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Personal attitudes towards positive incentives to reduce the use of Conventionally-fuelled Vehicles: a comparative study in Curitiba, Brazil.

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Abstract

Research has shown a substantial increase in the participation of Conventionally-Fuelled Vehicles (CFVs) in the urban transport modal split. The reasons for this unsustainable reality are multiple, from economic interventions to individual behaviour. The development and delivery of positive incentives for the adoption of more environmental-friendly modes of transport is an emerging strategy to help tackle the problem of excessive use of CFVs. The efficiency of this approach, like other information-based schemes, can benefit from the knowledge of which groups of individuals are more responsive to these types of interventions. This, in turn, supports the better development of strategies directed towards the behavioural choice. The aim of this paper is to compare individual attitudes to positive incentives schemes among different population groups. Much of the evidence to date on the potential efficacy of positive incentives has been gathered in Europe. The context of 'developing' countries has not yet received much research attention in relation to understanding the diverse individual factors that influence the perception of positive incentives for sustainable travel behaviour. Primary data was collected through the development and implementation of a questionnaire, which was administered to 562 undergraduate students from seven different universities in Curitiba, Brazil. Attitudes towards incentives and various individual factors (sociodemographic and psychological) were collected from literature and used as variables in the research. Among the key findings, a higher level of attitude towards incentives was found among women, non-car owners and younger people. The implications of the significant differences are discussed.

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Keywords: Positive incentives; attitudes; theories of behaviour.

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1. Introduction

The use of the so-called Conventionally-fuelled Vehicles (CFVs), such as cars or motorcycles running on fossil fuel derivatives, has notably risen worldwide over the last few decades. The environmental, economic and health-related issues that result from this increase and how to tackle them effectively have been subject of investigation among researchers and public authorities. The solution to these problems invariably involves reducing the levels of car use (Moser and Bamberg, 2008). To achieve such, several types of policies have been experimented. Regulation, pricing and physical modification of transport infrastructure are among the alternatives (Stead, 2016). However, these 'hard' (or structural) measures alone often fail to promote the reduction of car use (e.g. Stopher, 2004). On the other hand, 'soft' measures focus on stimulating a voluntary travel behaviour change (VTBC), usually with the use of information-based techniques such as public awareness campaigns, travel feedback programs or personalised travel planning. These schemes have the potential to change one's beliefs, attitudes and perceptions, thus motivating the adoption of new travel habits (Graham-Rowe et al. 2011). The implementation of soft measures achieved significant reduction rates in car use overall (for a review, see Cairns et al. 2008). An advantage of this type of interventions is that they do not imply in high financial or political costs as often as hard measures (Schade and Schlag, 2003; Moser and Bamberg, 2008).

While some of the 'soft' initiatives still prevail as efficient, others have been losing their performance in recent years, especially when compared to measures that use more innovative forms of delivering information. The traditional use of direct techniques such as personalized travel plans (PTPs) or travel feedback programs (TFPs), for example, often require face-to-face contacts with the individuals concerned (e.g. Meloni et al., 2013), along with travel diary filling or other costly and time consuming activities that act as barriers for a large scale implementation. A scheme that has received recent attention is the use of information technology-based positive incentives. Using a 'reward rather than punishment' approach, this strategy aims to persuade people to make changes in travel behaviour by offering prizes, personalized information, community support, points, discounts, and other instruments of persuasion through smartphone technologies and the web (EMPOWER Project, 2015). Several projects have developed, applied and evaluated positive incentives since the mid-2000s, such as the SUNSET (Sunset project, 2014), TravelSmart® (Hallion, 2007), CommuteGreener® (Matushkina and Nevalennaya, 2011), MOVESMARTER® (Geurs et al., 2015) and others. These projects were mainly based in 'developed' countries and, despite their very relevant documented results, did not offer in-depth examinations about the differences on individual perceptions of different types of incentives, especially in the context of a 'developing' country, where there are cultural particularities when it comes to technology adoption (Ejiaku, 2014).

2. The present study

In respect to soft measures to reduce CFVs use, Richter et al. (2011) argue that different people are influenced by different actors and therefore respond differently to these measures. In line with this, it has been argued that such interventions should be 'personalized'. That is, they should be delivered considering individual characteristics that may influence their behavioural responses to a particular incentive scheme. Prillwitz and Barr (2011) argue that the acceptance of transport-related interventions, in general, is highly influenced by psychological factors like attitudes and habits. The author justifies by adding that measures aimed at changing mobility styles face much more individual constraints and lower levels of public acceptance when compared to practices like recycling or switching to more energy-saving light bulbs. Different studies have tackled this acceptance issue by identifying different attitude-based target groups for the promoting of different types of interventions (Outwater et al., 2003; Anable, 2005; Prillwitz and Barr, 2009; Hunecke et al. 2010; Mikiki and Papaioannou, 2012). These studies often provide policy suggestions to each identified target group, based on their behavioural profiles. However, none of the reviewed studies empirically tested the response people would have to those suggested policies.

This paper is part of a broader research, which aims to evaluate the different levels of individual acceptability to positive incentives and identify what are the factors that contribute to these variations. In addition, a public segmentation approach will be proposed to support the provision of incentives in a tailored manner. This study, in particular, aims to compare individual attitudes to positive incentives schemes among different population groups in Curitiba, Brazil. We assume that attitudes are a significant predictor of intervention acceptance, in accordance with

the Theory of Planned Behaviour (Ajzen, 1991) and with the above-cited travel behaviour literature. Significant predictors of sustainable behaviour were extracted from the social-psychology theory and were assessed in this study's sample. A series of comparative tests were performed to identify significant differences of attitudes towards incentives within particular demographic and psychologic subgroups. Prior to that, a review of the literature was done to identify the kinds of incentives that were successfully implemented in the past and such types were included in the analysis. In summary, this research not only provides a review on the attitudes towards positive incentives, but also offers an empirical comparative overview of the potential individual acceptance of each incentive in Brazil, and what personal aspects might underlie this adoption.

The paper is organized as follows: next section provides the theoretical background of the research. Section 4 offers detailed information on the methodology and research approach. The results are presented in Section 5, followed by a discussion and conclusion in Section 6.

3. Previous research

3.1. Psychological determinants of travel behaviour

While there is little literature explaining the effect that a mobility behaviour intervention might have in different individual profiles, there is a large number of studies that address the individual determinants of typical travel choices like transport mode choice. Aspects influencing these choices for daily commuting are multiple. They can be situational (e.g. trip distance, tolls), socio-economic (e.g. age, gender, income) or psychological (e.g. intentions, attitudes, personal values). There is growing support that psychological and situational factors may, in fact, interact with each other (Steg, Vlek and Slotegraaf, 2001; Collins and Chambers, 2005).

When it comes to explaining mobility choices, many authors have tested constructs that are present in multiple theories of behaviour. Namely, the Theory of Planned Behaviour (TPB) (Bamberg and Schmidt, 2003; Hunecke et al. 2001; Steg, 2005; Anable, 2005; Anable and Gatersleben, 2005; Heldt and Johansson, 2006; Outwater et al., 2003; Hunecke et al., 2010), the Norm-Activation Model (NAM) (Nordlund and Garvill. 2003; Bamberg et al., 2011, Bamberg et al. 2007) and the Theory of Interpersonal Behaviour (TIB) (Bamberg and Schmidt, 2003; Bamberg et al. 2003; Fujii and Garling, 2007; Eriksson et al. 2008). These psychological models are well-established in literature when it comes to explaining the factors underlying the adoption of a behaviour (Anable, 2005). The multiple predictors of behaviour presented in these theories represent useful information for the design of policy interventions. As stated by Fishbein and Ajzen (2011), by identifying the behavioural factors that discriminate between individuals who perform the behaviour of interest and those who do not, properly targeted interventions can be created.

The Theory of Planned Behaviour (TPB), developed by Ajzen (1991), is the most widely researched model of behaviour (Armitage and Conner, 2001). It is essentially an extension of the previously published Theory of Reasoned Action (TRA), by Ajzen and Fishbein (1980). According to the TRA, the most important antecedent of behaviour is intention to act. Intention is conceptualized as "a person's readiness to perform a behaviour" (Fishbein and Ajzen, 2011, p.39) and is determined by two factors: attitudes towards the behaviour in question and subjective norm concerning that behaviour. Attitude is defined as "a latent disposition or tendency to respond with some degree of favourableness or unfavourableness to a psychological object" (Fishbein and Ajzen, 2011, p.76), while norms are conceptualized as "a perceived social pressure to perform (or not to perform) a given behaviour" (Fishbein and Ajzen, 2011, p.130). These relationships were theoretically established in 1980, but years later, Ajzen (1991) extended the theory by including a measure of perceived behavioural control (PBC) as a predictor of intentions and behaviour. The main reason behind this inclusion is that the original model (TRA) had failed to explain behaviours that were not under an individual's volitional control. That is, if external factors prevent a person to engage in a certain behaviour, he will likely not perform it, even if he has strong attitudes, norms and intentions to do so (Sheppard et al. 1988). Having that explained, PBC is defined as an individual's impression about how easy or difficult it would be to perform the behaviour of interest. In general, the higher the individual's confidence on the ability to execute a given behaviour, the higher the likelihood to adopt it.

In the travel behaviour domain, researchers have extensively used the TPB to explain car use, for example. The studies of Steg (2005), Anable and Gatersleben (2005) and Heldt and Johansson (2006), for example, present comprehensive results about the different motivational factors that form attitudes towards the car. Attitudes towards

the environment have also been linked to travel decisions by authors such as Anable (2005) and Donald et al (2014). To allow the formation of more effective transport policies, Hunecke et al. (2010) explored the formation of attitude-based target groups to predict mobility behaviour. Some years before, Outwater et al (2003) and Anable (2005) had already tested the usefulness of this segmentation approach, the former to predict transport mode choice and the latter to suggest more tailored policies for car use reduction.

Apart from considering travel behaviour a result of a reasoned and conscious process, research has provided strong evidence that automatic impulsive processes also influence travel behaviour (Bamberg et al. 2003). In fact, the influence of habit on the adoption of behaviour was preconized by Triandis (1979) in the development of the Theory of Interpersonal Behaviour. The strong relationship of habit and past behaviour with transport mode choice was evidenced by Bamberg et al. (2003) and more recently by Zailani et al. (2016), both extended the TPB by successfully adding habit and/or past behaviour constructs to the predictive model.

A number of authors have also reported extended versions of the TPB attempting to explain travel behaviour. What has received attention over the past years, alongside the addition of habit, is the inclusion of constructs of the Norm-activation Model (NAM) (Schwartz, 1977). This theory was originally proposed to explain altruistic behaviours. The NAM suggests that behaviour is directly predicted by a person's feeling of moral obligation to behave in a certain manner. Personal norms, in turn, are regulated by two factors: the notion that not performing that behaviour can lead to consequences (awareness of consequences) and the belief that the person's own actions could prevent those effects (ascription of responsibility) (Eriksson et al. 2006). When attempting to explain travel behaviours, some studies have addressed these constructs alone (Bamberg et al. 2011; Nordlund and Garvill. 2003), while others have proposed models that use them together with the predictors of the TPB (Anable, 2005; Bamberg and Moser, 2007; Bamberg and Hunecke, 2007; Donald et al, 2014).

Corroborating with the theoretical findings outlined above, a meta-analysis of 36 studies that addressed psychological correlates of car use and non-car use found that all of the TPB constructs, alongside the predictors of the NAM and habit, had significant effects on these behaviours (Gardner and Abraham, 2008).

3.2. Positive incentives and behaviour change

An incentive can be defined as "an event or object external to the individual which can incite action" (Latham and Locke, 1991; Kusumastuti et al., 2012). A positive incentive approach involves giving rewards for the adoption of sustainable alternatives to the car or improving travel choices in general (Kusumastuti et al. 2012). However, restricting the definition of positive incentives to rewarding strategies is inappropriate. In general, projects that used the terminology of positive incentives implement many strategies that do not have a 'punitive' nature to influence travel behaviour. Other types of incentives can take the following forms: giving personalized information, using Travel Demand Management (TDM) marketing strategies, providing self-monitoring tools, using social network to compare behaviour with relatives, etc. (Poslad et al.2015). Large-scale implementation experiences of positive incentives are still premature and consequently, the evidence of their efficacy are still limited, although promising. The next sections present a review of different schemed used to incentivize sustainable mobility behaviour.

3.2.1. Financial Rewards

Rewarding people for adopting a certain behaviour is an effective alternative to traditional punitive measures and its use in the transport context has achieved significant positive results (Ben-Elia and Ettema, 2009). Congestion pricing strategies, for instance, will depend on the availability of alternatives to be effective and the individual response depends on the person's income (Ettema and Verhoef, 2006). High-income commuters are less sensitive to pricing measures than the poor ones, which makes this kind of schemes socially unfair. Nevertheless, past empirical research has indicated that reward schemes are more influential to travel behaviour than charging (Tillema et al., 2013). Rewards can be divided in cash and non-cash. The later might take the form of discount vouchers for retail stores, public transport tickets or public attractions and have already been used in multiple projects (Spitsmijden, INSINC and MOVESMARTER) with positive results. Rewards in the Spitsmijden and INSINC projects were in the form of direct payment, while COMMUTEGREENER and MOVESMARTER used discounts, which were acquired with the accumulation of credits or points. Although the results of both approaches were positive in regards to decreasing car

use, the comparison between their effectiveness is difficult, as their impacts are often measured using different metrics and methods. Ben-Elia and Ettema (2011) state that participants consider rewards as an important tool for initial motivation to engage in the program, but usually do not depend on them to continue participation. This fact can be aligned with the different evaluations about alternatives to the car that are made by users of different modes, as found by past research (Fujii, Gärling and Kitamura, 2001; Beirão and Sarsfield Cabral, 2007). Car users tend to evaluate public transport worse than actual users, so a simple first experience motivated by a reward may be sufficient to shift behaviour. Past research also shows that increasing the size of monetary rewards only has marginal effects on behaviour change (Ben-Elia and Ettema, 2011; Tillema et al., 2013). Thus, from a cost-benefit perspective, the implementation of a small reward can already achieve significant change. The use of different types of rewards such as fast-food discount vouchers, free drinks in restaurants and free WIFI also have a positive effect in peak hour avoidance (Zhang, Fujii and Managi, 2014). Rewarding does not always mean monetary prizes. The use of points, rankings and other gamification techniques has been popular on recent projects such as COMMUTEGREENER, MOVESMARTER, SUNSET and EMPOWER.

Gamification is a recently created concept and refers to "the use of game design elements in non-game contexts" (Deterding et al., 2011). The application of this technique has considerably increased since 2010 and it has shown satisfactory results in motivation and personal engagement across multiple contexts. Examples of an application include motivating students (Denny, 2013), incentivising people to engage in physical exercises (Hamari and Koivisto, 2013) and stimulating people to reduce energy consumption (Gustafsson, Katzeff and Bang, 2010). The use of gamification in urban mobility is still modest. However, the few applications of this strategy in transport have shown optimistic results. An experiment during the STREETLIFE project shows that the proportion of sustainable trips among all recorded journeys went from 42.7% to 60.6% after introducing gamification strategies (i.e. points, badges and leader boards) (Kazhamiakin et al., 2015). As in the case of the STREETLIFE project, these elements can be combined with rewards. Players with the highest amount of points at the end of one month can be rewarded with discount vouchers, for example. The following schemes can be part of a gamification strategy to stimulate voluntary travel behaviour change:

- Points: travellers accumulate points when choosing to commute out of peak hours or by more sustainable modes;
- Badges: different badges (bronze, silver, gold) are given to commuters as a reward for continuing using the system and not using the car. The more the person cycles, for example, the higher the badge. This has the potential to motivate continuous participation in the incentive program;
- Leader boards: rankings are built with the more green travellers on top;
- Challenges: setting up goals for the traveller to earn extra rewards in case of completion.

Financial (cash or vouchers) and non-financial rewards (points, badges) have empirical evidence of effectiveness on travel behaviour. The literature on paying travellers for adopting sustainable behaviour (using cash or vouchers) is more robust since other techniques like multi-mode journey planners are more recent and still less popular among incentives programs. One reason might be because examining the impacts of non-reward incentives do require longer research periods as this type of incentive presumably takes longer to translate into behaviour change. Thus one shall not underestimate the potential of such strategies in comparison with rewards.

A relevant point of consideration is that non-reward incentives are better at provoking *intrinsic* motivation on the individual, which have been linked to being more constant and sustainable in the long run (Gneezy, Meier and Rey-Biel, 2011). These types of motivations are the ones that do not rely on apparent rewards, while extrinsic motivations are dependents of some external controlling variable apart from the individual's own sake (Cameron and David Pierce, 1994). The use of reward tools to stimulate behaviour change has been subject to discussions in the past about whether it has negative effects on individuals' *intrinsic* motivations. In fact, the provision of rewards may lead to positive outcomes in the short term, but may actually weaken intrinsic motivations to a point even lower than it was before the intervention (Gneezy, Meier and Rey-Biel, 2011). Thus, a balance should be reached between not offering incentives at all and offering incentives for such a long period that would rather develop a reduction on intrinsic motivations. Also, assessing these particular impacts of rewards on intrinsic motivations in the transport behaviour field is encouraged, as the literature is still scarce.

3.2.2. Information

Information as an incentive for adopting sustainable mobility behaviour can take a variety of forms. It can act as a support for the trip decision-making process, influencing the time of departure, chosen route or mode of transport; it can take the form of feedback about the consequences of daily travel habits or be able to educate people about the benefits of active travel and the disadvantages of driving. Tillema et al. (2013) have reported the effect of information on reducing levels of car use. Increasing knowledge about the long-term impacts of unsustainable travel behaviour on society and the environment is a crucial aspect of behaviour change (Gärling, Ettema and Friman, 2015). Past research also suggests that the provision of real-time information does affect mobility behaviour. Tseng et al. (2013) compared travel choices of 340 participants in the Netherlands in three different moments: with no incentives, with the provision of real-time traffic information and with the provision of financial rewards. Car travellers, who represented 80.9% of the sample at the beginning of the experiment, dropped to 75.6% with information and to 71.2% with the provision of rewards. The use of sustainable modes was increased, public transport used went from 5.8% to 9% with information and 13.2% with rewards. A longitudinal survey conducted by Taniguchi and Fujii (2007), when testing if the provision of advertising leaflets and free bus tickets affected the travel behaviour of 495 commuters in Japan, demonstrated a significant increase in the use of public transport after the intervention. Beirão and Sarsfield Cabral (2007) also support the notion that lack of information (especially bus routes and timetables) is one of the main issues involving low levels of public transport usage. The authors report that non-users tend to have a perception of difficulty to use the bus service and evaluate its performance worse than actual users. In this sense, positive incentives have a considerable potential to help informing people about the availability of services and consequences of behaviour.

3.2.3. Social networks

Several projects used performance comparison and sharing tools to stimulate people to make more sustainable travel choices, usually using web-based social networks (COMMUTEGREENER, MOVESMARTER, INSINC, SUPERHUB, SUNSET and EMPOWER). The notion that sharing and comparing performance may produce an effect on behaviour is supported by the TPB with its "subjective norm" predictor of behaviour. Research has indicated that an individual's willingness to use a more sustainable mode is influenced by the perception of other people using it (Anable, 2005). Bamberg et al. (2007) expand this idea by arguing that social norms do have an impact on the NAM's construct 'personal norm' (feelings of personal obligation to perform a certain behaviour), and TPB's constructs 'attitudes' and 'perceived behavioural control'. In addition, by allowing users to share their accomplishes in social media, a positive incentive program can increase its public reach, as 'social influence' is notably one crucial aspect of technology acceptance (Venkatesh and Morris, 2000). In conclusion, the use of social media to allow comparison and sharing of sustainable travel behaviour is an efficient technique to influence behaviour and should have more attention of positive incentives programs, especially considering the increasing usage growth of smartphones and other information technologies.

3.2.4. Summary of projects results

Table 1 presents a summary of the reviewed initiatives that have taken place, the types of incentives they used and the results published to-date. Projects that have not announced any results yet, such as MOVESMARTER, were omitted.

Table 1. Projects that use the strategy of positive incentives.

Project/app	Country/Period	Objectives	Incentives	Impacts
SPITSMIJDEN	Netherlands and Belgium (2006-Present)	Peak hours avoidance; Reduce private car use.	3 euro per voided peak hour in road A12; Monthly money reward to avoid peak hours in Rotterdam (up to 120 euros); Points; Information (multilayer web-based map).	2,500 fewer drivers in the peak hours in road A12 in six weeks; 46-50% of participants travelling during rush hour dropped to 26%; Public transport use increased from 4%to 9.5-12% of participants (Ettema et al. 2010).

TRAVELSMART	Australia (2005-2007)	Reduce private car use.	Information about alternatives.	Average 18% reduction on car use per day (10.4km) on participants; Average 5% reduction in car trips among participants; Annual public transport patronage increased by 6.16% (Hallion, 2007).
STREETLIFE	Finland – Italy – Germany (2013 – 2016)	Reduce private car use	Multi-mode journey planner; Advises for sustainable journeys; Gamification techniques.	Reduction on private car use (24.8% to 16.9% of trips); Increase in cycling (1% to 6% of trips); Increase in walking (5% to 12% of trips) (Kazhamiakin et al., 2015).
INSINC	Singapore (2012 – Present)	Reduce the use of public transportation on peak hours	Financial; Points; Social incentives.	7.49% decrease in peak hour trips (Pluntke and Prabhakar, 2013).
SUPERHUB	Multiple European countries (2011 – 2014)	Reduce private car use.	Goal-setting and goal review; Feedback and rewards; Social comparison; Personalized information.	14% increase in sustainable transport choices (apart from the car) (Gabrielli and Maimone, 2013).
SUNSET	Multiple European countries (2011-2014)	Reduce private car use; Avoid peak hours.	Real-time travel information; Feedback and self-monitoring; Rewards and points; Social networks.	Departure in peak hours dropped by 3%; Car use dropped from 63% to 57-47%; Use of public transport increased from 9% to 10-16% (SUNSET Project, 2014).
EMPOWER	Multiple European countries (2015 – Present)	Reduce CFVs' dependence.	Rewards; Adding objects to the environment; Shaping knowledge; Goals and planning; Feedback and monitoring; Natural consequences; Comparison of behaviour.	The CommuteGreener app has about 50,000 participants; Developers of the CommuteGreener app estimate that 37 million kilometres were travelled by public transport using the tool (Empower Project, 2018); The SMART app registered 102,609 trips made by 1,146 active users in August 2017 (Empower Project, 2018); Project outputs are currently being gathered within seven European take-up cities and results are still to be published.
CHANGERS app	Worldwide (unknown)	Reduce private car use.	Rewards; Feedback; Competition.	24,822 people using the app on 116 countries (EMPOWER Project, 2018).
CAPRI App	United States (unknown)	Reduce peak hour traffic	Gamification; Rewards; Competition.	Participants avoided peak hours by up to 30.1% (Zhu et al. 2015).

Based on the projects reviewed above and the categories evidenced by Poslad et al. (2015) and Ben-Elia and Ettema (2011), the following groups of incentives were identified and assessed in this research (Table 2).

Table 2. Theoretical categorisation of incentives.

Rewards	Information	Sharing
Cash; Discount vouchers; Points; Badges; Rankings; Challenges.	Maps; Journey planner; Real-time road conditions; Feedback on travel behaviour.	Behaviour sharing in social media; Buddying with someone to engage in the same travel behaviour (e.g. riding a bike together).

3.3. Theoretical framework

Further from identifying relevant aspects of travel behaviour and initiatives of positive incentives that have stimulated behavioural changes, a framework illustrating the theoretical relationships to be tested in this research was developed (Figure 1). All TPB, TIB and NAM constructs that were previously identified as influencers of travel behaviour in the literature were included. Differences in attitudes to eleven different types of positive incentives were tested in different individual profiles considering these behavioural and sociodemographic factors.

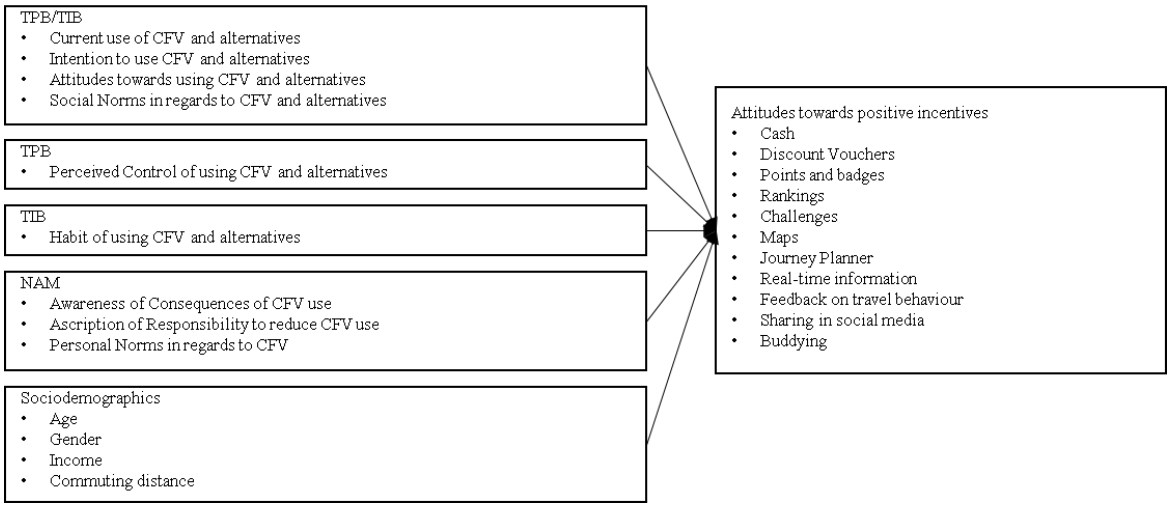

Fig. 1. Theoretical framework

4. Method

4.1. Study context

Curitiba is a well-known city in regards to urban planning and public transport system innovations in Brazil (Newman, 1996; Cervero, 1998). Brazil has an ongoing trend towards urban motorization and Curitiba plays a significant role. With as many as 700 cars per 1000 inhabitants, the city has the highest motorization rate among Brazilian Capitals. Between 2007 and 2017, the number of CFVs increased from 990.496 to 1.399.261 (number of licensed cars, motorbikes and pickup trucks), representing a 41.3% growth (DENATRAN, 2018). Attitudes may play a significant role in the high motorization rate of Brazil. Past research found that people in ‘developing’ countries have more desire in owning a car when compared to more ‘developed’ nations (Belgiawan et al., 2014). This is possibly because the quality of public transport and other alternatives to the car is worse in this particular context. The use of more environmental-friendly modes in Curitiba such as bikes, for example, is not culturally present in people’s everyday life, as their use is more frequent in sporadic leisure activities than in regular, day-to-day transportation (Kienteka, Reis and Rech, 2014).

4.2. Sample and procedure

A questionnaire was administered to undergraduate students in seven different universities located in Curitiba, from 4th April to 15Th June 2018. With this purposive sampling strategy, a non-probabilistic sample resulted, which is sufficient in order to observe the variables' relationships that this study aims. The strategy of surveying students was adopted because the likelihood of reaching a big sample was assumed to be higher, without implicating in high technical costs. Additionally, people from 18 to 24 years old are the group that mostly use the internet in Brazil: 85. 3% against a 64.7% average of the entire population (IBGE, 2016). People that started college also have a very high rate of internet usage (97.1%). Data concerning smartphone ownership also show this discrepancy between educational levels: 97.1% of people who at least started college against 77.1% average. Applying the survey to this sample increases the probability that respondents are familiar with the presented smartphone-based incentives. The administration of the questionnaire followed an organized group response. In this approach, students filled the survey in their respective classrooms after authorization of the responsible professor, who allowed a 20-minute period of the class to be taken. The researcher was present during the whole activity to answer any questions regarding interpretation, personally. Each group of students answered the questionnaire simultaneously and individually. Thirt-eight classes were surveyed, resulting in a total sample of 920 students (N=920). The questionnaire was constructed taking into account potential issues in survey completion, namely: satisficing, acquiescence, question-order effects, response-order effects and socially desirable bias (Krosnick and Presser, 2010). Before official administration, the survey was subject to two pretests in the form of field pilot studies (20 and 25 students participated). The exact administration protocol was simulated in both approaches, leading to the uncovering of question-interpretation issues, excessive missing values, unclearness of scales and practical problems such as an excessive time to complete. The questionnaire was refined based on these outputs and the final version was finally administered to the whole sample.

4.3. Measures

The independent variables included on this study correspond to theories of behaviour that already have empirical evidence within the travel behaviour research field, especially when it comes to explaining sustainable travel choices, as highlighted above in Section 2. Although the scales shown below are in English for presentation purposes, the original questionnaire was applied in Portuguese.

4.3.1. Variables of the TPB

Attitudes towards using the car, the bus and the bike for university commuting were measured using two semantic differential scales (*like/dislike* and *pleasant/unpleasant*), each using a 7-point bipolar scale from -3 to +3. Subjective norms were assessed with the following question to each of the three transport modes: Thinking about the important people in your life, how would they react to you using the car/bus/bike to go to the university? Two semantic differential scales were used (*would completely oppose/would completely support* and *think I should not use/think I should use*). Intention was measured using the following item: during the next month of classes, how often do you intend to use the car/bus/bike? A seven-point unipolar labelled scale was used, from *1-3 trips a week* to *more than 18 trips a week*. Actual behaviour was assessed asking participants to report how often they used the car/bus/bike for university routes within the last month, using the same scale of 'intention'. The TPB-related scales were constructed based on the guidelines provided by Fishbein & Ajzen (2011).

4.3.2. Variables of the NAM

The constructs related to the NAM were all measured using seven-point bipolar scales (*very true/very false*). These scales were adapted from previous publications that have used the NAM in transport-related research (Nordlund and Garvill 2003). Personal norm was measured with the following two-items: '*I feel morally obliged to use the car as less as possible'* and '*I feel obliged to use alternative modes to the car due to personal values'*. Awareness of consequences was composed by three statements: *Car-related pollution can lead to irreversible consequences to the planet; traffic noise decreases the quality of life in the cities* and; *the increasing level of cars is a threat to planet*

resources. Two statements were constructed for measuring 'Ascription of responsibility': *My decision about which transport mode to use makes me responsible for air pollution* and *I have the ability to reduce the environmental and social threat associated with car use.*

4.3.3. Variables of the TIB

Apart from Personal Norm (which is also present in the NAM), Car Habit was measured using the *response-frequency measure of habit* (RFM) introduced by (Lanken *et al.*, 1994). This method consists of asking respondents to pick which travel mode they would choose for different activities (e.g. going to a bar, visiting friends or going shopping). Participants are asked to respond quickly, without much deliberation. The strength of car use habit (for example) is extracted from the number of times a person chose a car as mode of transport. Six activities were presented to participants (*visiting family/practice sports/go shopping/go to the park on a sunny day/go to the supermarket/go out with friends in the evening*). Thus, the car habit score ranged from 0 to 6.

4.3.4. Sociodemographic

General sociodemographic variables that may potentially have a relationship with attitudes towards incentives were assessed (age, gender and income level). Distance from home to the university was also measured using an open-ended question.

4.3.5. Attitudes towards positive incentives (dependent variable)

Personal attitudes towards eleven different forms of positive incentives were assessed using seven-point semantic differential scales (*I don't like it/I like it a lot)*. As we assume that the sample studied has little to no knowledge about the positive incentives addressed in this study, an explanatory text of each type of incentive was presented before each question. The list of the assessed incentives and correspondent descriptions are shown below:

- Maps: Access a digital map containing information on bicycle routes, bus routes and schedules and walking routes;
- Money: To be able to reverse the mileage I take by bus, bicycle or on foot for money;
- Points and badges: Collect points and earn badges (bronze, silver or gold, for example) by using alternate modes (e.g. "you're a Gold level rider!");
- Ranking: Participate in a ranking showing people who most cycle, take the bus or walk in Curitiba (ex: "You are the 3rd in the ranking of sustainable modes' use in Curitiba!");
- Discount Vouchers: You can revert your trips by bus, on foot or by bicycle for discount vouchers (ex: department stores, movie tickets);
- Journey Planner: Have access to a trip planner showing information about the route you want to do (distance, duration, physical effort, cost, emissions) for each mode of transport in Curitiba;
- Real-time information: To have access to real-time information, including bus schedules, weather and traffic problems (e.g., "the next bus will pass in 5 minutes", "tomorrow will be sunny, how about using your bike?"; "traffic is chaotic now, how about going on foot?");
- Personalized Feedback: Have an individual report on my last trips and their consequences (distance travelled, total travel time, amount of pollutants emitted, calories spent, etc.);
- Social Media: Being able to share my travelling habits with friends and family through social networks (e.g. 'your name' has just taken a 12km bike ride!);
- Challenges: Receive periodic challenges to complete (ex: "challenge of the week – ride your bike for 10km!");
- Buddying: Find someone else who can join me to ride a bike, walk, or a bus trip. (e.g., "your friend goes to the university on the same line that passes by your home, how about going?").

4.4. Statistical analysis

Initially, confirmatory factor analysis (CFA) was conducted to confirm the validity of the TPB, TIB and NAM constructs that have more than one measuring item. Next, a principal component analysis (PCA) with Varimax rotation was performed to identify a smaller number of sets of highly correlated incentives, to be used in further analysis. We expected that the encountered factors would somehow match the theoretical categorization we previously assumed (Table 2). Comparative tests were done using independent t-tests and one-way analysis of variance, depending on the number of grouping variables. The dependent variable was computed in two different ways: using an averaged scale of all the eleven different types of incentives and; a summated scale of the separate categories of incentives revealed by the PCA. *Post-hoc* analysis was performed when appropriate.

5. Results

5.1. Descriptive statistics

From the 562 assessed students, 286 are men (50.9%), the average age was 22.1 years old. During the week preceding the completion of the questionnaire, 69% of students reported they went to the university by car at least once, while 62% used the bus, 19% walked, 9.6% used the bike and 5.5% went to the university by motorbike. Looking at the main mode of transportation (mode mostly used during that week), the car was reported by 43.1% of the respondents, followed by the bus (39.9%), walking (9.3%), bike (5.1%) and finally motorbike (2.5%). Average distance to the university was 11.1 kilometres with a standard deviation of 9.9km.

5.2. Test of measurement models

To check the quality of the measurement model for the latent constructs, confirmatory factor analysis (CFA) was performed using IBM® SPSS AMOS 21 (maximum-likelihood estimator). The sample used in this analysis reduced to 435, because only cases with no missing data in all variables were assessed. Single-item constructs were excluded from CFA since they cannot correct for measurement errors. One of the components of PBC, which measures autonomy to use each transport mode (PBC 2), had a very low factor loading (0.256) with respect to the bus and was excluded from the analysis. It is assumed that this poor loading is due to translation issues from the original scale to Portuguese, which may have not been optimal in this case. The resulting fit of the measurement model was good, $\chi^2(175, N=435) = 238.26$; $p < .001$; $\chi^2/df = 1.361$; RMSEA = .040; GFI = .944; CFI = .967. Table 3 summarizes the factor loadings, along with indicators of convergent validity (Average Variance Extracted – AVE) and construct reliability (Composite Reliability – CR and Cronbach's alpha - CA).

Table 3. Confirmatory Factor Analysis for composite scales (N=435).

	λ[a]			AVE			CR			CA		
Indicator	Car	Bus	Bike	Car	Bus	Bike	Car	Bus	Bike	Car	Bus	Bike
Attitudes[b]	-	-	-	0.660	0.687	0.712	0.791	0.814	0.832	0.745	0.807	0,83
ATT 1[c]	0.916	0.879	0.856	-	-	-	-	-	-	-	-	-
ATT 2	0.693	0.775	0.832	-	-	-	-	-	-	-	-	-
Subjective norm(SN)	-	-	-	0.741	0.728	0.799	0.851	0.843	0.888	0.85	0.842	0,889
SN 1	0.850	0.851	0.904	-	-	-	-	-	-	-	-	-
SN 2	0.872	0.856	0.884	-	-	-	-	-	-	-	-	-
Perceived Behavioural Control (PBC)	-	-	-	0.598	-	0.498	0.730	-	0.658	0.657	-	0,633
PBC 1	0.971	1	0.82	-	-	-	-	-	-	-	-	-

PBC 2	0.504	-	0.569	-	-	-	-	-	-	-	-	-
Personal norms (PN)	-			0.533			0.692			0.682		
PN 1	0.636			-			-			-		
PN 2	0.813			-			-			-		
Awareness of Consequences (AC)	-			0.591			0.811			0.799		
AC 1	0.805			-			-			-		
AC 2	0.653			-			-			-		
AC 3	0.835			-			-			-		
Ascription of Responsibility (AR)	-			0.435			0.606			0.590		
AR 1	0.692			-			-			-		
AR 2	0.626			-			-			-		

Note. AVE = Average variance extracted; CR = Composite reliability, CA = Cronbach's Alpha.
a. Standardized factor loadings
b. Latent constructs
c. Indicator items

Other constructs such as Habit, Intention and Actual Behaviour were assessed using single-item scales.

After the validation of the latent constructs, exploratory factor analysis with Varimax orthogonally rotation was conducted to identify meaningful categories of incentives which would increase the options for analysis. Three factors were extracted following the criteria of *eigenvalues* higher than 1. Table 4 presents the standardized factor loadings (values higher than 0.4 are highlighted).

Table 4. Principal Component Analysis for composite scales.

	λ^a		
Incentives	1	2	3
Rankings	**0.838**	-0.143	0.227
Points	**0.783**	-0.197	0.275
Social Media	**0.738**	0.109	-0.154
Challenges	**0.723**	0.131	-0.113
Buddying	**0.433**	0.225	-0.056
Journey Planner	0.021	**0.821**	0.011
Real-time information	0	**0.762**	0.103
Personalized feedback	0.391	**0.513**	-0.066
Maps	-0.017	**0.496**	0.331
Money	0.034	0.038	**0.867**
Discount Vouchers	0.085	0.301	**0.689**

a. Standardized factor loadings

The three generated factors have sufficient internal reliability (Cronbach's alpha > 0.70) and can be interpreted as three different categories: Factor 1 contains incentives that are related with competition strategies or sharing; Factor 2 represents information-type incentives and Factor 3 involves financial rewarding. This grouping approach almost corroborates with the previous theoretical categorization (Table 2), except for competition variables (using gamification strategies) that are now grouped with social network-related incentives instead of financial rewards.

5.3. Mean scores of dependent variables

To assess which incentive types are the most "preferred" among the students, attitude means were computed. After organising incentives in descending order of attitudes mean scores, a paired t-test was conducted to check for statistical significance between each pair of subsequent incentives on the list (e.g. voucher and money, money and real-time information, etc.) (Table 5).

Table 5. Difference in attitudes towards incentives means scores.

Factor	Incentives	M	SD	t[a]
Rewards	Voucher	6.54	0.93	-0.52
	Money	6.51	1.13	3.12**
Information	Real-time information	6.35	1.13	2.35*
	Maps	6.27	1.13	3.64***
	Journey-Planner	6.07	1.28	6.04***
	Feedback	5.66	1.54	-0.04
Gamification and sharing	Buddying	5.65	1.59	11.75***
	Challenges	4.69	1.83	-1.56
	Ranking	4.67	1.84	3.19***
	Points	4.48	1.84	11.72***
	Social media sharing	3.52	1.86	

Note. Mean scores range from 1 to 7.
a. Paired t-test between the mean of the incentive and the mean of the immediate below incentive.
* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Rewarding incentives were the most preferred type overall, with no statistical difference between vouchers and money (p-value > 0.05). Informational incentives come up second on the list, followed by gamification and sharing tools. Considering the possible scores on the scale (1 to 7), the attitude means were generally high to all of the incentives. Even the least preferred incentive scored higher than the scale mid-point (3.52). Only three pairs of incentives had no significance on their mean differences (voucher and money, feedback and buddying and challenges and ranking).

5.4. Comparative tests

The investigation of significant differences in attitudes towards incentives among particular demographic and psychological subsets of students was done in two phases. First, three summated scales were created considering the identified categories of incentives ('Financial Rewards', 'Information' and 'Gamification and Sharing') and significant differences were examined. Next, the investigation of differences was done considering a single summated scale considering all the eleven scores of attitudes towards incentives. Table 6 shows tests of significant differences in attitudes towards the categories of incentives (independent t-tests).

Table 6. Difference in attitudes towards incentives factors mean scores among subgroups.

	Information				Financial Rewards				Gamification and sharing			
	n	M	SD	Sig.	n	M	SD	Sig.	n	M	SD	Sig.

Gender											
Men	228	23.89	3.62	p < 0.01	229	12.96	1.94	229	22.47	6.53	
Women	202	24.91	3.86		202	13.17	1.68	203	23.61	6.60	
Car ownership											
No	249	24.57	3.89		250	13.21	1.61	250	23.77	6.39	p < 0.01
Yes	181	24.09	3.58		181	12.85	2.07	182	21.95	6.71	
Bike ownership											
No	294	24.31	3.76		294	13.03	1.82	295	22.91	6.42	
Yes	136	24.49	3.79		137	13.12	1.85	137	23.20	6.94	

Note. Information mean scores range from 4 to 28. Rewards mean scores range from 2 to 14. Gamification and sharing mean scores range from 5 to 35. Blank cells represent no significance found at the 0.05 level.

Women showed a significantly higher attitude toward information incentives compared to men ($p < 0.01$), while car owners revealed to have significantly lower attitudes towards gamification and sharing incentives ($p < 0.01$). Rewarding did not have any significant differences in relation to gender or owning a car/bike. Bike owners do not differ from others in terms of attitudes towards any category of incentives. Multiple one-way analysis of variance were executed to test variables that had three or more groups (Age, Mode mostly used, Income and Distance to campus). None of the tests reported the existence of significant differences in respect to the incentives categories. Nevertheless, when considering attitudes towards all incentives together, some meaningful differences show up. First, we present the results of independent t-tests that showed significance (Table 7).

Table 7. Difference in attitudes towards all incentives mean scores among subgroups.

Indicator	n	M	SD	Sig.
Gender				
Men	283	5.423	0.906	p < 0.05
Women	262	5.599	0.953	
Car ownership				
No	342	5.604	0.905	p < 0.01
Yes	211	5.339	0.949	
Attitudes towards bike				
Negative	206	5.377	0.991	p < 0.05
Positive	185	5.608	0.800	
Attitudes towards bus				
Negative	247	5.398	0.947	p < 0.01
Positive	118	5.740	0.810	
Subjective Norms - Bus				
Negative	59	5.193	0.955	p < 0.01
Positive	441	5.543	0.896	
Personal Norms				
Negative	234	5.261	0.975	p<0.001
Positive	149	5.754	0.774	
Awareness of Consequences				
Negative	29	5.085	1.074	p < 0.05
Positive	397	5.527	0.900	

Note. Mean scores range from 1 to 7. Not significant tests were omitted for better presentation.

The psychological aspects were treated as binary variables, in which if a respondent scored negatively on the original bipolar scale, its value was converted to 0, while positive scores became 1. This transformation resulted in two groups of students: those who scored positively on each psychological variable and those who scored negatively (e.g. positive and negative attitudes towards the bike). Women and non-car owners have significant higher levels of attitudes towards incentives ($p < 0.05$ and $p < 0.01$). When looking at psychological variables, students that better evaluate the bike or the bus as modes of transport report greater attitudes to incentives ($p < 0.05$ and $p < 0.01$), as well as students who feel socially influenced to use the bus ($p < 0.01$). Participants who scored positively in personal norm and awareness of consequences of car use have a significant higher attitude to incentives ($p < 0.001$ and $p < 0.05$).

Bike ownership, attitudes towards the car, subjective norms related to the bus and the bike, perceived behavioural control over the three transport modes and ascription of responsibility were also tested but no significant differences were revealed.

While different levels of intention to use the bike, financial income and distance to campus did not show significant differences in regards to attitudes towards incentives, the variables presented in Table 8 did.

Table 8. Difference in attitudes towards all incentives mean scores among indicators with larger than three groups.

	N	M	SD	F[a]	Sig.
Mode mostly used					
Car	201	5.406	0.928	3.949	$p < 0.01$
Bus	184	5.596	0.885		
Bike	23	5.763	0.915		
Walking	43	5.850	0.724		
Age					
<= 18	87	5.679	0.859	4.130	$p < 0.01$
>= 19 <= 20	193	5.607	0.836		
>= 21 <= 22	129	5.438	0.956		
>= 23 <= 24	55	5.514	0.794		
> 25	89	5.191	1.144		
Car Habit					
0	10	5.536	0.533	3.798	$p < 0.01$
1	23	5.522	1.205		
2	50	5.724	0.773		
3	94	5.706	0.793		
4	118	5.472	0.833		
5	76	5.388	1.006		
6	24	4.852	0.938		

Note. Mean scores range from 1 to 7. Not significant tests were omitted for better presentation.
a. One-way analysis of variance F-test.

In respect to transport mode mostly used to go to campus, a *post-hoc* analysis using Scheffe's test showed that specifically, car users have significant lower attitudes to incentives when compared to students who walk to campus. There was also a significant difference between younger and older students ($p < 0.01$). *Post-hoc* analysis shows that students older than 25 have lower attitudes to incentives when compared with those younger than 20. When analysing the seven possible scores of habit, students who have a very strong car habit (scored six) have significantly lower attitudes than all the others.

6. Conclusions

One of the contributions of this work is the provision of a systematic categorisation of positive incentives and how these are viewed by different people. This knowledge deepens the understanding of the variety of forms that this kind of behaviour intervention might take and its potential public acceptability. The demonstration of the types of incentives that have already shown an impact in previous implementation projects (Table 1) might subsidize future work by providing a research guideline and inspiring the envision of new incentive alternatives. A similar research effort of this nature is being conducted in the EMPOWER Project (2018).

The results of this research also demonstrate that an incentive-based intervention in the city of Curitiba could be positively received by the population, especially by the younger people of the sample (less than 20 years old). Attitudes towards this kind of scheme among university students, as evidenced here, are very positive. These findings are in line with those found by the SUNSET Project, which also measured the attractiveness of incentives (Kusumastuti et al. 2012). This paper builds on the results of SUNSET by testing more types of incentives using a larger sample and relating these attitudes to individual aspects. This output can stimulate future research about the acceptance of positive incentives, particularly in 'developing' countries, which were not subject to any publication so far.

Another contribution of this paper is the demonstration of how different people have significantly different attitudes towards positive incentives initiatives, in particular. This output discreetly helps to fulfil a knowledge gap verified by Richter et al. (2011), in regards to the identification of proper target groups for the implementation of 'soft' measures. It also helps to cover the research gap identified by Bamberg et al. (2011), who state that the connection between causal determinants of car use and voluntary change techniques should be better understood. The different susceptibility levels that people have to different positive incentives for sustainable travel behaviour was already evidenced by Anagnostopoulou et al. (2016), but this paper indicates that a portion of these divergences may advent from differences on the individual attitudes towards incentives. We also provide evidence on what types of individual factors might underlie these discrepancies. Participants with different levels of psychological constructs that notably correlate with transport mode choices like attitudes, norms and habit were found to have significantly different perceptions about incentives. Indeed, these behavioural constructs are significantly influenced by information-based behaviour change policies (Bamberg et al. 2003). Attitudes towards incentives were also different when looking at easily accessible sociodemographic variables of the population, especially age and gender. Owning a car also proved to be a significant variable when observing differences in these attitudes.

This study provides a good starting point to seek for better understanding of the behavioural process underlying individual acceptance of positive incentives to reduce CFVs use. From a technological point of view, it also contributes to the future development of innovative initiatives for the reduction of car use, especially in the context of a 'developing' country.

Surveying students is a potential limitation of the study since the psychology profile of this group might be biased. Also, the measures coming from the theories' that underlie this research are originally in English and a translation to Portuguese was made. Despite the authors' efforts to make it as most accurate as possible, some elements of bias might still be present.

The replication of a study of this nature using representative samples would be able to provide a better evidence for that end. Future research efforts could also be made to understand the magnitude of the influence that each personal factor has on accepting each type of positive incentive.

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References

Ajzen, I. (1991) 'The theory of planned behavior', Orgnizational Behavior and Human Decision Processes, 50, pp. 179–211. doi: 10.1016/0749-5978(91)90020-T.

Ajzen, I. and Fishbein, M. A. (1980) 'Uncerstanding Attitudes and Predicting Social Behavior Prentice-Hall', ResearchGate, 278. Available at: https://www.researchgate.net/publication/235361088_Uncerstanding_Attitudes_and_Predicting_Social_Behavior_Prentice-Hall.

Anable, J. (2005) '"Complacent Car Addicts"; or "Aspiring Environmentalists"? Identifying travel behaviour segments using attitude theory', Transport Policy, 12(1), pp. 65–78. doi: 10.1016/j.tranpol.2004.11.004.

Anable, J. and Gatersleben, B. (2005) 'all work and no play? The role of instrumental and affective factors in work and leisure journeys by different travel modes', World Transit Research. Available at: http://www.worldtransitresearch.info/research/2030.

Anagnostopoulou, E. et al. (2016) 'Persuasive Technologies for Sustainable Urban Mobility', arXiv:1604.05957 [cs]. Available at: http://arxiv.org/abs/1604.05957.

Armitage, C. J. and Conner, M. (2001) 'Efficacy of the Theory of Planned Behaviour: A meta-analytic review', British Journal of Social Psychology, 40(4), pp. 471–499. doi: 10.1348/014466601164939.

Bamberg, S. et al. (2003) 'Choice of Travel Mode in the Theory of Planned Behavior : The Roles of Past Behavior , Habit , and Reasoned Action Choice of Travel Mode in the Theory of Planned Behavior : The Roles of Past Behavior , Habit , and Reasoned Action', (August 2016), pp. 37–41. doi: 10.1207/S15324834BASP2503.

Bamberg, S. et al. (2011) 'Behaviour theory and soft transport policy measures', Transport Policy, 18(1), pp. 228–235. doi: 10.1016/j.tranpol.2010.08.006.

Bamberg, S., Hunecke, M. and Blöbaum, A. (2007) 'Social context, personal norms and the use of public transportation: Two field studies', Journal of Environmental Psychology, 27(3), pp. 190–203. doi: 10.1016/j.jenvp.2007.04.001.

Bamberg, S. and Möser, G. (2007) 'Twenty years after Hines, Hungerford, and Tomera: A new meta-analysis of psycho-social determinants of pro-environmental behaviour', Journal of Environmental Psychology, 27(1), pp. 14–25. doi: 10.1016/j.jenvp.2006.12.002.

Bamberg, S. and Schmidt, P. (2001) 'Theory-driven subgroup-specific evaluation of an intervention to reduce private car use', Journal of Applied Social Psychology, 31(6), pp. 1300–1329. doi: 10.1111/j.1559-1816.2001.tb02675.x.

Bamberg, S. and Schmidt, P. (2003) 'Incentives, Morality, Or Habit? Predicting Students' Car Use for University Routes With the Models of Ajzen, Schwartz, and Triandis', Environment and Behavior, 35(2), pp. 264–285. doi: 10.1177/0013916502250134.

Beirão, G. and Sarsfield Cabral, J. A. (2007) 'Understanding attitudes towards public transport and private car: A qualitative study', Transport Policy, 14(6), pp. 478–489. doi: 10.1016/j.tranpol.2007.04.009.

Belgiawan, P. F. et al. (2014) 'Car ownership motivations among undergraduate students in {China}, {Indonesia}, {Japan}, {Lebanon}, {Netherlands}, {Taiwan}, and {USA}', Transportation, 41(6), pp. 1227–1244. doi: 10.1007/s11116-014-9548-z.

Ben-Elia, E. and Ettema, D. (2009) 'Carrots versus sticks: Rewarding commuters for avoiding the rush-hour-a study of willingness to participate', Transport Policy, 16(2), pp. 68–76. doi: 10.1016/j.tranpol.2009.03.005.

Ben-Elia, E. and Ettema, D. (2011) 'Rewarding rush-hour avoidance: A study of commuters' travel behavior', Transportation Research Part A: Policy and Practice, 45(7), pp. 567–582. doi: 10.1016/j.tra.2011.03.003.

Blair H. Sheppard, J. H. and P. R. W. (1988) 'The Theory of Reasoned Action: A Meta-Analysis of Past Research with Recommendations for Modifications and Future Research', Consumer Research, 15(December), pp. 325–343. Available at: http://www.jstor.org/stable/2489467.

Cairns, S. et al. (2008) 'Smarter choices: {Assessing} the potential to achieve traffic reduction using "soft measures"', Transp. Rev., 28(5), pp. 593–618. doi: 10.1080/01441640801892504.

Cervero, R. (1998) The Transit Metropolis: A Global Inquiry. Island Press.

Collins, C. M. and Chambers, S. M. (2005) 'Psychological and Situational Influences on Commuter-Transport-Mode Choice', Environment and Behavior, 37(5), pp. 640–661. doi: 10.1177/0013916504265440.

DENATRAN, D. N. de T.- (2018) Frota de Veículos - 2018. Available at: https://www.denatran.gov.br/estatistica/635-frota-2018 (Accessed: 10 July 2018).

Denny, P. (2013) 'The Effect of Virtual Achievements on Student Engagement', in Proceedings of the SIGCHI Conference on Human Factors in Computing Systems. New York, NY, USA: ACM (CHI '13), pp. 763–772. doi: 10.1145/2470654.2470763.

Deterding, S. et al. (2011) 'From Game Design Elements to Gamefulness: Defining "Gamification"', in Proceedings of the 15th International Academic MindTrek Conference: Envisioning Future Media Environments. New York, NY, USA: ACM (MindTrek '11), pp. 9–15. doi: 10.1145/2181037.2181040.

Donald, I. J., Cooper, S. R. and Conchie, S. M. (2014) 'An extended theory of planned behaviour model of the psychological factors affecting commuters' transport mode use', Journal of Environmental Psychology. Elsevier Ltd, 40, pp. 39–48. doi: 10.1016/j.jenvp.2014.03.003.

Ejiaku, S. A. (2014) 'Technology adoption: issues and challenges in information technology adoption in emerging economies', Journal of International Technology and Information Management, 23(2), pp. 59–69. Available at: http://go.galegroup.com/ps/i.do?id=GALE%7CA410506099&sid=googleScholar&v=2.1&it=r&linkaccess=abs&issn=15435962&p=AONE&sw=w.

EMPOWER Project (2015) About EMPOWER. Available at: http://empowerproject.eu/about-empower/ (Accessed: 11 July 2018).

EMPOWER Project (2018a) Interventions and Behavioural Responses. Available at: http://empowerproject.eu/activity/interventions-and-behavioural-responses/ (Accessed: 21 February 2018).

EMPOWER Project (2018b) Positive Incentives Summaries. Available at: https://empowertoolkit.eu/evidence-database/positive-incentives-summaries/ (Accessed: 18 July 2018).

Eriksson, L., Garvill, J. and Nordlund, A. M. (2006) 'Acceptability of travel demand management measures: The importance of problem awareness, personal norm, freedom, and fairness', Journal of Environmental Psychology, 26(1), pp. 15–26. doi: 10.1016/j.jenvp.2006.05.003.

Eriksson, L., Garvill, J. and Nordlund, A. M. (2008) 'Interrupting habitual car use: The importance of car habit strength and moral motivation for personal car use reduction', Transportation Research Part F: Traffic Psychology and Behaviour, 11(1), pp. 10–23. doi: 10.1016/j.trf.2007.05.004.

Ettema, D., Knockaert, J. and Verhoef, E. (2010) 'Using incentives as traffic management tool: empirical results of the "peak avoidance" experiment', Transportation Letters, 2(1), pp. 39–51. doi: 10.3328/TL.2010.02.01.39-51.

Ettema, D. and Verhoef, E. (2006) 'Using rewards as a traffic management tool: Behavioural effects of reward strategies', IATBR Kyoto, (August), pp. 16–20.

Fishbein, M. and Ajzen, I. (2011) Predicting and Changing Behavior: The reasoned action approach. Edited by T. & F. Group. New York: Psychology Press.

Fujii, S. and Garling, T. (2007) Role and Acquisition of Car-Use Habit. Available at: http://trid.trb.org/view.aspx?id=815358.

Fujii, S., Gärling, T. and Kitamura, R. (2001) 'Changes in {Drivers}' {Perceptions} and {Use} of {Public} {Transport} during a {Freeway} {Closure} {Effects} of {Temporary} {Structural} {Change} on {Cooperation} in a {Real}-{Life} {Social} {Dilemma}', Environment and Behavior, 33(6), pp. 796–808. doi: 10.1177/00139160121973241.

Gabrielli, S. et al. (2013) 'Designing {Motivational} {Features} for {Sustainable} {Urban} {Mobility}', in {CHI} '13 {Extended} {Abstracts} on {Human} {Factors} in {Computing} {Systems}. New York, NY, USA: ACM ({CHI} {EA} '13), pp. 1461–1466. doi: 10.1145/2468356.2468617.

Gärling, T., Ettema, D. and Friman, M. (2015) 'Are citizens not accurately informed about long-term societal costs of unsustainable travel or do they not care?', Travel Behaviour and Society, 2(1), pp. 26–31. doi: 10.1016/j.tbs.2014.07.003.

Geurs, K. T. et al. (2015) 'Automatic trip and mode detection with move smarter: First results from the Dutch Mobile Mobility Panel', Transportation Research Procedia. Elsevier B.V., 11, pp. 247–262. doi: 10.1016/j.trpro.2015.12.022.

Graham-Rowe, E. et al. (2011) 'Can we reduce car use and, if so, how? A review of available evidence', Transportation Research Part A: Policy and Practice. Elsevier Ltd, 45(5), pp. 401–418. doi: 10.1016/j.tra.2011.02.001.

Gustafsson, A., Katzeff, C. and Bang, M. (2010) 'Evaluation of a Pervasive Game for Domestic Energy Engagement Among Teenagers', Comput. Entertain., 7(4), p. 54:1–54:19. doi: 10.1145/1658866.1658873.

Hallion, J. (2007) TravelSmart - Household in the West.

Hamari, J. and Koivisto, J. (2013) 'Social motivations to use gamification: An empirical study of gamifying exercise', in ResearchGate. Available at: https://www.researchgate.net/publication/236269293_Social_motivations_to_use_gamification_An_empirical_study_of_gamifying_exercise.

Hunecke, M. et al. (2001) 'Responsibility and Environment', Environment and Behavior, 33(6), pp. 830–852. doi: doi:10.1177/00139160121973269.

Hunecke, M. et al. (2010) 'Attitude-Based Target Groups to Reduce the Ecological Impact of Daily Mobility Behavior', Environment and Behavior, 42, pp. 3–43. doi: 10.1177/0013916508319587.

Kazhamiakin, R. et al. (2015) 'Using gamification to incentivize sustainable urban mobility', in Smart {Cities} {Conference} ({ISC}2), 2015 {IEEE} {First} {International}, pp. 1–6. doi: 10.1109/ISC2.2015.7366196.

Kienteka, M., Reis, R. S. and Rech, C. R. (2014) 'Personal and behavioral factors associated with bicycling in adults from Curitiba, Paraná State, Brazil', Cadernos de Saúde Pública, 30(1), pp. 79–87. doi: 10.1590/0102-311X00041613.

Klöckner, C. A. (2013) 'A comprehensive model of the psychology of environmental behaviour-A meta-analysis', Global Environmental Change, 23(5), pp. 1028–1038. doi: 10.1016/j.gloenvcha.2013.05.014.

Kusumastuti, D. et al. (2012) Deliverable D3.3 - Impact of Incentives.

Lanken, B. et al. (1994) 'Attitude Versus General Habit: Antecedents of Travel Mode Choice', Journal of Applied Social Psychology, 24(4), pp. 285–300. doi: 10.1111/j.1559-1816.1994.tb00583.x.

Latham, G. P. and Locke, E. A. (1991) 'A Theory of Goal Setting and Task Performance', Academy of Management Review, 16(2), pp. 480–483. doi: 10.5465/AMR.1991.4278976.

Matushkina, E. and Nevalennaya, A. (2011) 'Motivating contributions to Commute Greener! - Nature of motivation and motivation loss'.

Meloni, I. et al. (2013) 'Propensity for Voluntary Travel Behavior Changes: An Experimental Analysis', Procedia - Social and Behavioral Sciences, 87, pp. 31–43. doi: 10.1016/j.sbspro.2013.10.592.

Mikiki, F. and Papaioannou, P. (2012) 'Investigating pro-Environmental and Active Travel Behaviour for Successful Sustainable Travel Promotion', Procedia - Social and Behavioral Sciences, 48, pp. 1424–1433. doi: 10.1016/j.sbspro.2012.06.1118.

Möser, G. and Bamberg, S. (2008) 'The effectiveness of soft transport policy measures: A critical assessment and meta-analysis of empirical evidence', Journal of Environmental Psychology, 28(1), pp. 10–26. doi: 10.1016/j.jenvp.2007.09.001.

Newman, P. (1996) 'Reducing automobile dependence', Environment and Urbanization, 8(1), pp. 67–92. doi: 10.1177/095624789600800112.

Nordlund, A. M. and Garvill, J. (2003) 'Effects of values, problem awareness, and personal norm on willingness to reduce personal car use', Journal of Environmental Psychology, 23(4), pp. 339–347. doi: 10.1016/S0272-4944(03)00037-9.

Outwater, M. et al. (2003) 'Attitudinal Market Segmentation Approach to Mode Choice and Ridership Forecasting: Structural Equation Modeling', Transportation Research Record: Journal of the Transportation Research Board, 1854, pp. 32–42. doi: 10.3141/1854-04.

Pluntke, C. and Prabhakar, B. (2013) 'INSINC: A platform for Managing Peak Demand in Public Transit.', Sustainable Urban Transport. Available at: http://scsn.stanford.edu/publications/insinc-journeys.pdf.

Poslad, S. et al. (2015) 'Using a {Smart} {City} {IoT} to {Incentivise} and {Target} {Shifts} in {Mobility} {Behaviour}-{Is} {It} a {Piece} of {Pie}?', Sensors, 15(6), pp. 13069–13096. doi: 10.3390/s150613069.

Prillwitz, J. and Barr, S. (2009) 'Motivations and barriers to adopting sustainable travel behaviour'. Available at: https://ore.exeter.ac.uk/repository/handle/10036/104987.

Prillwitz, J. and Barr, S. (2011) 'Moving towards sustainability? Mobility styles, attitudes and individual travel behaviour', Journal of Transport Geography, 19(6), pp. 1590–1600. Available at: http://www.sciencedirect.com/science/article/pii/S096669231100127X.

Richter, J., Friman, M. and Gärling, T. (2011) 'Soft Transport Policy Measures: Gaps in Knowledge', International Journal of Sustainable Transportation, 5(May 2012), pp. 199–215. doi: 10.1080/15568318.2010.490289.

Schade, J. and Schlag, B. (2003) 'Acceptability of urban transport pricing strategies', Transportation Research Part F: Traffic Psychology and Behaviour, 6(1), pp. 45–61. doi: 10.1016/S1369-8478(02)00046-3.

Schwartz, S. H. (1977) 'Normative Influences on Altruism1', in Berkowitz, L. (ed.) Advances in Experimental Social Psychology. Academic Press, pp. 221–279. Available at: http://www.sciencedirect.com/science/article/pii/S0065260108603585.

Stead, D. (2016) 'Identifying key research themes for sustainable urban mobility', International Journal of Sustainable Transportation, 10(1), pp. 1–8. doi: 10.1080/15568318.2013.820993.

Steg, L. (2005) 'Car use: lust and must. Instrumental, symbolic and affective motives for car use', Transportation Research Part A: Policy and Practice, 39(2–3), pp. 147–162. doi: 10.1016/j.tra.2004.07.001.

Steg, L., Vlek, C. and Slotegraaf, G. (2001) 'Instrumental-reasoned and symbolic-affective motives for using a motor car', Transportation Research Part F: Traffic Psychology and Behaviour, 4(3), pp. 151–169. doi: 10.1016/S1369-8478(01)00020-1.

Stopher, P. R. (2004) 'Reducing road congestion: A reality check', Transport Policy, 11(2), pp. 117–131. doi: 10.1016/j.tranpol.2003.09.002.

Sunset project (2014) Project Final Report. Available at: http://www.sunset-project.eu/pdf/SUNSET_Project_Final_Report.pdf (Accessed: 10 February 2016).

Taniguchi, A. and Fujii, S. (2007) 'Promoting public transport using marketing techniques in mobility management and verifying their quantitative effects', Transportation, 34(1), pp. 37–49. doi: 10.1007/s11116-006-0003-7.

Tillema, T. et al. (2013) 'Charging versus rewarding: A comparison of road-pricing and rewarding peak avoidance in the Netherlands', Transport Policy. Elsevier, 26(2013), pp. 4–14. doi: 10.1016/j.tranpol.2012.01.003.

Tseng, Y.-Y., Knockaert, J. and Verhoef, E. T. (2013) 'A revealed-preference study of behavioural impacts of real-time traffic information', Transportation Research Part C: Emerging Technologies, 30, pp. 196–209. doi: 10.1016/j.trc.2011.11.006.

Venkatesh, V. and Morris, M. G. (2000) 'Why Don't Men Ever Stop to Ask for Directions? Gender, Social Influence, and Their Role in Technology Acceptance and Usage Behavior', MIS Quarterly, 24(1), pp. 115–139. doi: 10.2307/3250981.

Vredin Johansson, M., Heldt, T. and Johansson, P. (2006) 'The effects of attitudes and personality traits on mode choice', Transportation Research Part A: Policy and Practice, 40(6), pp. 507–525. doi: 10.1016/j.tra.2005.09.001.

Zailani, S. et al. (2016) 'Is the intention to use public transport for different travel purposes determined by different factors?', Transportation Research Part D: Transport and Environment. Elsevier Ltd, 49, pp. 18–24. doi: 10.1016/j.trd.2016.08.038.

Zhang, Z., Fujii, H. and Managi, S. (2014) 'How does commuting behavior change due to incentives? An empirical study of the Beijing Subway System', Transportation Research Part F: Traffic Psychology and Behaviour, 24, pp. 17–26. doi: 10.1016/j.trf.2014.02.009.