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SEMANTIC APPROACH TO CAPTURE PSYCHOLOGICAL FACTORS AFFECTING MODE CHOICE: COMPARATIVE RESULTS FROM CANADA AND CHILE

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Running head: Semantic approach to capture psychological factors affecting mode choice

ABSTRACT

Purpose
Study the causal effect of psychological factors on mode choice, using an instrument which gathered attitudinal, affective and habitual behaviour factors, with an application to a Canadian and Chilean sample.

Approach
Ad hoc questionnaire used to collect information related to psychological factors, studying the role of these factors upon mode choice using structural equation modelling, combining a measurement model and the latent variables.

Findings
Emotional (affective) factors have a strong influence on mode choice, as well as attitudinal and habitual factors. Car users have a strong positive emotion to the transport mode they use, when compared with public transport users and transit utilization.

Research limitations
The inclusion of social factors, such as norm, role and self concept, is desirable for a better understanding of people’s behaviour regarding transport mode usage. The structural equation modelling was used to analyse the causal effects among factors, but it is not intended to model mode choice. An advanced approach would be to estimate a hybrid discrete choice model.

Practical implications
Realizing the real importance of personal psychological factors on mode choice is a key issue when intending to implement mobility and travel demand management strategies. The success of these strategies strongly relies on people’s change of behaviour, which does not depend only on instrumental and socio demographic factors, such as cost, time and income, but also on these very inner personal aspects.

Originality/value
Capture psychological factors through a comprehensive survey, which rests on a psychological framework and considers simultaneously attitudinal, affective, and habitual personal factors, as well as instrumental and socio demographic information. Make a comparison among cities belonging to different countries regarding the role of these factors, cities with a different cultural and social background.

Keywords: psychological factors, mode choice, structural equation modelling, Chile, Canada

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1. INTRODUCTION
It has been recognised that contextual (instrumental) factors such as mode level of service and cost, in addition to personal socioeconomic and demographic characteristics, are not enough to explain mode choice behaviour. Empirical evidence shows that conventional mode choice models are plagued by many methodological problems due to their weak characterization of several behavioural factors, which are expected to affect individuals’ choices (Kenyon and Lyons, 2003; Shannon et al., 2006). Attempts have been made to consider psychological attributes in the specification of mode choice models to improve their explanatory power (Johansson et al., 2006; Cantillo et al., 2007).

However, such attempts are criticized for some limitations. On the side of data collection for mode choice modelling purposes, the measurement of these psychological factors has focused mainly in very few factors, without a theoretical framework supporting the selection of such factors. Attitudinal factors measurement has been oriented to quantify only the importance of some aspects describing the transport modes, rather than asking for the importance and value of the modes themselves (Golob and Hensher, 1998; Habib et al., 2010). Affective factors have being seldom considered (Lois and Lopez, 2009), whereas the social component has focused on the social norm, without looking for the impact of social role and self concept (Prato et al., 2012).

Habit has been mainly reported as a repeated behaviour, without caring about the level of rationality behind each decision (Yañez et al., 2010). In psychological terms, habit is an unreasoned behaviour, associated with a repetitive conduct, implying that inertia solely does not constitute habit itself.

With respect to modelling issues, research efforts have resulted in building up and estimating more complex demand models (Bolduc et al., 2008; Habib et al., 2011). These models deal with psychological factors as non context and theoretical framework based ones.

If transport policy intends to be successful when implementing measures oriented to promote the use of non motorized modes, public transport initiatives and reduce car use, then we need to disentangle explicitly the aspects which are affecting mode choice. In fact, different actions should be taken depending on the factors conditioning mode choice.

The aim of this study is a better understanding of commuters’ mode choice behaviour. This paper explicitly investigates the causal relationships among unobservable latent variables affecting mode choice, based upon a theoretical framework oriented to explain behaviour: the Theory of Interpersonal Behaviour (TIB) by Triandis (1977). The TIB suggests that observed behaviour is preceded by intention which is mediated by habit and contextual conditions. The cause and effect relationships among these psychological factors are analyzed using Structural Equation Models (SEM).

In order to explain the international differences in mode choice behaviour between countries, this study compares the models developed using datasets collected in two different cities in the Americas. Datasets come from conducting the same socio-psychometric survey in the cities of Concepción, Chile, and Edmonton, Canada. The survey incorporated the measurement of psychological factors and gathered socioeconomic and demographic data, as well as instrumental attributes.

The remainder of the paper is arranged as follows: the next section provides a review of the literature about psychological aspects affecting mode choice and a description of the Structure
Equation Models (SEM) used in the analysis. Section three includes a description of the study areas while Section four describes the data used in this research as well as some field work details. This is followed by models estimation and analysis in Section five, whereas conclusions are reported in the last section.

2. LITERATURE REVIEW

Conventionally, mode choice models are based on the Random Utility Maximization (RUM) framework which comes from microeconomics. Choice decisions can be conceptualized under such framework where a number of travel options are available to a passenger. According to his/her preferences, the passenger assigns weights to the different attributes characterizing each of the competing alternatives, selecting the mode which maximize his/her utility based upon his/her socioeconomic and demographic characteristics, in addition to the relative attractiveness of the available alternatives (Hensher et al., 2005).

Past research shows that traditional methods of choice modelling suffer from many problems and methodological limitations (Bamberg et al., 2003; Chorus and Timmermans, 2009). One reason for this as to do with the weak characterization of certain behavioural factors such as habit of car driving, personal attitude and affective appraisal, which usually drive people’s choices and can act as barriers to mode switch (Kenyon and Lyons, 2003; Shannon et al., 2006). Research referred the reluctance to modal shift to the formation of strong car use habits which could lead to the domination of a specific mode even in cases where the rational choice favours another (Banister, 1978; Aarts et al., 1997; Gärling et al., 1998; Fujii and Kitamura, 2003; Gärling and Axhausen, 2003; Mackett, 2003; Heinen et al., 2010). Once habits are formed, mode choice is less affected by cost and time savings, and rather passengers’ choices become more systematic with respect to their chosen mode and insensitive to changes in the transport system (Quentin and Hong, 2005; Cantillo et al., 2007, Domarchi et al., 2008).

In this context, previous studies have shown that incorporating psychological factors as alternative-specific constants or dummy variables within the utility functions of choice models improves their goodness of fit. However, such approaches have been mainly focused on generating more sophisticated demand models rather than unravelling the decision making process. In most cases, only the direct effects of such psychological variables were considered in the models without giving proper attention to the causal relationships between latent variables (Johansson et al., 2006; Temme et al., 2008; Habib et al., 2010).

Obviously, mode choice is a complex process which is strongly influenced by different socio-psychological factors. More recently, research suggested that explicitly studying psychological factors can help understanding the mode choice decision making process. In general, research in social psychology provides appropriate theoretical frameworks to consider the effects of psychological and contextual factors upon individuals’ decision making process (Triandis, 1977; Ajzen, 1985, 1991). However, little work has been done to measure explicit and jointly these psychological factors.

A socio-psychological theory to study the interaction between habit, attitude, affection, social factors and behaviour is the Theory of Interpersonal Behaviour (TIB) by Triandis (1977). According to the TIB, observed behaviour is preceded by both intention, which represents the motivation to perform a final behaviour, and habit which represents the past frequency of such behaviour, while being mediated by contextual facilitating conditions, as shown in Figure 1.
Intention in turn is guided by three major antecedents. The first determinant of intention is personal attitude which refers to the accumulated evaluation of the choice, which has a magnitude and a direction (Ajzen, 1991). On one hand, the magnitude of an attitude depends on two factors based on to the expectancy-value theory: the expectation that someone has regarding the results of the behaviour (expectancy), and the importance (value) that she/he allocate to such possible results (Reeve, 2005). On the other hand, the direction of an attitude represents whether the decision maker is for or against a specific outcome ( Gärling et al., 1998). The two dimensions (i.e., expectancy and value) of a consequent attitude can be measured using a 5-point Likert scales.

The second ancestor of intention is the social factor which can be described through social norm, social role and self-concept (Lyons, 2004). Social norm is associated with the effect of others’ behaviour on someone’s conduct. Social role is associated with the expectations someone might has of her/his social status. Self-concept is linked with self-esteem and views on her/himself. Likert scales and semantic differentials can be used to measure these aspects. It is worth noticing that social factors are not analyzed in this work.

The third determinant of intention is the affective factor which refers to the unconsciously emotional response that an individual evoke in particular situations (Gärling et al., 1998; Anable and Gatersleben, 2005). The Osgood semantic differential scale allows assigning a metric to quantify such feelings in terms of at least three fundamental dimensions: Evaluation (how good or bad something is), Potency (how powerful or weak something is), and Activation (how lively or quiet something is) (Osgood et al., 1971).

Further, habit formation plays a major role in identifying people choices and might have some suboptimal characteristics (Eriksson et al., 2008). Generally, habitual behaviour is context independent and is related to the frequency of past conduct (Verplanken, 2006). The Verplanken response-frequency questionnaire is used to measure the intensity of habitual behaviour by asking the respondent to make similar unreasoned decisions in different contexts and counting the number of occasions in which behaviour is repeated (Verplanken et al., 1994).

Finally, contextual facilitating or instrumental factors refer to all exogenous variables that affect the intention to a specific behaviour such as socioeconomic and demographic characteristics of individuals (i.e., car ownership, income and family size), and level of service attributes of the competing options (i.e., travel time and cost). Such contextual conditions have been intensely used in mode choice modelling, since they can be easily collected through a revealed preference survey.

In light of the above, the TIB provides a framework for the mode choice decision making process starting from the initial determinants of the behavioural response and moving forward till reaching the final observed outcome. Given such theoretical framework, the influence of attitudes and perceptions on mode choice behaviour can be modelled using the Structural Equation Model (SEM) approach.

SEM is a statistical method for linear-in-parameters multivariate regression modelling that considers the causal relationships between variables. In addition to the inclusion of observed exogenous and endogenous variables, a SEM can handle unobservable latent factors that are indirectly measured through their observable indicators. Such latent variables are modelled by specifying a measurement model and a structural model. The measurement model specifies the relationships between the observed indicators and the latent variables while the structural model specifies the relationships amongst the latent variables themselves (Hoyle, 1995; MacCallum
Within the SEM framework, causal relationships are expressed in the form of a path diagram where the direct effects between variables are represented by unidirectional arrows. Further, unobservable (latent) variables are enclosed by circles or oval shapes whereas directly observed variables are enclosed by rectangular boxes. Since the modeller is required to construct a model in terms of a system of unidirectional effects of one variable on another, SEM is considered a confirmatory rather than exploratory method. Compared to other modelling techniques, the SEM has major advantages in behaviour modelling given its capabilities in dealing with latent variables with multiple indicators, modelling mediating factors and dynamic phenomena such as habit and inertia in mode choice (Golob, 2003).

Most recently, the application of SEM in modelling travel behaviour has been rapidly expanded with strong impetus. In general, utilization of SEM and its variants: factor analysis and path analysis, fit very well given the TIB structure and possible relationships between components of this socio-psychological framework. For instance, path analysis might help to find out whether habit mediates on intention, attitude, affection or the social factor (Galdames et al., 2011; Osman et al., 2011).

This research is oriented to identify the causal effects of several psychological aspects on mode choice behaviour using the SEM approach.

3. STUDY AREA
In an attempt to address the underlying behavioural aspects affecting mode choice and understand the international differences in mode choice behaviour between cities, a comparative analysis is undertaken between two cities in two American countries with different population densities, standards of living and transportation network configuration.

Data come from two cities in both the forest Chilean region of Bio Bio and the oil-rich Canadian province of Alberta, using the same survey which incorporated the measurement of psychological factors. The first city is Concepción, the capital of Concepción Province and Bio Bio Region, Chile. Concepcion city belongs to the second largest conurbation in Chile, known as the Great Concepcion. The total population of the conurbation is close to one million of inhabitants, with an area of 221 km². Main economic activities in the Great Concepcion are fisheries, forestry, metallurgy, education and services, and related business. There are 5 ports in the metropolitan area, serving the exportation requirements.

According to the last OD survey, modal split is characterized by the use of public and private transport and walking. 49% of people use public transport, dominated by buses and shared taxis, 13% of trips are made by car, mainly as a car driver, and 31% are walking trips. 95% of trips have just one step, given the wide spatial coverage for the transport system and activities location. With respect to the supply, there are approximately 1,600 buses and 1,200 shared taxis, all of them operated privately; buses operate under a franchising scheme.

The second city is Edmonton, the capital of Alberta province, Canada. The City of Edmonton is located on the North Saskatchewan River near the centre of the province of Alberta and has an area of 684 km² with one of the lowest population densities in North America. The population of Edmonton has been growing at a very fast rate in the last few years. According to the Edmonton census, the city’s official population on April 1st, 2009 was 782,439 (average growth rate 4%). Edmonton is the construction, manufacturing, and transportation base for the oil and gas
industry and other resource industries in northern Alberta. As the province’s capital, Edmonton has a high proportion of public sector workers. The labour force is divided into Trade/Services (71.9%), Construction/Manufacturing/Transportation (24.9%), and Resource Industries (3.2%).

The city of Edmonton has a comprehensive, integrated transit network consisting of a variety of transit services operated by Edmonton Transit System (ETS) and composed of buses, Light Rail Transit (LRT) and Disabled Adult Transportation Services (DATS). The ETS covers more than 180 routes, 13 LRT stations with a transit fleet including over 900 buses and 74 LRT vehicles. 75% of trips are made by car (driver or passenger) whilst only a 9% of trips are by transit.

4. THE SURVEY AND DATA DESCRIPTION
This work uses the data collected in the cities of Concepción, Chile, and Edmonton, Canada, using the same survey which incorporated the measurement of psychological and instrumental factors, looking for the identification of behavioural factors affecting travel mode choice. The survey technique follows an innovative procedure where habit, affective and attitudinal factors were measured using appropriate scales (Domarchi, 2007; Escobar, 2008; Dogar, 2010), which were mentioned before and are described below; more details regarding the questionnaire itself can be found in Domarchi et al. (2008).

Attitude towards car and transit for all users was measured as a combination of expectation (e.g., public transport is a good mode for work trips), and value (e.g., public transit service is important for work trips), using five-point Likert scales for all the respondents (i.e., regardless of being a user or not). Attitude can be calculated as the product of the expectation and value indicators, implying that the attitude indicator might vary from 1 (the lowest expectancy and value scores) to 25 (the highest expectancy and value scores).

Osgood’s semantic differential scale was used for the evaluation of the affective factor by comparing pairs of antonym words using a 7-point scale for each pair of words. Sixteen pair wise comparisons allowed the study of four dimensions of the semantic differential: evaluation, potency, activation and control. The latter represents how confident or helpless something is (Russell, 1978). Each dimension contained four semantic bipolar graphic rating scales ranged from -3 to +3 allowing for measuring the direction of the association (positive or negative), with opposite adjectives (perfect antonyms) at each end allowing for measuring the intensity (very strong or very weak). An example of these comparisons is as follows:

| Clean | ___ | ___ | ___ | ___ | ___ | ___ | ___ | Dirty |
| Fast  | ___ | ___ | ___ | ___ | ___ | ___ | ___ | Slow  |

Habitual behaviour was measured using Verplanken response-frequency questionnaire based upon a number of 10 hypothetical situations. An indicator of habit for each transport mode was built by counting the number of times each mode was mentioned in the questionnaire. People were asked to mention the transport mode they would use for each situation, without too much reasoning, as requested by Verplanken procedure.

The first dataset was collected in 2007-2008 in Concepción, Chile, using face to face workplace interviews to a random sample of lectures, researchers and clerical officers from the Universidad de Concepción, contacted initially by e-mail (Domarchi, 2007; Escobar, 2008). A total sample of 409 records was initially available for the estimation process. After screening and consistency analysis of both data bases, the final sample size reached the total of 231 records, with 190 for car users and 41 for public transport users. People walking or using non common transport
modes were excluded from the analysis. With respect to gender, 50.4% were men. The average age was 47.6 years old, with a standard deviation of 11 years.

The second dataset was collected in 2009-2010 in Edmonton, Alberta, Canada, using face-to-face random intercept interviews at transit stops/stations, shopping malls and restaurants in the central business district during the afternoon lunch period, which imposed some restriction into the data collection process due to people time pressure (Dogar, 2010). A total sample of 176 records was initially collected, which was reduced to only 141 useful records, with 88 car users and 53 transit riders that were available for the model estimation, after a process of cleaning the dataset; people walking or using other transport modes were excluded from the analysis. With respect to gender, 79.4% were males and 20.6% were females. The average age was 37.8 years old, with a standard deviation of 9.8 years.

Original questionnaire was in Spanish, being necessary its translation into English, with some previous testing looking for the appropriateness of wording. In spite of the length of the full questionnaire, which considered the gathering of socio-demographic, instrumental and psychological information, people were not reluctant at all. Application time lasted 20 minutes at most.

It is worth noting that both samples cannot be regarded as representative neither for the Chilean nor the Canadian population.

5. MODELLING RESULTS AND ANALYSIS
This paper models the interaction between intention and habitual inertia, and their effect on the observed mode choice behaviour using the theory of interpersonal behaviour as the theoretical foundation of the analysis. Intention is measured in terms of attitudinal and affective factors. Although social factors are not studied in this research, it is suggested that they should be considered in future work.

In general, SEM analysis allowed for the detection of correlation between latent variables and to determine the importance of each latent attribute. Although, each latent variable (i.e., attitude, affection and habit) was measured using different tools, the SEM analysis made possible to compare among variables and constructs after normalization. Various SEM specification structures were estimated and tested against one another till reaching the final models. The method of moments is used to estimate the proposed models using the LInear Structural RELation (LISREL) software version 8.80.

Moreover, several statistical tests were performed such as Chi-square statistics, Normed Fit Index (NFI), Comparative Fit Index (CFI) and Root Mean Square Error of Approximation (RMSEA), in order to determine the goodness of fit of the estimated models to the observed data.

In practice, the recommended acceptance of a good fit to a model requires that the obtained NFI and CFI value should be in range from 0 to 1, with higher values indicating better model fit and a recommended value of 0.90 or greater for model acceptance. In addition, RMSEA values below 0.05 indicate good fit, while those ranging from 0.08 to 0.10 indicate mediocre fit whereas those greater than 0.10 indicate poor fit (Long, 2011). However, it is important to note that although model fit is necessary, it is not a sufficient condition for the validity of the hypothesis or theory. Goodness of fit within reasonable values implies only that the data under consideration support the hypothesis. Nevertheless, a conceptual model that guides the specification process,
especially the paths between latent and observed variables, is required.

**SEM Measurement Models**

Separate SEM measurement models were built for car and transit users in both Chile and Canada since their choices were different. The developed models specified a set of four latent variables (i.e., habit, affective factor, attitude towards car and attitude towards transit), as linear functions of other observed exogenous indicators measured using semantic scales through an ad hoc questionnaire. Such models are considered simultaneous confirmatory factor analysis such that the measurement models contained the relationships between four factors and their indicators. Path diagrams for car and public transit users, including habit, affective and attitudinal factors, are shown in Figures 2 and 3, respectively.

For Chilean car users, it can be seen that they give a stronger weight to the activation (quite or lively) and control (confident or helpless) dimensions of the affective factor compared to the potential and evaluation ones. This might be related to the sense of independence and reliability associated with private transportation. With respect to the attitude, they give more weight to the expectation (good) rather than to the value (important) of the mode, both for the car and the public transport modes. This can be interpreted as they might know that both travel options are good for work trips so as they might consider switching to transit. As evidence that car users would use their car for almost every single trip, habit is stronger and positive for the car, being negative for transit; they seldom will use public transport.

In an indication that car users highly valuate the sense of independence associated with private transportation, Canadian car users show a similar affective behaviour as they give a stronger weight to the activation (quite or lively) and control (confident or helpless) dimensions compared to the potential and evaluation ones. Regarding attitude, they give more importance to the value (important) rather than the expectation (good) component of attitude for car; whereas they give more importance to the expectation (good) rather than the value (important) component of attitude for transit. This means that they might know that transit is a good alternative but they do not perceive it as an important mode for work trips. Similar to the Chileans, Canadian car users show a strong and positive habit towards car driving, being negative for transit which means that they would use car for almost any activity while seldom will use public transit.

In general, it is interesting to notice that both models show a positive correlation between habit and attitude toward both car and transit, since it might be implying that there is reinforcement between these factors. Further, a negative correlation between attitudes for transit and car, for auto users, is realized. Certainly, this affects the possibility of promoting the use of transit between auto users. Besides, there is a negative correlation between affection and attitude and habit. There would not be a positive emotion towards the auto, when compared to the habit and attitude which are positively correlated. This might imply that being a frequent car user generates a positive attitude but there is no connection with a positive affection itself. A car provides independence, but there would be no attachment. This certainly provides the possibility of shifting car use through habit modification.

Chilean public transport riders consider equally important the evaluation (good or bad) and control (confident or helpless) dimensions of the affective factor compared to the potential and activation ones. It seems they feel fine knowing the mode they use and its characteristics, in
spite of not having domain of it. In contrast to car users, they give more weight to the value (important) rather than to the expectation (good) of the mode, both for the car and the public transport modes. They might be recognising that public transport is important for work trips, given the contextual constraints. Regarding habit, there is a negative relationship with public transport, and positive with car, meaning that they might have to use public transport, but if there is any possibility, they might shift to a different mode.

Similar to the Chileans, Canadian transit riders give a higher weight to the evaluation (good or bad) and control (confident or helpless) in addition to the potential (powerful or weak) dimension of the affective factor compared to the activation one; that is, there is a low motivation for using public transport. Further, in contrast to car users, transit riders give more weight to the expectation (good) rather than the value (important) component of attitude for car, whereas they still give more weight to the expectation (good) rather than the value (important) component of attitude for transit. In other words, they might know that transit is good and that is the reason why they use it, although it is not important for them. There is a sort of detachment toward the transit. A similar result was realized while examining the habitual behaviour of transit riders; a negative relationship with the transit option and a positive relationship with the car option, as shown in Figure 3. This might be interpreted as that transit riders are forced to use public transit, however they might shift to the car option if it is available which is considered as evidence to the superiority of the car as a mode of travel.

It is worth noticing the negative correlation between affection and habit and attitude towards transit in both models. This reinforces what has been expressed before as people use transit because they have to, but there is no attachment. The positive correlation between habit and transit attitude might have to be with the lack of an alternative transport mode.

**SEM with Latent Variables**

Two joint SEMs with latent variables are estimated such that a structural model for the relationship between the latent variables, and two measurement models for both the endogenous (i.e., mode choice) and exogenous indicators of the psychological factors are integrated. In general, the proposed models specify the causal influences among the latent variables by incorporating both a measurement model to deal with how indicators load on the factors, and the structural model to deal with the causal relationships among factors. Intention is modelled as a latent variable which is indirectly measured through three constructs; namely affective factor, attitude towards car and attitude towards transit. Further, each of the three factors is indirectly measured through its effects as indicated by the measurement models. In addition, habit is modelled as a latent variable which is indirectly reflected by the frequency of past use. Finally, both intention and habit affects the observed mode choice behaviour as suggested by Triandis. The Theory of Interpersonal Behaviour (TIB) is utilized as the path diagram of the corresponding SEMs for both Chilean and Canadian users as shown in Figure 4 and Figure 5, respectively.

< FIGURE 04 APPROXIMATELY HERE>

< FIGURE 05 APPROXIMATELY HERE>

In light of the TIB, this research models the way decisions are made using the SEM approach. However, the proposed approach starts from the final observed mode choice behaviour and moves backward till reaching the determinants of such choice. In other words, the suggested path diagram of SEM analysis models the relationship and the correlation between the unobservable behavioural factors and their observable indicators.
The SEM with latent variables indicates that the Chilean car users would use the car for almost every single trip as habit is stronger and positive for the car, being negative for transit. In addition, the results show that Concepción users give a stronger weight to the evaluation and control dimensions of the affective factor compared to the potential and activation ones. Further, users give more weight to the expectation (good) rather than the value (important) component of attitude for car; whereas they give more weight to the value (important) rather than the expectation (good) component of attitude for transit.

Similarly, the SEM with latent variables of the Canadian users indicates that car use habit is stronger and positive, being negative for transit. On the other hand, the results show that Edmonton users give a stronger weight to the activation and evaluation dimensions of the affective factor compared to the potential and control ones. Further, users give more weight to the value (important) rather than the expectation (good) component of attitude for car; whereas they give more weight to the expectation (good) rather than the value (important) component of attitude for transit.

In addition, both SEMs with latent variables show the causal relationships among factors such that intention is reflected by affective and attitudinal factors towards car and transit. Interestingly, it can be shown that both user samples give a strong positive weight to the attitude towards transit whereas a negative sign is associated with the attitude towards car. It seems that intention is guided by the attitude towards transit rather than the attitude to the car.

Further, both habit and intention integrate to influence the final observed mode choice behaviour. In an indication of the superiority of the car as a mode of travel, the final mode choice is associated with a negative habitual behaviour towards transit and a positive one towards car usage. On the other hand, intention is associated with a negative sign for car and positive sign for transit. This would be interpreted as that both user samples know the importance of the transit service and might be motivated to use it, although the strong habit does not allow that. In other words, there is a stated preference to use transit, but its operational and other conditions imply that the revealed preference is another: private car.

The SEMs with latent variables as studied in this paper do not allow us to estimate modal split probabilities. Nevertheless, latent variables can be obtained from the SEM, being introduced into a Logit model, which might help us to improve the explanatory and predictive potential of the discrete choice structure, in the fashion used by Galdames et al. (2011).

6. CONCLUSIONS
This paper utilized the Theory of Interpersonal Behaviour (TIB) as a theoretical framework for studying the latent psychological determinants of mode choice behaviour. The proposed approach adopted the structural equation modelling (SEM) technique to investigate the causal relationships between the underlying psychological factors affecting mode choice. Several model structures were proposed and estimated using LISREL software for SEM analysis. In general, the developed models show an acceptable goodness of fit, although small data samples were available.

Additionally, the paper compared among models and summarized similarities and dissimilarities of survey results for two cities in the Americas. This study used the datasets collected by the socio-psychometric surveys conducted by both the Universidad de Concepción (2007-2008) and the University of Alberta (2009-2010), about transport mode choice of Concepción and Edmonton users, respectively. The surveys gathered common socioeconomic, demographic and
mode specific data as well as behavioural information regarding habitual behaviour, affective meaning and personal attitudes.

Such comparative investigation shows the importance of including psychosocial variables and how models change in structure and fitness. Although different psychometric tools were used to quantify the latent psychological factors affecting mode choice, the SEM approach allowed for the detection of correlation between such latent variables and the determination of the importance of each of them. Further, the results showed that the consideration of psychological attributes as latent variables helped explain mode choice behaviour.

Positive emotions towards the chosen mode were detected among commuters for both samples. Attitude towards the chosen and alternative mode was different depending on the city being studied. Chilean car users give a higher importance to the goodness of travelling by car whereas importance is more relevant for Canadian auto users. When focusing on transit users, Chilean ones weight more the importance of travelling by this mean, whilst Canadian travellers give a higher rank to the goodness of the mode. Further, evidence to the superiority of the car as a mode of travel was realized such that car users would use the car for almost every single trip.

Differences on results when comparing users behaviour from different cites, in magnitude as well as in relative order for the psychological factor weights, might have to do with level of service quality, transport network covering, personal aspirations, socio-demographic and cultural background, and so on. Whereas transit can be seen as an inferior good for some people, particularly in lowest income sectors, affecting the attachment level and attitude towards it, car has just the opposite effect on people. Certainly this imposes a difficulty when trying to promote transit use and persuade people to stop using a car or remain using transit.

Although social factors were not studied in this research, it is suggested that their effect on intention should be considered in a future work.

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FIGURE 1 The Theory of Interpersonal Behaviour
FIGURE 2  Path diagram for the measurement models of car users

FIGURE 3  Path diagram for the measurement model of transit riders.
FIGURE 4 Path diagram for the SEM with latent variables of Chilean users.

FIGURE 5 Path diagram for the SEM with latent variables of Canadian users.