

# Application of a Theoretical Framework as a Context for a Travel Behavior Change Policy Intervention

F. Moghtaderi, M. Burke, J. Troelsen

**Abstract**—There has been a significant decline in active travel and a massive increase in the use of car dependent travel in many countries during the past two decades. Evidential risks for people's physical and mental health problems are correlated with this increased use of motorized travel. These health related problems range from overweight and obesity to increased air pollution. In response to these rising concerns health professionals, traffic planners, local authorities and others have introduced a variety of initiatives to counterbalance the dominance of cars for daily journeys.

However, the nature of travel behavior change interventions, which aim to reduce car use, are very complex and challenging regarding their interactions with human behavior. To change travel behavior at least two aspects have to be taken into consideration. First, how to alter attitudes and perceptions toward the sustainable and healthy modes of travel, in competition with experiences of private car use. And second, how to make these behavior change processes irreversible and sustainable. There are no comprehensive models available to guide policy interventions to increase the level of success of travel behavior change interventions across both these dimensions.

A comprehensive theoretical framework is required in the effort to optimize how to facilitate and guide the processes of data collection and analysis to achieve the best possible guidelines for policy makers. Regarding the gaps in the travel behavior change research literature, this paper attempted to identify and suggest a multidimensional framework in order to facilitate planning the implemented travel behavior change interventions. A structured mixed-method model is suggested to improve the analytic power of the results according to the complexity of human behavior.

In order to recognize people's attitudes towards a specific travel mode, the Theory of Planned Behavior (TPB) was operationalized. But in order to capture decision making processes the Trans-theoretical model of Behavior Change (TTM) was also used. Consequently, the combination of these two theories (TTM and TPB) has resulted in a synthesis with appropriate concepts to identify and design an implemented travel behavior change interventions.

**Keywords**—Behavior change theories, Theoretical framework, Travel behavior change interventions.

## I. INTRODUCTION

THE nature of human behavior is a very complex area. The most successful public health programs and initiatives are

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based on a comprehensive understanding of the specific behaviors and the context in which the behaviors occur. Policy interventions relating to travel behavior change aim to change travel behavior among a particular group of people, such as children's travel to school. Moreover, other types of interventions attempt to encourage a specific travel mode, such as active travel (walking or cycling) or using public transport. The interventions attempt to reach their goals by implementing different policies and strategies. Clear conceptual behavior change theoretical frameworks are not always common across these interventions.

The effects of travel mode on health and well-being are well known and wide ranging. Adverse health effects of using motorized travel modes include air and noise pollution, road accidents, and psychological factors including self-perceptions, identity, social norms and lifestyle. The less obvious consequences are known as well, including social isolation, community severance, and reduced quality of life in neighborhoods affected by heavy traffic [1].

Furthermore, research in this area had shown that there are important issues that influence people's car use. These include aspects of the built, social and policy environment in cities. But also important are an individual's feelings of perceived effectiveness, personal norms, social value orientation and trust in the transport behavior of others. However, the real value of segmentation lies in its ability to be translated into attainable strategies by using the in-depth understanding of people's beliefs and prediction about travel mode choice to guide their decisions [2]. A growing body of evidence suggests that interventions that aim to change people's behaviour developed with an explicit theoretical structure are more effective than those lacking such a theoretical foundation. Moreover, strategies that combine multiple theories and concepts can possibly have larger effects [3].

Regarding these gaps, this paper aims to develop an appropriate theoretical framework for travel behavior change policy interventions. To plan a successful behavior change intervention, especially in urban studies, it is necessary to have an in-depth understanding about the particular behavior, attitudes and perception of the project's aimed group, within a particular urban context. Afterward, one can then design and plan particular strategies and policies for greater efficacy.

In terms of the structure of the paper, firstly, a brief review was carried out on travel behavior change interventions. This sought to provide a fuller understanding of the intent, design and contents of these interventions, how they relate to people's attitudes and perceptions with regard to specific travel behavior, and people's decision making processes. The

results of this review demonstrate the necessity of a well-defined theoretical structure. Secondly, the most relevant theories were reviewed. This leads to the operationalizing of specific aspects of TPB and TTM into a coherent theoretical framework that may help guide interventions and the package of policies and strategies that they may employ.

## II. BACKGROUND AND SCOPES

### *A. Travel Behavior Change Initiatives*

In the past two decades the levels of car dependency across the world have grown, along the related problems, including the environmental problem, people's mental and physical health, and with road traffic blighting many local communities. In response, central governments and local councils around the world have introduced a variety of interventions to encourage active travel and public transport modes of travel. These interventions' designs often incorporate a combination of instrumental, situational and psychological elements that influence travel choice. These elements differ in distinct ways for particular groups of people (women, children, seniors) or modes of travel (cycling, walking, etc.). These differences can include the different aspects of the socio-cultural, and are mediated by the built environment. Many of these interventions use a set of persuasion techniques, underpinned by social psychology, to strengthen the effect on the travel behavior change (TBC) programs, such as in the TravelSmart programs currently conducted across parts of Australian cities [4].

Early behavior change interventions relied on mass information campaigns with little stratification and targeting. These interventions were based on the belief that people simply needed to be educated about an issue in order to change their behavior. These campaigns used a variety of techniques including workshops, brochures, mass media campaigns, posters. However, assessment of these programs revealed that educating people would indeed increase their knowledge about advantages of sustainable travel behavior and disadvantages of using private cars. But it was not enough to accomplish actual changes in the travel behavior. This is not to suggest that information has no role to play. However, studies had shown that information should be used in combination with other behavior change tools to become more effective [5].

Evolution in travel behavior change led to more appropriate interventions aimed towards a new mobility culture by understanding and changing people's attitudes, and the process of changing travel behavior. Already acknowledged in the variety of scientific area, these interventions are gaining ground in the mobility area, through the contribution of social psychology and marketing [6]. As an example, children's travel behavior change interventions are a subset of these kind of interventions. Children's independent and active travel is of value for a number of reasons. For children being physically active has a direct effect on their health and well-being. Children who are driven to school or other destinations hardly know their neighborhood. Moreover, travel behavior habits in

childhood can possibly lead to internalization and make the car the primary choice in adult life [7], [8].

To respond to these concerns, relevant and interested organizations around the world have introduced a variety of initiatives in order to reduce the dominance of cars for the school journey. These interventions, as with other travel behavior change initiatives, are mostly established on a social-ecological model of behavior change. [9]. Though there are numerous kinds of school travel interventions, relevant research revealed that they have not all achieved success with regards to increasing children's active and independent travel to school [10].

Research into what makes travel behavior change initiatives effective is still at an early stage of development with a systematic assessment of these travel behavior initiatives and their determinants lacking. But, it is already clear that success factors include program type and how they interact with people, their intersection with and impact on social, cultural and built environments, and the quality of implementation. Travel behavior change interventions tend to work best by applying a set of 'multicomponent strategies' with a number of entry points into the program, and promotion through different accessions and settings [11]. Importantly, there should be a strong theoretical structure underpinning the intervention, with specific understandings of people's intentions, their socio-cultural and built environment, their attitudes and concerns about the behavior. This is not how many of travel behavior change programs were designed implemented at present in Australia.

### *B. Theories of Behavioral Change*

There is a large body of literature concerned with people's behavioral change. Each behavioral change theory or model focuses on different factors, which help gain a better understanding about a specific behavior, and to explore the behavioral change processes. Several behavior theories which have been used in similar research were reviewed (including social cognitive theory, health action process approach, theory of planned action, and stages of change models). Among all of these theories and models, the most relevant ones to people's travel behavioral change interventions were selected to be reviewed in more detail. Behavioral change theories attempt to explain why and how people change a specific behavior. In recent years, there has been an expansion in interest in the operation of these theories in different areas of research, including health, education, criminology and international development, in order to gain an understanding about behavioral change and improve the services offered in these areas. Travel behavior interventions target two key aspects; people's attitudes and intention toward the sustainable travel mode, and the process of decision making to change their travel behavior. This process starts with understanding the advantages and disadvantages of different modes, the possibilities available to households and individuals, and the processes by which they may change their travel modes and embed active and sustainable travel modes into their lifestyle.

Therefore, designing interventions to improve or change

behavior requires an understanding of relevant theories of behavior change and the ability to use them skillfully. The most popular behavior change theories used in similar studies are the Theory of Planned Behavior (TPB)”, which focus on people’s attitudes toward a specific behavior, and the Trans-Theoretical Model of behavioral change (TTM)”, which relates to people’s decision making process. Following is a brief explanation of each of these theories, together with an evaluation of their capability to support frameworks for implementation and evaluation of behavior change projects.

### 1) Theory of Planned Behavior (TPB)

This theory is an extension of the theory of reasoned action and posits that behavioral intention is the most important determinant of behavior. According to [12] behaviors are more likely to be influenced by three issues, including the positive attitudes that individuals have about their behavior, the positive attitudes of people who influence the individual’s decisions (subjective norm), and the sense that one has about her/his ability to perform the behavior (perceived behavioral control). Fig. 1 shows the relations amongst these TPB elements. TPB is the most widely applied model of beliefs, attitudes and intentions, and it is used as a concept for several strands of research relating to human behavior [13]. Intention is the most important variable in predicting behavioral change, which is often linked with one’s personal motivation [15]. As TPB highlights, perceived behavioral control (PBC) over opportunities, resources and skills is essential to perform a specific behavior, and is a critical aspect of behavioral change processes. This suggests that in order to change a specific behavior to the desired one, it is important to present information to help influence positive attitudes towards the new behavior and to emphasize subjective norms or opinions that support the behavior [13].

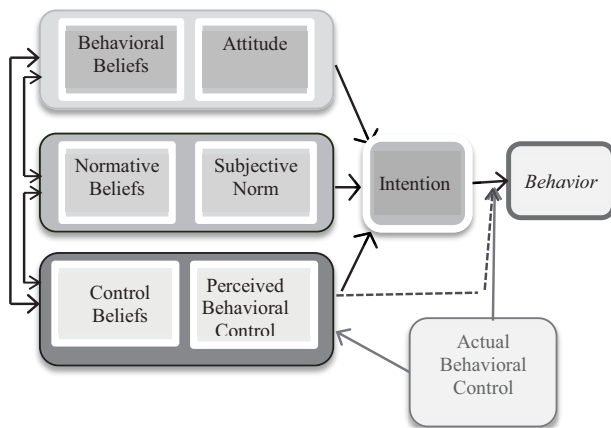


Fig. 1 TPB’s components and relationships [14]

The concept that attitudes are dispositions to evaluate psychological objects would appear to imply that people hold one attitude toward any given object or event, however recent research has shown that this concept is too simple. Recent studies have shown that when attitudes change, the new

attitude overrides the old one, but may not supplant the old attitude. According to this dual attitudes model, people can hold two different attitudes toward a given object in the same context, with one of them being habitual and the other being explicit. Accordingly, in order to retrieve the explicit attitude from an implicit one, it is assumed that motivation and capacity are required [17].

There are also limitations to the TPB, which presumes the individual has achieved the opportunities and resources to perform the new behavior, regardless of the intention [16]. There are variables that can affect behavioral intention and one’s motivation, including past experience, fear, boundaries and threats, and mood, and these are not accounted for in TPB. While it does consider the normative influences, it does not consider the environmental or economic factors that can possibly affect an individual’s intention to perform a specific behavior. The assumption of TPB is that the decision-making process is a linear procedure and the theory does not consider that this can change over time. There is no clear sense of how much time is needed for an intention to appear as a behavior at each stage, or how long a person can remain at a stage. Despite its advantages, further theoretical insights are required to cover the TPB’s limitations in terms of travel behavior change.

### 2) Trans-Theoretical Model

The TTM, also known as the ‘stages of change’ model, is one of the most popular theories used to describe how people modify their own behavior. The TTM focuses on the intentional change within the decision-making process [18]. Prochaska and Diclemente [19] suggest TTM developed from analysis of the theories of behavior change together with the integration of more than 300 theories of psychotherapy. According to this model, behavior change is a five-step process, moving through pre-contemplation, contemplation, preparation, action, and maintenance.

Pre-contemplation (not ready), is the stage at which an individual is positioned prior to any thought towards changing their behavior. Many traditional health promotion and active transport programs neglect this stage of behavior change [20]. The contemplation (getting ready) stage is where people gradually realize the advantages and disadvantages of the problematic behaviors and understand that their behavior is problematic [21]. People are intending to change their problematic behavior in the near future. Awareness of both the costs and benefits of changes in behavior may not propel behavior change though; some people remain at this stage for a long time with no change [20]. The preparation (ready) stage is where people are intending to change the problematic behavior into the aimed behavior, and they may already have begun taking some steps toward change [21]. At this level, behavioral change is about to happen and people have made their decision and intend to perform the new behavior [22]. Action is the stage at which people have made specific apparent modifications in their behavior within the past six months [22]. At the action stage, it is critical to be aware of regression [20]. Maintenance is the stage at which the

behavior has already been changed, and the previous behavior is no longer desirable for the individual. People at this stage are less tempted to relapse than those at the action stage, and they gradually become more confident about their ability to continue their changed behavior [20].

This process is not linear but it can be delineated as being cyclical, as often people move back and forth between stages along the continuum a number of times before the aimed behavior is reached. In this model, the processes of change differ amongst people as they move from one stage of change to another. Therefore, in order to efficiently change a behavior the right actions (processes) must be performed at the proper time (stages). According to this theory, for successful interventions, which aim to changing a specific travel behavior, it is essential to make a consistent and coherent link between the stages that people are in, and the strategies and policies being employed as interventions. It is predictable that without carefully planned interventions, people may remain stuck in the early stages, lacking the motivation to move through the stages [20].

The TTM provides a strong framework for behavior change programs. However, like other theories there are limitations, which should be considered when using the theory. The social context in which the behavior occurs has been partly neglected within this theory. It is difficult to trace a specific time line of the stages of change, considering that questionnaires that seek such information from respondents are not always standardized or validated, so that an inaccurate stage of change may be assigned to a specific person's behavior. The assumptions of the model, which presumes that individuals make coherent and logical plans in their decision-making process, is not always true as human behavior is far too complex. Different groups of people have different intentions and attitudes toward travel behavior, therefore although this is an applicable theory from which to plan and design strategies and policies for travel behavior interventions, it may not always be sufficient.

An advantage is that TTM provides suggested strategies for behavior change interventions to address people at different stages of the decision-making process. This can generate interventions that are tailored and effective [23]. One of the important aspects of this model that makes it suitable for this research is the idea that change in people's behavior occurs over time [19]. The stages of change describe the process in which shifts in attitudes, intentions and behaviors happen [18].

### III. OPERATIONALIZING THEORIES FOR AN EXPLORATION

As described earlier, different theories and models have been used in behavioral and social science research, but there are similarities between these theories and models. The TPB approach focuses on the role of the perceived effect of behavior and, focuses on different terms, perceived benefits and barriers and outcome expectations. The influence of perceptions of control over behavior is also emphasized. Moreover the roles of social influences and perceived norms also featured in TPB [24]. Furthermore, the approaches of these theories vary in their applicability to the research into

physical activity. This theory may help in preparing guidelines for understanding and manipulating travel behavior, and establishing interventions that work both for individuals, but especially in consideration of key social structures. Meanwhile, TTM is specifically established with a view toward developing interventions, and this theory has been applied extensively in planning interventions. This model focuses on the decision making process. The key components of these two theories are described and summarized in Table I.

TABLE I  
SUMMARY OF THE SUGGESTED BEHAVIOR CHANGE THEORIES AND MODELS

Theory	Level	Key concepts
Trans-Theoretical Model	Individual	Pre-contemplation
		Contemplation
Theory of Planned Behaviour	Interpersonal	Preparation
		Action
		Maintenance
		Attitude toward the behaviour
		Outcome expectations
		Value of outcome expectations
		Subjective norms
		Beliefs of others
		Motive to comply with others
		Perceived behavioural control

Because of the two different aspects of this research, which are a consideration of people's attitudes toward sustainable travel behavior, and assuming guidelines for travel behavior change interventions, a combination of two explained behavior change theories was suggested to develop a suitable theoretical structure; the trans-theoretical model (TTM) and the theory of planned behavior (TPB). Following a summary of these two theories are presented to achieve the reliable structure as the theoretical frame work.

#### A. Components of TPB

The theory of planned behavior explains that people behave in accordance with their intentions and their perceptions of control over their behavior. Therefore, having a clear understanding of what the people's attitudes are in order to understand and predict their social behavior is critical [25]. This theory can provide a suitable context for understanding and evaluating attitudes of people and intention toward their travel behavior and the suggested travel mode. It is reported in related research that residual consequences of the expected effect on the prediction of intentions can be obtained only if the TPB variables are assessed with regard to the particular behavior (action or inaction). In terms of travel behaviour, the aimed group of people's attitudes toward sustainable travel modes and its anticipated effects should be assessed in relation to using motorized modes of travel or private cars to and from daily destinations [26].

Attitudes, subjective norms and perceived behavioral control (PBC) are assumed to be based on corresponding sets of beliefs. In accordance with this theory, pilot work is required in order to identify the full set of travel behavior, normative, and control beliefs [27]. Any interventions which are carried out with the aim of changing travel mode or increasing AT can be designed by having a clear image and

understanding of current people's attitudes and intentions, across age groups and genders. To achieve this, three major TPB components should be assessed, which are explained below.

#### 1) Attitude toward the Behavior

As behavioral beliefs will link behavior to a certain outcome, a person's attitude toward a particular behavior refers to the degree to which a person makes a favorable or unfavorable evaluation of the behavioral outcome [25]. Different questions should be asked relating to identify people's attitudes. For example for an intervention related to children independent mobility questions can be asked such as "what do you feel about your children's active travel?" or "Is it irresponsible for parents to allow their children to walk or cycle in our neighborhood without adult?"

#### 2) Subjective Norm

Subjective norms refer to the perceived social pressure from others that will cause approval or disapproval of a given behavior [25]. In order to capture people's assumptions of subjective norms, at the first step, injunctive norms should be assessed, whereas responses to other statements help to assess descriptive norms. The injunctive norm issues asked about the perceived expectations of the importance of others' opinions; "it is common here to see children at this age walk or cycle or even use the bus without an accompanying adult," "people I care about encourage me to give a licence for CIM to my child," "it is normal here in Australia for parents to give their children 'licence' to travel independently,"

Descriptive norm items refer to the perceived behavior of others. This may lead to queries about whether "Most people like me are going to let their children travel actively to school" or whether "Most people who are important to me currently give this licence to their child". The injunctive and descriptive norm items may be combined to produce an overall subjective norm measure [27].

#### 3) Perceived Behavioral Control

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 [25]. Responses to the following statements may be used to measure it: "If I wanted to, I could easily give a licence for CIM and AT to my child"; "whether I give the licence to my child for CIM is entirely up to me"; "for me to give the CIM licence to my child is..."; "It will be difficult for me to let my child travel actively and independently to school". For improved planning of travel behavior change interventions questions similar to these examples may be asked in the earliest stages of data collection.

#### *B. Components of TTM*

"Processes of change" is a principal theme of the TTM, which empowers an understanding of how changes in behavior occur and so provides considerable guidelines for interventions, since the processes are the independent variables or the stages of change through which people need to

move. People assign cognitive, affective, and evaluative processes in their progression from early stages. When they move to the later stages, they need other elements including commitment, conditioning, contingencies, environmental controls and support [18].

It should be mentioned that, according to people's different cultural backgrounds, community type and environment and school facilities etc., they are at different stages. It is important to capture the different stages that people, which the intervention is designed for, are in to be able to produce more effective intervention. After identifying the stage of change, according to the general theory of TTM, in order for people to progress through the processes of change three components are required:

#### 1) Decisional Balance

An expanding consciousness about how the advantages of changing the specific behavior outweigh the disadvantages [18]. It is important to determine the advantages and disadvantages of sustainable modes of travel from the specific group of people's points of view, whom the intervention is planned for. For example, interventions targeting an increase in children's independent mobility should look at these advantages and disadvantages within each specific urban context. This may use comparisons of the effectiveness of past interventions, where they exist, and comparisons of sustainable modes versus driving children to and from school. Better targeted information enables the policy maker to emphasize the advantages of CIM, success stories elsewhere, and the disadvantages of driving children.

#### 2) Self-Efficacy

Confidence that one can make and maintain changes in situations [18]. The main factors that give a specific group of people (for example parents of school children) the confidence to let their children use sustainable and independent modes of travel should be considered carefully.

#### 3) Processes of Change

Strategies and actions, which people suggest can help them to make and maintain change, should be drawn out from previous interventions before application in new ones [18]. It is important to understand what people think about their needs and supports in order to change their travel behavior. For example, parents can suggest the supports and the structures and the aspects of interventions that made them confident to grant more freedom to their children and to maintain that behavior long-term.

#### *C. The Theoretical Framework*

In summary, theory focused on people's attitudes toward a particular behavior is required is required for successful interventions. The extant literature surrounding the TPB has been proven to be a suitable predictor of individual's attitudes in behavioral change [25]. However, the revealed limitations of TPB clarified that although it can be a useful, and somehow, necessary for understanding people's attitudes, it is not enough, per se, to plan effective travel behavior change

interventions. A theory with a focus on people’s decision making process is also required and key concepts underlying the TTM are useful additions.

As part of a broader study on children’s travel behavior change interventions in Australian cities, the authors have developed a set of research questions about the attitudes and perceptions of parents, their beliefs, their concerns, their requirements, and how these may be translated into effective interventions. These have been linked with the theory drawn from the TPB and TTM directly, to better inform the research and in particular to help frame a set of focus groups and interviews conducted in 2014 with parents and guardians of primary school children in Brisbane. Attempts were made to clearly link each key concern with base theory, with the results shown in Table II.

TABLE II  
THE LINK BETWEEN THE RESEARCH QUESTIONS AND THE THEORETICAL FRAMEWORK

Research question	Theory	Theory’s component
What are the main attitudes and perceptions of parents that enable or prevent children’s independent mobility?	TPB	Attitude toward the behaviour
	TTM	Stage of change Subjective norm
What are the beliefs related to attitude, norms and perceived behavioural control of parents that enable or prevent children’s independent mobility and active travel?	TPB	Perceived behavioural control
		Self-efficacy
What are the concerns and requirements, which prevent or encourage parents to grant CIM licence to their child?	TTM	Decisional balance
How can parental attitudes and perceptions best be translated into knowledge that is useful to planners, urban designers and policy makers especially in terms of travel behaviour among interventions?	TTM	Processes of change

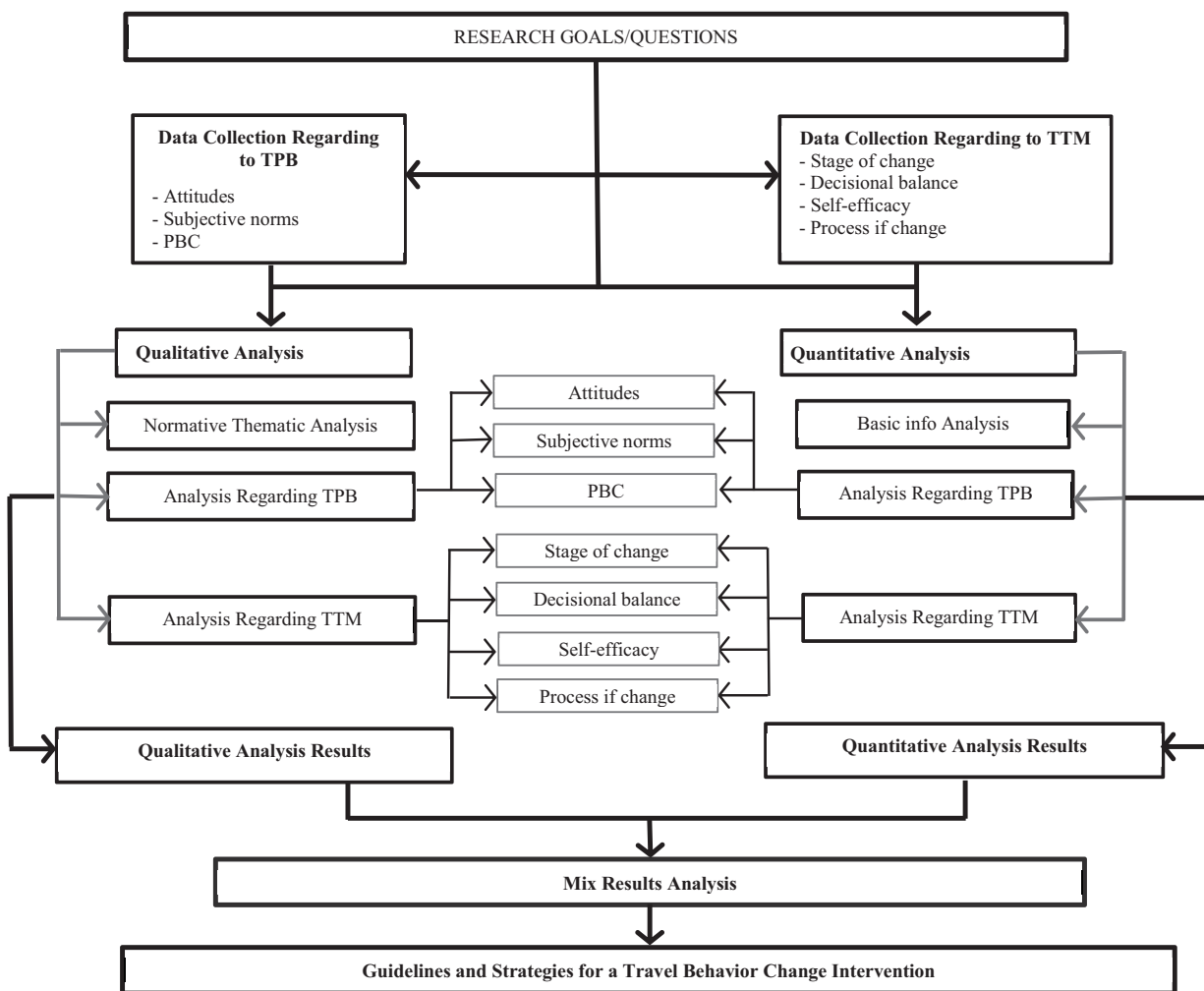


Fig. 2 The theoretical framework for travel behavior change intervention.

Fig. 2 takes this same set of theory further and presents a possible theoretical framework by which those interested in travel behavior change programs, including children’s programs, may harness this theory and improve both

interventions and their evaluations. And also the process of which should be undertaken before designing any implemented travel behavior change intervention. Fig. 2 clarifies that in all of the steps on any studies relating to travel

behavior change, the theories and their component should be consider carefully. With use of such a structure the guidelines for planning intervention can be more comprehensive and effective.

#### IV. DATA COLLECTION WITH REGARD TO THE THEORETICAL FRAMEWORK

With regard to designing a travel behavior change intervention, a first step should be gain a comprehensive understanding about the target population's attitudes and perception. The theoretical framework provided in Fig. 2 may help direct the data collection stage at the first step. Data have to be collected in a way, which can linked with the theories components. There are several data collecting methods in the urban and social context including different types of interviews, focus groups and questionnaires. If capacity is available, a mixed method for data collection is suggested, involving at least some focus groups or interviews, to achieve more in-depth understanding of the target group's attitudes, perceptions and concerns than may be revealed through questionnaires alone, and which allow for further testing of the questionnaire results.

Questionnaires can provide key demographic data, travel data (household car ownership, summary travel behaviors), beliefs, subjective norms, attitudinal/perceptual data, self-efficacy and other key constructs. Differences across neighborhood contexts can be revealed. These should help identify what appear to be key issues, and help establish the next steps for designing the intervention.

Many different types of focus group can be found in the literature, but features like organized discussion [28], collective activity [29] and social events [30], and there are similarly a range of options for effective interviews. However arranged, interviews and focus groups should involve organized discussions with a sample of the target group to gain information about their views and experiences of their own travel behavior, their attitudes toward the past interventions, and more generally about the topic. Such discussions can particularly assist with identifying not just what problems are, but also how they may be resolved in behavior change interventions.

Table III provides an example of possible questions and topics for these activities with linkages to the theoretical framework developed in this paper. This isn't exhaustive and doesn't cover all the theoretical components. Further, some of questions may be mostly met via questionnaires, others via interviews and focus groups, or they may be covered via both methods. Attention should be placed on physical environment factors, social environment factors, policy factors, as well as individual personal factors and characteristics of the individuals. This wide but directed data set can help guide the analysis stage, providing rich and focused information.

#### V. DATA ANALYSIS WITH REGARD TO THE THEORETICAL FRAMEWORK

Mixed methods will require a mixed analysis framework to

handle the different types of data. The analysis framework should also deliberately draw out the TTM and TPB components in an organized fashion, enabling a clear link between theory, question formation, analysis and results. In situations where there are different neighborhoods or target populations, the analysis should investigate the sub-sets of data separately to reveal comparative differences. Linking interview and focus group data with questionnaire items demands higher level research skills, but should not be beyond the capacities of well-performing active transport intervention teams, either in government or industry. This method of qualitative data analysis may also be time consuming.

TABLE III  
SAMPLE QUESTION DESIGN WITH LINKS TO THE THEORETICAL FRAMEWORK

Focus group/interview question	Theory	Theory's component
What are your attitudes towards children walking, cycling and generally roaming around, without adult supervision?	TPB TTM	Attitude toward the behavior Stage of change
What is the norm here in Australia, regarding how parents with children your child's age either restrict or give their children 'license' to travel independently?	TPB	Subjective norm
At what age should children be allowed to travel to school without an adult present? Why do you say that?	TPB	Subjective norm
Do you feel comfortable in giving CIM license to your child?	TTM TPB	Perceived behavioral control Self-efficacy
What conditions make a neighborhood safe and secure for children?	TTM	Decisional balance
Are you familiar with programs such as TravelSmart or Active School Travel? How? Have your children ever participated in these programs?	TTM	Processes of change

#### VI. CLOSING THOUGHTS

Travel behavior change from car dependent modes of travel to active and sustainable modes may help communities deal with many problems of urban life. This paper attempt to suggest a framework in order to design and plan more implemented interventions to achieve this, with a focus on children's travel behavior change interventions. The proposed framework can be more time consuming in comparison with more limited methods used in travel behavior interventions presently. However, the use of well-structured research as a part of planning interventions should lead to better targeted and more effective interventions that may help achieve and maintain preferred travel behaviors.

This attempt at a coherent theoretical framework drawing on TPB and TMM, in combination, reveals the wide array of issues necessary for effective interventions. The suggested methods to explore these issues with target communities, and to then harness those findings in better interventions is being tested at present in Brisbane by the authors, but it is hoped that sharing this conceptual advance assists others in finding ways forward. The framework may also help policy-makers and scheme implementers at least consider a broader range of issues as they go about their work encouraging healthier and more sustainable travel behavior.

There are a number of avenues for future research. Firstly, further studies are needed to assess and evaluate this

conceptual framework across a range of target populations and contexts. As the framework is tested, as we may well learn more about travel behavior change, and, as other research continues in the travel behavior change field, there are likely significant improvements that can be made to this theoretical framework. Second, as we learn more about the psychological differences between children and adults, and the roles of each in shaping children's travel behavior, that frameworks specific to children may emerge, that are quite distinct from those used for parents and guardians, though this is uncertain. But improving intervention efficacy will greatly assist their roll-out and then their effect on our cities and regions.

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