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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

Stages of Change: Investigating the Applicability of Staging Algorithms and Multidimensional Questionnaires within the Field of Active Transportation

Jade Van Blerk

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Mobility Management

SUPERVISOR :
Prof. dr. Kris BRIJS

MENTOR :
Mevrouw Tooba BATOOL

CO-SUPERVISOR :
dr. Veerle ROSS

2018
2019

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Summary

The focus of the study is the Transtheoretical Model of Change (TTM), which has primarily been applied to addictive behaviours such as smoking and drug use. The TTM and its constructs have been used to measure readiness to change as well as develop tailored interventions to support behavioural change. After an extensive review of the relevant literature, the *URICA, SOC for Active Transport Modes and Self-Confidence Questionnaire* and *Decisional Balance (DBI) Questionnaires* were selected to measure the *Readiness to Change* of university students and staff aged 19-42 pursuing increased levels of physical activity through active transport modes.

The primary purpose of this study is to test the applicability and usefulness of selected Transtheoretical Model of Change measurement instruments within the context of active transport. This study also aimed to determine whether all 5 stages of the TTM model could be identified within the sample population. A further goal was to explore whether the sample respondent's *Decisional Balance* and *Self-Confidence* scores would increase in later stages.

The internal validity of all scales was confirmed by Cronbach's Alpha. Initial results revealed that both instruments successfully identified 5 TTM stages in the sample population. One-way ANOVA's and Pearson Correlations confirmed that TTM stage had a significant effect on DBI and Situational Confidence scores and that they increased with later stages. A Principal Components Analysis determined that the URICA questionnaire was unable to measure separate Action and Maintenance stages as the related items loaded heavily onto the same component. It was concluded that the URICA, although useful, would require further refinement and study. The SOC for Active Transport modes was determined to be useful however limited with regard to the provision of more complex underlying psychological constructs.

Preface

This document was completed as part of the requirements for *Master Thesis Part 2* Which forms part of the Master in Transportation Science programme. I selected this topic, which was developed and put forward by IMOB (Instituut voor mobiliteit), because of my interest in active transport and travel behaviour.

Initially grappling with this subject was difficult but I was able to refine my research questions and sub-questions with help and input from my supervisory team: Professor Brijs (Supervisor), Professor Ross(co-Supervisor) and Ms Batool (Mentor). The study has yielded interesting results which can hopefully contribute to active transport research.

I would like to thank my supervisors for their guidance and support through this process. I would like to thank Ms Batool in particular for always being available to answer my queries as well as provide direction and advice. I would also like to thank my mother (Michele van Blerk) and (Brigid O'Connor) without whom this would not have been possible.

Contents

1 Introduction

1.1 Problem Statement

Increased use of active transport modes contributes to increased physical activity which in turn has multiple benefits to human health. This process can be supported by measuring individual's readiness to change and developing tailored interventions. The TTM is a model that has been utilised to measure readiness to change within the realm of physical activity as well as other health related subjects. The aim of this research is to attempt to measure the Readiness to Change of individuals increasing their physical activity levels through active transport. In doing so the research hopes to determine the usefulness and applicability of such instruments as the *URICA-E2*, *SOC for Active Transport Modes*, *Situational Confidence Questionnaire* and *Decisional Balance Questionnaire*.

1.2 Context and Importance of Research

The most popular implementation of the TTM has been within the realm of health behaviour research. Limited exploration of the model's applicability in the area of transport and specifically active transport is available. Successful interventions for the promotion of active transport are important due to the positive health, environmental and economic benefits of reduced vehicle usage. Physical inactivity has been described as a global pandemic and one of the leading causes of mortality worldwide (Kohl et al., 2012). The benefits of physical activity are well documented however approximately 63% of adults (18-64) do not reach the Wold Health Organization's (WHO) recommended physical activity levels for good health. In some cases, there also seems to be a discrepancy between the level of physical activity that people think they are achieving and their actual activity level. The WHO advocates for the use of non-motorized transport modes such as walking and cycling as they can reduce health risks and mortality levels (Attard, Shiftan, Ison, & Shaw, 2015).

A study carried out of the health and economic benefits of active transport policies in Barcelona indicated that an increase in walking and cycling in the city prevented 86 and 8.5 deaths respectively. There was also an average economic benefit of 47,3 and 4,7 million Euro's (Pérez et al., 2017). Active transport and walking in particular, are feasible for many people and have several positive health effects. These include a reduction in the risk of cardiovascular disease, death and endometrial cancer (Wanner, Götschi, Martin-Diener, Kahlmeier, & Martin, 2012). Walking is considered to be one of the best forms of physical activity. This is because it is low impact and convenient for sustained physical fitness (Wahlich et al., 2017).

Barriers to physical activity range from behavioural to external uncontrolled factors. Previous studies have identified, lack of time, increased television viewing, rapid urbanisation, as well as motivational and psychosocial factors as reasons why people do not reach daily recommended levels of physical activity(Aily et al., 2017; Blake, Stanulewicz, & Mcgill, 2017; Kohl et al., 2012). Attempts to remedy the problem of inactivity have largely focused on behavioural interventions whereas a systems approach is recommended (Kohl et al., 2012). As mentioned previously, active transport is a convenient and accessible way to increase physical activity levels. Therefore, expanding on researching within the area of behavioural science and active transport is necessary.

2 Theoretical Framework

Before starting the process of developing interventions to promote health through active transport, the underlying motivations for people's behaviour must be understood. A starting point would be the application of established social psychological models which could be used to explain people's choices (Bamberg,2007). These include for example Azjen's Theory of Planned Behaviour (TPB) (Bamberg, Azjen & Schmidt,2003). The theory put forward suggests that people's behaviour is determined by their personal motivation or 'intention to behave'. A number of factors which include: *attitude* (an individual's feelings about a behaviour), *subjective social norm* (the perceptions the individual has about what significant others think about a behaviour), and *perceived behavioural control* (the individuals' beliefs about their ability to achieve a certain behaviour) are said to influence a person's intention towards a behaviour.

The assumption of this theory and similar models is that the impact of these motivational constructs on behaviour is mediated by *behavioural intention*. To affect behavioural change, intention determining variables need to be targeted in order to increase intention and the probability of action. Within the realm of physical activity (PA) there are several other models that have been the dominating theories for mediating constructs. These include: Social Cognitive Theory (SCT) , Self-determination Theory (SDT) and the Transtheoretical model (TTM)(Rhodes & Pfaeffli, 2010).

Social Cognitive Theory consists of two primary concepts, namely: *Self-efficacy* and *Outcome expectations*. *Self-efficacy* is the most important construct within the SCT and is defined as the confidence one has to exercise control over their behaviour (Young, Plotnikoff, Collins, Callister, & Morgan, 2014). There has been extensive research to indicate that *Self-efficacy* is strongly and consistently associated with PA research. *Outcome expectations* refer to an individual's judgement of the possible outcomes and consequences of not performing a particular behaviour. The primary assumption of the SCT model is that people will behave in a manner that they believe will lead to positive outcomes whilst avoiding behaviours that lead to negative outcomes. There are three major classes of *Outcome expectations*: physical (bodily sensations), social (anticipate social approval or disapproval) and self-evaluative (expectations about how one would feel about themselves after performing an action) (Bandura, 1990).

A third construct within SCT is *Goals* which is thought to exert a direct influence on behaviour as well as mediate the influence of other model constructs. *Goals* can be distal or proximal. The former being a general guide and the latter being specific enough to influence current actions. *Goals* or behavioural intention are not however sufficient to achieve a desired behaviour, self-regulatory skills are also a requirement. The final construct is *Socio-structural factors* which include both helping and impeding factors and are thought to affect health related behaviour indirectly through influence on goal setting (Bandura, 1990).

Self Determination Theory (SDT) is a human motivation theory used to examine the effects of the different types of motivation underlying behaviour. The theory is centred around the fulfilment of human needs, self-actualization and reaching one's full potential(Teixeira, Carraça, Markland, Silva, & Ryan, 2012). SDT differentiates between *intrinsic* and *extrinsic motivation*, the former involves doing something because of the positive feelings associated with the action. The latter refers to doing an activity for reasons apart from the enjoyment of the activity itself, for example social reward. The SDT refers to extrinsic motivators as controlled forms of motivation externally regulated by punishment or reward. Extrinsic motivators are thought to be successful in the short-term but not adequate for long term behavioural change(Ryan & Deci, 2000).

Models such as the TPB, SCT and SDT are said to be useful in predicting people's current behaviours. It is however questionable as to whether they provide an adequate framework for understanding the process underlying behavioural change (Bamberg,2007). Stage Models are an alternative approach to the aforementioned frameworks, as they construct behavioural change as a process involving a number of stages rather than a single step process.

2.1.1 The Transtheoretical Model

Prochaska and DiClemente's (1984) Transtheoretical Model (TTM) of behavioural change is one of the most popular and widely used stage models in health research. The two main constructs of the model are the stages of change (SOC) and Processes of Change (POC). The most common version of the TTM model includes the following five stages: *Pre-contemplation* (people believe the consequences of their behaviour to be insignificant or are unaware of any problem), *Contemplation* (people come to see the benefits of behavioural change but perceive the cost of change to be too high and thus remain apprehensive) , *Preparation* (people make the decision to change in the future and begin to take small steps toward realising that goal), *Action* (people are actively engaged in changing their current behaviour or acquiring the desired behaviour) and *Maintenance* (behavioural change is established and maintained over time) (Velicer & Prochaska,1997).

In terms of time frame *Pre-contemplators* are said to not be intending to change within the next 6 months. *Contemplators* intend to change within the next 6 months whilst people in the preparation stage are said to planning to change within the next 30 days. Those within the *Action* and *Maintenance* stages would have reached the desired behaviour with the *Action* stage being reached within the last 6 months (Prochaska, Wright, & Velicer, 2008).

The TTM model represents behaviour change within a temporal dimension which posits that individuals evolve over time (Velicer & Prochaska,2008). When applied to behaviour it suggests that different people may be in different stages at different times and thus different intervention approaches are required. People may also complete several cycles through the stages before they achieve long-term behavioural change. Stage theory forms an essential part of the TTM. The primary assumption made by stage theory is that *behavioural change comes about when a person progresses though a set of defined stages*. The transitions between stages are in turn influenced by different variables (Sutton,2001).

The most frequent application of the model is for smoking cessation however it has been applied to a range of health behaviours. Some examples include: physical activity in a French adult sample (Bernard et al., 2014), predicting physical activity levels amongst overweight adults with serious mental illness (Ahmed Jérôme Romain & Abdel-Baki, 2017), stages of driving behaviour change (Kowalski, Jeznach, & Tuokko, 2014) and environmental actions (Nisbet & Gick, 2008). Despite widespread usage of the TTM little is known about its applicability to travel behaviour change (Friman, Huck, & Olsson, 2017).

2.1.2 The Sixth Stage: Termination

There is a sixth *Termination* stage where individuals are said to have maintained the desired behavioural change for at least 5 years. The implication of this is that after this period of time an individual has a high level of *Self-efficacy* with regard to the desired behaviour and can thus be expected to maintain it.

The sixth stage of the TTM is often omitted, particularly within PA literature(Johnson, Fallon, Harris, & Burton, 2013). This is partially due to the fact that the limited research into the termination stage has been ambiguous at best (Fallon &Hausenblas,2001). In PA research carried out by Corneya and Bobick

(1999), it was found that only 4% of survey participants could be classified within the *Termination* stage.

In this case termination was defined as having 100% perceived behavioural control, and a 100% positive attitude toward exercise. The number of survey participants identified as being in the *Termination* stage for exercise was found to be less than the numbers recorded (15-17%) by Prochaska and Velicer (1997) in their research into problem drinkers and smokers. As a result, the authors argued against the relevancy of a *Termination* stage for physical exercise. It was concluded that those taking part in physical activity are likely to remain in a constant state of maintenance.

Two studies conducted by Cardinal (1999;2000) measured self-perceived physical activity and specifically investigated the *Termination* stage. Almost 16% of participants were identified as being in the *Termination* stage for exercise behaviour. This number was similar to that found by Prochaska and Velicier (1997), and thus supports the argument that the *Termination* stage is relevant to physical activity behaviour.

Fallon & Hausenblas (2001) further investigated the existence of the *Termination* stage for exercise behaviour using the constructs of *Self-efficacy* and *Temptation*. The investigation was done from a gendered perspective as they took into consideration the differences between male and female exercise behaviour. The results of the study provided partial support for a termination stage with regards to exercise behaviour. It was determined that participants identified as being in the termination stage displayed a higher level of self-efficacy to overcome barriers to physical exercise. They also had fewer competing demands to not exercise, this was in comparison to individuals in the *Maintenance* stage.

Studies within the area of the TTM and PA have found limited support for the inclusion of the *Termination stage*. Active transport is a form of PA and therefore one could argue that the same limited applicability of this stage could be expected in this case. Beyond that, the focus of this research is not to prove or disprove the usefulness of the *Termination* stage. Furthermore, due to time limitations it would not be feasible to explore this aspect in this study. Therefore, in keeping with the precedent of previous studies, the current research will exclude this stage.

2.1.3 The TTM and its Mediators

The progression between the different SOC is influenced by its mediators of change (theoretical constructs) which include: *Decisional Balance*, *Temptation*, *Self-Efficacy* and POC.

Decisional Balance is described as the individual's perception of the possible pros and cons of a decision to undertake a behaviour.

Temptation is the urge to partake in a specific behaviour whilst *Self-Efficacy* is a person's belief in their ability to carry out actions to attain a particular type of performance(Ahmed Jérôme Romain, Caudroit, Hokayem, & Bernard, 2018).

Decisional Balance measures both the cognitive and motivational aspects of decision-making. Predictable relationships between the pros and cons of *Decisional Balance* across stages have been identified across multiple studies (Prochaska et al., 2008). It was noted that individuals in the *Precontemplation* stage showed a higher level of support for the cons or negative aspects of behavioural change than the pros. The opposite is true for people identified as being in the *Action* or *Maintenance* stages, in these cases the pros of behaviour change are perceived to outweigh the cons. The change in the perceived pros and cons of behavioural change usually occurs in the Contemplation or Preparation

stages. This implies that people possibly change their attitudes towards a particular behaviour before making any kind of change (Prochaska et al., 2008).

The *Self-Efficacy* scale measures the degree to which an individual is confident that they can maintain behavioural change in different situations. Cross sectional analysis has shown that *Self-Efficacy* tends to increase as individuals advance from the *Preparation* to the *Maintenance* stages (Prochaska et al., 2008).

The ten *Processes of Change* are described as the activities, both covert and overt, that people use to progress through the stages. The POC are classified as either *Experiential processes* or *Behavioural processes*. *Experiential processes* are used primarily for early stage transitions whilst *Behavioural Processes* are used for later stage transitions.

Experiential processes include: *Consciousness raising*; this involves researching new ideas and ways to change behaviour. *Dramatic relief*; involves producing negative experiences associated with the undesired behaviour, *Self-re-evaluation*; *Environmental re-evaluation*, and *Social liberation*. Behavioural processes include: *Self liberation*, *Helping relationships*, *Counterconditioning*, *Reinforcement management*, and *Stimulus control*(Ahmed Jérôme Romain et al., 2018). TABLE 1*: Summary of the Processes of Change taken from Prochaska and DiClemente's Transtheoretical Model (Tejero, Trujols, Hernández, Pérez de los Cobos, & Casas, 1997)* provides detailed explanation of each POC.

TABLE 1: Summary of the Processes of Change taken from Prochaska and DiClemente's Transtheoretical Model (Tejero, Trujols, Hernández, Pérez de los Cobos, & Casas, 1997)

Process of Change	Description
Consciousness Raising	Intensification of the processing of information regarding problems associated with addictive behaviour and raising the benefits of modifying it.
Counterconditioning	Modification of the response (cognitive, motor and/or physiological) elicited by conditioned stimuli to the addictive behaviour or by high-risk situations, generating and developing alternative behaviours.
Dramatic Relief	Experiencing and expressing emotional reactions elicited by observations and/or warnings regarding the negative aspects—principally the health-related consequences— associated with addictive behaviour.
Environmental Re-evaluation	Evaluation, on the part of the addict, of the impact of his addictive behaviour on his interpersonal behaviour Environmental re-evaluation and on the people closest to him. Recognition of the positive consequences that modifications in his addictive habit would have on these interpersonal relations.
Helping Relationships	Represents the existence and use of social support (family members, friends, etc.) that can facilitate the process Helping relationships of changing the addictive behaviour.
Reinforcement management	Behavioural strategy which increases the probability that a certain behaviour relating to behavioural change management

	will occur. Consists in self-reinforcement and/or outside reinforcement of this behaviour.
Self-liberation	Personal commitment of the addict himself, and increase in his capacity for deciding and choosing. Requires Self-liberation the belief that he can be an essential element in the process of changing the addictive behaviour, since he has, or can acquire and develop, the abilities necessary for changing.
Self-re-evaluation	Affective and cognitive evaluation, on the part of the addict, of the impact of his addictive behaviour on his values and lifestyle, as well as recognition of the significant improvement that giving up the addictive behaviour would mean in his life
Social Liberation	Increase in the addict's capacity to decide and choose, propitiated by becoming conscious both of the social image of the addictive behaviour and the social will to combat it by increasing available adaptive alternatives.
Stimulus Control	Process of avoiding exposure to high-risk situations for the negative behaviour. A characteristic example is the restructuring of the environment in order to reduce the probability of re-exposure to certain conditioned stimuli able to elicit the addictive behaviour.

The relationship between the various TTM mediators and the SOC have been shown to be consistent across various behaviours. This is however not the case when it comes to the relationship between the SOC and POC. When applied to smoking cessation, *Experiential* POC are used in the early stages whilst behavioural POC were used in the later stages. *Experiential* POC's involve an individual gaining knowledge through personal experiences. For example, for the 'Consciousness Raising' POC, a person may experience increased awareness about a specific behaviour and recall or notice more information relevant to it.

Behavioural POC's occur as an individual carries out certain activities in order to modify their behaviour. An example of this is the POC 'Stimulus Control', an individual may remove certain things from their environment that support a behaviour that they are trying to change (Ahmed Jérôme Romain et al., 2018). This sequential order was not found when the TTM was applied to PA. Instead both the *Experiential* and *Behavioural* POC increased in use across the stages(Marshall & Biddle, 2001).

Romain et.,al (2018) argue that the SOC are merely constructs and should therefore not be the only consideration when tailoring individualised behavioural interventions. The SOC are said to valuable in terms of explaining where individuals are with regard to motivation but do not provide an explanation of why they progress through stages or how they can be motivated. To remedy this, research regarding the TTM should venture beyond focusing on the SOC and utilise all of the model's theoretical constructs. They go on to present longitudinal studies that demonstrate the association between PA and the TTM.

Plotnikoff, Hotz, Birkett, and Courneya (2001) as cited in Romain et.,al (2018) made use of a sample of 1602 adults to asses whether *Self-efficacy*, *Decisional Balance*, and POC predicted the transition

between exercise SOC within a 12-month period. Results showed that the transitions between the SOC were in fact predicted by *Self-efficacy*, *Decisional balance*, and both *Experiential* and *Behavioural* POC. Higher levels of *Self-efficacy*, perceived advantages as well as *Behavioural* POC predicted the transition out of the *Precontemplation* and *Contemplation* stages. The transition out of the *Preparation* stage was also predicted by increased levels of *Self-efficacy* and perceived advantages. In addition to this, retention in post action stages was predicted by a higher level of perceived benefits relative to perceived disadvantages. This was further enhanced by the activation of both types of POC. In summary Romain et., al state that Plotnikoff, Hotz, Birkett, and Courneya's study goes some way toward validating the TTM in exercise.

Romain et.,al identified similar study by Plotnikoff, Lippke, Johnson, & Courneya, 2010 . The study was carried over 6 months with a sample of 1674 adults with Type 1 or type 2 diabetes. The purpose was to test the TTM's ability to predict PA transitions. Moderate support for the TTM constructs ability to predict stage conditions was noted. The transition from *Precontemplation* to *Contemplation* was predicted by perceived benefits and experiential POC. Transition out of preparation was predicted by higher *Self-efficacy*, transition out of the *Action* stage was predicted by the pros and the *Behavioural* POC. Individuals likely to remain in the *Maintenance* stage were predicted by higher levels of *Self-efficacy*, perceived benefits, and experiential and behavioural POC.

The aforementioned studies along with additional research by Dishman, Vandenberg, Motl, and Nigg (2010) (as cited in Romain et.,al 2018) demonstrate that all TTM constructs, to varying extents, are predictors of the transitions between SOC. Thus, it can be determined that when it comes to PA, progress through the SOC is determined by people's perception of more benefits versus costs. In addition, greater confidence (Self-efficacy) as a result of both *Experiential* and *Behavioural* POCs must be present (Ahmed Jérôme Romain et al., 2018).

2.1.4 Application of the TTM

There has been some limited application of the model within the realm of transportation. An example includes the exploration of the utility of model with regard to describing car drivers decisions to change to public transportation (Bamberg, 2007). This study determined that the use of a 4-cluster solution for data interpretation is the most useful. At least three of the clusters matched the expected features for the *Precontemplation*, *Contemplation* and *Maintenance* stages whilst the existence of separated *Preparation* and *Action* stages was not confirmed. There was also varying evidence for the assumption that specific motivational variables can predict assignment to decision stages.

Forward (2014) made use of a combination of the TTM and the *Theory of Planned behaviour* to explore people's willingness to bike. The measure of stages was adapted from Courneya (1995) and included five questions where respondents had to select the statement that best described their behaviour. A separate question to test habit was also included. The questions are as follows:

- 'I currently do not bike and I do not intend to start biking in the next 6 months' (precontemplation);
- 'I currently do not bike, but I am thinking about starting to bike regularly in the next 6 months' (contemplation);
- 'I currently do not bike but I am planning to start' (preparation);
- 'I currently bike regularly but I have only begun doing so within the last 6 months' (action);
- 'I currently bike regularly and have done so for longer than 6 months' (maintenance).

The results of this study confirmed that the constructs measured by the combination of the TTM and Theory of planned behaviour can helpful with regard to understanding people's modal choice selection (Forward, 2014).

Although there has been little application of the TTM to active transport, it has been utilised more extensively within the domain of PA. The mediators of change in the model have proven to be useful in the provision of individualized counselling for PA. It has been recommended that the stages of the model not be used to tailor interventions as they are a construct rather than a theory(Ahmed Jérôme Romain et al., 2018).

(Han, Pettee Gabriel, & Kohl, 2017) applied the TTM to sedentary behaviours and its association with PA status. The study focused on college students' stages of emotional readiness to avoid sedentary behaviour. It also made use of newly developed validated TTM, physical activity and sitting time questionnaires to investigate relevant psychological determinants and identify the association between current PA and sedentary behaviour.

The *Stages of Emotional Readiness to Avoid Sedentary Behaviour* questionnaire was used to measure respondent's motivation to avoid sitting time. The questionnaire used consisted of one question with a five-item, dichotomous (yes/no, true/false) response option. The questionnaire distributed the respondent's intentions to avoid sitting time into one of the five stages: *Precontemplation*, *Contemplation*, *Preparations*, *Action*, and *Maintenance*.

The TTM constructs for avoiding sitting time were measured using a *Processes of Change Questionnaire for avoiding sitting time.* This was done by determining the ten processes that respondents used to reduce sedentary behaviours at the different stages. The questionnaire consisted of 40 items including a set of 4 items used to assess each of the 10 processes of change. A 5-point Likert scale was used to determine how frequently participants used each of the 10 processes. The scale ranged from 1 (never) to 5 (repeatedly). *Self-efficacy* was measured by way of a 6-item *Situational Confidence* scale which was modified for avoiding sedentary behaviours. In this case participants were asked how confident they were that they would be able to avoid prolonged sitting times in some situations that would lead to sedentary behaviour. The items were scored on a 5-point Likert scale from 1 (not at all confident) to 5 (extremely confident). Finally, the *Decisional Balance Questionnaire* was used to identify the importance of each pro and con statement relative to an individual's decision to avoid sitting time or not. The questionnaire consisted of 6 pros and cons laid out on a 5-point Likert scale ranging from 1(not at all important) to 5 (extremely important).

The *Past week modifiable activity questionnaire* (SMAQ) is a self-administered questionnaire which was used to assess leisure time physical period over the past 7day period. The questionnaire included 38 popular leisure activities such as swimming and walking for example. The times that's the leisure time activities were recorded in hours/week and weighted by estimated metabolic equivalent (MET). This was done for each activity and summed for all activities. The questionnaire was shown to be both reliable and valid.

The *Multi-context Sitting Time Questionnaire* by Whitfield et al. was adapted for the study. It was used determine time spent sitting across domains and contexts. The questionnaire was initially developed for both students and professionals, however in the case of this study some questions were adapted specifically for students.

Aside from the aforementioned questionnaires, and objective measure was also employed to assess time spent in sedentary behaviours and physical activity. Participants were required to wear a triaxial accelerometer for 7 days. This type of objective measure falls outside of the scope of the current study.

In conclusion, the study found that the mean scores of the TTM constructs increased as the stages progressed. There were however no significant associations between the TTM constructs for sedentary behaviour and current PA levels.

2.1.5 TTM Variables

There are three classes of variables within the TTM: The Stages of Change, dependent variables (Decisional Balance and Self-efficacy) and the independent variables which are the POC(Armitage, 2010). *Decisional Balance* and *Self-Efficacy* are considered to be independent variables because they can be used to track an individual's progress through the stages towards the problem resolution.

2.1.6 Critiques of the TTM

There has been a great degree of criticism of the TTM. The primary critiques relate to the model's limited empirical applicability, limited clarity and consistency with regard to which factors influence the transitions between stages. The lack of clarity in terms of explaining how and why people change has also been challenged (Friman et al., 2017). Bandura (1997) called for the rejection of the TTM because it 'lacked conceptual clarity'. It was argued that the TTM did not meet the criteria for other developmental stages used in other areas of science. An example of this are the stages a butterfly goes through before reaching full development. The criteria for classification as a developmental stage model (like that of the butterfly) requires that phenomena observed in earlier stages should be present in later stages. The TTM fails to meet this criterion however it is not unusual for stage theories to develop according to alternative conceptualisations. An example of this are Punctuated equilibrium models which posit that there are long periods of equilibrium or stability punctuated by shorter periods of imbalance or change. This pattern can be observed with the TTM as *Precontemplation, Contemplation* and *Maintenance* are characterised as periods of stability that are then punctuated by short periods of disequilibria (Prochaska et al., 2008).

The research design of previous TTM studies has also been questioned. It is argued that previous research has relied on cross-sectional designs rather than stronger research designs such as longitudinal studies of stage transitions and experimental studies of matched and mismatched interventions (Sutton,2005; Weinstein et al.,1998). Despite these critiques the model remains popular because of its usefulness in designing tailored and individualized interventions.

A further critique of the TTM is that the stages of change are viewed as a discrete rather than continuous variable (Sutton,2000 as cited in Prochaska et al., 2008). Discrete stages rely on arbitrarily divided time periods. An example of this are the *Action* and *Maintenance* stages which are defined as being at criterion for less than 6 months (Action) and more than 6 months (Maintenance). This division is arbitrary although supporters of the TTM argue that these time divisions are empirically determined. The way in which these time periods are determined is based off of data relating to relapse curves across addictive behaviours. This data showed that relapse was common in the 0-6-month period and less so after 6 months. This led TTM developers to make use of 6 months as a criterion (Prochaska et al., 2008).

Taking a continuous measure approach would observe readiness to change within individuals as they complete certain actions. In some cases, TTM stages are referred to as stages of readiness. It is difficult to describe individuals in the *Action* or *Maintenance* stages with regard to readiness. As a result

readiness leads to the use of discrete variables such as ‘sedentary’ and ‘active’ for example(Prochaska et al., 2008). In theory, if one were to advocate for readiness in place of stages one would be favouring an action paradigm rather than a stage one. Sutton (2000) puts forward the notion that a method for assessing whether a change is continuous is to observe whether discontinuity patterns would result in non-linear trends. If a linear trend were to be identified, this would imply pseudo-stages imposed on a continuum.

Lippke, Ziegelmann, Schwarzer and Velicer (2007) investigated the relationship between stage, behaviour, intention, planning, duration of behaviour, pattern performance, easiness and habit for physical activity and nutrition amongst German-speaking adolescents and adults. The study involved testing stage assumptions and overall supported the stage discontinuity model which challenges Sutton’s (2000) hypothesis of pseudo stages on a continuum (Prochaska et al., 2008). The question as to whether discrete or continuous variables should be used is however not of great concern as their usage is more dependent on the discipline in question.

2.1.7 Methodological approaches

In previous studies pertaining to the TTM, three methodologies have been primarily used: Multi-dimensional questionnaires, Single-item continuous measures of readiness to change and Staging algorithms. For the purpose of this study, two methods have been selected: Staging algorithms and Multi-dimensional questionnaires (Friman et al., 2017). Both methods will be discussed further in this section.

2.1.8 Staging Algorithms

Staging Algorithms and Self-Categorizations are thought to be more applicable for the TTM as they are consistent with the model’s assumption of discrete stages (Sutton,2001). They have primarily been utilized in studies that apply the TTM to smoking cessation. In this approach a small number of questionnaire items is utilised, and participants are allocated to one of the stages. No individual can be located in multiple stages at the same time. Sutton (2001) critiques the staging algorithms used by Prochaska, DiClemente and others by noting that they suffer from a number of problems with stage definition. One example put forward is that of an algorithm designed by DiClemente et.al (1991) which was used for smoking cessation. The algorithm did not allow for individuals who were attempting to quit smoking for the first time to move past the *Preparation* stage whilst others could not go directly to the next stage.

A problem shared by many staging algorithms based on the TTM is that time periods are arbitrary. Sutton (2001) puts forward the example of the stage definitions used by Belding et al (1995,1996,1997) as listed in TABLE 2: *Stage definitions used by Belding and colleagues (1995,1996,1997) as cited in Sutton (2001)*. This factor brings into question whether the stages measured differ qualitatively from one another and whether they are true stages rather than pseudo stages. These pseudo stages would instead be part of a general continuum of behavioural change which would then undermine the validity of interventions tailored for specific stages(Sutton, 2001).

TABLE 2*:* Stage definitions used by Belding and colleagues (1995,1996,1997) as cited in Sutton (2001)

Precontemplation	Used unauthorized drugs in last 30 days. Do not plan to quit using in next 6 months
Contemplation	Used unauthorized drugs in last 30 days. Plan to quit in next 6 months, but not in next 30 days
Preparation	Used unauthorized drugs in last 30 days. Plan to quit in next 30 days
Action	No use of unauthorized drugs in last 30 days, but have used in last 6 months
Maintenance	No use of unauthorized drugs in last 6 months

2.1.9 Multidimensional Questionnaires

Multi-dimensional questionnaires have traditionally been used in applications of the TTM to alcohol and drug use. This approach involves measuring each stage by way of a set of questionnaire items. Individuals are then positioned within a stage in accordance with their scores. Three types of questionnaires have commonly been used in studies of alcohol and drug use: The University of Rhode Island Change Assessment (URICA) (McConnaughy, Prochaska & Velicer, 1983), the Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES) (Miller & Tonigan, 1996) and the Readiness to Change Questionnaire (RTCQ) (Rollnick *et al.*,1992). These questionnaires will be discussed in turn.

2.1.10 The University of Rhode Island Change Assessment (URICA)

The URICA was one of the early multidimensional questionnaires designed to assess stages of change. It consisted of a total of 32 items with 8 allocated to each of 4 stages of the TTM, namely: *Precontemplation*, *Contemplation*, *Action* and *Maintenance*. Responses to the questionnaire are recorded on a 5-point Likert scale which ranges from 1 (indicating strong disagreement) to 5 (strong agreement). The results can then be calculated by summing up the scores from the *Contemplation*, *Action* and *Maintenance* sub-scales and subtracting the score taken from the *Precontemplation* subscale. This provides a second order Readiness to Change (RTC) score(Ceccarini, Borrello, Pietrabissa, Manzoni, & Castelnuovo, 2015). ***TABLE 3****: Example of items included on the URICA assessment Sutton (2001)* provides an example of the URICA. As can be noted the items make general reference to the behavioural problem of the subject rather than addressing it directly. It is primarily utilised within clinical contexts.

The URICA is classified as continuous measure as subjects may achieve high scores in multiple stages at the same time. A higher total score indicates that an individual has a higher RTC. The highest total test score is 140 whilst the minimum is 1. A score below 80 is considered low whilst everything above that is considered high (Ceccarini et al., 2015). The URICA views progression through the stages as continuous and gradual rather than discontinuous (McConnaughy et al., 1983).

TABLE 3: Example of items included on the URICA assessment Sutton (2001)

Precontemplation "As far as I'm concerned, I don't have any problems that need changing" "All this talk about psychology is boring. Why can't people just forget about their problems?"
Contemplation "I have a problem and I really think I should work on it" "I'm hoping this place will help me to better understand myself"
Action "I am doing something about the problems that had been bothering me" "Anyone can talk about change: I'm actually doing something about it"
Maintenance "It worries me that I might slip back on a problem I have already changed, so I am here to seek help" "I'm here to prevent myself from having a relapse of my problem"

The URICA is a useful tool as it has been shown to have good internal consistency across its four sub-scales (Andrés, Saldaña, & Gómez-Benito, 2011). A range of studies for differing behavioural conditions have established its reliability, construct validity and psychometric properties(Ceccarini et al., 2015). Factor and Cluster analysis have demonstrated that the URICA has validated constructs. This is shown through the association of the SOC with different behavioural profiles (McConnaughy et al., 1989). This discovery supports the likelihood that respondents could carry out actions and behaviour that represents more than one stage at the same time. The four-factor structure of the URICA has also been supported through Principal Component Analysis (PCA) and structural equation modelling (McConnaughy et al., 1989; Andrés et al., 2011 as cited in Ceccarini et al.,2015). Beyond this the URICA is able to measure processes and outcome variables for multiple health and addictive behaviours. The questionnaire is also described as easy to administer and only takes 5-10 minutes to complete. Additionally, it can also be self-administered as it requires no training. As previously mentioned it has been generally utilized in clinical contexts such as weight-loss treatment programmes (Ceccarini et al., 2015).

The University of Rhode Island Change Assessment, the third generation (URICA-E2) has been developed as a continuous measure of change for the *Stages of Change of Exercise*. It is believed that the stages of change for exercise behaviours are more complex than those of behaviours such as smoking and alcohol cessation(Lerdal et al., 2009). Reed (1995) tested the psychometric properties of this instrument in an unpublished thesis. Following this Lerdal et al., (2009) translated the questionnaire into Norwegian and tested its validity and usefulness in predicting behavioural change. Their findings confirmed five of the dimensions of readiness to change (Precontemplation Non-Believers, Precontemplation Believers, Contemplation, Preparation and Maintenance), whilst the sixth dimension, Action, showed the lowest Eigenvalue (0.93). Cluster Analysis determined that there were distinct profiles among the respondents in terms of readiness to change their exercise behaviour. Overall it was concluded that the *Action* stage was not adequately measured. Further application of this instrument is required.

2.1.11 The Stages of Change Readiness and Treatment Eagerness Scale (SOCRATES)

The SOCRATES is a 20-item scale developed for the measurement of stages change for problem drinking. Each of the 5 stages (precontemplation, contemplation, determination, action and maintenance) has 4 items. This questionnaire was found to have a lack of clearly defined distinctions between the *Precontemplation* and *Determination* stages as well as the *Action* and *Maintenance* stages (Miller & Tonigan, 1996). Miller & Tonigan (1996) concluded that this questionnaire does not measure stage constructs in the manner conceived of by Prochascka and DiClemente. It suggested that the scales of the SOCRATES be better be described as "continually motivational processes that may underlie stages of change"(Sutton, 2001). **TABLE 4***: Portion of 19 item SOCRATES Questionnaire* (Miller, W. R., & Tonigan, J. S. ,1996) provides an example of the instrument. For each statement, participants are required to circle a number from 1 to 5 depending on the degree to which they agree or disagree with a statement.

TABLE 4: Portion of 19 item SOCRATES Questionnaire (Miller, W. R., & Tonigan, J. S. ,1996)

	NO! Strongly Disagree	No Disagree	? Undecided or Unsure	YES Agree	Yes Strongly Agree
1. I really want to make changes in my drinking	1	2	3	4	5
2. Sometimes I wonder if I am an alcoholic.	1	2	3	4	5
3. If I don't change my dinking soon, my problems ae going to get worse.	1	2	3	4	5
4. I have already started making some changes in my drinking.	1	2	3	4	5
5. I was drinking too much at one time but I have managed to change my drinking,	1	2	3	4	5

2.1.12 The Readiness to Change Questionnaire (RTCQ)

Rollnick et al developed the Readiness to Change Questionnaire (RTCQ) based on the TTM. It is a 12-item questionnaire that measures the extent to which the respondent adheres to the constructs of *Precontemplation*, *Contemplation* and *Action* (Scaglia et al., 1995). The RTCQ has been previously applied to measure the stages of change with regard to excessive drinking (Rollnick et al., 1992; Heather, Rollnick & Bell, 1993) and drunk driving offenders (Wells-Parker, Kenne, Spratke, & Williams, n.d.). Despite the multi-dimensional questionnaire's inconsistencies with discrete stages in the TTM model, the RTCQ has been accurate in the prediction of alcohol consumption and time to first drink (Sutton,2001).

In previous applications it is claimed that the RTCQ was inappropriately utilised therefore an alternative version was developed(Heather & Hönekopp, 2008). The alternative version is named the Readiness to

Change Questionnaire [Treatment Version]: RTCQ [TV]. The most notable difference between the two instruments is that the original refers only to drinking reduction whilst the treatment version refers to both reduction and abstinence from alcohol(Heather & Hönekopp, 2008).

The RTCQ [TV] is a 15-item questionnaire that does not include the *Preparation* or *Maintenance* stages. The stages allocated are therefore restricted to *Precontemplation*, *Contemplation* and *Action* stages. Each stage is then assessed by five items. The development of this instrument was described by Heather et.al (1999) as cited in Heather & Hönekopp (2008). In this study the participants highest score out of the three stages measured was identified as the current stage of change that the individual was in. Measures of reliability and validity were shown to be satisfactory. The *Contemplation* scale on the other hand was shown to have relatively weak internal consistency and thus requires further research.

The UK Alcohol treatment Trial (Heather & Hönekopp, 2008) examined the factor structure of the questionnaire. Evidence of improved construct validity was determined through observation of the relationships between stage allocation by the RTCQ[TV] and negative alcohol expectancies. It was determined that the revised RTCQ provides a shorter and improved measurement of stage of change with regard to alcohol treatment. TABLE 5: Part of RTCQ[TV] Questionnaire (Treatment Improvement Protocol,1999).

TABLE 5*:* Part of RTCQ[TV] Questionnaire (Treatment Improvement Protocol,1999)

Key: **SD**=Strongly Disagree **D**=Disagree **U**=Unsure **A**=Agree **SA**= Strongly Agree

		SD	**D**	**U**	**A**	**SA**	For office use only
1.	There is no need for me to change my drinking habits.						PC
2.	I enjoy my drinking, but sometimes I drink too much.						C
3.	I have reached the stage where I should seriously consider giving up or dinking less alcohol.						PA
4.	I am trying to stop drinking or drink less than I used to.						A

2.1.13 Decisional Balance Measure

TTM research also includes a focus on the relationship between the stages and *Decisional Balance*. Initial measures of *Decisional Balance* were carried out using 8 item categories developed by Janis and Mann (1977) on their "Decisional Balance Sheet". Velicier et al's., (1985) smoking cessation study produced a *Decisional Balance* measure that varied from the original one. This approach involved examining two scale scores of the pros and cons (perceived advantages and disadvantages) of behavioural change. A separate scale was then formed and examined by subtracting the cons from the pros (Musser, 2003).

The Decisional Balance Inventory (DBI) is a self-report questionnaire that focuses on the pros and cons that an individual may encounter when contemplating behavioural change. The original instrument developed by Velicer was made up of 24 items that were used to assess the opinions of adolescents regarding smoking. The shortened version of the DBI was later developed by Pallonen (1998) and is made up of 12 items. The brief version of the DBI consists of three factors and measures one of the key constructs of the TTM. The three factors include: the cons of the behaviour which is in this case smoking (6 items), social pros (3 items) and coping pros (3 items). Each item is rated on a 5-point Likert scale ranging from 1=not important to 5 =extremely important(Khazaee-Pool, Pashaei, Koen, Jafari, & Alizadeh, 2017).

TABLE 6: Part of the 20 item DBI adapted for weight (University of Maryland, 2019*)* provides an example of a section of the 20 item DBI .

TABLE 6: Part of the 20 item DBI adapted for weight (University of Maryland, 2019)

Key

1=Not important at all **2**=Slightly important **3**=Moderately important **4**=Very important **5**=Extremely important

How Important is this to me? Importance in making a decision about losing weight:

	Not at all	**Slightly**	**Moderately**	**Very**	**Extremely**
1. The exercises needed for Me to lose weight would be Drudgery.	1	2	3	4	5
2. I would feel more optimistic If I lose weight.	1	2	3	4	5
3. I would be less productive	1	2	3	4	5

3 Research Questions

3.1 Key Research Question

Can the Transtheoretical Model be applied as a suitable measure of Readiness to Change in individuals using active transport to increase their physical activity levels?

3.2 Sub Questions

1. What is the most suitable approach for measuring and identifying the stages: staging algorithm or multi-dimensional questionnaire?

2. Can all the stages of the TTM be identified in the target population?

3. What implications does this research have for future behavioural change interventions?

4. Does Self-Confidence increase amongst respondents in later stages?

5. Do the 'pros' measured by the *Decisional Balance questionnaire* increase as individuals move through the stages?

3.3 Framework

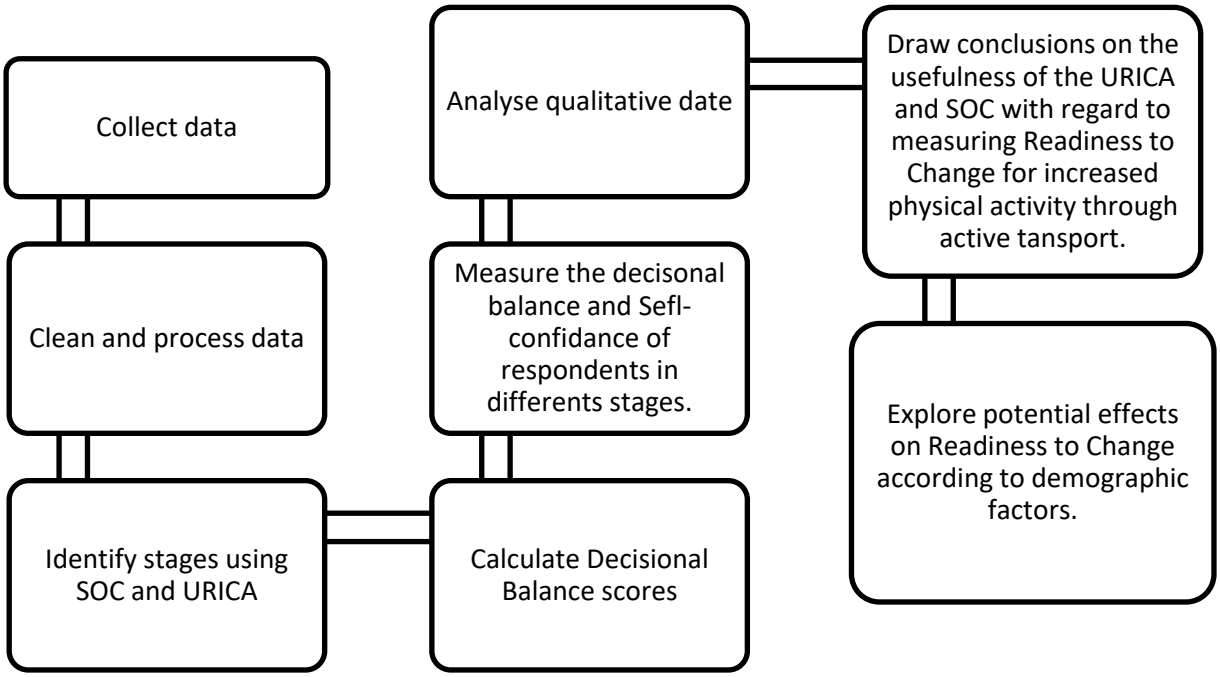
3.3.1 Scope

- The study will rely primarily on data collected from individuals aged 18+ studying or working at Hasselt University. Respondents from other institution will also be included if available.
- Focus on matching individuals with the identified stages.
- Identify which stages are more or less relevant for this particular sample.
- Identify which measurement instruments are the most useful within this particular context.
- Measure the *Decisional Balance* and Self-confidence of study participants.

3.3.2 Limitations

- This study will not evaluate the effectiveness of behavioural change campaigns, persuasive technology or policies relating to the promotion of active transport.
- Research and data-collection will take place over a limited time period. Longitudinal studies may yield different results.
- This study will not measure the *Processes of Change*.
- This study will not make use of an objective measure.

FIGURE 1:Schematic Representation of Research Plan



4 Methodology

4.1 Methods

The purpose of this research is to test the applicability of the TTM as a measure of Readiness to change in individuals pursuing increased levels of physical activity through active transport. This study will focus on four TTM measurement instruments namely: The University of Rhode Island Change Assessment Scale, the Stages of Change for Active Transport Modes and separate Decisional Balance (DBI) and Situational Confidence questionnaires (SQC). The intended outcome is that the most appropriate instrument (URICA or SOC for Active Transport Modes) for measuring Readiness to Change in the use of active transport modes to increase physical activity will be identified. Additional outcomes will be the determination as to whether the 'pros' of behaviours measured by the DBI as well as Situational Confidence levels measured by the SQC increase as respondents progress through the stages.

A Multidimensional questionnaires and Staging Algorithm were chosen as the preferred approach for data collection for this study. Through an in-depth exploration of the literature it has been identified that these two approaches are the more popular and widely used methods for data collection in TTM related research. This is particularly true in the case of alcohol and smoking cessation however they have also been applied in PA and weight-loss related studies. A further benefit of multidimensional questionnaires is that they are a continuous measure of the stages.

As noted in earlier sections Staging Algorithms and Self-Categorizations are considered more applicable for the TTM due to them being consistent with the model's assumption of discrete stages (Sutton,2001). They include a small number of questionnaire items which are then used to allocated participants to a particular stage. No individual can be placed in different stages at the same time.

4.2 Measures

The URICA-E2

The URICA-E2 was selected for adaptation for this study. This instrument was selected because of its established reliability across various TTM studies(Andrés et al., 2011). The URICA has successfully been used to measure outcomes and variables for numerous health and addictive behaviours. Furthermore, this tool has been described as easy to use and does not require prior training before administration. This particular version of the URICA was selected as it measures all the stages of the TTM including: *Precontemplation Non-Believers*, *Precontemplation Believers*, *Contemplation*, *Preparation*, *Action* and *Maintenance*. This version of the URICA breaks up *Precontemplators* into the subgroups of *believers* and *non-believers*. However, as this study does not require that believers and non-believers be measured separately, these groups were kept as one category. During the course of the research process, a Principal Components Analysis was carried out on the Precontemplation Believers and Non-Believers scales. The Non-Believers items were then removed because they had the lowest factor loadings.

The questionnaire was retrieved from University of Rhode Island Cancer Prevention Research Centre website (Cancer Prevention Research Centre, 2019) and adapted for use within this specific study by

adjustment of the phrasing of the questionnaire. An example of some of the adapted statements are as follows:

'As far as I'm concerned, I don't need to increase my physical activity through active transport.'

'I could increase my physical activity levels through active transport, but I don't plan to.'

The terms utilised in the questionnaire such as *Active transport* are defined at the start of the questionnaire alongside the completion instructions, details of this can be viewed in Annexure A.

The questionnaire itself is a 24-item continuous measure where each of the items is given a scale of 1-5, with 1 for 'strongly disagree', 2 for 'disagree', 3 for 'undecided', 4 for 'agree', and 5 for 'strongly agree'. Participants are required to then required to write down the number that they believe matches their feelings towards a particular statement. As previously mentioned, the Principal Components Analysis reduced the questionnaire to 20 items that were then analysed further.

The SOC for Active Transport Modes

The *SOC for exercise* was taken from Romain et al., (2012) and adapted for the current study. It was originally adapted from a questionnaire described by (Nigg et al., 2005) and used to measure the SOC for exercise behaviour in overweight/obese individuals. As with the other measurement instruments (URICA and DBI) A number of key terms detailed in Annex are defined in the questionnaire for clarity. These definitions were provided to survey participants at start of the questionnaire along with a description of how it should be completed.

The *SOC for Active Transportation Modes* questionnaire presented respondents with four questions requiring a 'yes' or 'no' response. An example of the phrasing of the questions is as follows:

'Do you currently use Active Transport modes to be more physically active?'

'Do you intend to regularly use Active Transport modes to be more physically active in the next 6 months?'

If respondents answered 'no' to questions 1 and 2 they were allocated to the *Precontemplation* stage. If they answered 'no' to questions 1 and 3 but 'yes' to question 2 they were placed in the *Contemplation* stage. If they answered no to question 1 and 'yes' to question 3 then they were classified as being in the *Preparation* stage. If they answered 'yes' to question 1 and 'no' to question 4 then they were considered to be in the *Action* stage. If they answered 'yes' to questions 1 and 4, they were placed in *Maintenance*.

Decisional Balance Inventory

A Decisional Balance scale adapted for PA behaviour by Nigg et al (1998) was adapted for the current study.

The 10-item measure is used to assess the various pro's(advantages) and con's(disadvantages) perceived by an individual when making a decision to increase their physical activity levels through active transport. The measure is composed of 5 items classed as 'pros' and 5 items classified as 'cons. Questionnaire respondents were required to rate the importance of each item in their decision to increase their physical activity levels through active transport on a five-point scale. The scale ranged from 1 (not important) to 5 (extremely important).

The pros and cons relative to increased usage of active transport modes were determined through a brief review of various literature(Biehl, Ermagun, & Stathopoulos, 2018; Davis, 2003).

On this particular scale items detailed in Annex A 1,3,5,7,9 are classified as 'pros' whilst items: 2,4,6,8,10 are 'cons.

During the course of the current study the 10-item scale was reduced to an 8-item measure. This is because after the collection of survey results it was noted that a substantial number of participants had not answered question 10. In order to maintain an equal number of 'pro' and 'con' items, question number 3 was removed.

Situational-Confidence Questionnaire

Self-efficacy or Situational Confidence is a component of the TTM framework and represents an individual's confidence with regard to performing the target behaviour in various situations. The present study has adapted a 6 item questionnaire taken from *Applying the Transtheoretical Model to Regular Moderate Exercise in an Overweight Population: Validation of a Stages of Change Measure* (Sarkin, Johnson, Prochaska, & Prochaska,2001).

Participants were presented with 6 scenarios in which they may find it difficult to use active transport to increase their physical activity levels. They were required to rate their confidence for each scenario using a 5-point scale ranging from 1(not confident at all) to 5(completely confident). Examples of the scenarios which participants were presented with include:

"I can increase my physical activity levels by using active transport on most days."

"I can increase my physical activity levels by using active transport when I am very busy."

4.3 Participants

A convenience sample was taken primarily from The University of Hasselt staff and student body. The questionnaire was also distributed to other educational institutions. The University of Hasselt is a university located in Belgium in the province of Limburg. The university population consists of 6500 students and 1400 researchers and staff (University of Hasselt,2019).

The inclusion criteria are that participants should be over the age of 18 and be physically able to carry out trips (to and from work/school/shopping) unassisted.
The initial sample size collected was 641 however after initial analysis and data cleaning, the final number of usable results was 260.

4.4 Ethical Considerations

This study was approved by the relevant ethical committee.

4.5 Data Collection

The survey consisting of the TTM and demographic questionnaires was entered into Qualtrics and distributed via a link. The link was given to the Hasselt University administration who then sent it out to the student body by email. The message was initially sent out on 02/042019, a reminder email was then sent again on 08/04/2019. The data collection period continued until 21/04/2019 after which the

survey was disabled, and the data was downloaded for analysis. During this period the questionnaire was also circulated to other academic institutions.

5 Analysis

Qualitrics software was used for the construction and distribution of the questionnaires. Microsoft Excel and SPSS Statistics Version 25 were then used to analyse the survey results.

URICA

The calculation of the initial TTM questionnaire results was carried out in Microsoft Excel. The method for calculating the URICA and allocating respondent to stages was as follows:
Each item on the questionnaire corresponded with one of the 6 TTM stages. Each stage was allocated 4 questions which participants rated from 1 to 5. The scores for each stage summed and then averaged. For example, the answers to the 4 questions allocated to the Precontemplation stage were added together and divided by 4. After this, the sum of the scores from each stage was calculated. The final readiness to change score was calculated by subtracting the mean score of the *Precontemplation* stage from the sum of all the scores from each stage.

If an individual scored 8 or lower, they were classified as being in the *Precontemplation* stage. A score of between 9 and 11 was classified as being in the *Contemplation* stage whilst scores from 12-14 were classified as the *Preparation* or *Action* stages. Scores greater than 14 were placed in the *Maintenance* stage.

After the initial allocation of stages, a Principal Components Analysis (PCA) was carried out on the 8 Precontemplation items. The 4 items with the lowest component loadings were removed. A second PCA was then conducted on the entire questionnaire. Pearson Correlations were then carried out between the URICA stages and the DBI and Situational-Confidence scores. Cross tabulations between the URICA allocated stages and the stages of the SOC for Active Transport Modes were carried out. This was also done for the URICA allocated stages and demographic data such as the number of minutes of active travel achieved by respondents per week.

The SOC for Active Transport Mode

The analysis method adopted for this instrument will be adapted from *Measuring the Processes of Change from the Transtheoretical Model for Physical Activity and Exercise in Overweight and Obese Adults* (Ahmed Jerôme Romain, Bernard, Hokayem, Gernigon, & Avignon, 2016).

As with the URICA the results of this questionnaire were calculated in excel by way of a nested “IF” statement. Participants were required to answer “yes” or “no” to four questions. If the answer to questions 1 and 2 was no then a participant was placed in the *Precontemplation* stage. If the answer to question 1 and 3 was no but the answer to question 2 was yes then the participant was allocated to the *Contemplation* stage. If the answer to question 1 was no and the answer to question 3 was yes then the participant was placed in the *Preparation* stage. If the answer to question 1 was yes and the answer to question 4 was no then the participant was allocated to the *Action* stage. If the participant answered yes to question 1 and yes to question 4 then they were placed in the Maintenance stage. There were a number of participants that did not adequately fill out the questionnaire. As a result, they could not be placed in a stage.

The internal validity of the scale was examined with Cronbach’s Alpha and One-way ANOVA’s were carried out with bot the DBI and Situational Confidence scores.

Decisional Balance Measure

The Decisional Balance scores were calculated in Excel. As mentioned in earlier sections the original 10 item scale was reduced to 8 items due to certain questions being poorly answered. The questionnaire therefore contained four "pros" and four "cons". In order to calculate the results everyone's "pro" and "con" score was summed separately and averaged. The difference between the two scores was then calculated by subtracting the cons from the pros. If the final score was a positive number, then it meant that the individual was endorsing more pros than cons in relation to the target behaviour. If the score was negative, then that meant that more cons were perceived by the participant. The internal validity of the scale was confirmed with Cronbach's Alpha.

Situational Confidence Questionnaire

The Situational Confidence scores were calculated in Excel. The score was reached by calculating the sum of each participants responses and then calculating the average. The maximum score that could be achieved was five thus a higher score indicated an increased level of self-efficacy whilst lower scores determined that the opposite was true. The internal validity of the scale was confirmed with Cronbach's Alpha.

Demographic Information

Along with the TTM related questionnaires, participants were required to answer a series of demographic questions. The questions collected data about the age, gender, location and educational background of the sample. Their travel habits were also recorded by way of questions about their access to motorised transport as well as the amount of time they spent per week travelling via active transport modes. The purpose of collecting this data was to allow for further analysis of the TTM questionnaire results in relation to variables such as preferred transport mode and access to motorised transport.

6 Results

Descriptive Statistics

The final sample size after the removal of incomplete responses was N=260. The sample comprised of 144 (55.4%) females, 113(43.5%) males and 2(.8%) responses categorised as other. The mean age of sample respondents was M=30 with a Standard Deviation of SD=4.392. 23-year olds make up the largest group with 16.5%. 46.2% of respondents reported to have been educated to university degree level. 25.8% of respondents reported using active transport for 150mins or more per week, 25%, 22% 11% reported 20-60mins, 60-100mins and 100-150mins per week respectively, 15.8% reported that they achieved 0-20mins per week. 73.8% of the sample reported that they have access to a form of motorised transport whilst 26.2% claimed that they did not. The most preferred transport mode to and from school or work in the sample was the motor car with 38.8% respondents indicating this mode as their preference. A combination of walking and/or cycling with public transport was the second most preferred with 32.3%. walking was the least preferred mode with 1.2%.

TABLE 7 : Descriptive Statistics

Gender		
	Frequency	***%***
None Selected	1	0.4
Female	144	55.4
Male	113	43.5
Other	2	0.8
Education		
Higher education-Not University	39	15.0
Secondary School general academic program	85	32.7
Technical Secondary School	16	6.2
University Degree	120	46.2
Active Travel/Week		
0-20 mins	41	15.8
100-150 mins	29	11.2
150min+	67	25.8
20-60 mins	65	25.0
60-100 mins	58	22.3
Access to Motorised Transport		
No	68	26.2
Yes	192	73.8
Preferred Transport Mode		
A combination of walking and/or cycling with public transport	84	32.3
Bicycle	72	27.7
Car	101	38.8
walking	3	1.2

6.1 TTM Measures

TABLE 8: URICA Stage Allocation displays the results of the URICA questionnaire. The final sample size was 260 after incomplete responses were removed. 43.8% of respondents were allocated to the Contemplation stage, this was the largest grouping whilst Precontemplation, Action, Preparation and Maintenance followed with 35%,11.2%,9.2% and 0.8% respectively.

TABLE 8: URICA Stage Allocation

N=260	***Frequency***	***%***
Precontemplation	91	35.0
Contemplation	114	43.8
Preparation	24	9.2
Action	29	11.2
Maintenance	2	0.8

TABLE 9: SOC Stage Allocation displays the results of the *Stages of Change for Active Transport* staging algorithm. The results of this measure differed substantially from the URICA. The majority of participants (58%) were allocated to the Maintenance stage with Precontemplation (26%), Contemplation (6%), Preparation and Action (both 4%) following.

TABLE 9: SOC Stage Allocation

N=260	***Frequency***	***%***
Precontemplation	68	26.2
Contemplation	17	6.5
Preparation	11	4.2
Action	11	4.2
Maintenance	153	58.8

A crosstabulation of the results of both TTM measurement instruments shows that 93.10% of respondents allocated to the Action stage, 72.80% of the Contemplation stage, and 95.80% allocated to the Preparation stage by the URICA were placed in the Maintenance stage by the *SOC for Active Transport.* 63% of respondents allocated to the Precontemplation stage by the URICA were allocated to the same stage by the alternative questionnaire. This was the highest percentage match between the two instruments. For the other stage's matches ranged from 0-9.90%

Further cross tabulations were carried out between stage allocation and the self-reported number of minutes of active transport achieved per week by each respondent.

TABLE 11: Cross Tabulation Active Transport Per Week and URICA shows that 31% of respondents allocated to the Action stage by the URICA reported 150 mins or more spent using active transport per week, 20-60mins and 60-100mins were the next largest groups with 27.6% and 24.1% respectively. 50% of people allocated to Maintenance reported 150mins+/week whilst the remainder achieved 0-20mins. It is however noted that there were only two individuals allocated to this stage therefore the validity of this result is questionable. 33.3% of respondents placed in the Preparation stage reported 150mins+/week with 20-60 mins/week and 100-150 mins/week also recording substantial numbers

(29.2% and 20.8%). The largest group in the Precontemplation stage was individuals (37.4%) who reported 0-20mins of active travel per week.

TABLE 10*:* Cross Tabulation Active Transport per Week and SOC for Active Transport shows that 45.5% of respondents allocated to the Action stage reported 150 mins+ of active transport per week. 31.1% placed in Maintenance reported 150+ mins/week with the second and third largest groups being 60-100mins and 20-60mins. 40.6% and 37.5% of respondents were respectively allocated to the Precontemplation and Contemplation stages reported 0-20mins/week. The Preparation stage showed 36.4% of respondents achieving 0-20mins/week and 20-60mins/week.

TABLE 10: Cross Tabulation Active Transport per Week and SOC for Active Transport

			0-20 mins	**100-150 mins**	**150m in+**	**20-60 mins**	**60-100 mins**	
SOC Stage Allocation	A	Count	1	1	5	1	3	11
		% within SOC Stage Allocation	9.1%	9.1%	45.5 %	9.1%	27.3%	100.0%
	C	*Count*	6	0	3	5	2	16
		% within SOC Stage Allocation	37.5%	0.0%	18.8 %	31.3%	12.5%	100.0%
	M	*Count*	2	24	48	35	44	153
		% within SOC Stage Allocation	1.3%	15.7%	31.4 %	22.9%	28.8%	100.0%
	P	*Count*	28	4	9	20	8	69
		% within SOC Stage Allocation	40.6%	5.8%	13.0 %	29.0%	11.6%	100.0%
	Prep	*Count*	4	0	2	4	1	11
		% within SOC Stage Allocation	36.4%	0.0%	18.2 %	36.4%	9.1%	100.0%
Total		Count	41	29	67	65	58	260

		% within SOC Stage Allocation	15.8%	11.2%	25.8 %	25.0%	22.3%	100.0%

TABLE 11: Cross Tabulation Active Transport Per Week and URICA

			0-20 mins	**100-150 mins**	**150min+**	**20-60 mins**	**60-100 mins**	
URICA Stage allocation	A	*Count*	1	4	9	8	7	29
		% within URICA Stage allocation	3.4%	13.8%	31.0%	27.6%	24.1%	100.0 %
	C	*Count*	5	15	30	27	37	114
		% within URICA Stage allocation	4.4%	13.2%	26.3%	23.7%	32.5%	100.0 %
	M	*Count*	1	0	1	0	0	2
		% within URICA Stage allocation	50.0%	0.0%	50.0%	0.0%	0.0%	100.0 %
	P	*Count*	34	5	19	23	10	91
		% within URICA Stage allocation	37.4%	5.5%	20.9%	25.3%	11.0%	100.0 %
	PREP	*Count*	0	5	8	7	4	24
		% within URICA Stage allocation	0.0%	20.8%	33.3%	29.2%	16.7%	100.0 %
Total		*Count*	41	29	67	65	58	260
		% within URICA Stage allocation	15.8%	11.2%	25.8%	25.0%	22.3%	100.0 %

P=Precontemplation C=Contemplation PREP=Preparation A=Action M=Maintenance

6.2 Principal Components analysis for URICA questions

A Principal Components Analysis was performed on the question items for the Precontemplation 'believer's' and 'non believers' stages. The items included the following:

Precontemplation non-believers

Q14 As far as I am concerned, I don't need to exercise regularly
Q16 I am not increasing my physical activity levels by using active transport right now and I don't care.

Q19 I am satisfied with not increasing my physical activity levels by using active transport modes.
Q22 I could increase my physical activity levels by using active transport, but I don't plan to.

Precontemplation believers

I don't have the time or energy to increase my physical activity levels by using active transport modes right now. Q24

I know that increasing my physical activity levels by using active transport modes is worthwhile, but I don't have time for it in the near future. Q32

I think increasing physical activity levels by using active transport modes is good, but I can't fit it into my schedule right now. Q34

I am aware of the importance of increasing my physical activity through using active transport modes, but I can't do it right now. Q37

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) as well as the Bartlett's Test of Sphericity were applied in order to determine whether further analysis could be performed. The KMO value was 0.847 which is an acceptable value. The Bartlett's test of sphericity indicates a significance level of 0.000 which at an alpha level of 0.005 is statistically significant. This confirms that a valid PCA can be performed.

Two components with Eigenvalues greater than 1 were identified by a Scree Plot.
The components were then subjected to a Varimax Rotation. The first 4 variables had high component loadings for component 1 (0.925, 0.898,0.854 and 0.742). The remaining variables recorded lower loadings for this component but higher values for component 2 (0.797,0.737,0.722 and 0.609). Higher values indicate a closer relationship between the variable and component. Based on these results component 1 can be identified as Precontemplation 'believers' whilst component 2 can be named Precontemplation 'non-believers'.

The Total Variance explained which indicates how much of the variability in the data has been modelled by the extracted factors. The results indicate that component 1 accounts for 54.55% of the data variability whilst component 2 contributes 16.614%.

Based on these results the variables that loaded more heavily on component 1 were selected for further analysis with the remaining variables from the URICA questionnaire.

6.3 Principal Components Analysis for URICA

After the 4 variables relating to the Precontemplation 'non-believers' were removed, PCA was performed on the remainder of the questionnaire. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) as well as the Bartlett's Test of Sphericity were applied in order to determine whether further analysis could be performed. A result of .885 and a significance level of .000 at alpha level .005 confirmed that a PCA was possible.
Out of a total of 20 components 4 were recorded as having Eigenvalues greater than 1, these were identified by way of a Scree test shown in FIGURE 2: *Scree Plot of Component Numbers and Eigenvalues* 5 components were extracted as the purpose of this study is identify and validate 5 stages. A Varimax rotation was performed and results indicated that components 1 and 2 had the highest Eigenvalues and cumulatively accounted for 55.514% of the variance within the construct. The 5 components cumulatively account for 72.461% of the construct variance which is slightly low.

FIGURE 2: Scree Plot of Component Numbers and Eigenvalues

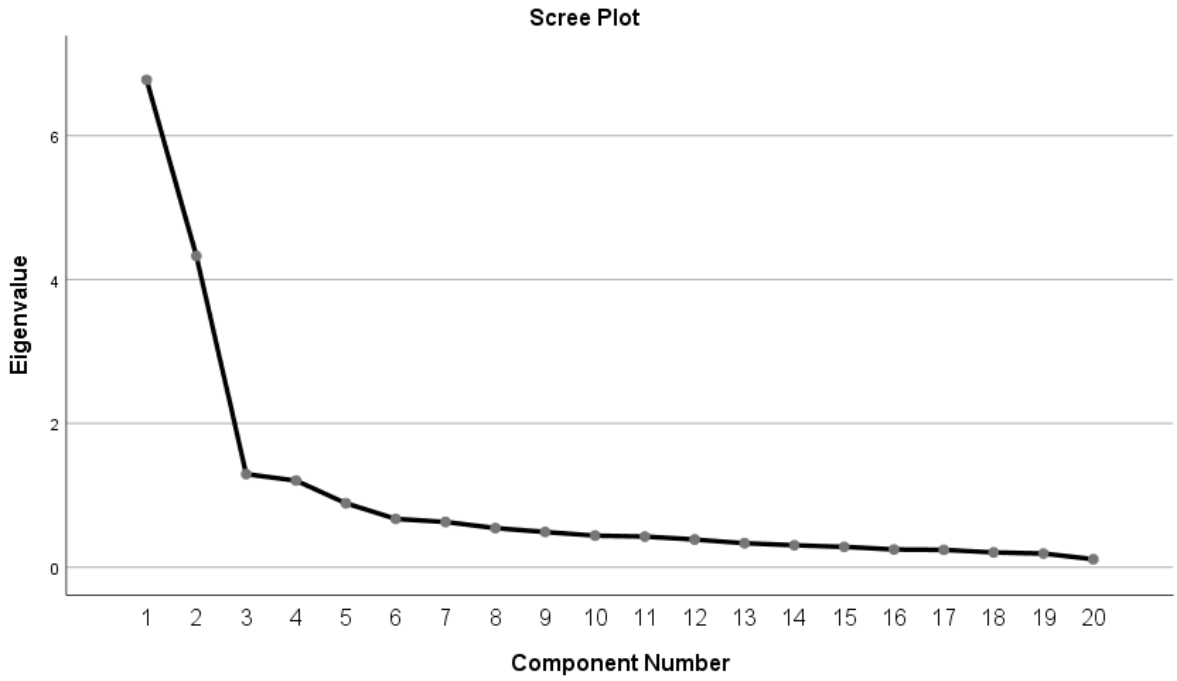


TABLE 12: Component Loadings for URICA displays figures taken from the rotated component matrix. As shown, items associated with the Precontemplation stage of the TTM model loaded well onto component 1. Each item recorded a value of .8 and over. Component 1 was therefore identified as measuring the Precontemplation stage of the model.

Component 3 was identified as the Contemplation stage as its associated items showed significant loadings. Items from the Preparation stage loaded significantly on both components 4 and 5. "I have organised with a friend so that we can start using active transport modes to increase our physical activity levels within the next few weeks" and "I have been calling friends to find someone to start using active transport modes to increase my physical activity levels with over the next few weeks" showed the highest individual loadings on both components 4 and 5. Overall the highest loadings were on component 4 and it was therefore named the Preparation stage.

Items from the Action stage of the TTM loaded significantly onto component 2 excluding "I have used active transport modes to increase my physical activity levels for the past 6 months". A similar pattern was observed for items from the Maintenance stage except for two items "I have been successful at using active transport modes to increase my physical activity levels and I plan to continue" and "I have managed to use active transport modes to increase my physical activity levels for the last 6 months". These items loaded less heavily on component 2 than the other items associated with Action and Maintenance. However, out of all the other components, they loaded the highest on component 2.

As mentioned previously the 5th component was determined to be insignificant by the scree plot but was included for further analysis due to the fact that there are 5 stages in the TTM model used for this study. However as indicated by results the 5th component has not proved useful in terms of identifying a separate stage. This could be explained by the URICA stage allocation demonstrated in **TABLE 8**: URICA Stage Allocation. The data indicates that only 2 individuals out of the sample were allocated to the Maintenance stage thus making it difficult to identify a separate component.

TABLE 12: Component Loadings for URICA

Items and Components	**1** *Precontemplation*	**2** *Action/Maintenance*	**3** *Contemplation*	**4** *Preparation*
Precontemplation				
I don't have the time or energy to use active transport modes to increase my physical activity levels right now.	**0.815***	-0.069	-0.074	-0.037
I know using active transport modes to increase my physical activity levels is worthwhile, but I don't have time for it in the near future.	**0.881***	-0.054	-0.02	0.078
I think using active transport modes to increase my physical activity levels is good, but I can't fit it into my schedule right now.	**0.887***	0.031	0.124	0.044
I am aware of the importance of using active transport modes to increase my physical activity levels but I can't do it right now.	**0.819***	0.01	0.21	-0.045
Contemplation				
I have been thinking that I might want to start using active transport modes to increase my physical activity levels on a more regular basis.	0.102	0.198	**0.812**	0.027
I have been thinking about whether I will be able to use active transport modes to increase my physical activity levels.	-0.226	0.080*	**0.789***	0.085*
I have been thinking that I may want to begin using active transport modes to increase my physical activity levels.	0.02	0.228	**0.779***	0.221

I really think I should work on getting started with using active transport modes to increase my physical activity levels over the next 6 months.	0.304	0.392	**0.629**	0.066
Preparation				
I have set up a plan of how to use active transport modes to increase physical activity level over the next few weeks.	-0.156	0.179	0.506	**0.47**
I have organised with a friend so that we can start using active transport modes to increase our physical activity levels within the next few weeks.	-0.028	0.097	0.106	**0.842**
I have been calling friends to find someone to start using active transport modes to increase my physical activity levels with over the next few weeks.	0.034	0.209	0.162	**0.835**
I am preparing to start using active transport modes to increase my physical activity levels in the next few weeks.	0.123	0.489	0.491	**0.349**
Action				
I am finally regularly using active transport modes to increase my physical activity levels.	-0.42	**0.534**	0.252	0.033
I have started regularly using active transport to increase my physical activity levels within the last 6 months.	-0.148	**0.795**	0.204	0.132
Recently, I have started to use active transport modes to increase my physical activity levels.	0.011	**0.755**	0.302	0.187
I have used active transport modes to increase my physical activity levels for the past 6 months.	-0.575	**0.457**	0.187	0.106
Maintenance				
I have been using active transport modes to increase my physical activity levels for a long time and I plan to continue.	-0.679	**0.455**	0.047	0.072
I have been successful at using active transport modes to increase my physical activity levels and I plan to continue.	-0.719	**0.443**	0.048	0.015

I have started to use active transport modes to increase my physical activity levels and I plan to continue	-0.182	**0.778**	0.177	0.146
I have managed to use active transport modes to increase my physical activity levels for the last 6 months.	-0.522	**0.568**	0.106	0.082
Eigen values	6.776	4.327	1.294	1.205
Explained variance %	33.881	21.633	6.471	6.026

6.4 Internal Consistency

Internal Consistency is a measure based on the correlations between items on the same test or subscale. It confirms whether a group of items that claim to measure a construct produce similar scores. Internal Consistency can be measured by Cronbach's Alpha which can be calculated from the pairwise comparisons between items. Internal Consistency can range from negative infinity to 1. Extremely high levels of reliability such as .95 or higher are not necessarily desirable as they indicate the possibility of redundancy amongst scale items. A good level of internal consistency would be within the range of .8 to .9 (Tavakol & Dennick,2011).

The internal validity of all scales was tested. Cronbach's Alpha *for The Stages of Change for Active Transportation* was recorded as .923 which indicates a good level of internal consistency albeit bordering on redundancy. *The Cronbach's Alpha if item deleted* shows that the reliability would be reduced if any of the questions were to be removed.

The Internal consistency of the URICA scale had an alpha level of .822 which indicates a good level without any threat of redundancy. The consistency of the scale could be improved with the removal of question items 24,32 and 37 as shown in

TABLE 13*: Item-Total Statistics*. These items are all taken from the Precontemplation scale.

TABLE 13: Item-Total Statistics

	Scale Mean if Item Deleted	**Scale Variance if Item Deleted**	**Corrected Item-Total Correlation**	**Cronbach's Alpha if Item Deleted**
Q15 U	51.96	97.508	.298	.820
Q17U	52.20	95.671	.469	.811
Q18 U	51.84	98.906	.267	.821
Q20 U	52.16	93.238	.567	.806
Q21 U	52.71	92.232	.614	.803
Q23 U	52.77	91.295	.670	.800
Q25 U	52.42	91.312	.598	.803
Q26 U	51.93	94.268	.511	.809
Q27 U	52.82	94.560	.533	.808
Q28 U	52.38	95.434	.421	.813
Q29 U	52.20	91.267	.635	.802
Q30 U	53.20	97.537	.365	.816
Q31 U	52.05	95.034	.412	.814
Q32 U	52.72	105.976	-.057	**.837**
Q33 U	53.25	96.848	.479	.811
Q34 U	52.72	102.774	.083	.830
Q35 U	52.56	92.978	.590	.805
Q36 U	52.80	91.829	.677	.801
Q37 U	52.63	102.821	.074	**.831**
Q24 U	52.92	107.805	-.137	**.841**

The alpha levels for both the Pro and Con dimensions of the DBI were .649 and .510 which are adequate and satisfactory respectively (Taber,2017). As with the SOC questionnaire, the reliability of the Pro's scale would be reduced if any item were to be removed. In contrast the reliability of the Con's scale would be improved slightly if the item "I would feel embarrassed if people saw me using active transport modes to increase my physical activity levels" were to be removed.

The Self-Confidence measure also showed good internal validity with an alpha of .746. Reliability would be slightly improved if the item "I can use active transport to increase my physical activity levels on most days" was removed.

6.5 Correlations

URICA, DBI, Situational Confidence Score

A Pearson Correlation was conducted to examine the relationship between the URICA, DBI and Situational Confidence scores. As indicated by **TABLE 14** : Pearson Correlation URICA, Situational Confidence and DBI Scores, there was a significant positive correlation at alpha=0.01 with the URICA score and the Situational Confidence score(r=.394) as well as the DBI(r=.237). This indicates that a higher URICA scores and thus later stage allocation is positively associated with higher DBI and Situational Confidence scores.

TABLE 14 : Pearson Correlation URICA, Situational Confidence and DBI Scores

Correlations

		DBI Score	**Situational Confidence score**	**URICA RTC Score**
DBI Score	Pearson Correlation	1	.411**	.237**
	Sig. (2-tailed)		0.000	0.000
	N	260	260	260
Situational Confidence score	Pearson Correlation	.411**	1	.394**
	Sig. (2-tailed)	0.000		0.000
	N	260	260	260
URICA RTC Score	Pearson Correlation	.237**	.394**	1
	Sig. (2-tailed)	0.000	0.000	
	N	260	260	260

**. Correlation is significant at the 0.01 level (2-tailed).

6.6 ANOVA SOC stage allocation, DBI and Situational Confidence Score

A MANOVA was initially selected to test the effects of stage allocation on DBI and Situational confidence score. However, the assumption of linearity required for a MANOVA was not met therefore separate 1-way ANOVA's were performed. With regard to ANOVA assumptions the requirements for sample size and independence of observations were met. The dependent variables were continuous, and the independent variable was categorical with multiple levels.

The data was tested for normality, the Shapiro Wilk and Kolmogorov-Smirnov tests both yielded significant values for Maintenance and DBI score as well as Precontemplation and Situational Confidence score, p<.05. Owing to the fact that the sample size of N=260 is fairly large the violation of the assumption of normality was not deemed to be problematic (Ghasemi & Zahediasl,2012). Further tests indicated that the scores for both the DBI and Situational Confidence were normally distributed

with skewness of -.267(SE=.151) and -.077(SE=.151) and Kurtosis of .312 (SE=301) and -.390(SE=301) respectively.

The data was screened for univariate outliers. **FIGURE 6:** Box Blot for Decisional Balance Score and **FIGURE 7**: Box Plot for Situational Confidence Score show the identified outliers. In the case of the DBI Scores case number 19 had a higher score than average whilst cases 44 and 153 had scores that fell below the interquartile range. For the Situational Confidence scores there was only once case (number 27) that fell below the interquartile range. A decision was made to retain these outliers as there was no pertinent reason to exclude.

The Box's Test of Equality of Covariance Matrices showed a significance level of .029 which indicates that the assumption of homogeneity has been met and further analysis is warranted. The Levene's Test of Equality of Error Variances showed significance levels above .05 for each outcome variable. This further confirms the assumption of homogeneity has been met.

The assumption of sample size was violated in this case. Maintenance was the largest group N=153, followed by Precontemplation N=68, Contemplation N=17, Preparation and Action both N=11. It is preferable to have a minimum of 20 scores per each level of independent variable however the analysis was continued with this taken into consideration.

TABLE 15: Test of Between Subjects Effects DBI AND SOC

DBI score					
	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Between Groups	40.883	4	10.221	13.124	0.000
Within Groups	198.590	255	0.779		
Total	239.472	259			

Analysis of variance showed off a main effect of SOC Stage allocation on DBI score F (4, 255) = 13.12, p = .000. This indicates that there is a statistically important difference between the mean DBI scores of each TTM stage. Posthoc analyses using Tukey's HSD indicated that the mean scores for Precontemplation and Contemplation (M=-.69, SD=0.24), p=.034, Precontemplation and Action (M=-.99, SD=.29), p=.006 and Precontemplation and Maintenance (M=-.92, SD=.13), p=.000. There were no other significant differences between the mean scores of other stages.

TABLE 16: Test of Between Subjects Effects Situational Confidence and SOC

Situational Confidence score					
	Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Between Groups	53.259	4	13.315	23.990	.000
Within Groups	141.527	255	.555		
Total	194.786	259			

Analysis of variance was also carried out between SOC Stage allocation and Situational Confidence score identified a main effect of F (4,255) =23.99, p=.00. This confirms that there is a statistically important difference between the mean Situational Confidence scores of each TTM stage. Post hoc analysis indicated significant mean score differences between Maintenance and Precontemplation (M=-.98, SD=.12), p=.00, Maintenance and Contemplation (M=-.87,SD=.19),p=.00, Maintenance and Preparation (M=-.73,SD=.23),p=.016 and Maintenance and Action (M=,SD=),p=.008.

As indicated by ***FIGURE 3:*** *Mean DBI and Situational Confidence score by URICA Stage* and ***FIGURE 4****: Mean DBI and Situational Confidence Score by SOC Stage*, the mean DBI and Situational Confidence scores vary according to TTM stage. Both scores follow a similar pattern with the Action and Maintenance stages being associated with the highest scores and Precontemplation with the lowest. This is confirmation that these scores collected by the two aforementioned questionnaires increase amongst respondents who are allocated to later stages.

FIGURE 3: Mean DBI and Situational Confidence score by URICA Stage

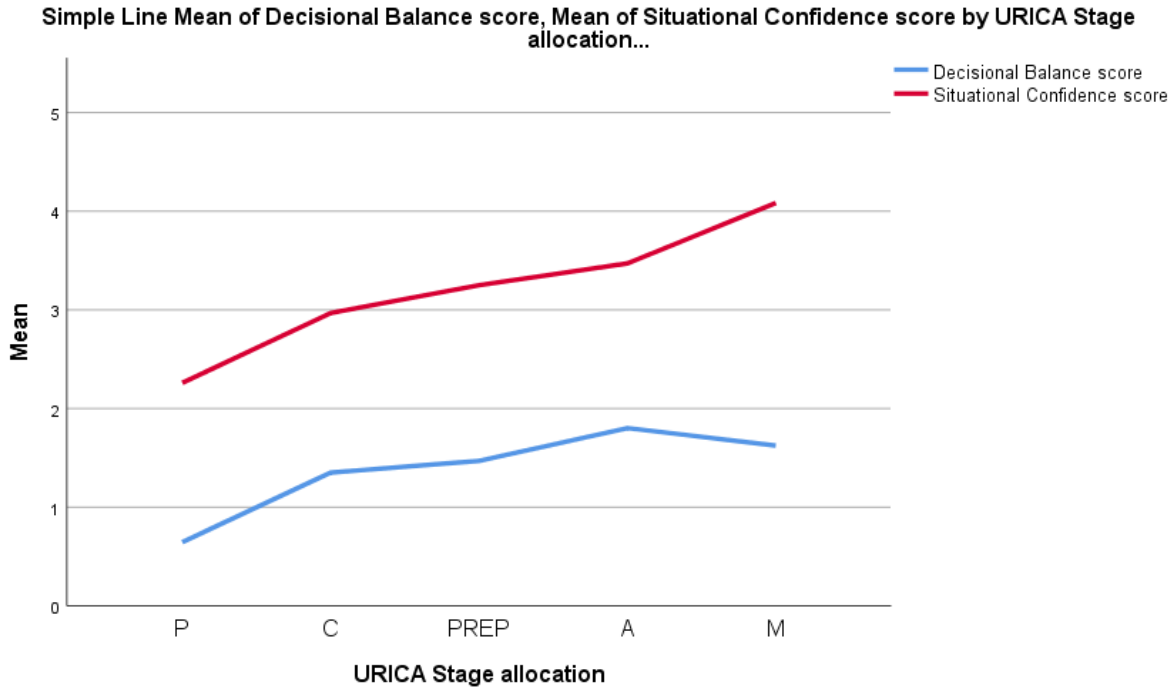
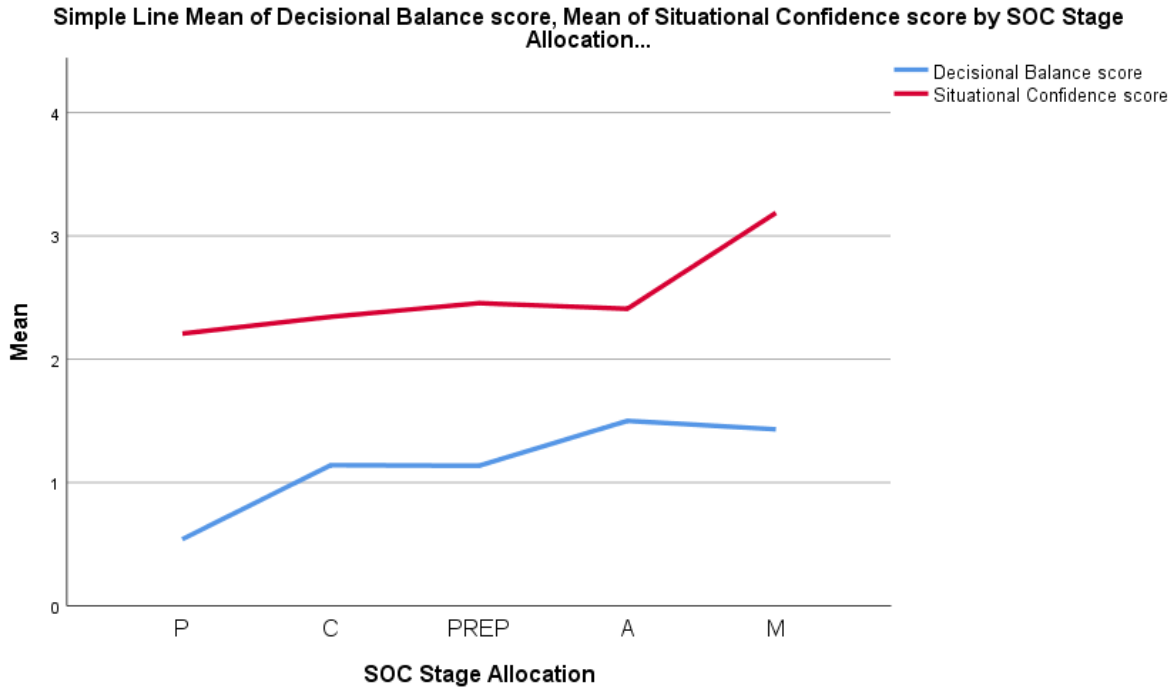


FIGURE 4: Mean DBI and Situational Confidence Score by SOC Stage



demonstrates the relationship between the mean DBI and Situational Confidence scores and the stage allocation by the URICA questionnaire. As with the SOC for Active Transport stage allocation the Maintenance stage is associated with higher mean scores whilst the Precontemplation stage is associated with the lowest scores. In the case of the DBI, the scores associated with both the Action and Maintenance stages are similar, with Action being slightly higher. This differs from the Situational Confidence Score which has a more clearly defined difference between Action and Maintenance. This graph mirrors the results of the Pearson correlation which confirmed that there was a significant positive correlation between DBI and Situational Confidence score and later stage allocation.

7 Discussion

This study set out to explore the psychometric properties of the URICA adapted for active transport as well as for the *SOC for Active Transport Modes* staging algorithm. The primary intention of the process was to test the general applicability of the TTM and its constructs as a suitable measure of readiness to change in individuals using active transport to increase their physical activity levels. In addition, the study explored, the usefulness of each measure, whether all the TTM stages could identified in the sample population and whether Situational Confidence and Decisional Balance scores increased as individuals progressed to later stages. Other TTM instruments namely the Situational Confidence scale and Decisional Balance Index were adapted for active transport and used to further validate the aforementioned questionnaires. The TTM has received a great deal of attention from a research perspective particularly within the areas of addiction and to a lesser extent physical activity. Exploration of the applicability of TTM instruments for active transport are limited therefore this study has attempted to fill this gap.

The initial allocation of respondents to the TTM stages successfully managed to identify each of the five stages within the sample. There were substantial differences in the pattern of stage allocation between the two questionnaires. The URICA placed the majority of participants in the Precontemplation and Contemplation stages. The rest of the sample was split almost equally between Preparation and Action with the latter having a slightly higher number. Only two respondents were allocated to the Maintenance stage. In contrast the SOC *for Active Transport Modes* staging algorithm allocated the majority of the sample to the Maintenance stage with smallest groups being Preparation and Action.
This variation in stage allocation between the two instruments is not unexpected as one is a continuous measure (URICA) and the other adheres to the discrete stage allocation conceptualised by the original model.

A crosstabulation of the stage allocation of both instruments showed that Preparation was the only stage which had consistent results i.e. 63.70% of participants placed in that stage by the URICA were placed in the same stage by the *SOC for Active Transport Modes*. 100% of participants placed in the Maintenance stage by the URICA were allocated to the same stage by the staging algorithm but this is likely to be because only 2 URICA respondents were identified as being in the final stage. In contrast the staging algorithm placed the majority of respondents in that stage. The limited consistency of these instruments implies that they cannot be used interchangeably.

Cross tabulations comparing stage allocation of both questionnaires to self-reported active transport levels, showed higher percentages of individuals in later stages completing maximum levels of active travel per week. Once again in the case of the URICA the low number of respondents allocated to the Maintenance stage affected this result. Both questionnaires also showed a high percentage of individuals allocated to earlier stages reported lower levels of active transport per week. The data did not however strictly adhere to this pattern as some individuals in later stages also reported low levels of activity and vice versa.

As previously noted, the *SOC for Active Transport* allocated a large portion of respondents to the Maintenance stage. When compared with the demographic data, this result does not contradict the self-reported active transport usage data. 25% of respondents reported over 150 minutes of active travel per week. 11% achieved 100-150 minutes per week whilst 22% reported 60-100 minutes. These numbers combined indicate that the sample is quite active and therefore meets the Action or Maintenance criteria as defined by the staging algorithm. In addition to this, 73% of respondents reported that they had access

to motorised transport. One could deduce from this that a large percentage of the sample opt to incorporate some degree of active travel into their daily lives despite being able to use motorised transport. One can also observe that 32% of respondents selected a combination of active and public transport as their preferred mode of travel for work/school related trips. This was the second most preferred mode after motorised vehicles which was 38%.

A closer look at the SOC stage allocation in relation to the number of minutes spent using active transport reveals that 45.5% of respondents allocated to the Action stage reported 150 mins+ of active transport per week. 31.1% placed in Maintenance reported 150+ mins/week with the second and third largest groups being 60-100mins and 20-60mins. 40.6% and 37.5% of respondents were respectively allocated to the Precontemplation and Contemplation stages reported 0-20mins/week. The Preparation stage showed 36.4% of respondents achieving 0-20mins/week and 20-60mins/week.

A cross tabulation of the URICA stages and active travel per week shows that 31% of respondents allocated to the Action stage reported 150 mins or more spent using active transport per week, 20-60mins and 60-100mins were the next largest groups with 27.6% and 24.1% respectively. 50% of people allocated to Maintenance reported 150mins+/week whilst the remainder achieved 0-20mins. It is noted once again that there were only two individuals allocated to this stage which undermines this result. 33.3% of respondents placed in the Preparation stage reported 150mins+/week with 20-60 mins/week and 100-150 mins/week also recording substantial numbers (29.2% and 20.8%). The largest group in the Precontemplation stage was individuals (37.4%) who reported 0-20mins of active travel per week. An objective measure would be a more reliable validation technique however these figures provide a rough indication of the accuracy of the instruments stage allocation.

Both instruments show a relationship between stage allocation and active transport usage that is in line with TTM theory. The expectation is of course that individuals in later stages would report higher levels of active transport usage. The URICA showed a high number of respondents in the Preparation stage reporting the maximum amount of time spent using active transport. It also showed at least one individual in the Maintenance stage achieving 0-20mins of active travel per week. This would be seemingly contradictory. However, it is expected that individuals may cycle through the different stages multiple times particularly when it comes to activities such as exercise and active travel. The URICA also measures underlying psychological constructs so individuals may be achieving target levels of active travel without a complex underlying thought process.

A Principal Components Analysis carried out on the URICA questionnaire initially identified 4 components with Eigenvalues greater than 1. An additional 5^{th} component was extracted to serve the purposes of this study which makes use of a 5 stage TTM model. The loadings of the 5^{th} component proved to be insignificant therefore it was concluded that only 4 dimensions of the original 5 stage model were identified by this study. This is despite all five stages being identified by the initial calculation of the questionnaire. The overall component loadings were lower than those recorded by previous studies (Reed, 1995; Lerdal et.al,2008).

Based on the conceptual groupings of each item onto each factor, the following TTM dimensions were identified, Precontemplation, Contemplation, Preparation, both Action and Maintenance loaded significantly onto component 2. The loadings associated with the Action dimension were slightly higher than the latter. Lerdal et.al (1998) observed a similar result with a number of the items associated with Action loading highly on the Factor allocated to Maintenance. The explanation put forward in that case was that the ideas underpinning the responses associated with Action involved ‘keeping up with exercise’ which could then be linked with the idea of Maintenance. The fact that the questionnaire was

translated to Norwegian also affected the phrasing of question items in a way that led to the discussed result.

In the current study both the Action and Maintenance dimensions were measured by 1 component. The phrasing of the question items was in some cases quite similar, for example , 'I have used active transport modes to increase my physical activity levels for the past 6 months'(Action) and 'I have managed to use active transport modes to increase my physical activity levels for the last 6 months' (Maintenance). The latter item loaded more heavily on component 2. A similar situation was observed with the items 'Recently, I have started to use active transport modes to increase my physical activity levels'(Action) and 'I have started to use active transport modes to increase my physical activity levels and I plan to continue'(Maintenance).

The Action stage is defined as 'people who are actively engaged in changing their current behaviour or acquiring the desired behaviour' whilst Maintenance is defined as 'behavioural change is established and maintained over time '(Velicer & Prochaska,1997). As mentioned in earlier sections the 6-month time period used to differentiate these two stages has been critiqued for being arbitrary. One could argue that there is little that conceptually separates these two stages as both require the performance of the desired behaviour but for different periods of time. This result indicates that it may be necessary to re-evaluate the language and phrasing used in subsequent questionnaires in order to clearly measure two separate stages. This is the case for both the English and Dutch versions.

A further important consideration is that there were only 2 individuals allocated to the Maintenance stage from this sample. This would most likely affect the results of the measurement as it would be difficult to establish any type of response pattern. Lerdal et.al also make note of the 'transient' nature of the Action scale as individuals can only be allocated to this stage for a limited time before moving to Maintenance. This may have contributed to respondents failing to differentiate between the two stages. There could be an argument for a combined Action/Maintenance scale however, it is clear that a larger sample or at least a greater number of respondents allocated to the Maintenance stage would be needed before this could be confirmed.

Pearson Correlations were carried out with the URICA score and DBI and Situational Confidence scores. Results confirmed the positive correlation between later stages and higher scores. This indicates that respondents in the sample placed in later stages such as Preparation and Action were likely to associate more pro's than con's with the target behaviour than those in the Precontemplation stage. The same can be observed for Situational confidence. What can be noted is that the Precontemplation stage has the lowest scores for both questionnaires. DBI pro scores have previously been noted to increase from the Contemplation or Preparation stages (Sutton,2001). This shows that individuals possibly adjust their attitudes towards a behaviour before making the actual change (Prochaska et al., 2008). In this instance the DBI score increases substantially amongst users in the Preparation stage and remains stable in the Action and Maintenance stages.

The results of the two ANOVA's performed with *the SOC for Active Transport Modes* stage allocations and DBI and Self Confidence scores confirmed TTM stage has a significant effect on the score levels.

FIGURE 4: Mean DBI and Situational Confidence Score by SOC *Stage*, demonstrates the relationship between these three variables. As with the URICA, the highest scores are associated with the Maintenance, Preparation and Action stages. Once again DBI scores appear to increase from the Preparation stage thus further confirming the theory that individuals undergo an attitude change before enacting behavioural change. The same pattern is observed with Situational Confidence scores which

implies that individuals experience an increase in confidence related to the target behaviour as they progress through the stages.

The results of the analysis point to a similar pattern when observing the interaction between the two stage measurement instruments and the Self-Efficacy and DBI scales. This adheres to existing TTM theory and confirms that in both cases higher scores are linked to later stages.

The results confirm that both staging algorithms and multidimensional questionnaires can identify 5 stages of the TTM. This is the case when simply observing calculated scores. Upon further investigation it was noted that the URICA was not measuring 5 separate stages adequately. This was linked to sample size as well as similar underlying concepts in the questionnaire item. As a continuous measure the URICA allows for individuals to score highly on one stage whilst simultaneously achieving high scores on other subscales. Which arguably reflects the fluctuating nature of exercise or in this case physical activity through active transport. This approach perhaps aligns more with the idea of utilising active modes. This is because it makes allowances for the fact that using active transport is dependent on multiple external factors such as weather, access and health just name a few. An individual may cycle through the stages continuously depending on their life circumstances. Previous applications of the TTM have been focused on individuals committing to stop a behaviour rather than start one (Lerdal et.al, 2008). This may require a different approach understanding the stages of the model.

The *SOC for Active Transport* staging algorithm provides less insight into the underlying psychological determinants of behaviour as the scale is simplified. On the other hand the tool adheres to the original conceptualisation of the TTM and its discrete stages. The questionnaire is easy to administer and much less laborious to complete in comparison to the URICA. Feedback received from survey respondents brought attention to the fact that the URICA questions were somewhat confusing particularly when translated into Dutch. The URICA is generally recommended for clinical settings which was not the case for this study, this would likely allow for more clarification for respondents.

7.1 Conclusion and Recommendations

The results of this study are potentially important within the context of growing global obesity rates and increase in chronic heart disease and other preventable illnesses related to sedentary behaviour. More importantly this work contributes to the centralisation of active transport modes as key approach to combatting the aforementioned ills along with other public health concerns such as congestion and emissions. The results suggest the utility of the *SOC for Active Transport* rather than the URICA has the potential ability to identify respondents change profiles at different stages. Adjustments to the URICA instrument items may however improve its utility for future studies. Both instruments confirmed that situational confidence and Decisional balance or the perception of the pros of a target behaviour increase as individuals progress through the stages.

These observations could prove to be useful with regard to both predicting the likelihood of respondents to change active travel behaviours, and also in matching behavioural change processes to meet individual needs. Insight into the most effective instrument for this has also been provided. Further examination of these instruments in varying and more diverse populations could contribute to the creation of profiles which could aid in the development of strategies to support the uptake of active transport and thus make a positive impact on public health.

Recommendations for further studies include testing both instruments in a more diverse population and generating a larger sample size. Introducing an objective measure as well as an element concurrent validity is also a potential strategy for more robust testing. Although the staging algorithm (*SOC for Active Transport*) proved to be more successful in the identification of all stages in the selected population, it does not have the ability to generate profiles (Lerdal et.al,2008). The URICA proves more useful in this regard. The removal of redundant items from the URICA scale is recommended. Items that represent each stage and have the highest factor loadings may be retained in order to make the scale more efficient and user friendly.

8 Annex A

8.1 Demographic Questionnaire

Please answer all the following questions as they describe you by circling the relevant option. Write brief answers where requested.

Definition

Travel Mode: The type of transport you use to get from point A to point B. Example: Car, Bike, Walking, Public Transport.

	Question	Answer
1.	What is your gender?	1.Male 2.Female 3.Other
2.	Please indicate your age range	1.Below 18 2.18-25 3.26-33 4. 33-39 5.40+
3.	What is your current occupation?	1.Student(full-time) 2.Employed/own business (full-time) 3.Neither
4.	Where do you currently live? (during the week)	1.Hasselt 2.Diepenbeek 3.Greater Limburg area 4.Other_____ (please state)
5.	What is your highest level of education?	1.Secondary School 2.Bachelor's 3.Master's 4.Doctoral
6.	Do you own or have regular access to a form of motorized transport (car, motorbike, scooter)	1.Yes 2.No
7.	Do you have an illness or disability that would make it difficult for you to travel (between work/school etc) independently?	1.Yes 2.No
8.	What is the primary way in which you travel to work, school or any other regular activities (e.g shopping, errands etc)	1.Car 2.Public transport 3.Bike 4.Walking 5.Walking and/or biking combined with public transport.
9.	Within a 7-day period, how many minutes to you spend using active transport?	1.0-20 mins 2.20-60 mins 3.60-100 mins 4.100-150 mins

		5.150min+
10.	Briefly explain why you use a particular travel mode. i.e Why do you bike/walk/drive or use public transport regularly?	

8.2 The University of Rhode Island Change Assessment

The following questionnaire is adapted from the following research:

Marcus, B.H., Selby, V.C., Niaura, R.S., & Rossi, J.S. (1992). Self-efficacy and the stages of exercise behavior change. Research Quarterly for Exercise and Sport, 63, 60-66.

Reed, G.R. (1994). Measuring stage of change for exercise behaviour change, URICA-E2. Unpublished Dissertation

The questionnaire is designed to identify how you personally feel about your current levels of physical activity from using active transport modes. Please think about your current situation and travel habits, even if you primarily make use of active transport modes. Read each question below carefully, and then decide whether you agree or disagree with the statements.

Please enter the number in the right-hand column that indicates how strongly you agree or disagree with the following statements.

1= Strongly Disagree
2 = Disagree
3 = Undecided
4 = Agree
5 = Strongly Agree

Definitions

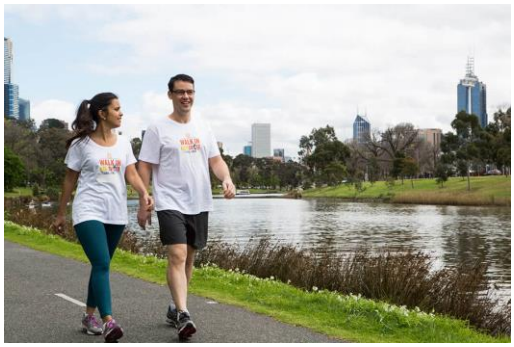
What is **Physical Activity?**

This is energy expenditure by way of bodily movement. This can include exercise as well as any kind of physical work or domestic chores (cleaning, gardening, childcare, shopping etc). Transport related activity (walking, cycling, accessing public transport) is also included as part of physical activity.

What are **Active Transport Modes?**

Active Transport Modes are in this case is defined primarily as ways of getting from A to B that require some degree of physical exertion. Examples of *Active Transport Modes* are: cycling, walking or even using a combination of active and public transport where one would be required to walk or cycle for 10 minutes or longer.

Examples of Active Transport Modes



Walking

Cycling

Using public transport and walking or cycling for a minimum of 10 minutes

Modes requiring physical effort

Not an Active Transport Mode

Travelling in a car or another motorized vehicle (e.g. scooter) alone or accompanied

1.	As far as I'm concerned, I don't need to increase my physical activity levels by using active transport modes.	
2.	I have been increasing my physical activity levels by using active transport modes for a long time and I plan to continue.	
3.	I am not increasing my physical activity levels by using active transport right now and I don't care.	
4.	I am finally regularly increasing physical activity levels by using active transport modes.	
5.	I have been successful at increasing my physical activity levels by using active transport modes and I plan to continue.	
6.	I am satisfied with not increasing my physical activity levels by using active transport modes.	
7.	I have been thinking that I might want to start increasing my physical activity levels by using active transport modes on a more regular basis.	
8.	I have started regularly increasing my physical activity levels by using active transport within the last 6 months.	
9.	I could increase my physical activity levels by using active transport, but I don't plan to.	
10.	Recently, I have started to increase my physical activity levels by using active transport modes.	
11.	I don't have the time or energy to increase my physical activity levels by using active transport modes right now.	
12.	I have started to increase my physical activity levels by using active transport modes right now, and I plan to continue.	
13.	I have been thinking about whether I will be able to increase my physical activity levels by using active transport modes.	
14.	I have set up a plan of how to increase my physical activity levels by using active transport modes over the next few weeks.	
15.	I have managed to increase my physical activity levels by using active transport modes over the last 6 months	
16.	I have been thinking that I may want to begin increasing my physical activity levels by using active transport modes.	
17.	I have organised with a friend so that we can start increasing our physical activity levels by using active transport modes within the next few weeks	
18.	I have increased my physical activity levels by using active transport modes for the last 6 months.	
19.	I know that increasing my physical activity levels by using active transport modes is worthwhile, but I don't have time for it in the near future.	
20	I have been calling friends to find someone to start increasing physical activity levels by using active transport modes with over the next few weeks.	
21.	I think increasing physical activity levels by using active transport modes is good, but I can't fit it into my schedule right now.	
22.	I really think I should work on getting started with increasing my physical activity levels through using active transport modes over the next 6 months	
23.	I am preparing to start increasing my physical activity though using active transport modes in the next few weeks.	

24.	I am aware of the importance of increasing my physical activity through using active transport modes but I can't do it right now.	

Scoring
Precontemplation (non-believers in exercise) items: 1, 3, 6, 9
Precontemplation (believers in exercise) items: 11, 19, 21, 24
Contemplation items: 7, 13, 16, 22
Preparation items: 14, 17, 20, 23
Action items: 4, 8, 10, 12
Maintenance items: 2, 5, 15, 18

8.3 SOC for Exercise Questionnaire

The following questionnaire is taken and adapted from: *Health-related quality of life and stages of behavioural change for exercise in overweight/obese individuals* (A.J. Romain et al., 2012) .

The questionnaire is designed to identify how you personally feel about your current levels of physical activity though active transport. Please think about your current situation and travel habits, even if you primarily make use of active transport modes. Read each question below carefully, and then decide whether you agree or disagree with the statements. Please tick the answer of your choice to each question.

		Yes	**No**
1.	Are you currently increasing your physical activity levels by using active transport modes?		
2.	Do you intend to regularly increase your physical activity levels by using active transport modes in the next 6 months?		
3.	Do you intend to regularly increase your physical activity levels by using active transport modes in the next 30 days?		
4.	Have you regularly increased your physical activity levels by using active transport modes for the past 6 months?		

8.4 Decisional Balance Scale

The following questionnaire is adapted from the *Decisional Balance scale* adapted for PA behaviour by Nigg et al (1998).

Each statement represents a thought that might occur to a person who is deciding whether or not to increase their physical activity levels through Active Transport. Please indicate how IMPORTANT each of these statements might be to you if you were considering a decision to use Active Transport for daily travel. There are FIVE possible responses to each of the items that reflect your answer to the question "How important would this be to you?" Please circle the number that best describes how important each statement would be to you if you were deciding whether or not to use active transport.

1=Not important at all **2**=Slightly important **3**=Moderately important **4**=Very important **5**=Extremely important

PLEASE READ EACH STATEMENT AND FILL IN THE NUMBER IN THE RIGHT HAND SIDE COLUM TO INDICATE HOW YOU RATE ITS LEVEL OF IMPORTANCE AS IT RELATES TO YOUR MAKING A DECISION ABOUT WHETHER TO INCREASE YOUR PHYSICAL ACTIVITY LEVELS ACTIVE TRANSPORT.

1.	I would feel healthier and have more energy if I increased my physical activity levels through active transport modes.	
2.	I would feel embarrassed if people saw me increasing my physical activity levels by using active transport modes.	
3.	I would feel less stressed if I increased my physical activity levels through active transport modes.	
4.	Increasing my physical activity levels through active transport modes would be inconvenient.	
5.	I would save money if I increased my physical activity levels through active transport modes.	
6.	I would feel unsafe on the road if I were to increase my physical activity levels through active transport modes.	
7.	I would avoid time spent in traffic if I increased my physical activity levels through active transport modes.	
8.	My choice of clothing would be affected if I were to increase my physical activity levels through active transport modes.	
9.	I would enjoy my environment (city, town, etc) if I increased my physical activity levels through active transport modes.	
10.	I would find certain tasks like shopping more difficult if I increased my levels of physical activity through active transport modes.	

SCORING: 1,3,5,7,9 pros; 2,4,6,8,10 cons

8.5 Situational Confidence Questionnaire: Increasing Physical Activity Through Active Transport Modes

The following questionnaire was adapted from the SCQ for Regular to Moderate Exercise by Sarkin, Johnson, Prochaska, & Prochaska,(2001).

Each statement represents a scenario in which you do or do not perceive it to be possible to increase your physical activity levels through active transport. There are FIVE possible responses to each of the items that reflect your answer to the question. The scale ranges from 1(not confident at all) to 5 (Completely confident).

Please read each statement and fill in the number in the right-hand column that corresponds with the level of confidence you feel relative to the scenario described in the statement.

1=Not confident at all **2**=slightly confident **3**=somewhat confident **4**=fairly confident **5**=completely confident

1.	I can increase my physical activity levels by using active transport on most days.	
2.	I can ask a friend or family member to to join me as I increase my physical activity levels by using active transport.	
3.	I can increase my physical activity levels by using active transport on most days even if I could choose a motorised transport mode instead.	
4.	I can increase my physical activity levels by using active transport during varying weather conditions (rain, high temperatures, low temperatures,snow etc)	
5.	I can increase my physical activity levels by using active transport when I am very busy.	
6.	I can increase my physical activity levels by using active transport when carying out different types of trips (e.g. to work/school/shopping/social)	

9 Annex B

9.1 Statistical Analysis

TABLE 17: Cross Tabulation of URICA and SOC stage allocation

			SOC Stage Allocation					Total
			A	**C**	**M**	**P**	**Prep**	
URICA	A	*Count*	1	0	27	0	1	29
		% within URICA Stage	3.40%	0.00%	93.10%	0.00%	3.40%	100.00%
	C	*Count*	8	6	83	11	6	114
		% within URICA Stage	7.00%	5.30%	72.80%	9.60%	5.30%	100.00%
	M	*Count*	0	0	2	0	0	2
		% within URICA Stage	0.00%	0.00%	100.00%	0.00%	0.00%	100.00%
	P	*Count*	2	9	18	58	4	91
		% within URICA Stage a	2.20%	9.90%	19.80%	63.70%	4.40%	100.00%
	PREP	*Count*	0	1	23	0	0	24
		% within URICA Stage	0.00%	4.20%	95.80%	0.00%	0.00%	100.00%
Total		*Count*	11	16	153	69	11	260
		% within URICA Stage	4.20%	6.20%	58.80%	26.50%	4.20%	100.00%

9.1.1 Principal Components Analysis of 8 URICA Precontemplation Items

TABLE 18: Correlation Matrix 8 URICA Precontemplation Items

		Q14 U Non	**Q16 U Non**	**Q19 U Non**	**Q22 U Non**	**Q24 U**	**Q32 U**	**Q34 U**	**Q37 U**
Correlation	*Q14 U Non*	1.000	.315	.382	.322	.250	.253	.170	.054
	Q16 U Non	.315	1.000	.610	.585	.509	.498	.413	.365
	Q19 U Non	.382	.610	1.000	.488	.450	.371	.353	.243
	Q22 U Non	.322	.585	.488	1.000	.496	.531	.512	.436
	Q24 U	.250	.509	.450	.496	1.000	.694	.692	.594
	Q32 U	.253	.498	.371	.531	.694	1.000	.844	.685
	Q34 U	.170	.413	.353	.512	.692	.844	1.000	.806
	Q37 U	.054	.365	.243	.436	.594	.685	.806	1.000

TABLE 19: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.847
Bartlett's Test of Sphericity	*Approx. Chi-Square*	1180.726
	df	28
	Sig.	.000

TABLE 20: Communalities

	Initial	**Extraction**
Q14 U Non	1.000	.545
Q16 U Non	1.000	.663
Q19 U Non	1.000	.682
Q22 U Non	1.000	.602
Q24 U	1.000	.690

Q32 U	1.000	.812
Q34 U	1.000	.885
Q37 U	1.000	.808

TABLE 21: Total Variance Explained

	Initial Eigenvalues			**Extraction Sums of Squared Loadings**			**Rotation Sums of Squared Loadings**		
Component	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	4.356	54.455	54.455	4.356	54.455	54.455	3.362	42.027	42.027
2	1.329	16.614	71.069	1.329	16.614	71.069	2.323	29.042	71.069
3	.703	8.792	79.861						
4	.495	6.190	86.051						
5	.371	4.640	90.691						
6	.352	4.405	95.097						
7	.276	3.447	98.544						
8	.116	1.456	100.000						

FIGURE 5: Scree Plot

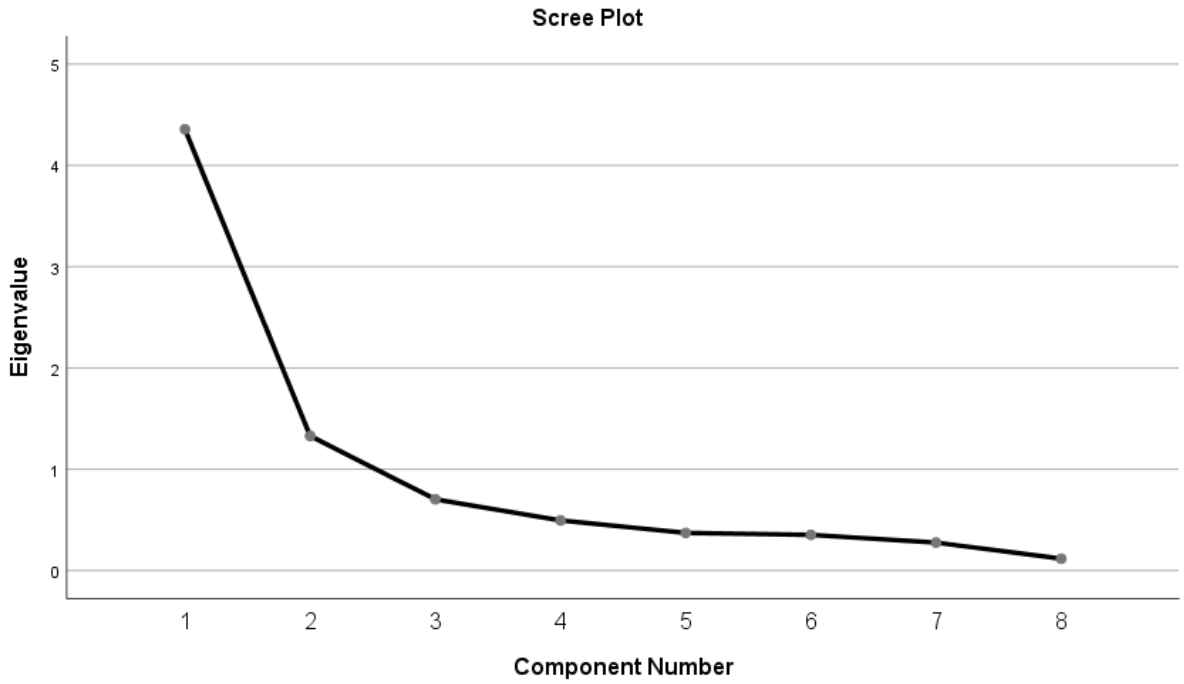


TABLE 22: Component Matrix[a]

	Component	
	1	**2**
Q32 U	.864	-.255
Q34 U	.857	-.388
Q24 U	.822	-.119
Q37 U	.755	-.488
Q22 U Non	.743	.223
Q16 U Non	.722	.376
Q19 U Non	.634	.529
Q14 U Non	.393	.625

Extraction Method: Principal Component Analysis.

a. 2 components extracted.

TABLE 23: Rotated Component Matrix[a]

	Component	
	1	**2**
Q34 U	.925	.173
Q37 U	.898	.033
Q32 U	.854	.286
Q24 U	.742	.374
Q19 U Non	.217	.797
Q14 U Non	-.036	.737
Q16 U Non	.376	.722
Q22 U Non	.481	.609

Extraction Method: Principal Component Analysis.

Rotation Method: Varimax with Kaiser Normalization.[a]

TABLE 24:Component Transformation Matrix

Component	1	2
1	.819	.573
2	-.573	.819

TABLE 25: Correlation Matrix

		Q24U	Q32U	Q34U	Q37U	Q15U	Q18U	Q17U	Q20U	Q21U	Q23U	Q25U	Q26U	Q27U	Q28U	Q29U	Q30U	Q31U	Q33U	Q35U	Q36U
Correlation	**Q24U**	1.000	.706	.698	.596	-.537	-.567	-.397	.049	-.233	-.141	-.219	-.209	-.148	-.411	-.056	-.066	-.429	-.034	.106	-.020
	Q32U	.706	1.000	.845	.691	-.555	-.594	-.361	.051	-.206	-.067	-.234	-.143	-.068	-.425	-.013	.022	-.455	.062	.187	.047
	Q34U	.698	.845	1.000	.808	-.490	-.544	-.257	.179	-.124	-.004	-.166	-.033	-.027	-.347	.113	.025	-.385	.105	.292	.143
	Q37U	.596	.691	.808	1.000	-.450	-.496	-.218	.197	-.147	.012	-.141	.025	-.057	-.382	.144	.001	-.361	.040	.352	.150
	Q15U	-.537	-.555	-.490	-.450	1.000	.795	.543	.058	.396	.302	.427	.242	.264	.607	.143	.141	.598	.128	-.004	.187
	Q18U	-.567	-.594	-.544	-.496	.795	1.000	.544	.069	.391	.299	.435	.250	.239	.600	.111	.087	.605	.090	-.045	.177
	Q17U	-.397	-.361	-.257	-.218	.543	.544	1.000	.234	.474	.377	.520	.353	.309	.457	.280	.176	.528	.162	.209	.302
	Q20U	.049	.051	.179	.197	.058	.069	.234	1.000	.355	.382	.299	.505	.371	.126	.654	.176	.199	.223	.561	.468
	Q21U	-.233	-.206	-.124	-.147	.396	.391	.474	.355	1.000	.692	.662	.270	.355	.521	.399	.185	.406	.325	.345	.465
	Q23U	-.141	-.067	-.004	.012	.302	.299	.377	.382	.692	1.000	.618	.305	.376	.397	.475	.281	.320	.312	.497	.576
	Q25U	-.219	-.234	-.166	-.141	.427	.435	.520	.299	.662	.618	1.000	.302	.309	.453	.354	.210	.459	.327	.330	.474
	Q26U	-.209	-.143	-.033	.025	.242	.250	.353	.505	.270	.305	.302	1.000	.452	.300	.549	.156	.364	.250	.373	.362

Q27U	-.148	-.068	-.027	-.057	.264	.239	.309	.371	.355	.376	.309	.452	1.000	.289	.429	.296	.262	.455	.322	.483
Q28U	-.411	-.425	-.347	-.382	.607	.600	.457	.126	.521	.397	.453	.300	.289	1.000	.228	.134	.719	.203	.139	.231
Q29U	-.056	-.013	.113	.144	.143	.111	.280	.654	.399	.475	.354	.549	.429	.228	1.000	.331	.229	.329	.534	.532
Q30U	-.066	.022	.025	.001	.141	.087	.176	.176	.185	.281	.210	.156	.296	.134	.331	1.000	.214	.570	.183	.344
Q31U	-.429	-.455	-.385	-.361	.598	.605	.528	.199	.406	.320	.459	.364	.262	.719	.229	.214	1.000	.200	.129	.190
Q33U	-.034	.062	.105	.040	.128	.090	.162	.223	.325	.312	.327	.250	.455	.203	.329	.570	.200	1.000	.263	.419
Q35U	.106	.187	.292	.352	-.004	-.045	.209	.561	.345	.497	.330	.373	.322	.139	.534	.183	.129	.263	1.000	.583
Q36U	-.020	.047	.143	.150	.187	.177	.302	.468	.465	.576	.474	.362	.483	.231	.532	.344	.190	.419	.583	1.000

TABLE 26: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.885
Bartlett's Test of Sphericity	*Approx. Chi-Square*	3113.669
	df	190
	Sig.	.000

TABLE 27:Communalities

	Initial	**Extraction**
Q24 U	1.000	.711
Q32 U	1.000	.838
Q34 U	1.000	.899
Q37 U	1.000	.781
Q15 U	1.000	.731
Q18 U	1.000	.750
Q17U	1.000	.568
Q20 U	1.000	.713
Q21 U	1.000	.760
Q23 U	1.000	.774
Q25 U	1.000	.709
Q26 U	1.000	.738
Q27 U	1.000	.534
Q28 U	1.000	.699
Q29 U	1.000	.718
Q30 U	1.000	.731
Q31 U	1.000	.744
Q33 U	1.000	.770
Q35 U	1.000	.660
Q36 U	1.000	.661

Extraction Method: Principal Component Analysis.

TABLE 28: Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
Component	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*	*Total*	*% of Variance*	*Cumulative %*
1	6.776	33.881	33.881	6.776	33.881	33.881	3.529	17.647	17.647
2	4.327	21.633	55.514	4.327	21.633	55.514	3.389	16.943	34.590
3	1.294	6.471	61.985	1.294	6.471	61.985	2.949	14.747	49.337
4	1.205	6.026	68.011	1.205	6.026	68.011	2.734	13.669	63.006
5	.890	4.450	72.461	.890	4.450	72.461	1.891	9.454	72.461
6	.672	3.360	75.821						
7	.629	3.144	78.965						
8	.545	2.723	81.688						
9	.490	2.448	84.136						
10	.440	2.199	86.335						
11	.427	2.134	88.469						
12	.386	1.928	90.397						
13	.334	1.671	92.069						
14	.305	1.527	93.596						
15	.284	1.418	95.014						
16	.247	1.236	96.249						
17	.242	1.209	97.459						
18	.206	1.031	98.490						
19	.191	.954	99.443						
20	.111	.557	100.000						

Extraction Method: Principal Component Analysis.

TABLE 29: Component Matrix[a]

	Component				
	1	**2**	**3**	**4**	**5**
Q24 U	-.561	.554	-.034	.230	.187
Q32 U	-.537	.669	.047	.218	.230
Q34 U	-.434	.761	-.049	.190	.305
Q37 U	-.394	.726	-.152	.106	.254
Q15 U	.726	-.373	-.010	.099	.234
Q18 U	.727	-.422	-.060	.081	.185
Q17U	.702	-.058	-.142	.098	.205
Q20 U	.420	.570	-.287	-.353	-.063
Q21 U	.716	.206	-.103	.386	-.216
Q23 U	.653	.387	-.084	.336	-.279
Q25 U	.716	.166	-.076	.381	-.134
Q26 U	.542	.300	-.186	-.518	.226
Q27 U	.546	.329	.237	-.267	.037
Q28 U	.734	-.194	-.052	.184	.294
Q29 U	.525	.552	-.100	-.345	-.100
Q30 U	.347	.295	.722	-.052	.033
Q31 U	.735	-.207	-.030	.037	.399
Q33 U	.404	.395	.670	.009	.041
Q35 U	.358	.677	-.241	-.043	-.118
Q36 U	.542	.564	.054	.049	-.208

Extraction Method: Principal Component Analysis.
a. 5 components extracted.

TABLE 30: Component Transformation Matrix

Component	**1**	**2**	**3**	**4**	**5**
1	-.400	.619	.397	.480	.261
2	.694	-.254	.523	.325	.272
3	-.094	-.125	-.318	-.155	.922
4	.336	.214	-.683	.609	-.070
5	.486	.701	-.010	-.519	.053

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

9.1.3 Internal Validity Decisional Balance Pros

TABLE 31: Case Processing Summary

		N	%
Cases	*Valid*	260	100.0
	Excluded[a]	0	.0
	Total	260	100.0

a. Listwise deletion based on all variables in the procedure.

TABLE 32: Reliability Statistics

Cronbach's Alpha	*N of Items*
.649	4

TABLE 33: Item Statistics

	Mean	*Std. Deviation*	*N*
Q42P	3.32	1.034	260
Q46P	2.98	1.192	260
Q48P	2.92	1.202	260
Q50P	3.18	1.181	260

TABLE 34: Item-Total Statistics

	Scale Mean if Item Deleted	*Scale Variance if Item Deleted*	*Corrected Item-Total Correlation*	*Cronbach's Alpha if Item Deleted*
Q42P	9.08	6.896	.446	.573
Q46P	9.43	6.771	.354	.634
Q48P	9.48	6.459	.406	.598
Q50P	9.22	5.981	.522	.513

TABLE 35: Scale Statistics

Mean	*Variance*	*Std. Deviation*	*N of Items*
12.41	10.389	3.223	4

Internal Validity Decisional Balance Cons

TABLE 36: Case Processing Summary

		N	%
Cases	*Valid*	259	99.6
	Excluded[a]	1	.4
	Total	260	100.0

a. Listwise deletion based on all variables in the procedure.

TABLE 37: Reliability Statistics

Cronbach's Alpha	*N of Items*
.510	4

TABLE 38: Item Statistics

	Mean	*Std. Deviation*	*N*
Q43C	1.14	.486	259
Q45C	1.65	.986	259
Q47C	2.19	1.174	259
Q49C	2.77	1.261	259

TABLE 39: Item-Total Statistics

	Scale Mean if Item Deleted	*Scale Variance if Item Deleted*	*Corrected Item-Total Correlation*	*Cronbach's Alpha if Item Deleted*
Q43C	6.61	6.006	.218	.516
Q45C	6.10	4.103	.423	.328
Q47C	5.56	3.883	.324	.419
Q49C	4.98	3.709	.301	.454

TABLE 40: Scale Statistics

Mean	*Variance*	*Std. Deviation*	*N of Items*
7.75	6.762	2.600	4

9.1.4 Internal Validity SOC for Active Transport

TABLE 41: Case Processing Summary

		N	%
Cases	*Valid*	259	99.6
	Excluded[a]	1	.4
	Total	260	100.0

a. Listwise deletion based on all variables in the procedure.

TABLE 42: Reliability Statistics

Cronbach's Alpha	*N of Items*
.923	4

TABLE 43: Item Statistics

	Mean	*Std. Deviation*	*N*
Q38 SOC	.63	.484	259
Q39 SOC	.68	.468	259
Q40 SOC	.65	.477	259
Q41 SOC	.63	.483	259

TABLE 44: Item-Total Statistics

	Scale Mean if Item Deleted	*Scale Variance if Item Deleted*	*Corrected Item-Total Correlation*	*Cronbach's Alpha if Item Deleted*
Q38 SOC	1.97	1.685	.837	.895
Q39 SOC	1.92	1.869	.691	.942
Q40 SOC	1.94	1.652	.890	.877
Q41 SOC	1.96	1.650	.877	.881

TABLE 45: Scale Statistics

Mean	*Variance*	*Std. Deviation*	*N of Items*
2.59	2.971	1.724	4

9.1.5 Internal Validity Situational Confidence Scale

TABLE 46: Case Processing Summary

		N	%
Cases	*Valid*	255	98.1
	Excluded[a]	5	1.9
	Total	260	100.0

a. Listwise deletion based on all variables in the procedure.

TABLE 47: Reliability Statistics

Cronbach's Alpha	*N of Items*
.746	6

TABLE 48: Item Statistics

	Mean	*Std. Deviation*	*N*
Q51	3.17	1.185	255
Q52	3.02	1.245	255
Q53	2.54	1.273	255
Q54	2.76	1.274	255
Q55	2.29	1.309	255
Q56	3.25	1.339	255

TABLE 49: Item-Total Statistics

	Scale Mean if Item Deleted	*Scale Variance if Item Deleted*	*Corrected Item-Total Correlation*	*Cronbach's Alpha if Item Deleted*
Q51	13.87	23.376	.076	.806
Q52	14.02	17.724	.608	.675
Q53	14.50	18.377	.518	.700
Q54	14.28	17.619	.599	.677
Q55	14.75	18.317	.502	.705
Q56	13.79	16.898	.632	.665

TABLE 50: Scale Statistics

Mean	*Variance*	*Std. Deviation*	*N of Items*
17.04	25.652	5.065	6

9.1.6 Internal Validity URICA

TABLE 51: Case Processing Summary

		N	%
Cases	*Valid*	250	96.2
	Excludeda	10	3.8
	Total	260	100.0

a. Listwise deletion based on all variables in the procedure.

TABLE 52: Reliability Statistics

Cronbach's Alpha	*N of Items*
.822	*20*

TABLE 53: Item Statistics

	Mean	*Std. Deviation*	*N*
Q15 U	3.32	1.186	250
Q17U	3.08	1.005	250
Q18 U	3.44	1.093	250
Q20 U	3.11	1.054	250
Q21 U	2.57	1.063	250
Q23 U	2.51	1.054	250
Q25 U	2.86	1.158	250
Q26 U	3.35	1.058	250
Q27 U	2.46	.998	250
Q28 U	2.89	1.120	250
Q29 U	3.08	1.106	250
Q30 U	2.07	1.015	250
Q31 U	3.23	1.179	250
Q32 U	2.55	1.090	250
Q33 U	2.02	.878	250
Q34 U	2.56	1.115	250
Q35 U	2.71	1.040	250
Q36 U	2.47	1.007	250
Q37 U	2.65	1.160	250
Q24 U	2.35	1.103	250

TABLE 54: Scale Statistics

Mean	*Variance*	*Std. Deviation*	*N of Items*
55.28	*105.895*	*10.291*	*20*

9.1.7 Analysis of Variance Assumptions

A. Tests of Normality

TABLE 55: Tests of Normality

	SOC Stage	**Kolmogorov-Smirnov[a]**			**Shapiro-Wilk**		
		Statistic	*df*	*Sig.*	*Statistic*	*df*	*Sig.*
DBI score	Action	.235	11	.091	.881	11	.106
	Contemplation	.163	16	.200*	.952	16	.524
	Maintenance	.091	153	.003	.981	153	.037
	Precontemplation	.076	69	.200*	.971	69	.106
	Preparation	.174	11	.200*	.949	11	.635
Situational Confidence score	Action	.156	11	.200*	.956	11	.723
	Contemplation	.157	16	.200*	.906	16	.101
	Maintenance	.079	153	.021	.983	153	.061
	Precontemplation	.138	69	.002	.933	69	.001
	Preparation	.202	11	.200*	.889	11	.136

*. This is a lower bound of the true significance.

a. Lilliefors Significance Correction

TABLE 56: Statistics

		SOC Stage	**DBI Score**	**Situational Confidence score**
N	*Valid*	260	260	260
	Missing	0	0	0
Mean			1.1673	2.81
Median			1.2500	2.8
Mode			1.75	2.83
Std. Deviation			.96156	.867
Skewness			-.267	-.077
Std. Error of Skewness			.151	.151
Kurtosis			.312	-.390
Std. Error of Kurtosis			.301	.301

B. Identification of Outliers

FIGURE 6: Box Blot for Decisional Balance Score

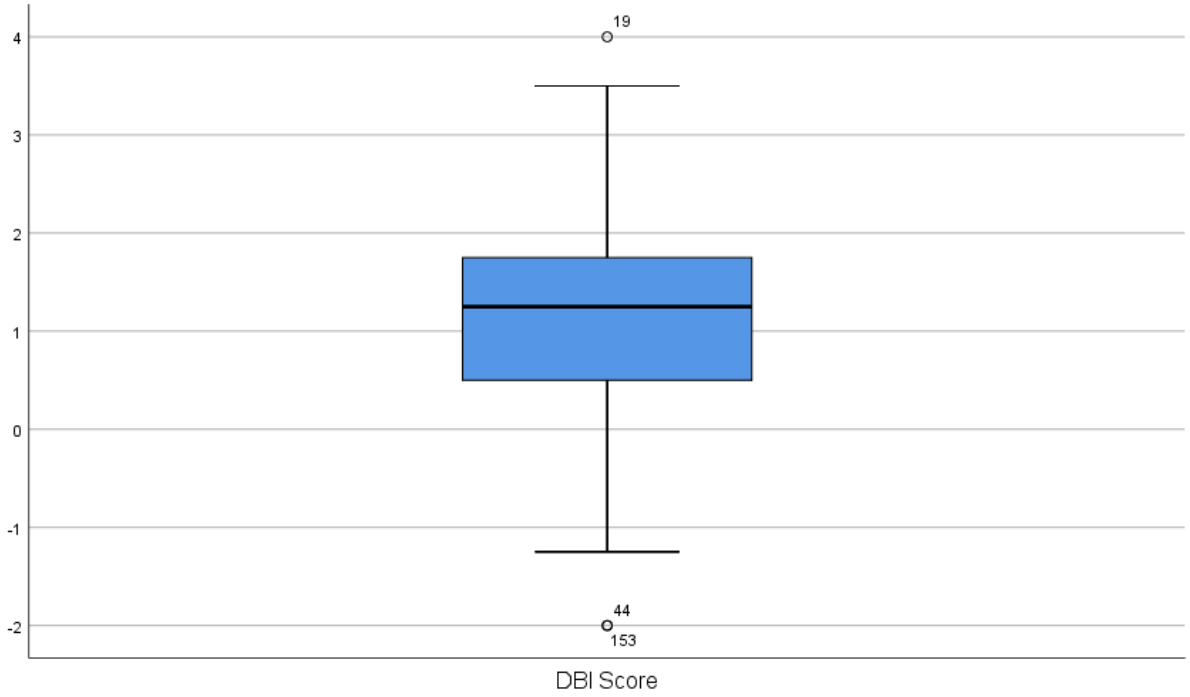
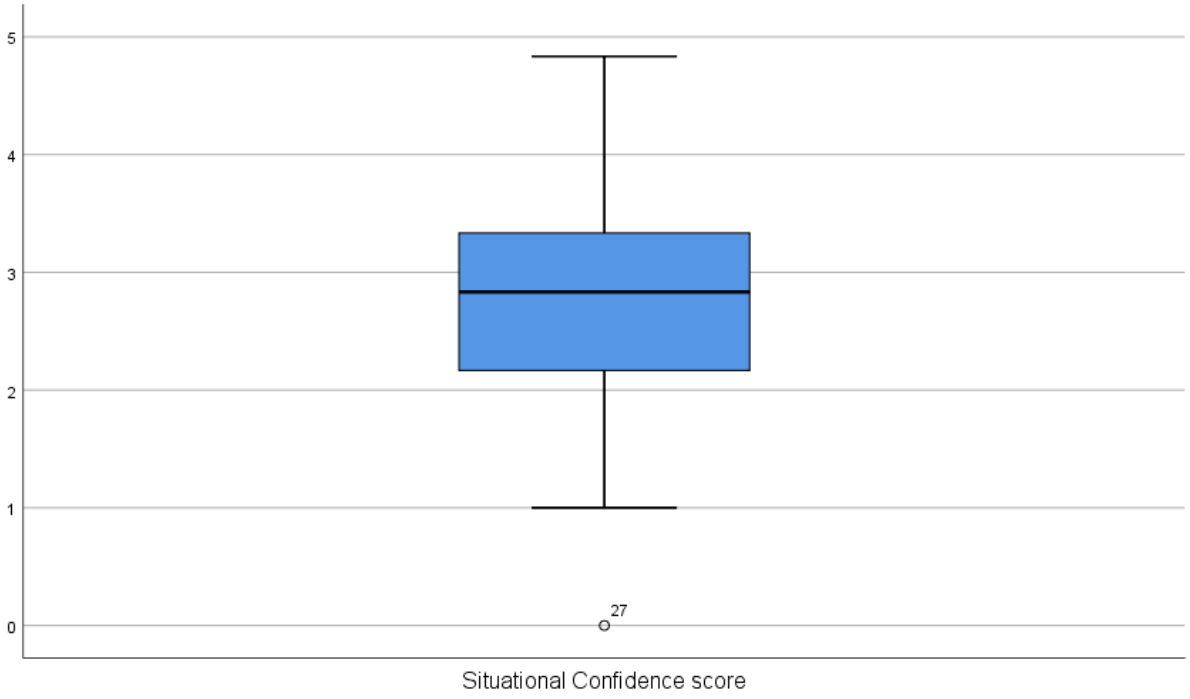


FIGURE 7: Box Plot for Situational Confidence Score



C. Analysis of Variance of DBI Score and SOC Stage

Table 57: Descriptives

Final score

					95% Confidence Interval for Mean			
	N	*Mean*	*Std. Deviation*	*Std. Error*	*Lower Bound*	*Upper Bound*	*Minimum*	*Maximum*
1	68	.5147	.87767	.10643	.3023	.7271	-2.00	2.25
2	17	1.2059	.82080	.19907	.7839	1.6279	.00	2.75
3	11	1.1364	.62614	.18879	.7157	1.5570	.00	2.00
4	11	1.5000	1.10680	.33371	.7564	2.2436	-.25	4.00
5	153	1.4314	.88863	.07184	1.2894	1.5733	-1.25	3.50
Total	260	1.1673	.96156	.05963	1.0499	1.2847	-2.00	4.00

D. Posthoc Tests

TABLE 58: Multiple Comparisons

Dependent Variable: DBI score
Tukey HSD

(I) SOC Stage	(J) SOC Stage	*Mean Difference* (I-J)	*Std. Error*	*Sig.*	**95% Confidence Interval** *Lower Bound*	*Upper Bound*
1	2	-.69118*	.23930	.034	-1.3486	-.0337
	3	-.62166	.28679	.195	-1.4096	.1663
	4	-.98529*	.28679	.006	-1.7732	-.1974
	5	-.91667*	.12862	.000	-1.2700	-.5633
2	1	.69118*	.23930	.034	.0337	1.3486
	3	.06952	.34148	1.000	-.8687	1.0077
	4	-.29412	.34148	.911	-1.2323	.6441
	5	-.22549	.22561	.855	-.8453	.3944
3	1	.62166	.28679	.195	-.1663	1.4096
	2	-.06952	.34148	1.000	-1.0077	.8687
	4	-.36364	.37629	.870	-1.3975	.6702
	5	-.29501	.27548	.821	-1.0519	.4618
4	1	.98529*	.28679	.006	.1974	1.7732
	2	.29412	.34148	.911	-.6441	1.2323
	3	.36364	.37629	.870	-.6702	1.3975
	5	.06863	.27548	.999	-.6882	.8255
5	1	.91667*	.12862	.000	.5633	1.2700
	2	.22549	.22561	.855	-.3944	.8453
	3	.29501	.27548	.821	-.4618	1.0519
	4	-.06863	.27548	.999	-.8255	.6882

*. The mean difference is significant at the 0.05 level.

TABLE 59: Homogenous Subsets DBI Score

Tukey HSD[a,b]			
		Subset for alpha = 0.05	
SOC Stage	*N*	*1*	*2*
1	68	.5147	
3	11	1.1364	1.1364
2	17	1.2059	1.2059
5	153		1.4314
4	11		1.5000
Sig.		.113	.708

Means for groups in homogeneous subsets are displayed.
a. Uses Harmonic Mean Sample Size = 19.092.
b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

9.1.8 Analysis of Variance Situational Confidence Score and SOC

TABLE 60: Descriptives

Situational Confidence score								
					95% Confidence Interval for Mean			
	N	*Mean*	*Std. Deviation*	*Std. Error*	*Lower Bound*	*Upper Bound*	*Minimum*	*Maximum*
1	68	2.21	.81	.099	2.014	2.41	1.00	4.0
2	17	2.32	.73	.178	1.95	2.70	1.33	4.33
3	11	2.45	1.14	.345	1.69	3.22	.00	4.83
4	11	2.41	.77	.233	1.89	2.93	1.33	3.83
5	153	3.19	.68	.055	3.08	3.29	1.50	4.83
Total	260	2.81	.87	.054	2.71	2.92	.00	4.83

E. Posthoc Tests

TABLE 61: Multiple Comparisons

Dependent Variable:							
						95% Confidence Interval	
(I) Compiled results SOC			*Mean Difference (I-J)*	*Std. Error*	*Sig.*	*Lower Bound*	*Upper Bound*
Tukey HSD	1	2	-0.11	0.20	0.981	-0.67	0.44
		3	-0.24	0.24	0.852	-0.91	0.42
		4	-0.20	0.24	0.925	-0.86	0.47
		5	-0.98*	0.11	0.000	-1.27	-0.68
	2	1	0.11	0.20	0.981	-0.44	0.67
		3	-0.13	0.29	0.991	-0.92	0.66
		4	-0.09	0.29	0.998	-0.88	0.71
		5	-0.86*	0.19	0.000	-1.39	-0.34
	3	1	0.24	0.24	0.852	-0.42	0.91
		2	0.13	0.29	0.991	-0.66	0.92
		4	0.05	0.32	1.000	-0.83	0.92
		5	-0.73*	0.23	0.016	-1.37	-0.09
	4	1	0.20	0.24	0.925	-0.47	0.86
		2	0.09	0.29	0.998	-0.71	0.88
		3	-0.05	0.32	1.000	-0.92	0.83
		5	-0.78*	0.23	0.008	-1.42	-0.14
	5	1	0.98*	0.11	0.000	0.68	1.27
		2	0.86*	0.19	0.000	0.34	1.39
		3	0.73*	0.23	0.016	0.09	1.37
		4	0.78*	0.23	0.008	0.14	1.42

*. The mean difference is significant at the 0.05 level.

TABLE 62: Situational Confidence score Homogeneous Subsets

			Subset for alpha = 0.05	
	SOC Stage	*N*	*1*	*2*
Tukey HSD[a,b]	1	68	2.210784313725490	
	2	17	2.323529411764706	
	4	11	2.409090909090909	
	3	11	2.454545454545455	
	5	153		3.186274509803921
	Sig.		.850	1.000

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 19.092.

b. The group sizes are unequal. The harmonic mean of the group sizes is used. Type I error levels are not guaranteed.

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