past negative experience with the bus (beta = .14, $t = 2.09$, $p < .05$) were significant.

Mediating relation. I examined also in Phase 2 data whether or not behavioral intention operated as a mediating variable for other variables to predict the behavior. The same set of three regression equations was performed: (a) regression of behavior on the predictors, (b) regression of behavioral intention on the same predictors, and (c) regression of behavior on the same predictors and behavioral intention. Table 14 summarizes the procedure.

When the dependent variable (actual behavior) was regressed on the predictor variables, the model was significant ($p < .001$), and subjective norm, descriptive norm, general PBC measure and past negative experience with the bus were significant. When the mediator (behavioral intention) was regressed on the same predictors next, the model was significant ($p < .001$), and almost exactly the same predictors were significant (although descriptive norm was marginally significant, $p = .055$). On the last step, when the dependent variable was regressed on the predictors and the behavioral intention, descriptive norm and general PBC measure were significant besides behavioral intention. This result for the third regression equation was very similar to that of Phase 1, in which descriptive norm, general PBC measure and expectancy-value PBC measure were significant.

This result indicates that while subjective norm, general measure of PBC, descriptive norm and past negative experience were mediated by behavioral intention to influence behavior, general measure of PBC and descriptive norm also directly influence behavior, independent of the effect of behavioral intention.

Table 14

Mediator Analysis for Phase 2

variable	1st regression (DV = B) beta	zero-order	partial	p <	2nd regession (DV = IN) p <	3rd regression p <	mediated by intention	direct link with B
Intention						0.001		x
General attitude	0.06	0.43	0.06					
Belief-based attitude	0.03	0.41	0.04					
Subjective norm	0.19	0.50	0.21	0.05	0.05		x	
General control	0.42	0.63	0.44	0.001	0.001	0.01	x	x
Affect	-0.05	0.19	-0.05					
Descriptive norm	0.32	0.57	0.39	0.001	marginal	0.001	x	x
Past negative experience	0.16	0.13	0.22	0.05	0.05		x	

Notes. In the first regression, behavior is regressed on all the predictors, except for behavioral intention. In the second regression, behavioral intention is regressed on the same predictors (the same as Table 12). In the third regression, behavior is regressed on all the predictors and behavioral intention (the same as Table 13).

p values are shown only for significant predictors. p value for DE is .055.

Changes between Phase 1 and 2

For these analyses, only the data for those who participated in both Phase 1 and 2 were used (n = 175 for both phases).

Changes in beliefs and psychological constructs since Phase 1. Wilcoxon tests were performed in order to investigate whether or not there were any changes in the TPB variables and other new variables since Phase 1 (see Table 15). First, none of the evaluations of behavioral beliefs had changed. This indicates that participants evaluated the factors (behavioral beliefs) in choosing a certain transportation mode the same way. In contrast, there were several changes in the subjective probabilities for various behavioral beliefs. In terms of car use, subjective probability of being "quick" and "comfortable" when driving decreased significantly, ($z = -2.04$, $p < .05$ and $z = -5.23$, $p < .001$, respectively). In terms of bus use, subjective beliefs that it would be "convenient", "cheap" and would mean "having a good control over my time" increased ($z = -2.38$, $p < .05$; $z = -5.23$, $p < .001$; $z = -3.31$, $p < .001$, respectively).

Second, within the control beliefs, the pattern of changes was different. Unlike the behavioral beliefs, none of the subjective probabilities for the control beliefs changed, while the evaluation of them had. Evaluation of the control beliefs, "living near a good bus route" and "knowing schedule well" increased significantly ($z = -2.14$, $p < .05$ and $z = -2.57$, $p < .01$, respectively).

There were also changes in other variables. General attitude toward car use decreased ($z = -2.11$, $p < .05$), whereas that toward the bus did not change. Affective judgement for car use decreased ($z = -3.27$, $p < .01$), while that for bus use did not

Table 15

Comparison of Means between Phase 1 and Phase 2 (n = 175)

BEHAVIORAL BELIEF	phase 1		phase 2		
evaluation	M.	S.D.	M.	S.D.	p =
schedule	1.36	0.80	1.44	0.64	
convenience	1.55	0.66	1.53	0.54	
quick	1.39	0.79	1.29	0.77	
comfortable	0.86	0.96	0.78	0.95	
cheap	1.15	0.94	1.04	0.87	
weather	0.71	1.02	0.73	0.99	
control	1.42	0.70	1.44	0.67	
subjective probability for car					
schedule	1.56	0.72	1.62	0.64	
convenience	1.50	0.77	1.46	0.78	
quick	1.63	0.63	1.50	0.70	0.051
comfortable	1.55	0.79	1.13	0.95	0.000
cheap	-0.20	1.34	-0.36	1.28	
weather	1.17	1.02	1.09	0.99	
control	1.53	0.74	1.54	0.66	
subjective probability for bus					
schedule	-0.01	1.17	0.17	1.00	0.054
convenience	-0.01	1.19	0.17	1.03	0.018
quick	0.06	1.23	0.07	1.14	
comfortable	0.45	1.01	0.31	0.94	
cheap	0.82	1.10	1.35	0.82	0.000
weather	0.18	1.09	0.05	1.11	
control	-0.39	1.20	-0.12	1.09	0.001
CONTROL BELIEF					
evaluation					
on bus route	1.45	0.86	1.58	0.69	0.053
know					
schedule	0.89	0.96	1.07	0.85	0.017
subjective probability					
on bus route	0.89	1.33	0.86	1.34	
know					
schedule	0.56	1.24	0.47	1.22	
General attitude toward bus	0.04	1.22	0.13	1.07	
General attitude toward car	0.51	1.38	0.37	1.27	
Affect for bus use	-0.43	1.09	-0.45	0.97	
Affect for car use	0.16	1.21	-0.07	1.08	0.001
Intention to take the bus	0.15	1.41	0.37	1.56	0.006
Subjecitve norm for bus use	0.24	0.92	0.26	0.87	
Descriptive norm for bus use	1.87	1.03	2.08	0.99	0.004
General control over bus use	0.46	1.39	0.53	1.24	

Note. Only significant p values are shown.

change. Intention to take the bus ($z = -2.71$, $p < .01$) and descriptive norm ($z = -2.56$, $p < .01$) increased significantly.

Predicting changes since Phase 1. Although it was not stated in the hypotheses, it occurred to me during the course of the analyses that I might be able to predict the behavior change using the same predictors. Hence, post hoc regression analyses on behavior change were performed using difference scores between Phase 1 and 2 for each predictor as predictor variables. The dependent variable was the difference between Phase 1 and 2 in the percentage of times respondents took the bus to and from the university.

First, 13 difference-score predictors (including one for behavioral intention) were computed for each variable. Table 16 lists the means and standard deviations for the difference scores. Means of the difference scores for affective judgement for bus use and awareness of the problems caused by car use were negative, although the values were very small, indicating that affective judgement and the problem awareness decreased on average among participants. Negative mean value for value measure, however, indicates that the rank order the participants assigned to the value "protecting the environment" was higher in Phase 2, as the higher rank had smaller values. On average, the percentage of the times participants took the bus to and from the university increased by 11.1 percent.

Next, behavior change was regressed on the 13 difference score predictors. (For the following regression, all the variables were entered together.[8]) Table 17 lists standardized regression coefficients with associated t and p values for each predictor. The result showed that the difference scores significantly explained 28.3 percent (adjusted R^2

Table 16

Difference Scores between Phase 1 and 2 for Variables

	Mean	S.D.
Percentage of bus use	11.06	33.51
Intention to take the bus	0.23	1.09
General attitude toward bus	0.09	0.96
Belief-based attitude toward bus	1.22	7.81
Affect for bus use	-0.01	0.87
Subjective norm for bus use	0.03	0.75
Descriptive norm for bus use	0.21	0.91
Moral norm for bus use	0.10	0.80
General control over bus use	0.07	1.08
Belief-based control over bus use	0.08	3.94
Value ranking of environmental concern	-0.28	1.67
Awareness of environmental problems	-0.05	0.40
Responsibility for environmental problems	0.03	0.90
Past negative experiences with buses	0.03	0.92

Table 17

Prediction of Behavior Change between Phase 1 and 2 Using Difference Scores

	beta	Partial	Tolerance	t	p
Intention to take the bus	0.47	0.45	0.82	5.55	0.00
General attitude toward bus	-0.01	-0.01	0.62	-0.05	0.96
Belief-based attitude toward bus	0.04	0.04	0.80	0.47	0.64
Affect for bus use	-0.18	-0.18	0.72	-1.97	0.05
Subjective norm for bus use	-0.12	-0.12	0.79	-1.36	0.18
Descriptive norm for bus use	0.18	0.20	0.94	2.21	0.03
Moral norm for bus use	-0.02	-0.02	0.89	-0.24	0.81
General control over bus use	0.09	0.10	0.84	1.05	0.29
Belief-based control over bus use	0.06	0.07	0.87	0.76	0.45
Value ranking of environmental concern	0.04	0.05	0.93	0.52	0.61
Awareness of environmental problems	0.03	0.04	0.89	0.40	0.69
Responsibility for environmental problems	-0.02	-0.03	0.90	-0.28	0.78
Past negative experiences with buses	-0.01	-0.01	0.91	-0.14	0.89

.21) of the variance in the behavior change, F (13, 122) = 3.71, $p < .001$. In the model, difference scores for behavioral intention ($t = 5.55$, $p < .001$), affective judgement for bus use ($t = -1.96$, $p = 0.51$; marginally significant) and descriptive norm ($t = 2.21$, $p < .05$) were significant. Difference score for behavioral intention in the model uniquely explained 18 percent of the variance.

Comparison of those who had started to use the bus more often and those who remained car users. An attempt was made to categorize the car users (based on self-reported data) in Phase 1 into two groups: those who had started to use the bus more often after the U-pass implementation (Group 1), and those who still used a car all the time (Group 2). Group 1 consisted of those who took the bus at least once during the 10-day period in Phase 2 to commute to and from the university, and Group 2 represented those who drove to and from the university 100 percent of the time, in both Phase 1 and Phase 2. However, the number of the participants in the first group ($n = 14$) was not large enough to make a confident generalization of the result to different samples.[9] Because of the limited sample size for the first group, the following result should be interpreted with caution.

Means and standard deviations of the variables are listed for these newly-formed groups in Table 18. Overall, evaluation of behavioral beliefs stayed relatively constant over time for both groups, except for "quick" for Group 1 (Phase 1 mean = 1.57 versus Phase 2 mean = 1.14) and "cheap" for Group 2 (Phase 1 mean = 0.52 versus Phase 2 mean = 0.27). Most of subjective probabilities for car use decreased for Group 1, whereas they were almost unchanged for Group 2, except for "cheap" (Phase 1 mean = 0.48 versus Phase 2 mean = 0.09). Likewise, most of subjective probabilities for bus use

Table 18

Means and Standard Deviations for Group 1 and 2

	Group 1				Group 2			
	Phase 1		Phase 2		Phase 1		Phase 2	
BEHAVIORAL BELIEF	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
evaluation								
schedule	1.43	0.65	1.50	0.65	1.56	0.75	1.67	0.69
convenience	1.36	0.74	1.57	0.51	1.81	0.39	1.70	0.47
quick	1.57	0.65	1.14	1.10	1.81	0.46	1.82	0.39
comfortable	0.64	0.84	0.57	1.02	1.18	0.92	1.24	0.90
cheap	0.86	0.86	0.86	0.95	0.52	1.12	0.27	0.76
weather	1.14	0.86	1.00	1.04	1.03	0.95	1.18	0.88
control	1.64	0.63	1.50	0.52	1.81	0.39	1.76	0.61
subjective probability for car								
schedule	1.50	1.09	1.50	0.85	1.63	0.65	1.85	0.36
convenience	1.79	0.43	1.64	0.84	1.90	0.29	1.85	0.36
quick	1.93	0.27	1.79	0.43	1.81	0.39	1.82	0.46
comfortable	1.86	0.36	1.29	1.07	1.72	0.63	1.70	0.68
cheap	0.21	1.12	0.00	1.24	0.48	1.25	0.09	1.28
weather	1.00	1.41	0.93	1.33	1.30	1.13	1.45	0.75
control	1.93	0.27	1.79	0.43	1.85	0.57	1.79	0.42
subjective probability for bus								
schedule	-0.79	0.98	0.21	0.97	-0.44	1.19	-0.39	1.12
convenience	-0.36	1.01	0.14	0.95	-0.72	1.35	-0.52	1.06
quick	-0.36	1.15	0.14	1.29	-0.53	1.32	-0.52	1.18
comfortable	0.29	1.20	0.50	0.76	-0.13	1.26	-0.21	1.19
cheap	0.93	1.38	1.07	1.38	0.91	0.99	1.15	1.09
weather	-0.07	1.21	-0.57	1.09	-0.38	1.13	-0.39	1.17
control	-0.79	0.89	-0.14	1.03	-0.91	1.30	-0.79	1.17
CONTROL BELIEF								
evaluation								
on bus route know	1.57	0.94	1.71	0.61	1.15	1.06	1.24	1.09
schedule	1.14	1.03	1.21	0.70	0.70	1.13	0.85	1.06
subjective probability								
on bus route know	0.43	1.55	0.64	1.34	0.09	0.58	0.45	1.48
schedule	-0.21	1.42	0.50	1.51	-0.19	1.51	-0.12	1.34

Table continues.

Variables	Group 1				Group 2			
	Phase 1		Phase 2		Phase 1		Phase 2	
	mean	S.D.	mean	S.D.	mean	S.D.	mean	S.D.
General attitude toward bus	-0.21	1.12	0.14	1.10	-0.89	1.08	-0.64	1.14
Affect for bus use	-0.29	1.14	0.71	0.91	-0.76	1.25	-0.76	1.04
Subjective norm for bus use	-0.11	0.84	0.11	0.79	-0.19	0.86	-0.41	0.75
Descriptive norm for bus use	1.69	1.11	1.86	0.95	1.77	1.00	1.73	0.72
Moral norm for bus use	-0.39	1.11	-0.61	1.15	-0.95	1.08	-0.91	1.09
General control over bus use	-0.36	1.22	0.36	1.01	-0.70	1.24	-0.42	1.20
Awareness of environmental problems	0.25	0.68	0.14	0.59	0.02	0.67	-0.02	0.58
Past negative experience with buses	1.23	0.6	1.86	0.86	1.85	1.03	1.90	1.10
Intention to take the bus	-0.36	1.08	0.79	1.42	-1.18	1.04	-1.42	0.83
Preference for Upass	0.14	1.51	0.57	1.50	-0.30	1.40	-0.42	1.25

increased for Group 1, except for "weather" (Phase 1 mean = -.07 versus Phase 2 mean = -.57), whereas those for Group 2 were relatively unchanged, except for "cheap" (Phase 1 mean = .91 versus Phase 2 mean = 1.15). All of the other variables increased in Phase 2 for Group 1, except for perceived moral obligation for not using car (Phase 1 mean = -.39 versus Phase 2 mean = -.61). For Group 2, other variables either stayed relatively constant over time or increased slightly, whereas subjective norm (Phase 1 mean = -.19 versus Phase 2 mean = -.41), intention to take the bus (Phase 1 mean = -1.18 versus Phase 2 mean = -1.42) and preference for "U-pass" ("I'm happy that U-pass has been introduced") (Phase 1 mean = -.30 versus Phase 2 mean = -.42) decreased.

These data were analyzed using 2 (Group 1 versus Group 2) x 2 (Phase 1 versus Phase 2: within subject factor) mixed-model ANOVAs (see Table 19). Main effects of time across groups were not the main focus of this analysis, although they are reported here also.

Significant main effects of time were obtained on the following variables: evaluation of behavioral belief, "quick," F (1, 45) = 4.18, $p < .05$; subjective probability for behavioral belief for bus regarding "schedule," F (1, 44) = 5.12, $p < .05$; and "control", F (1, 44) = 4.06, $p = .05$; general attitude toward bus use, F (1, 45) = 5.43, $p < .05$; general control, F (1, 45) = 8.07, $p < .01$; past negative experience with the bus, F (1, 45) = 4.45, $p < .05$; and intention to use U-pass, F (1, 45) = 9.02, $p < .01$.

Examination of marginal means across groups revealed the following. Both groups of car users in Phase 1 evaluated "being quick" in choosing transportation mode as less important in Phase 2 (Phase 1 mean = 1.7 versus Phase 2 mean = 1.48). Subjective probability for being able to have a flexible schedule when taking the bus and that for

Table 19

Results of ANOVA on Each Variable

	Main effect of time		Main effect of group		Interaction	
	F	p	F	p	F	p
BEHAVIORAL BELIEF						
evaluation						
schedule	0.49		0.42		0.01	
convenience	0.21		5.60	0.022	2.89	
quick	4.18	0.047	8.09	0.007	4.18	0.047
comfortable	0.00		6.72	0.013	0.14	
cheap	0.54		3.38		0.54	
weather	0.00		0.02		0.66	
control	1.17		2.32		0.19	
subjective probability for bus						
schedule	5.12	0.03	0.25		4.52	0.04
convenience	3.12		2.64		0.48	
quick	1.47		1.49		1.14	
comfortable	0.17		3.23		0.30	
cheap	0.55		0.04		0.06	
weather	1.17		0.03		1.17	
control	4.06	0.05	1.33		1.50	
subjective probability for car						
schedule	0.93		1.62		0.93	
convenience	1.35		2.04		0.22	
quick	0.57		0.19		0.57	
comfortable	3.45		0.84		2.79	
cheap	1.82		0.27		0.16	
weather	0.04		2.07		0.32	
control	1.04		0.13		0.17	
CONTROL BELIEF						
evaluation						
on bus route	0.49		2.65		0.03	
know						
schedule	0.35		2.22		0.05	
subjective probability						
on bus route	1.08		0.43		0.07	
know						
schedule	4.02	0.051	0.48		2.37	

Table continues.

Variables	Main effect of time		Main effect of group		Interaction	
	F	p	F	p	F	p
General attitude toward bus	5.43	0.02	4.77	0.03	0.19	
Affect for bus use	0.00		1.81		0.00	
Subjective norm for bus use	0.03		1.53		2.31	
Descriptive norm for bus use	0.28		0.08		0.91	
Moral norm for bus use	0.54		1.70		1.27	
General control over bus use	8.07	0.007	2.76		1.62	
Awareness of environmental problems	1.32		1.06		0.30	
Past negative experience with buses	4.45	0.04	1.71		2.83	
Intention to take the bus	9.02	0.004	25.89	0.000	21.34	0.000
Preference for Upass	1.02		3.03		3.27	

Note. Only significant (or marginally significant) p values are shown.

being able to have a good control over one's time increased for both groups in Phase 2 (Phase 1 mean for "schedule" = -.61 versus Phase 2 mean for "schedule" = -. 09; Phase 1 mean for "control" = -.85 versus Phase 2 mean for "control" = -.45). General attitude toward and general control for taking the bus increased in Phase 2 (Phase 1 general attitude mean = -.55 versus Phase 2 general attitude mean = -.25; Phase 1 general control mean = -.53 versus Phase 2 general control mean = -.03), as well as past negative experience with bus use and intention to take the bus (Phase 1 mean for past experience = 1.54 versus Phase 2 past experience mean = 1.84; Phase 1 mean for intention = -.77 versus Phase 2 mean for intention = -.32).

Significant differences between the two groups were obtained for the evaluation of behavioral beliefs, "convenient", $\underline{F}$ (1, 45) = 5.6, $\underline{p} < .05$; "quick", $\underline{F}$ (1, 45) = 8.09, $\underline{p} < .01$; and "comfortable", $\underline{F}$ (1, 45) = 6.72, $\underline{p} < .05$; as well as for general attitude toward bus use, $\underline{F}$ (1, 45) = 4.77, $\underline{p} < .05$, and intention to take the bus, $\underline{F}$ (1, 45) = 25.89, $\underline{p} < .001$.

Group 1 evaluated all three behavioral beliefs, namely "being convenient", "being quick", and "being comfortable" when choosing transportation mode, as less important compared to Group 2 (marginal mean for "convenient" for Group 1 = 1.46 versus 1.76 for Group 2; marginal mean for "quick" for Group 1 = 1.36 versus 1.82 for Group 2; and marginal mean for "comfortable" for Group 1 = .61 versus 1.21 for Group 2). General attitude toward bus use was more positive for Group 1 (marginal mean = -.04) than for Group 2 (marginal mean = -.76). Group 1 intended to take the bus more (marginal mean = .21) than Group 2 did (marginal mean = -1.3).

There were significant interactions between time and group for the following variables: evaluation of the behavioral belief, "quick", $F(1, 45) = 4.18$, $p < .05$; subjective probability for the behavioral belief for bus regarding "schedule", $F(1, 44) = 4.52$, $p < .05$; and intention to take the bus, $F(1, 45) = 21.34$, $p < .001$.

Group 1 evaluated "being quick" in choosing transportation mode as less important in Phase 2 than in Phase 1 (mean difference = -.43), whereas evaluation by Group 2 did not change across time (mean difference = 0). Subjective probability for being able to have a flexible schedule when taking the bus increased for Group 1 in Phase 2 (mean difference = 1), whereas it stayed almost the same for Group 2 (mean difference = .05). Behavioral intention to take the bus increased in Phase 2 for Group 1 (mean difference = 1.15), but it decreased for Group 2 (mean difference = -.24). Implications of these results are discussed below.

CHAPTER 4

Discussion

This study is one of the few that has evaluated a U-pass program by collecting data both before and after the implementation of the program. It demonstrates the effect of a U-pass program in two ways: the change in actual behavior outcome (transportation mode choice change), which was referred to as "macro-level" change by Bamberg and Schmidt (1998), and the change in psychological variables, such as behavioral beliefs, which was referred to as "micro-level" change. Furthermore, this study demonstrates the predictive validity of the theory of planned behavior in predicting university students' transportation mode choice. It also shows that some of the new variables, added in order to expand the original model, explained further variance over and above the original TPB constructs.

Predictive Validity of the Theory of Planned Behavior

The five original TPB variables, namely general attitude toward the bus, expectancy-value measure for attitude toward the bus, subjective norm, general measure for perceived behavioral control (PBC), and expectancy-value measure for PBC, demonstrate good ability to predict university students' transportation mode choice. In Phase 1, the five variables alone (and two covariates) accounted for 61 percent of the variance of behavioral intention and, with intention added, 52 percent of the variance of actual behavior. In Phase 2 these were 51 percent and 62 percent, respectively. These values are relatively high compared to the reported values of 41 percent for behavioral intention and 34 percent for behavior from a meta-analytic study of TPB (Godin & Kok, 1996).

Mediating relations involving the five variables and behavioral intention are partially supported in this study, as predicted in the original TPB model (Ajzen, 1988). In the original model, it is predicted that behavioral intention mediates the relation between the variables (attitude, subjective norm and PBC) and actual behavior, with PBC also linked to behavior directly, independent of behavioral intention. This study shows that the effect of general PBC measure on actual behavior is mediated by behavioral intention, and that PBC also directly predicts actual behavior, as demonstrated in both Phase 1 and 2.

On the other hand, the result of the mediator analysis for attitude and subjective norm was more complicated. In Phase 2, the relation between subject norm and actual behavior was mediated by behavioral intention, but not in Phase 1. Attitude measures were not significant predictors of actual behavior (in the first regression model in the mediator analysis) in either of the phases. Examination of the zero-order and partial correlations shows that both general measure and expectancy-value measure of attitude are significantly correlated with behavior at zero-order. However, they are correlated substantially with other variables in the regression model and their partial correlations are reduced to the extent that they are not significant. The same is true with subjective norm in Phase 1, in which it failed to predict actual behavior (see Table 6 and 14).

Overall, expectancy-value measures performed poorly compared to general measures. Examination of the correlations shows that expectancy-value measures are less related to behavioral intention than general measures in both Phase 1 and Phase. In addition, the correlation between general measures and expectancy-value measures are

not as high as I had hoped, although they are comparable to the values reported in previous studies (see Ajzen, 1991).

One explanation for this might be that the selection of beliefs might not have been perfect. Both behavioral and control beliefs were taken either from previous studies or added on intuitive bases because of the time constraint to perform a pilot study to collect them among our particular sample. Ajzen (1991) pointed out the importance of performing a pilot study in order to find salient beliefs specific to the sample, in order to have high correlation with general measures.

It is also possible that the expectancy-value measure itself might not be an adequate description of attitude or PBC. Valiquette et al. (1988) questioned the multiplicative combination of beliefs and evaluations in calculating the measure. Courneya et al. (1999) reported that their preliminary analysis of the study had revealed that the multiplicative function between the evaluation and subjective probability score was inferior to the subjective probability scale alone. Although use of salient beliefs was proven to be effective in examining the changes in beliefs in longitudinal settings (Bamberg & Schmidt, 1998), one might have to be cautious about the use of expectancy-value measure as originally defined in Ajzen's model (1988).

Predictive ability of new variables

Several previous studies have showed that adding new variables improves the predictive ability of the original TPB (e.g., Conner & Armitage, 1998; Parker et al., 1995). In this extended model, some variables also demonstrated predictive ability over and above the original TPB variables.

Descriptive norm. Among the newly added variables, descriptive norm was the most reliable predictor for both behavioral intention and behavior, in both Phase 1 and 2. It added further variance over and above the original TPB variables. In predicting behavioral intention, both subjective norm and descriptive norm are significant predictors, indicating that the distinction between descriptive norm and subjective norm (injunctive norm) was meaningful, and each explained unique variance. This supports previous studies that reported the predictive utility of descriptive norms (e.g., Conner et al., 1996; De Vries et al., 1995).

Furthermore, not only does descriptive norm predict behavior mediated by behavioral intention, but also it is directly linked to behavior independent of behavioral intention. This suggests that descriptive norm, the mere perception of what most others are doing, may influence behavior regardless of any further decision-making processes. This impact of descriptive norms may have a strong implication for behavioral intervention, in that simply registering what most others are doing can lead an individual to do the same as others. Of course, whether descriptive norm is a useful way to influence an individual's behavior or not would also depend on the behavior in target. In a domain of socially undesirable behaviors, injunctive norm or moral norm might have a stronger influence on an individual's behavioral intention and behavior.

Perceived moral obligation, value, responsibility for and awareness of the problems caused by car use. Our study also demonstrates the point described above. Among three measures for norms, moral norms failed to be a significant predictor in any regression models. This result contrasts with that in a study of cannabis use (Conner & McMillan, 1999), in which a moral norm was a reliable predictor of behavioral intention

(to use cannabis). One reason for this discrepancy might be the difference of the nature of target behavior. Cannabis use is considered to be socially undesirable behavior, whereas the use of a car probably has not been established as such, especially in North America. It is likely that respondents did not perceive much of an issue of moral obligation regarding the use of a car.

Likewise, the same reason could be applied to explain why value and perceived responsibility for the problems caused by car use failed to be a significant predictor of transportation mode choice. The concept of value and perceived responsibility were often used in the study of pro-environmental behavior, such as recycling (Guagnano et al., 1995; Hopper & Nielsen, 1991) and willingness to take political action for environmental protection (Stern, Dietz, & Kalof, 1993). Compared to these behaviors, not driving alone has a long way to go to be established as "pro-environmental behavior", at least in this particular sample. Even when the new variables were entered first in hierarchical regressions, value and perceived responsibility for the problems caused by car use were not significant predictors of behavioral intention or behavior.

On the other hand, the awareness of the problems caused by car use was a significant predictor for behavioral intention over and above the original TPB constructs in Phase 1. In addition, when only new variables were entered first, it was a significant predictor for both behavioral intention and behavior, in both Phase 1 and 2. This result corroborates Steg and Vlek's (1997) findings that respondents who had a higher awareness of the problems caused by car use actually used their car less and felt guiltier when using a car. In our study also, the awareness of the problems caused by car use is relatively highly correlated with a perceived moral obligation for not using a car in both

Phase 1 and Phase 2. However, the unique contribution of the latter was not large enough to be a reliable predictor of behavioral intention or behavior.

Affective judgement for bus use. Affective judgement toward bus use contributed to the prediction of behavior uniquely, but not of behavioral intention. It was a significant predictor of behavior in the full model in Phase 1, and also in the model in Phase 2 that included the five TPB variables and three new variables, descriptive norm, moral norm and affective judgement.

The fact that affective judgement predicts actual behavior but not behavioral intention in our study could suggest that affective judgement is more involved in a spontaneous process rather than a deliberate one, as Fazio (1990) termed it. In a deliberate process of behavior activation, an individual thinks literally in a deliberate fashion, taking other factors (such as social norm and perception of control over behavior) into consideration, and forms a behavioral intention (plan) before performing a behavior. On the other hand, in a spontaneous process, attitudes that are more automatically activated will influence the behavior, hence, not mediated by intention (or plan). Affective judgement could be classified under more "automatic" attitudes, without a need for deliberate thinking.

However, in this study, the relation between affective judgement and behavior is slightly more complicated. In the regression equations in which affective judgement was significant, the regression coefficients for it were negative. To explain this counterintuitive result, the partial and zero-order correlations were examined. At zero-order level, affective judgement is positively correlated with behavior in both Phase 1 and Phase 2. In Phase 1, the correlation is not significant. But when it is regressed with other

predictors, that is, when statistically holding the other variables in the model constant, it is negatively correlated with behavior.

This is suspected to be a case of suppression. When none of the five TPB variables is present in the model, the coefficient for the affective judgement becomes positive. Ironically, the TPB variables seem to work as a suppressor for the affective judgement in this model. This could be due to relatively high to moderate correlations of affective judgement measure with all of the TPB variables.

Cohen and Cohen (1983) described the suppression model as follows: "Suppression is a plausible model for many homeostatic mechanisms, both biological and social, in which force and counterforce tend to occur together and have counteractive effects" (p. 96). In case of my study, this situation can be translated into a substantive example as follows: When the percentage of bus use increases as a result of more positive general attitude toward bus use (and of any other factors involved in the TPB model), the increased percentage of bus use will reduce the affective judgement for bus use. In other words, the more people use the bus routinely, the less exciting taking the bus becomes.

Past negative experience with bus. This study shows that past negative experience with the bus is significantly negatively correlated with affective judgement measure for both Phase 1 and 2, although it is not correlated with PBC or any other TPB variables as Ajzen (1988) suggested. Past negative experience is also a significant predictor for behavioral intention for both Phase 1 and 2. Its relation to actual behavior is mediated by behavioral intention.

However, examining the direction of the correlation reveals that it is opposite from the way it was intended to predict the transportation mode choice. It had been

hypothesized that the more past negative experience one had with the bus, the less likely one would use the bus. The result shows that the opposite is true; past negative experience is positively correlated with bus use. This suggests that the sheer frequency of bus use makes it more likely that one would have negative experience with the bus. Therefore, past negative experience with the bus did not predict behavioral intention as I expected. It seems that having past negative experience with the bus is not as strong a determinant of transportation mode choice as PBC. Even if one has had negative experience with the bus, one might not have other choices but to take the bus if one does not have alternative resources.

Changes from Phase 1

Changes in variables. Several changes in variables support the hypothesis that the U-pass program was effective. Overall, the degrees of positive beliefs about car use decreased, while those about bus use increased. It is noteworthy that the evaluation of behavioral beliefs did not change, whereas the subjective probability for them did. This would indicate that participants still evaluated the same factors as important in choosing a transportation mode at the time of Phase 2, yet, their perception of bus use had changed positively. As a result, they perceived that bus use was more desirable than they did in Phase 1.

It is not surprising that none of the subjective probabilities for the control beliefs changed, considering the nature of control beliefs, "living near a good bus route" and "knowing schedule well". Because Phase 2 data was collected only two months after the U-pass implementation, it is suspected that participants had not had time to change their situation.

On the other hand, participants evaluated the control beliefs as more important in Phase 2 than they did in Phase 1. This could imply two things: First, participants now realized more strongly that these two factors are, in fact, barriers to taking the bus because they started to take the bus more often; and secondly, participants evaluated these two factors as more important by then because other barriers, such as price, had become relatively insignificant.

This result also supports the findings by Bamberg (1995, as cited in Bamberg & Schmidt, 1998) that once participants start to use transit more often as a result of a U-pass program, they will develop more unbiased, realistic perceptions of public transportation and that beliefs about the outcome of using public transportation will positively change. This point is also documented in a study of condom use among adolescents (Reinecke, Schmidt, & Ajzen, 1996). In their study, condom use was predicted at two points in time (one year apart) using TPB. They reported that the Wave 1 predictors underwent substantial changes in the course of one year, at least partly as a result of having experience with condom use; attitudes toward using condom became more favorable and perceived behavioral control to use condom became stronger.

These findings again underscore the effect of actually performing the target behavior on psychological factors, which has a strong implication for an intervention program. It might be suggested that facilitating performance of a target behavior, for example, by removing barriers, should come first before attempting to change underlying psychological factors, as once the behavior is performed, it is likely to influence the psychological factors. Van Vugt et al. (1996) pointed out in their study of evaluating the effects of implementation of carpool priority lanes in the Netherlands, that removing

important personal barriers to increase opportunity for the public to cooperate is one of the key factors for the success of structural interventions.

Changes within car users and psychological mechanisms that possibly underlie the change. When car users in Phase 1 were categorized, based on the result of Phase 2, into Group 1 (those who had started to take the bus more often) and Group 2 (those who always use cars), significant differences were found between the groups. Difference between the two groups was most clearly seen in the evaluation of behavioral beliefs. Group 1 evaluated being convenient, comfortable, and quick in choosing transportation mode as less important than did Group 2. These differences in evaluation of attributes associated with transportation mode might have some utility in distinguishing subsequent choices for transportation mode.

It is noteworthy that perceived behavioral control for taking the bus across groups significantly increased overtime, considering that it did not change significantly as a whole sample (including other user groups), when means of Phase 1 and 2 were compared. Obviously, bus users had had high perceived control for taking the bus already at the time of Phase 1, and the implementation of the U-pass program did not affect it great deal, whereas, among car users, the U-pass program seemed to contribute to enhance their perceived control for taking the bus.

The result also showed that the degree of changes over time observed for some variables were different depending on the group. Group 1 evaluated behavioral belief "being quick" when choosing transportation mode as less important in Phase 2 than in Phase 1, whereas the evaluation by Group 2 was unchanged. Group 1 perceived being able to have a flexible schedule when taking the bus was more likely in Phase 2 than they

did in Phase 1, whereas Group 2's perception of the likelihood stayed almost constant (i.e., they did not perceive it as likely in neither phases).

These results again support the effects of U-pass program, and stress the importance of performing a target behavior as described above. As a result of taking the bus more often, Group 1 might have developed a more positive view of bus use, as seen in the positive change in behavioral belief about having a flexible schedule when using the bus. In contrast, Group 2 was not exposed to a "new" experience of taking the bus, hence, their perception of having a flexible schedule when using the bus did not change. It is also of note that Group 1 perceived more strongly that bad weather did matter when taking the bus in Phase 2 than they did in Phase 1, although the difference was not statistically significant. This might be another example of having developed a more realistic view of bus use after they started to take the bus more often.

These results may also shed light on psychological mechanisms that possibly underlie changes in psychological factors. For example, Vugt et al. (1996) employed the concept of "self-justification" processes to explain observed changes, in investigating impacts of implementing a structural intervention (implementation of the carpool priority lane) on one's attitudes and intentions regarding the use of carpool lane. A self-justification process is explained as a psychological revaluation of behavioral options or situations in terms of their attributes to defend one's preferred choice (Aronson, 1988). In fact, results of this study closely replicate some of their findings.

Vugt et al. (1996) focused on solo drivers who were unwilling to cooperate with the intervention, and hypothesized that they would experience cognitive dissonance (Festinger, 1957), a tension arising from the contradiction between their actual behavior

and beliefs about that behavior (i.e., that driving alone contributes more to environmental problems and that carpooling is more socially desirable). They proposed that such dissonance might be resolved by: (1) changing one's behavior (that is, starting to carpool), and (2) re-appraising the attributes inherently linked to driving alone and carpooling (self-justification processes), and that if solo drivers were unwilling to change their behavior, they would engage in a self-justification process.

Their result showed that solo drivers increased the importance of attributes linked to driving alone (e.g., flexibility) and decreased the importance of an attribute that is prototypic of carpooling (low cost), and that their preference for carpooling decreased. In this study also, Group 2's intention decreased in Phase 2, whereas Group 1's intention increased. Moreover, Group 2 reported that support from their significant others for taking the bus decreased in Phase 2, although the difference was not statistically significant. The same process of self-justification might apply to explain the change in evaluation in Group 1. To justify their actual behavior (i.e., taking the bus), they might have downgraded the importance of being quick in choosing transportation mode, as they realize that taking the bus is not as quick as driving alone.

Vugt et al. (1996) also reported that the self-justification effects were observed only for the importance ratings, but not for the beliefs. This was exactly the case with behavioral belief "being cheap" in this study, although the difference over time was not statistically significant. Group 2 perceived taking the bus would be cheaper in Phase 2 than in Phase 1, and driving would be less cheap in Phase 2 than in Phase 1, which is an unbiased perception of a real situation. It is speculated that instead of trying to change the perception of the reality, they changed the evaluation of the reality; that is, they put less

importance on cost when choosing transportation mode compared to Phase 1. Vugt et al. (1996) explained their result the same way. They suggested that the tendency to maintain a favorable view of one's behavior might be reduced by the extent to which reality permits individuals to do so. "Given that beliefs are more verifiable and more strongly constrained by reality than are evaluations, it is understandable that self-justification effects occurred primarily through changes in the importance assigned to travel attributes rather than through changes in the beliefs about those attributes" (p. 371).

Predicting changes. The use of difference scores between Phase 1 and 2 (to reflect the changes) as predictors to predict the change observed in the dependent variable (percentage of time respondents took the bus to and from the university) was relatively successful. The difference scores accounted for 21% of the variance in behavioral change between Phase 1 and 2. This result indicates that the change in behavior was at least in part due to the changes in psychological variables.

Bamberg and Schmidt (1998) emphasized the reciprocal nature of psychological factors and behavior; psychological factors influence behavior, and performing the behavior will influence the psychological factors. Although any causal inferences cannot be made, at least at the correlational level, this study demonstrated the changes in psychological factors occurred after the U-pass program implementation. These changes, in turn, contribute to explain behavioral changes (changes in transportation mode choice) brought about by the U-pass program.

Limitations of the study and suggestions for future studies

Some limitations of this study must be mentioned. First, the items in the questionnaire could be improved further. Several variables were measured by only one

item. For example, behavioral intention was measured by only one item, mainly because it was difficult to ask about the intention to take the bus to and from the university in any other way. Affective judgement for bus use was also measured by only one item. Although three items were initially constructed to measure it, they did not achieve reasonable internal consistency; hence, two of the items had to be dropped. Better items that can tap into affective judgement need to be developed.

Second, as with many other studies of TPB, this study was based on self-reported measures of dependent variables and predictors. As such, social desirability and some sort of justification might have influenced how the respondents answered the questions. It might be suspected that the questionnaire treated bus use as "pro-environmental" behavior too obviously, even though it was not intended, which might have discouraged "car users" from participating in the Phase 2 study. Future studies need to keep this point in mind so that the respondents' answers will not be influenced by perceived researchers' intentions.

Third, the current study did not investigate possible interactions among variables. Several researchers (e.g., Conner & McMillan, 1999) have shown moderating effects among variables, including interaction effect between behavioral intention and PBC on behavior (Terry & O'Leary, 1995) and that between attitudes and social norms on behavioral intention (Grube & Morgan, 1990). Interacting relationship may be observed between the original TPB variables and new variables added in this model, such as interaction between attitudes and awareness of the problems caused by car use in predicting behavioral intention. Future studies should include analysis of interaction, as

exploring interactions among variables would elucidate more specific conditions under which the model operates.

Conclusion

The present study investigates and demonstrates the ability of the theory of planned behavior in predicting university students' transportation mode choices. Furthermore, variables added in order to expand the theory improved the prediction of the transportation mode choices. Descriptive norm was an especially reliable predictor in both predictions of behavioral intention and behavior. Adding this variable would seem to improve the TPB model.

This study also examines the effect of a U-pass program. Not only does it demonstrate the degree of change in students' actual transportation mode choices, it also provides a psychological explanation as to why the changes occurred. As one of the goals of social cognition models such as TPB is to find ways to change behavior, the findings of this study have important implications for intervention programs. This study supports the impact of performing actual behavior on psychological factors, and the reciprocal nature of the impact between the psychological factors and performance of behavior.

Footnotes

[1] On collection of Phase 2 data via on-line questionnaire, mistakes in web-site programming were found. Because of the mistakes, two variables (behavioral intention and behavioral belief for car about comfort) were not transmitted. In order to make up this lost data, we sent emails to all the participants who had replied to ask them to answer the two questions again, exactly the same way as they did initially. Participants were contacted up to four times for a reply.

[2] However, these beliefs and general attitudes toward car use were not used for regression analyses, because the dependent variable, behavioral intention, was measured only for bus use.

[3] For the same reason described in footnote 2, the affective judgement measure for car use was not included in regression analyses.

[4] 283 Phase 1 participants left email addresses as a contact information, but, unexpectedly many email notices (37) were returned undelivered due to email address changes since the Phase 1 data collection.

[5] As a result of having to ask the participants again by email, we lost 9 participants (5 percent) out of 176 who had completed on-line questionnaires. Among 167 participants who replied to the request to answer the same question again, 7 participants (4 percent) had unidentifiable email addresses, therefore, had to be dropped, resulting in a total of 160 participants who completed the questionnaire on-line.

[6] In the Phase 1 questionnaire, the question was "I'm happy that U-pass will be introduced."

[7] We considered financial status as unchanged since the time of Phase 1, which was 3 months prior to the time of Phase 2. Hence, the data collected at the time of Phase 1 for the financial status was used for Phase 2 analysis also.

[8] The focus of this analysis was not to investigate whether or not the new variables would add further variance over and above the original TPB variables, but to investigate which of the three types of predictors (i.e., difference scores, Phase 1 predictors and Phase 2 predictors) as a whole would predict the behavioral change and to what extent. Therefore, hierarchical regression analysis was not employed.

[9] The frequencies for various transportation mode users, based on the self-reported data at the time of Phase 1, who participated in Phase 2 were: 47 car users, 48 bus users, 26 bicyclists, 7 car poolers and 47 un-categorized. The 47 car users were further categorized into 2 groups.

References

Abelson, R. P., Kinder, D. R., Peters, M. D., & Fiske, S. T. (1982). Affective and semantic components in political person perception. Journal of Personality and Social Psychology, 42, 619-630.

Ajzen, I. (1985). From intentions to actions: A theory of Planned behavior. In J. Kuhl & J. Beckmann (Eds.), Action-control: From cognition to behavior. Heidelberg: Springer.

Ajzen, I. (1988). Attitude, personality, and behavior. Milton Keynes: Open University Press.

Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes, 50, 179-211.

Ajzen, I., & Driver, B. L. (1991). Prediction of leisure participation from behavioural, normative, and control beliefs: An application of the theory of planned behaviour. Journal of Leisure Sciences, 13, 185-204.

Ajzen, I., & Fishberin, M. (1980). Understanding attitudes and predicting social behavior. Englewood Cliffs, NJ: Prentice-Hall.

Ajzen, I., Timdo, C. and White, J. B. (1982). Self-monitoring and the attitude-behavior relation. Journal of Personality and Social Psychology, 42, 426-435.

Aronson, E. (1988). The Social Animal. New York: W. H. Freeman & Co.

Beck, L. & Ajzen, I. (1991). Predicting dishonest actions using the theory of planned behavior. Journal of Research in Personality, 25, 285-301.

Bamberg, S., & Schmidt, P. (1998). Changing travel-mode choice as rational choice: Results from a longitudinal intervention study. Rationality and Society, 10, 223-252.

Baron, R. M., & Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of Personality and Social Psychology, 51, 1173-1182.

Black, J. S., Stern, P. C., & Elsworth, J. T. (1985). Personal and contextual influences on household energy adaptations. Journal of Applied Psychology, 70, 3-21.

British Columbia Ministry of Environment, Land and Parks. (1999). Greenhouse Gases in British Columbia. Retrieved May 19, 1999 from the World Wide Web: www.elp.gov.bc.ca/sppl/soerpt/gas/gas.html

British Columbia Ministry of Energy, Mines and Petroleum Resources, & Ministry of Environment, Land and Parks. (1995). British Columbia Greenhouse Gas Action Plan. Retrieved May 19, 1999 from the World Wide Web: www.elp.gov.bc.ca/epd/epdpa/ar/climate/bcggap.html

Bronner, A. E. (1982). Decision styles in transport mode choice. Journal of Economic Psychology, 2, 81-101.

Brown, J., Hess, D., & Shoup, D. (1998, June). Unlimited access. paper presented at the Transit and University Communities Conference, Colorado, USA.

Brunswik, E. (1952). The conceptual framework of psychology. Chicago: University of Chicago Press.

Cialdini, R. B., Reno, R. R. , & Kallgren, C. A. (1990). A focus theory of normative conduct: Recycling the concept of norms to reduce littering in public places. Journal of Personality and Social Psychology, 58, 1015-1026.

Cohen, J., & Cohen, P. (1983). Applied multiple regression/correlation analysis for the behavioral science. (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates.

Conner, M., & Armitage, C. J. (1998). Extending the theory of planned behavior: a review and avenues for further research. Journal of Applied Social Psychology, 28, 1429-1464.

Conner, M., Martin, E., Silveradale, N. & Grogan, S. (1996). Dieting in adolescence: an application of the theory of planned behavior. British Journal of Health Psychology, 1, 315-325.

Conner, M., & McMillan, B. (1999). Interaction effects in the theory of planned behavior: Studying cannabis use. British Journal of Social Psychology, 38, 195-222.

Courneya, K. S., Friedenreich, C. M., Arthur, K, & Bobick, T. M. (1999). Understanding exercise motivation in colorectal cancer patients: A prospective study using the theory of planned behavior. Rehabilitation Psychology, 44, 68-84.

Dawes, R., & Corrigan, B. (1974). Linear Models in Decision-making. Psychological Bulletin, 81, 95-106.

De Vries, H., Backbier, E., Kod, G. & Dijkstra, M. (1995). The impact of social influences in the context of attitude, self-efficacy, intention, and previous behavior as predictors of smoking onset. Journal of Applied Social Psychology, 25, 237-257.

Dobson, R., & Tischer, M. L. (1978). Perceptual market segmentation technique for transportation analysis. Transportation Research Record, 673, 145-152.

Doll, J., & Orth, B. (1993). The Fishbein and Ajzen theory of reasoned action applied to contraceptive behaviour: Model variants and meaningfulness. Journal of Applied Social Psychology, 23, 395-415.

Drolet, R. (1999, January). University/college pass proposal to develop a program. Paper presented to the members of the Victoria Regional Transit Commission.

Fazio, R.H. (1990). Multiple processes by which attitudes guide behavior: The MODE model as an integrative framework. In M. P. Zanna (Ed.), Advances in experimental social psychology, Vol. 23. San Diego, CA: Academic.

Fenwick, I., Heeler, R., & Simie, P. (1983). Switching commuters from car o public transit: A micro modeling approach. Journal of Economic Psychology, 3, 333-345.

Festinger, L. (1957). A Theory of Cognitive Dissonance. Evanston, IL: Row & Peterson.

Fishbein, M. (1967). Readings in attitude theory and measurement. New York: Wiley.

Fishbein, M. (1972). The prediction of behaviors for attitudinal variables. In C. D. Mortensen & K. K. Sereno (Eds.), Advances in communication research. New York: Harper & Row.

Fishbein, M., & Ajzen, I. (1975). Belief, attitude, intention, and behavior: An introduction to theory and research. Reading, MA: Addison-Wesley.

Fishbein, M., & Coombs, F. S. (1974). Basis for decision: an attitudinal analysis of voting behavior. Journal of Applied Social Psychology, 4, 95-124.

Forward, S. (1997). Measuring attitudes and behavior using the theory of planned behavior. In T. Rothengatter & E. C. Vaya (Eds.), Traffic and transportation psychology: Theory and application. Amsterdam: Pergamon.

Godin, G., & Kok, G. (1996). The theory of planned behavior: A review of its applications to health-related behaviors. American Journal of Health Promotion, 11, 87-98.

Gorsuch, R. L., & Ortberg, J. (1983). Moral obligation and attitudes: Their relation to behavioral intentions. Journal of Personality and Social Psychology, 44, 1025-1028.

Government of Canada. (1998). Addressing Climate Change. Retrieved June 8, 1999 from the World Wide Web: www.climatechange.gc.ca/english/html/addressi.html

Grube, J. W., & Morgan, M. (1990). Attitude-social support interaction: Contingent consistency effects in the prediction of adolescent smoking, drinking, and drug use. Social Psychology quarterly, 53, 329-339.

Guagnano, G. A., Stern, P. C., & Dietz, T. (1995). Influences on attitude-behavior relationships: A natural experiment with curbside recycling. Environment and Behavior, 27, 699-718.

Hopper, J. R., & Nielsen, J. M. (1991). Recycling as altruistic behavior: Normative and behavioral strategies to explain participation in a community recycling program. Environment and Behavior, 23, 195-220.

Lawton, R., Parker, D., Manstead, A. S. R., & Stradling, S. G. (1997). The role of affect in predicting social behaviors: The case of road traffic violations. Journal of Applied Social Psychology, 27, 1258-1276.

Levin, I. P., & Louviere, J. J. (1981). Psychological contributions to travel demand modeling. In I. Altman, J. F. Wohlwill, & P. Everett (Eds.), Human behavior and environment: Advances in theory and research: Vol. 5 Transportation and Behavior. New York: Plenum.

Luce, R. D. (1959). Individual choice behavior: A theoretical analysis. New York: Wiley.

Lynne, G. D., Casey, C. F., Hodges, A. Rahmani, M. (1995). Conservation technology adoption decisions and the theory of planned behavior. Journal of Economic Psychology, 16, 581-598.

Manstead, A. S. R., Proffit, C., & Smart, J. L. (1983). Predicting and understanding mothers' infant-feeding intentions and behavior: Testing the theory of reasoned action. Journal of Personality and Social Psychology, 44, 65-71.

McBean, G. A., Slaymaker, O., Northcote, T., Leblond, P., & Parsons, T. S. (1992). Review of models for climate change and impacts on hydrology, coastal currents and fisheries in B.C. (Climate Change Digest CCD 92-02 SCC 92-02, pp 15-16). Downsview, Ontario: Environment Canada, Canadian Climate Center.

Meyer, J., & Beimborn, E. (1996). Evaluation of an innovative transit pass program: The Upass. Retrieved March 20, 1999 from the World Wide Web: http://www.uwm.edu

Meyer, R. J., Levin, I. P., & Louviere, J. J. (1978). Functional analysis of mode choice. Transportation Research Record, 673, 1-7.

Milgram, S., Bickman, L., & Berdowitz, O. (1969). Note on the drawing power of crowds of different size. Journal of Personality and Social Psychology, 13, 79-82.

Parker, D., Manstead, A. S. R., & Stradling, S. G. (1995). Extending the theory of planned behavior: The role of personal norm. British Journal of Social Psychology, 34, 127-137.

Parker, D., Manstead, A. S. R., Stradling, S. G., Reason, J. T., & Baxter, J. S. (1992). Intention to commit driving violations: An application of the theory of planned behavior. Journal of Applied Psychology, 77, 94-101.

Parker, D., Stradling, S. G., & Manstead, A. S. R. (1996). Modifying beliefs and attitudes to exceeding the speed limit: An intervention study based on the theory of planned behavior. Journal of Applied Social Psychology, 26, 1-19.

Reinecke, J., Schmidt, P., & Ajzen, I. (1996). Application of the theory of planned behavior to adolescents' condom use: A panel study. Journal of Applied Social Psychology, 26, 749-772.

Restle, F. (1961). Psychology of judgement and choice. New York: Wiley.

Richard, R., van der Pligt, J., & de Vries, N. (1996). Anticipated affect and behavioral choice. Basic and Applied Social Psychology, 18, 111-129.

Rokeach, M. (1973). The nature of human values. New York: Free Press.

Schifter, D. B., & Ajzen, I. (1985). Intention, perceived control, and weight loss: an application of the theory of planned behavior. Journal of Personality and Social Psychology, 49, 843-851.

Schwartz, S. H. (1977). Normative influences on altruism. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology: Vol. 10 (pp. 221-279). New York: Academic Press.

Schwartz, S. H. (1992). Universals in the content and structure of values: Theoretic advances and empirical tests in 20 countries. In M. P. Zanna (Ed.), Advances in Experimental Social Psychology, Vol. 25. San Diego, CA: Academic Press.

Schwartz, S. H., & Bilsky, W. (1990). Toward a theory of the universal content and structure of values: Extensions and cross-cultural replications. Journal of personality and Social Psychology, 58, 878-891.

Schwartz, S. H., & Tessler, R. C. (1972). A test of a model for reducing measured attitude-behavior inconsistencies. Journal of Personality and Social Psychology, 24, 225-236.

Sejwacz, S. H., Ajzen, I., & Fishbein, M. (1980). Predicting and understanding weight loss: Intentions, behaviors, and outcomes. In I. Ajzen & M. Fishbein (Eds.), Understanding attitudes and predicting social behavior, pp. 101-112. Englewood-cliffs, NJ: Prentice-Hall.

Steg, E. M. (1996). Behavior change for reducing the use of motor-cars, Theoretical analysis and empirical study about problem awareness, willingness-to-change and evaluation of policy measures. Doctoral dissertation, Department of Psychology, University of Groningen, The Netherlands.

Steg, L., Geurs, M., & Ras, M. (1999). The effect of motivational factors on car use: A multidisciplinary modeling approach. Manuscript submitted for publication.

Steg, L., & Sievers, I. (in press). Cultural theory and individual perceptions of environmental risks. Environment and Behavior.

Steg, L., & Vlek, C. (1997). The role of problem awareness in willingness-to-change car use and in evaluating relevant policy measures. In J. A. Rothengatter & E.

Carbonell Vaya (Eds.), Traffic and transport psychology: Theory and Application. Amsterdam: Pergamon.

Stern, P. C., Black, J. S., & Elworth, J. T. (1983). Adaptations t changing energy conditions among Massachusetts households. Energy, 8, 515-523.

Stern, P. C., Diets, T., & Black, J. S. (1986). Support for environmental protection: The role of moral norms. Population and Environment, 8, 204-222.

Stern, P. C., Dietz, T., & Kalof, L. (1993). Value orientations, gender, and environmental concern. Environment and Behavior, 25, 322-348.

Stern, P. C., Dietz, T., Kalof, L., & Guagnano, G. A. (1995). Values, beliefs, and pro-environmental action: Attitude formation toward emergent attitude objects. Journal of Applied Social Psychology, 25, 1611-1636.

Taylor, S., & Todd, P. (1997). Understanding the determinants of consumer composting behavior. Journal of Applied Social Psychology, 27(7),602-628.

Terry, D., & O'Leary, J. E. (1995). The theory of planned behaviour: The effects of perceived behavioural control and self-efficacy. British Journal of Social Psychology, 34, 199-220.

Tertoolen, G., Van Kreveld, D., & Verstraten, B. (1998). Psychological resistance against attempts to reduce private car use. Transportation Research A, 32, 171-181.

Tybout, A. M., & Hauser, J. R. (1981). A marketing audit using a conceptual model of consumer behavior: Application and evaluation. Journal of Marketing, 45, 82-101.

Valiquette, C. A. M., Valois, P., Desharnais, R., & Godin, G. (1988). An item-analytic investigation of the Fishbein and Ajzen multiplicative scale: The problem of a

simultaneous negative evaluation of belief and outcome. Psychological Reports, 63, 723-728.

Van Liere, K., & Dunllap, R. E. (1978). Moral norms and environmental behavior: An application of Schwartz's Norm-Activation Model to yard burning. Journal of Applied Social Psychology, 8, 174-188.

Van Vugt, M., Van Lange, P. A. M., Meertens, R. M., & Joireman, J. A. (1996). How a structural solution to a real-world social dilemma failed: A field experiment on the first carpool lane in Europe. Social Psychology Quarterly, 59, 364-374.

Verplanken, B., Aarts, H., van Knippenberg, A., & Moonen, A. (1998). Habit versus planned behavior: a field experiment. British Journal of Social Psychology, 37, 111-128.

Vlek, C. A. J., & Steg, E. M. (1997). Societal reasons, conditions and policy strategies for reducing the use of motor vehicles: A Behavioral-science perspective and some empirical data. In OECD, Toward Sustainable Transportation. Proceedings of the "International Conference Towards Sustainable Transportation", Vancouver, March 25-27,1996.

Williams, M. E., & Petrait, K. L. (1999). Upass: A model transportation management program that works. Retrieved May 19, 1999 from the World Wide Web: http://www.fta.dot.gov/fta/library/program/UPASS/UPAS.html

Appendix 1

Sample questionnaire

1 Please think about the last 10 days you came to school. Please put the number of days you took the following transportation mode on the way to and back from school.

	Coming to school	**Going home**
Drive alone	_____	_____
Bus	_____	_____
Bike	_____	_____
Drive with others (car pool, or with family, or friends)	_____	_____
Others (walk, etc.)	_____	_____

2 How long would it take from your door to campus by each transportation mode?
Please **estimate** if you don't use the mode. (Time for looking for parking spots does not include.)

Drive alone_____Bus_____ Bike_____ Drive with others_____ Walk_____

3 How important is each of the following aspects to you when commuting to and from school? Please circle one answer for each aspect.

	extremely important	very important	neutral	not very important	completely unimportant
a. That the schedule is flexible.	2	1	0	-1	-2
b. That it is convenient to use.	2	1	0	-1	-2
c. That it is quick to come to school.	2	1	0	-1	-2
d. That I feel comfortable.	2	1	0	-1	-2
e. That it is cheap to come to school.	2	1	0	-1	-2
f. That I am protected from weather.	2	1	0	-1	-2
g. That I can have a good control over my time.	2	1	0	-1	-2

4 If I were to drive to school or if I do already (please circle one answer for each statement):

	strongly agree	agree	neutral	disagree	strongly disagree
a. I can have a flexible schedule.	2	1	0	-1	-2
b. It is very convenient.	2	1	0	-1	-2
c. It is relatively quick.	2	1	0	-1	-2
d. It is comfortable.	2	1	0	-1	-2
e. It is relatively cheap.	2	1	0	-1	-2
f. Bad weather doesn't matter.	2	1	0	-1	-2
g. I can have a good control over my time.	2	1	0	-1	-2

5 If I were to take the bus to school or if I do already (please circle one answer for each statement):

		strongly agree	agree	neutral	disagree	strongly disagree
a.	I can have a flexible schedule.	2	1	0	-1	-2
b.	It is very convenient.	2	1	0	-1	-2
c.	It is relatively quick.	2	1	0	-1	-2
d.	It is comfortable.	2	1	0	-1	-2
e.	It is relatively cheap.	2	1	0	-1	-2
f.	Bad weather doesn't matter.	2	1	0	-1	-2
g.	I can have a good control over my time.	2	1	0	-1	-2

Below is a list of statements concering aspects of commuting to and from school. Please indicate to what extent you agree with each of these statements, by circling a number representing your answer.

		strongly agree	agree	neutral	disagree	strongly disagree
6	I like the idea of driving to school.	2	1	0	-1	-2
7	Traveling by bus is fun.	2	1	0	-1	-2
8	I do not feel bad about it when I drive to school.	2	1	0	-1	-2
9	I'm happy that Upass will be introduced.	2	1	0	-1	-2
10	Driving makes me feel good.	2	1	0	-1	-2
11	I like the idea of taking the bus to school.	2	1	0	-1	-2
12	Most people who are important to me would Support me in using bus to commute to and from school.	2	1	0	-1	-2
13	I feel guilty about it when I drive to school.	2	1	0	-1	-2
14	Driving gives me a thrill.	2	1	0	-1	-2
15	Most people who are important to me think that I should take the bus to and from school.	2	1	0	-1	-2
16	I intend to use transit to commute to and from school.	2	1	0	-1	-2

The following questions are about how most of your friends/classmates commute to and from school. Please circle one answer for each statement. **Try to estimate** if you do not know for sure.

	0-25%	25-50%	50-75%	75-100%
17 About what percentage of your friends take the bus to commute to and from school?	1	2	3	4

Consequences of car use

We would like to know how people feel about the consequences of car use. Please indicate to what extent you agree with each of the following statements, by circling a number representing your answer.

		strongly agree	agree	neutral	disagree	strongly disagree
18	Car use causes serious air pollution in the world.	2	1	0	-1	-2
19	Car use is a major source of noise problems in the world.	2	1	0	-1	-2
20	Traffic jams are a problem in Victoria.	2	1	0	-1	-2
21	Car use contributes to the depletion of energy sources.	2	1	0	-1	-2
22	In Victoria, air pollution caused by car use is getting serious.	2	1	0	-1	-2
23	I feel personally responsible for the problems resulting from car use when I drive.	2	1	0	-1	-2
24	In Victoria, car use is a major source of noise problems.	2	1	0	-1	-2
25	Finding a parking spot is a problem in Victoria.	2	1	0	-1	-2
26	Many neighborhood in Victoria are unsafe because there is too much traffic.	2	1	0	-1	-2

27 How difficult would it be for you to take the bus to school (or, more often, if you already do)?

Very easy	easy	neutral	difficult	very difficult
2	1	0	-1	-2

28 How much would the following factors facilitate your decision to take the bus to come to school?

	Very facilitating	Quite facilitating	Doesn't matter	Not very facilitating	Not at all facilitating
a. To be on a good bus route	2	1	0	-1	-2
b. To know the bus schedule well	2	1	0	-1	-2

29 The next time you take the bus to school, how likely will it be that the following are true for you?

	Very Likely	Likely	neutral	Unlikely	Very Unlikely
a. I will be on a good bus route.	2	1	0	-1	-2
b. I will know the bus schedule well.	2	1	0	-1	-2

30 How many negative experiences have you had with taking the bus to school?

many	several	a few	none
4	3	2	1

31 Which of the following values are most and least important to you? Please give each of the following values a number from 1 to 7, where 1 = the most important, 2 = second-most important, etc., to 7 = least important. Be sure to use each number from 1 to 7 just once.

___Social power
___True friendship
___ Equality
___ Wealth
___ Protecting the environment
___ Authority
___ Family security

Some demographic information about you

32 Gender ____

33 Age _____

34 Do you have any disability that affects your mobility? Yes 1 No 2

35 Please circle one statement that fits you:
In terms of finances,
1. I'm really short of money.
2. I'm just getting by.
3. I have adequate amount of money.
4. I have a good supply of funds (to go to university).

For the phase 1 questionnaire only:

We would very much like to learn more about your views on this topic. If you are willing for us to contact you in October, please complete the following:

**The follow-up survey will be available on-line. If you wish to do the follow-up survey on-line, please write your email address.

At this email address (**please print**)_____

Your name (please print)_____

At this phone number (in **October**):_____

At this address (**October address**):

Street_____

City_____Postal Code_____

You have now come to the end of the questionnaire. Thank you very much for your co-operation.

VITA

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Post Occupancy Evaluation of Therapeutic Gardens in a Multi-Level Care Facility for the Aged. (2000). R. Gifford & Y. Heath. Activities, Adaptation, & Aging. 25(2). Pages unknown yet; forthcoming. 40 pages manuscript.

Home alone with dementia. (1998). H. Tuokko, P. Maccourt & Y. Heath. Paper presented at the 20th Annual Conference and Annual General Meeting of Alzheimer Canada, in Vancouver, B.C., in April. 30 pages manuscript.

Transportation Mode Choice of University Students: Influence of Psychological Factors. (my Master thesis). Y. Heath & R. Gifford. Paper that will be presented at the International Association for People-Environment Studies (IAPS) conference in July, 2000, in Paris. 60pages manuscript.

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Extending the Theory of Planned Behavior: Predicting Transportation Mode Choices

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