To Drive, or Not to Drive:
Mode Choice in Daily Commute

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Some of the chapters included in this thesis take the same form as papers that have been published. The chapters are preceded by a General Introduction and followed by a General Discussion, which integrate the research presented in the papers. Some of the material in the individual chapters may overlap.

Abstract

Mode choice for daily commute refers to the process whereby commuters choose a travel mode for their daily trips to work. Despite its ordinary nature, it often involves a series of decisions and consideration of various factors and barriers. More research is needed to understand the various aspects of commuters' mode choice for daily commute. This thesis comprises three studies that focus on four aspects of mode choice: mode motivating factors, mode commitment, mode decisions, and mode interventions. The thesis aims to present the research gaps that exist in current research related to the four aspects and address them appropriately in the three studies.

The first study sought to identify the motivating factors behind commuters' mode choices. To address the limitations of investigating only one or two factors and recruiting only a particular type of commuter in a single study, the first study explored the influence of seven psychological factors on five types of commuters' mode choices. An online survey was distributed to various types of commuters in New Zealand. The results showed that commuters have more than one motivating factor to use their usual modes and some commuters share similar motivating factors.

The first study also aimed to examine how committed commuters are towards their usual modes. To address the limitations of using the categorical measure of modality, the first study involved measuring commuters' mode commitment using a continuous measure. A 1-week online travel diary was distributed to a subset of the commuters who completed the online questionnaire. The results revealed that the five types of commuters were all committed to their usual modes. However, some of them were more likely to use a combination of more than two modes while others were more likely to use a maximum of two modes for their weekly commutes.

The second study was developed based on the previous findings that all types of commuters were strongly committed towards their usual modes despite having different reasons to use their modes. Thus, the study sought to investigate how commuters decide to use their usual modes for daily commutes by focusing on bounded rationality's concept of 'satisficing' as a decision-making strategy. A sample of New Zealand commuters was invited to complete an online questionnaire. The study found that commuters tend to satisfice when deciding to use their usual modes and commuters with high satisficing tendencies tend to be more positive and satisfied with their regular commutes.

The third and final study was developed based on assumption that drivers tend to satisfice when deciding to use the car which may explain why current mode-shift interventions have mixed results in terms of their effectiveness. So, the study aimed to test an attitude change intervention known as self-persuasion (i.e., generating arguments to convince oneself) to encourage drivers to reduce their car use. A sample of New Zealand car drivers was invited to complete two online questionnaires and was randomly assigned into one of three conditions (i.e., self-persuasion, direct-persuasion, and control). The study did not find evidence of an effect of self-persuasion on drivers' car use intentions, behaviours, and attitudes.

Overall, results from the three studies showed the various decisions and factors involved in commuters' mode choice despite seeming ordinary. The novel approaches used in each study provided new and interesting insights into understanding commuters' mode choices. The main implication of this thesis is that researchers and policymakers need to take into account these decisions and factors and use various approaches and methods to further understand commuters' mode choices for their daily commutes and to develop long-lasting mode-shift interventions.

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“Your story is what you have, what you will always have. It is something to own.”
(Michelle Obama, Becoming, pp. xi)

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List of Publications from this Thesis

Peer-reviewed journal articles reproduced in this thesis with permission from Elsevier.

Sivasubramaniyam, R. D., Charlton, S. G., & Sargisson, R. J. (2020). Mode choice and mode commitment. *Travel Behaviour and Society, 19*, 20-32. https://doi.org/10.1016/j.tbs.2019.10.007

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Chapter 1

General Introduction

Commuting, the daily journey between home and work (Lyon and Chatterjee, 2008), is an important aspect of peoples' lives that demands a lot of their valuable time because it helps them fulfil their personal responsibilities such as earning a living, transporting family members, and pursuing education (e.g., Michelson, 2011; Vilhelmson, 1999; White & Dolan, 2009). For that reason, people commute almost every weekday making commuting a routine behaviour. Despite its routine and repeated nature, commuting has received considerable attention because of its impacts on the environment and the quality of the public's health, particularly with regards to the different travel modes people choose to use for their commute. During one's commute, the decision to drive, to share a ride, to take the bus, to cycle, to walk or to use any other travel mode is known as commute mode choice. The routine nature of commuting may imply that mode choice is a mundane and ordinary decision to make every day (Olsson, Gärling, Ettema, Friman, & Fujii, 2013; Verplanken, Aarts, & van Knippenberg, 1997). In reality, mode choice for commuting trips is more dynamic than it seems because choosing a travel mode to get to work often involves a series of decisions and consideration of factors and barriers such as travel time, costs, routes, destination, safety, and risks (Gehlert, Dziekan, & Gärling, 2013; Recker, McNally, & Root, 1986). For many regular commuters, making these decisions has become habitual over time; thus, they are often considered with very little effort or consciousness, making mode choice seem like a simple decision (see Aarts & Dijksterhuis, 2000a; Aarts & Dijksterhuis, 2000b).

Other than its habitual nature, mode choice is also worth studying because of the negative impacts some modes have on the environment and public health (Nilsson & Küller, 2000; Witten, Huakau, & Mavoa, 2011). Specifically, car use leads to environmental

pollution, decreased air quality, increased greenhouse gas emissions, and high fossil fuel consumption (Mees, 2000). On the contrary, walking and cycling are less likely to cause environmental harm as they do not involve fuel consumption (Goodman, 2013). In fact, active commuting is a form of physical activity, which improves commuters' long-term health (Goodman, 2013; Saelens, Sallis, & Frank, 2003) and physical fitness (Oja, Vuori, & Paronen, 1998). In contrast, the air pollution resulting from the extensive use of private vehicles is often associated with increased levels of mortality and cardiorespiratory morbidity (Fisher et al., 2002; Kjellstrom, Neller, & Simpson, 2002). Another reason to study mode choice is its implications for commuters' stress levels and overall life satisfaction. While commuters tend to find car use to be stressful and less satisfying (Novaco, Stokols, Campbell, & Stokols, 1979; Novaco, Stokols, & Milanesi, 1990; Rasmussen, Knapp, & Garner, 2000; Wener & Evans, 2011), they tend to find active commuting and public transport use less stressful and more satisfying (Abou-Zeid, 2009; St-Louis, Manaugh, van Leirop, & El-Geneidy, 2014).

Therefore, studying mode choice, especially for commuting trips is useful because, despite its mundane and ordinary nature, it is necessary for commuters to carry out day-to-day responsibilities, is more dynamic than it seems, and tends to have significant environmental and health implications. In the 20 last years, there has been increasing interest among transport psychologists in mode choice, particularly due to the extensive use of cars in Western societies (see Ministry of Transport, 2018, 2019; WHO, n.d.) and its negative impacts on the environment (see IEA, 2019; Statistics New Zealand, 2018). The current research on mode choice span across various aspects, but in this thesis I focused on four aspects of mode choices: (1) mode motivating factors, (2) mode commitment, (3) mode decisions, and (4) mode interventions. Specifically, I presented the findings of current mode choice research on the four aspects, identified the gaps in the current research, and addressed

the gaps appropriately by conducting three independent studies addressing four key questions. The research questions and studies that address them are summarised in Figure 1. In the first study of this thesis, I found out the psychological reasons why different types of commuters use their *usual modes* (i.e., the main travel mode commuters use to get to work) for their regular commute. In the same study, I examined and compared how committed different commuters are towards using their usual modes for their regular commutes. Then, in the second study, I examined the decision-making strategy that commuters use when deciding to use their usual modes. In the third and final study, I tested an intervention that has never been tested before in the domain of travel behaviour to encourage regular car users to reduce their car use for their daily commutes.

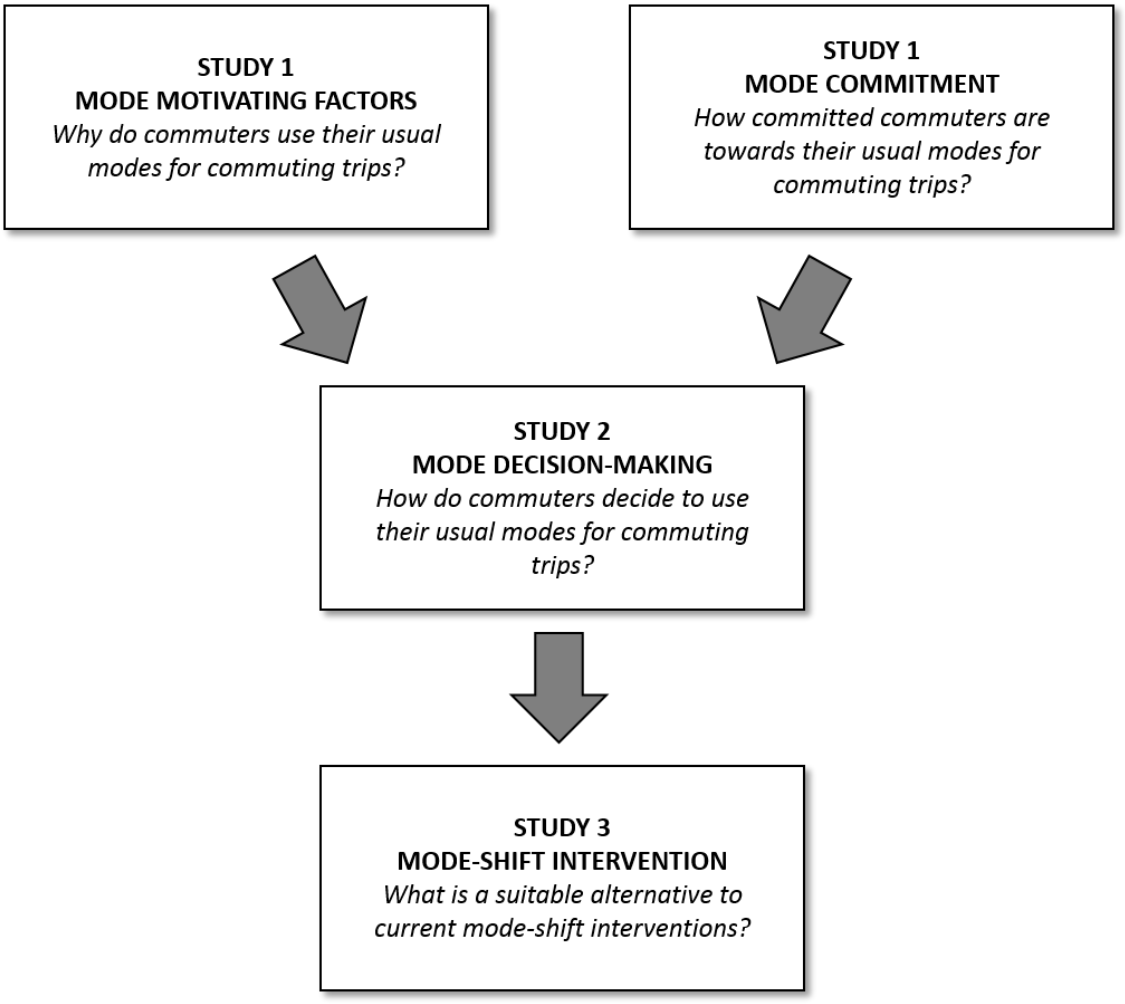

Figure 1. Summary of studies and research questions in this thesis.

Understanding the Factors behind Commuters' Mode Choices

In the next subsections of this general introduction, I present the current research findings on the four aspects of mode choice starting with the first aspect: mode motivating factors. Studies examining mode choice factors have found various possible motivating or psychological factors to explain why people use their cars for commuting trips and why they also use other modes such as sharing rides, taking the bus, cycling, and walking. These factors can be generally categorised into psychological or internal factors (e.g., attitudes, habits, norms, values, etc.), structural or external factors (e.g., facilities, cost, travel mode availability, etc.), and demographic factors (e.g., age, employment status, education level, annual income, etc.). This thesis will focus on the psychological factors of commuters' mode choices because of their key role in developing effective 'soft' measures to reduce car use (Möser & Bamberg, 2008). Psychological theories or concepts often underpin the development of soft measures to reduce car use such as providing sustainable workplace and school travel plans, introducing customised travel plans, offering public transport information, running travel awareness campaigns, and implementing car-sharing schemes (Cairns et al., 2008). On the other hand, 'hard' measures to reduce car use include implementing road tolls, congestion charges, and increasing fuel prices (Friman, Larhult, & Gärling, 2013). Using hard measures on their own is not very effective at reducing car use (Stopher, 2004). However, using a combination of hard and soft measures has been useful in reducing car use (Cairns, Davies, Newson, & Swiderska, 2002; Shoup, 1997). Thus, there is an imminent need to address and understand the psychological factors associated with commuters' mode choices to develop appropriate soft measures that can be used along with hard measures to reduce car use effectively.

Habits

One of the most common psychological explanations as to why commuters tend to use certain modes more frequently than others is because of their strong habits of using those modes and weak habits of using less frequently used modes. Aarts and Dijksterhuis (2000b) defined habits as behaviours that people perform repeatedly with limited or minimal consciousness or cognitive effort. When commuters use a particular mode repeatedly, they are more likely to use the same mode in the future (e.g., Bamberg, Ajzen, & Schmidt, 2003; Gardner, 2009) because of their unchanging travel contexts (Ouellette & Wood, 1998; Wood, Tam, & Witt, 2005). If commuters use the same route, depart from the same place, or travel to the same destination during their regular commutes, they are more likely to use the same travel modes. In contrast, if their travel contexts change from time to time, commuters are more likely to consider using different travel modes. For example, car owners who recently relocated to new residential locations were more willing to use alternative modes like the bus or train to get to work compared to car owners who did not move to new residential locations (Bamberg, 2006; Verplanken, Walker, Davis, & Jurasek, 2008). Another reason why habits influence commuters' mode choices is automaticity. With constant repetition of a behaviour, people become more familiar with the behaviour; thus they tend to perform the behaviour with little consciousness or cognitive effort. As a result, they are less likely to consider alternative behaviours (Gifford & Checherita-Westphal, 2009). In Aarts and Dijksterhuis' (2000a) study, cyclists with strong habits of cycling refused to consider another travel option and continued to choose cycling as an option for commuting even after they were deliberately told not to choose cycling as an option for commuting trips. The results imply that cyclists' decision to cycle was automatic as a result of their constant cycling behaviour. Therefore, habits can influence commuters' mode choices because when commuters use the same modes

repeatedly within the same behavioural contexts, using those modes becomes more familiar and automatic to them.

Utility

Another factor that may influence commuters to use certain modes more than others is the perceived utility of using those modes such that commuters tend to use modes that provide them with the most benefits or gains and avoid modes that result in disadvantages or losses. The rational choice approach has typically viewed mode choice as a type of consumer behaviour (Cervero, 2002), where commuters make rational decisions after evaluating various alternatives to maximise their utility or benefits. Furthermore, when evaluating alternatives, commuters rely on information such as their expected travel time, monetary cost, and other mode-related attributes (Ben-Akiva & Lerman, 1985; Domencich & McFadden, 1975; McFadden, 1976; Small & Winston, 1999) and then they choose the alternative that minimises any form of monetary or financial loss (see Kahneman & Tversky, 1979). Kahneman and Tversky (1979) referred to 'loss aversion' as individuals' tendencies to avoid situations or choices that may result in losses or risks. Several researchers have examined loss aversion in the domain of mode choice in terms of time and monetary losses (e.g., Beirao & Cabral, 2007; Cervero, 2002; Foerster, 1979; Stradling, Meadows, & Beatty, 2000; Washbrook, Haider, & Jaccard, 2006). For example, some car users avoided taking public transport because of the long waiting and commuting times compared to driving the car (Beirao & Cabral, 2007; Cervero, 2002), while other car users switched to public transport (i.e., bus or subway) to avoid the road pricing charges for car use during peak hours (An, Hu, & Wang, 2014). In sum, commuters' mode choices also depend on their tendencies to evaluate the information or attributes of various travel modes and to maximise their benefits and minimise their losses associated with using certain modes.

Experienced Utility

Another form of utility is ‘experienced utility’, which Kahneman and Tversky (1970) defined as the hedonic quality and affective experience that individuals derive from their decisions and choices. Experienced utility also plays an important role in commuters’ mode choices such that commuters tend to use modes that provide them with maximum pleasure and satisfaction. Transport researchers have examined the role of experienced utility in commuters’ mode choices and found that commuters receive satisfaction and psychosocial benefits in different ways, depending on their commuting experience (e.g., Ettema, Friman, Gärling, Olsson, & Fujii, 2012; Ettema, Gärling, Olsson, Friman, & Moerdijk, 2013). Frequent public transport users are satisfied with their commutes because of certain attributes of the service (e.g., reliability of the service, treatment by the employees, and simplicity of the service information; Friman, Edvarsson, & Gärling, 2001) and the positive in-vehicle activities that they often engage in (e.g., talking to other passengers, listening to music, gazing outside, and using the internet; Ettema et al., 2012). Car users, on the other hand, are more satisfied with car use compared to public transport because using the car provides them psychosocial benefits such as a sense of fun, enjoyment, autonomy, mastery, protection, and prestige (Ellaway, Macintyre, Hiscock, & Kearns, 2003; Ettema et al., 2013). Some of the psychosocial benefits of car use are similar to those of active commuting such that cycling and walking commutes are also highly associated with affective and health benefits such as relieving stress and providing a sense of relaxation and freedom (Anable & Gatersleben, 2005; Davies, Halliday, Mayes, & Pocock, 1997). Therefore, when it comes to their mode choice for daily commutes, commuters may choose travel modes that are pleasurable, satisfying, and significantly contribute to their overall positive commuting experience.

Social Psychological Factors

Commuters' mode choices also depend on certain social psychological factors such as attitudes and social norms. One popular social psychology theory used in travel research is Ajzen's (1991) Theory of Planned Behaviour (TPB). Ajzen (1991) introduced the TPB to highlight the role of 'intentions' on peoples' actual behaviour such that the stronger one intends to perform a behaviour, the more likely they are to perform the behaviour. Ajzen (1991) also claimed that one's attitudes (i.e., positive or negative evaluations of an object, person, or behaviour), social norms (i.e., positive or negative evaluations by a larger group of people which individuals are compelled to follow), and perceived behaviour control (i.e., perceptions of ability to perform a behaviour) tend to influence one's intentions. In other words, the more positive people's evaluation of a behaviour, the stronger their society's support of a behaviour, and the more they believe they could perform a behaviour, the stronger their intentions to perform the behaviour, which then influence their actual behaviour (Ajzen, 1991). Several travel researchers who used TPB as a theoretical model found that car users', motorcyclists', and bus users' positive attitudes, strong social norms, and high perceived behaviour control towards the car, motorcycle, and bus respectively, were associated with their strong intentions to use those modes (e.g., Chen & Chao, 2011; Donald, Cooper, & Conchie, 2014). Other researchers used TPB to evaluate the effectiveness of providing free or subsidised bus tickets on commuters' intentions to use the bus and found that the TPB model accounted for more variance in commuters' intentions to use the bus after the provision of bus tickets (e.g., Bamberg, Ajzen, & Schmidt, 2003; Bamberg, Rolle, & Weber, 2003). In other words, the intervention not only affected commuters' intentions to use the bus, but also their attitudes, social norms, and perceived behavioural control associated with bus use (Bamberg, Ajzen, & Schmidt, 2003; Bamberg, Rolle, & Weber, 2003). Thus,

social-psychological factors such as attitudes, social norms, perceived behavioural control and behavioural intentions also play a major role in commuters' mode choices.

Environmental Attitudes

One important attitude influencing commuters' mode choices is their environmental attitude which refers to a person's concern for the natural environment (Bamberg, 2003; Bissing-Olson, Iyer, Fielding, & Zacher, 2013; Hawcroft & Milfont, 2010). Positive environmental attitudes are often associated with the frequent use of sustainable modes (e.g., ride-sharing, cycling, and walking), whereas negative environmental attitudes are often associated with the frequent use of non-sustainable modes (Atasoy, Glerum, & Bierlaire, 2012; Flamm, 2009; Friman et al., 2001). Kim, Bae, and Chung (2012) suggested that commuters' pro-environmental attitudes and beliefs can affect their willingness to reduce their car use and/or to use sustainable modes. One of the main sources of one's environmental attitudes or beliefs is their environmental knowledge. Individuals who knew more about the impacts of owning and using private vehicles (i.e., high environmental knowledge) believed that protecting the environment is very important (i.e., positive environmental attitude), which encouraged them to reduce their car use (Friman et al., 2001). Other than having extensive environmental knowledge, being concerned about the environment is also related to individuals' environmental attitudes and tendencies to use more sustainable modes such that respondents who scored high on an environmental-concern scale, used public transport more frequently and were more likely to own bicycles than those who scored low on the same scale (Atasoy et al., 2012; Rieser-Schussler & Axhausen, 2012). Furthermore, prior engagement in pro-environmental behaviours such as switching the tap off instead of letting it drip or putting on an extra sweater instead of using the heater is also related to one's environmental attitudes and behaviours. For example, Roberts, Popli, and Harris (2018) found that commuters who engaged in non-travel-related environmental behaviours were more likely to have positive

environmental attitudes and were less likely to commute to work using their car. Thus, commuters' environmental attitudes that stem from their pre-existing environmental knowledge, concern, and behaviours can influence the type of travel modes they use to get to work.

Studying Commuters' Commitment to Mode Choice

Studies on the factors motivating commuters' mode choice (e.g., Bambeg, Ajzen, & Schmidt, 2003; Verplanken et al., 2008; Cervero, 2002; Ellaway et al., 2003; Roberts et al., 2018) revealed that commuters have various reasons for using their usual modes and these reasons may influence how often they use those modes for commuting trips and eventually how committed they are towards using those modes. For example, commuters with strong habits of using their usual modes may have a stronger commitment towards their mode choice, while commuters with weaker habits might have a weaker commitment. Another example would be if commuters perceived more gains to be associated with their mode choice, they are more likely to be committed to that mode. In contrast, if they perceived more losses, they may have a weaker commitment towards that mode. In other words, the motivating factors behind commuters' mode choices can influence how committed commuters are towards their usual modes, especially for commuting trips. Other than the potential influence of motivating factors, another reason to study mode commitment is it can provide information on commuters' capability and willingness to use travel modes other than their mode choice, which will be useful in encouraging mode-shift behaviours. As a result, commuters who are more willing to use alternative modes can be encouraged to change or modify their relative use of various modes (i.e., using one mode more often than another) instead of forcing them to completely replace their non-sustainable modes for a more sustainable mode.

Modality as Mode Commitment

To date, most research on how often commuters use their usual modes has utilised the concept of 'modality' to refer to mode commitment. Various researchers defined modality in different ways. Firstly, Lavery, Páez, and Kanaroglou (2013) defined modality as the number of travel alternatives that commuters consider as feasible transportation options. In other words, modality is an indicator of commuters' flexibility in their travel choices. Heinen and Chatterjee (2015) used the term 'modal variability' to refer to the flexibility of transport modes used by commuters for their weekly travel. Meanwhile, Vij, Carrel, and Walker (2013) introduced 'modality style' to refer to commuters' behavioural dispositions to use modes that they habitually use to highlight the role of habits in commuters' mode commitment. There are two types of modality styles: unimodal and multimodal (Kuhnimhof, Chlond, & von der Ruhren, 2006). Unimodal travellers (also known as monomodal) use one travel mode for all travel purposes in a week (see Chatterjee, Clark, & Bartle, 2016; Goodman, Guell, Panter, Jones, Ogilvie, 2012; Heinen & Chatterjee, 2015; Olafsson, Nielsen, & Cartensen, 2016) presumably because they are not aware of the other travel alternatives or they resort to using travel modes that they consistently use in the past (Vij et al., 2013). Multimodal travellers, on the other hand, use at least two modes of transportation within a given period, such as one week (Nobis, 2007). According to Vij et al. (2013), commuters tend to be multimodal to optimise their trip experience. While there have been many studies on multimodality (e.g., Buehler & Hamre, 2015; Heinen & Chatterjee, 2015; Susilo & Axhausen, 2014; Kroesen, 2015), Diana and Pirra (2016) claimed that these studies often capture multimodality through descriptive statistics on the number of travel modes commuters use, without the consideration of the commuters' frequency of using each mode. Thus, they emphasised a need for a multimodality index that not only considers commuters' use of several different modes but also if there are modes that dominate other modes.

Influences of Modality

Commuters' tendencies to be unimodal or multimodal depend on several aspects. The first aspect is the type of modes they use for their travel. Studies show that car users are more likely to be unimodal (see Nobis, 2007; Olafsson et al., 2016; Stradling, 2007; Vij et al., 2013), whereas active commuters such as cyclists and pedestrians are more likely to be multimodal (see Lavery et al., 2013; Olafsson et al., 2016). According to Vij et al. (2013), car users tend to have strong habits of using the cars, while Lavery et al. (2013) claimed that active travellers are more open to using more than one mode for their travels. Furthermore, commuters' modality styles also depend on their personal characteristics such as their age, education status, and residential location (e.g., Buehler & Hamre, 2015, 2016; Lavery et al., 2013; Nobis, 2007). For example, university students with more travel options (e.g., cycling, bus, walking, scooter, etc.) are more likely to be multimodal, whereas 36- to 50-year-old men, full-time employees, or those with young children are more likely to be unimodal car users as they have responsibilities that require extensive car use (Nobis, 2007). Moreover, multimodality is also more prevalent among commuters who are more tolerant of traffic conditions, are willing to limit their car travel, feel safe to cycle, and are more proactive with their travel preferences (Lavery et al., 2013). Commuters' modality styles also depend on their trip purposes such that travellers are more likely to be unimodal for commuting trips than for non-commuting trips (Carrel, Vij, & Walker, 2011; Heinen, Maat, & van Wee, 2011; Kuhnimhof et al., 2006). Commuters' unimodality for commuting trips may be related to their stronger travel habits for routine commuting trips (see Vij et al., 2013). Overall, several factors can influence commuters' modality styles (i.e., unimodal or multimodal) and these factors play an important role in understanding commuters' mode commitment and mode choices for commuting trips.

Examining Commuters' Decision-Making Approach

Up to this point, the literature on mode choice factors and mode commitment has shown that commuters have different reasons for using their usual modes for commuting trips and yet most of them are committed to their modes especially for work trips (Carrel et al., 2011; Heinen et al., 2011; Kuhnimhof et al., 2006). One way to explain commuters' unimodal tendencies for work commutes is to understand the way they decide to use their usual modes for commuting trips. Unimodal commuters with different motivating factors may share a similar decision-making approach when making mode decisions. Thus, investigating *how* they decide to use their usual modes for commuting trips is one of the key ideas for this thesis.

Rational Choice Approach vs. Bounded Rationality Approach

Research on travel decision-making has relied on the rational choice approach to understanding how commuters make travel-related decisions (e.g., Ben-Akiva & Lerman, 1985; Domencich & McFadden, 1975; McFadden, 1976; Small & Winston, 1999). According to the rational choice approach, individuals tend to search through and evaluate all their possible options before making a decision (see Becker, 1976; De Palma, 1998; Simon, 1955). Several transport researchers (e.g., Beirao & Cabral, 2007; Cervero, 2002; Foerster, 1979; Stradling et al., 2000; Washbrook et al., 2006) have demonstrated that commuters tend to rely on travel-related information (e.g., time, cost, etc.) before choosing an alternative that minimises their monetary and time loss. However, in everyday life, commuters do not always have all the information needed to make the 'best' decision and they often make decisions under uncertain and biased conditions (see Ajzen, 1977; Thaler, 1991). Simon (1976) suggested an alternative decision-making approach, *bounded rationality*, which suggests that individuals have aspiration levels that they use to make decisions and select an alternative that meets the minimum level of their aspirations (Gifford & Checherita-Westphal, 2009; Jou,

Hensher, Liu, & Chiu, 2010). To put it differently, people tend to settle for what is good enough for them (i.e., satisfice). Some travel behaviour research has adopted the bounded rationality approach to understanding commuters' day-to-day decisions such as route choice, departure time choice, and mode choice (e.g., Avineri & Prashker, 2006; Ben-Elia, Erev, & Shiftan, 2008; Jou et al., 2010; Mahmassani & Chang, 1987). These studies found that commuters tend to set aspiration levels such as acceptable time delay and monetary loss when making commuting decisions, especially mode choice (e.g., Jou et al., 2010). In short, the bounded rationality approach to understanding commuters' decisions suggests that commuters tend to consider only a subset of the travel choices available to them before making a decision, instead of considering all the possible options. This makes the bounded rationality approach a more realistic way to understand commuters' mode choices compared to the rational choice approach.

Satisficing in Travel Behaviour

Another way of understanding commuters' travel mode decisions under the bounded rationality approach is to examine the characteristics associated with their tendencies to satisfice or to settle for what is good enough for them. Firstly, satisficing is a low-effort decision-making process because there is less time and cognitive effort involved in searching and evaluating alternatives (Simon, 1956, 1957). Commuters have demonstrated the tendency to make low-effort commuting decisions by setting levels of acceptability of certain travel characteristics (e.g., travel time and costs) and considering a few travel options instead of all possible options (Avineri & Prashker, 2006; Jou et al., 2010; Mahmassani & Jou, 1998). Secondly, satisficing involves resorting to habits because 'good-enough' decisions are more likely to be repeated in the future (Gifford & Checherita-Westphal, 2009). In the context of travel behaviour, mode decisions are typically habitual (Verplanken et al., 1997; Verplanken, Aarts, van Knippenberg, & van Knippenberg, 1994) and in some cases, these habits are hard

to break (Aarts & Dijksterhuis, 2000a). Thus, using habitual modes reflects commuters' tendencies to satisfice. Thirdly, satisficing involves a low tendency to consciously monitor and evaluate the decision-making processes (i.e., decision-specific reinvestment; see Kinrade, Jackson, Ashford, & Bishop, 2010). When satisficing, decision-makers' tendencies to resort to 'good enough' alternatives imply that they invest less cognitive effort in evaluating their decision-making process (i.e., low reinvestment). Commuters' low decision-reinvestment is evident in Aarts and Dijksterhuis' (2000a) study where habitual cyclists' and drivers' decisions to cycle or drive are controlled by the automatic travel-goal-behaviour associations instead of their conscious reasoning to use those modes. Lastly, satisficing does not tend to involve negative emotions such that when making 'good enough' decisions, satisficers are typically satisfied with their decisions and are less likely to regret their decisions even if there are better alternatives available (Iyengar, Wells, & Schwartz, 2006; Schwartz et al., 2002). Similarly, commuters are typically satisfied with their habitual commuting decisions, especially decisions to use travel modes that they constantly use (Ettema et al., 2012; Ettema et al., 2013; Mao, Ettema, & Dijst, 2016). In sum, satisficing can be characterised in four ways and these characteristics are evident in commuters' day-to-day travel decisions, which suggest that commuters are prone to satisficing when making mode decisions.

Understanding Mode-shift Interventions

Knowing why commuters use certain modes (i.e., motivating factors), how often they use those modes (i.e., mode commitment), and how they decide to use those modes (i.e., mode decision-making strategy) can be very useful in identifying effective ways to reduce commuters' car use and increase their use of sustainable modes such as ride-sharing, taking the bus, cycling, and walking. A variety of 'mode-shift' interventions have been introduced to reduce car use and these interventions can be broadly categorised into two types: structural and psychological (Graham-Rowe, Skippon, Gardner, & Abraham, 2011).

Structural Interventions

Structural interventions involve the modification of the physical and/or legislative commuting environment and the commuting choice architecture to decrease the attractiveness and opportunities for car use while increasing the attractiveness of sustainable mode use (Arnott et al., 2014; Gärling & Schuitema, 2007). Some examples of structural interventions include introducing road and/or fuel pricing, planning and improving bus and bicycle lanes, implementing road closures, and pedestrianizing streets. Structural interventions are also known as Travel Demand Management (TDM), which is defined as the application of various strategies, policies, or initiatives to reduce travel demand or to redistribute the demand across multiple travel modes (Carran-Fletcher, Joseph, & Thomas, 2020). TDM has found success in encouraging the use of sustainable modes. For example, promoting bike-share schemes and improving bicycle lanes, footpaths, rail networks, and public transport systems have resulted in increased cycling and walking behaviour (e.g., Midgley, 2011; Parker et al., 2013), and rail and bus ridership (e.g., Handy, Shafizadeh, & Schneider, 2013; Rodriguez, Evenson, Diez Roux, & Brines, 2009; TfL, 2019). Moreover, increasing parking prices (see Litman, 2018) and implementing congestion charges (e.g., Croci, 2016) have reduced private vehicle travels and traffic congestion. However, in Sargisson's (2018) study, introducing parking charges for university staff and students did not reduce their car travel and did not increase their bus travel or cycling as they either parked off-campus more often or paid the parking fees after they were introduced. In other words, introducing pricing strategies to reduce car use can be both effective and not effective.

Similarly, providing rewards or incentives to promote sustainable commuting behaviour have been effective in some cases (e.g., Ben-Elia & Ettema, 2011; Fujii, Gärling, & Kitamura, 2001; Fujii & Kitamura, 2003; Jakobsson, Fujii, & Gärling, 2002) and ineffective in others (e.g., Kristal & Whillans, 2020; Lai & Sheu, 2016). For example, Ben-

Elia and Ettema (2011) rewarded their participants with money for each day they avoided driving and found that their participants reduced their driving behaviour, especially during rush hour. Apart from providing money, providing commuters with free bus tickets reduced their car use, but the effect was only temporary as commuters returned to their previous levels of car and bus use once the incentives stopped (Fujii et al., 2001; Fujii & Kitamura, 2003). In Lai and Sheu's (2016) study, the provision of free bus tickets to motorcyclists did not increase their bus ridership. A similar result was found in a more recent study by Kristal and Whillans (2020) where there were no positive effects on commuters' bus use after providing them with a 7-day free bus ticket. To put it differently, like the implementation of parking charges, the provision of incentives in the form of free bus tickets can be effective in some cases and not effective in other cases. The mixed results of incentivizing sustainable commuting had some researchers (e.g., Ben-Elia & Ettema, 2011; Jakobsson et al., 2002) questioning the long-term effects and feasibility of using financial incentives to reduce car use.

One possible hindrance to the effectiveness of structural interventions is the level of acceptance by commuters such that they are less likely to accept the interventions when they believe that the interventions are limiting their freedom to use the car and are ineffective at solving the congestion and environmental problems associated with car use (Gärling & Schuitema, 2007; Rienstra, Rietveld, & Verhoef, 1999; Schade & Schlag, 2003; Schuitema & Steg, 2005). For example, commuters were more accepting of the implementation of a toll ring in Oslo, Norway when the traffic congestion decreased (Odeck & Brathen, 2002) but were not accepting of the implementation of a toll ring in Stuttgart, Germany when there were no positive effects on traffic congestion (Schlag & Teubel, 1997). Therefore, changing the structural context of one's commute should be accompanied by measures to influence

their attitudes and acceptability of interventions designed to reduce car use and increase sustainable commutes. These measures are typically known as psychological interventions.

Psychological Interventions

Psychological interventions are measures directed at changing commuters' affects, beliefs, and attitudes about their commuting options to promote voluntary behaviour change to use sustainable modes more often and/or reducing car use (Graham-Rowe et al., 2011; Hodgson, Namdeo, Araujo-Soares, & Pless-Mulloli, 2012). One of the most common psychological interventions is providing car users with travel information to increase their awareness of their car use and equip them with the knowledge and skills needed to use sustainable modes (Brög, 1998; Fujii & Taniguchi, 2005). For example, Bamberg (2006) provided commuters with personally tailored information on how to use public transport (e.g., a map of public transport routes and stops, schedules and tariffs, etc.) which successfully motivated them to use public transport more often; there was an increase in participants' bus use from 18% to 36% of their total trips in a day. In Mutrie et al.'s (2002) study, providing information on active commuting encouraged participants to walk more often in a week such that participants who received the intervention spent more time walking to work compared to those who did not receive the intervention. However, this was not the case for cycling as there was no difference in the time spent cycling between participants in both intervention and control groups. Like the effects on cycling, providing commuters with individualised feedback on the negative effects of car use on the environment (see Tertoolen, van Kreveld, & Verstraten, 1998) or encouraging them to make behavioural plans to modify their car use (see Fujii & Taniguchi, 2005) was not effective at reducing their car use. Meanwhile, studies on carpooling found that providing personalised information on carpooling successfully reduced solo driving among commuters and increased their carpooling behaviour (e.g., Cooper, 2007; Rose, 2008; Zvonkovic, 2001). However, a more

recent study by Kristal and Whillans (2020) did not find any significant positive changes in commuters' carpooling behaviour after providing them information on carpooling.

The provision of tailored information to commuters to encourage the use of sustainable modes may be ineffective because of commuters' strong habits of using the car (see e.g., Gärling & Axhausen, 2003; Verplanken, Aarts, van Knippenberg, & Moonen, 1998; Verplanken et al., 1994). As a result of their strong car use habits, commuters are less likely to consider using any travel mode other than the car (Aarts, Verplanken, & van Knippenberg, 1997; Verplanken et al., 1997). There are psychological interventions that aim to interrupt commuters' habitual car use and one such intervention is to change commuters' travel contexts. As commuters' habits are connected to the situations in which they are carried out in, the habits will no longer be useful or appropriate once the situation has changed (see e.g., Wood et al., 2005). For example, after an 8-day temporary closure of a frequently-used freeway, there was an increase in drivers' public transport use from 9% to 20%. In other words, drivers were forced to use public transport as they could no longer resort to their habitual car use as a result of the change in their commuting context (Fujii et al., 2001). Another way to interrupt commuters' strong driving habits is to induce a deliberate decision-making process before commuting by encouraging them to make a detailed plan for a new travel behaviour. The process of deciding where, when, and how a new travel behaviour will be performed is known as 'implementation intention' (Gollwitzer, 1993). Planning a behavioural change or deliberately evaluating one's travel behaviour has been found to interrupt commuters' habitual travel mode use (e.g., Bamberg, 2000; Fujii & Taniguchi, 2005). For example, Eriksson, Garvill, and Nordlund (2008) asked their participants if they were willing to reduce their car use and if they were willing, they were asked to indicate which car-reduction strategies they planned to use (i.e., implementation intention). As a result of the intervention, there was a larger reduction in car use amongst car users with strong

habits and strong personal norm to reduce car use (Eriksson et al., 2008). In sum, interrupting commuters' habitual car use has high mode-shift potential.

Combining Structural and Behavioural Interventions

The previous two subsections revealed that although structural interventions can be successful in the short term, they are costly and less publicly acceptable. In contrast, although psychological interventions take longer to be effective, they are typically less costly and more publicly acceptable (Gardner and Abraham, 2007; Graham-Rowe et al., 2011). For example, driving reduction programmes which involve the provision of tailored information (e.g., Bamberg, 2006; Brög, 1998, Mutrie et al., 2002) are cheaper to implement and more acceptable to drivers compared to infrastructure modifications such as bus priority lanes and road pricing (Emmerink, Nijkamp, & Rietveld, 1995; Fujii, Gärling, & Kitamura, 2001; Taylor & Ampt, 2003). Thus, to account for the shortcomings of both types of interventions, there have been suggestions to combine the use of both structural and psychological interventions to reduce car use. The complementary applications of both types of interventions can optimise the effectiveness of mode-shift initiatives (Gärling & Schuitema, 2007; Möser & Bamberg, 2008; Mutrie et al., 2002; Saleh, 2007). However, there have been mixed results of combining both types of interventions on commuters' mode choices (e.g., Anable et al., 2004; Baudains, Dingle, & Styles, 2002; Hodgson, May, Tight, & Conner, 1998; Rye & McGuigan, 2000). For example, providing both travel information and discounts on public transport reduced car use in some commuters but increased car use in others (Anable et al., 2004). In Hodgson et al.'s (1998) study, providing information and implementing cycling and park-and-ride schemes were not effective at reducing car use. However, in Rye and McGuigan's (2000) study, implementing carpool-friendly programmes (e.g., carpool matching and preferential parking), reducing public transport costs, and providing travel information successfully reduced the number of people driving alone to

work. In other words, both types of interventions, when implemented separately or together, can be effective in some instances and ineffective in others.

One possible reason why both structural and psychological interventions have mixed effects regardless of whether they were implemented separately or simultaneously lies in the method of persuasion itself. Both structural and psychological interventions involve a direct method of persuasion, where commuters are told how they should behave. Specifically, providing tailored information, financial incentives, free bus tickets, and changing the commuting infrastructure are obvious ways of asking commuters to reduce their car use and use alternative modes instead. However, direct methods of persuasion can be ineffective (Wakefield, Loken, & Hornik, 2010) presumably because individuals are aware of the persuasive nature of such interventions (c.f., Aronson, 1999, 2007; Dillard & Shen, 2005). As a result, they are more likely to perceive such interventions as threats to their freedom and reject the interventions to restore their freedom of choice (Ringold, 2002). Therefore, mode-shift interventions should adopt an alternative approach that involves providing commuters with the means to influence their own travel mode behaviour (i.e., self-persuasion; see Aronson, 1999).

Summary

Overall, from this review, it is clear that there are many aspects to commuters' mode choices for their daily commute. Although mode choice may seem like a simple choice that commuters make daily to get to work, the various aspects of their mode choice have implications for the environment and public health, and consequently on the interventions developed to help commuters make more sustainable travel choices. It is evident that there are many possible psychological reasons behind commuters' mode choices and these reasons are different for commuters who use different modes. Furthermore, the psychological reasons behind commuters' mode choices may play an important role in how often they use their

modes (i.e., how committed commuters are towards their mode choices). The review revealed that mode commitment has been extensively studied in terms of modality with two categories (i.e., unimodality and multimodality) and a commuter's modality style may depend on various aspects of their commute, including the types of trips they use their modes for. Specifically, commuters tend to be unimodal for commuting trips than for non-commuting trips (e.g., shopping, transporting someone else, going to the gym, etc.), presumably due to the way they make decisions for their regular commuting trips.

The literature on travel decision-making revealed that the bounded rationality approach to understanding how commuters make mode decisions is more realistic than the rational choice approach because commuters tend to consider only a subset of the travel choices available to them before making a decision, instead of all the possible options, which can lead to satisficing or good enough decisions. Put together, commuters' mode motivating factors, mode commitment, and mode decisions are important aspects to consider when developing interventions to encourage commuters to reduce their car use and use more sustainable modes because such aspects reveal commuters' willingness and potential to shift modes. The review, however, revealed that the effectiveness of current mode-shift interventions are still questionable as there are mixed results and a lack of long-term success. Thus, there needs to be a more comprehensive understanding of how each of these aspects of mode choice relates to each other and how they can be useful to create more successful mode-shift interventions. Although current travel research has somewhat addressed the four key research questions, there are still specific research gaps that need to be addressed. In the next chapters of this thesis, I will outline the key research gaps in current research concerning the four key aspects of mode choice (i.e., mode motivating factors, mode commitment, mode decision-making strategy, and mode-shift interventions) and present three studies that I conducted to address the specific gaps.

Chapter 2

Study One

Mode Choice and Mode Commitment[1]

[1] This study was published as a paper with the same title in the Journal of Travel Behaviour and Society, 19, 20-32, 2020 authored by Rathee D. Sivasubramaniyam, Samuel G. Charlton, and Rebecca J. Sargisson.

Research Gap

Studies examining factors that motivate commuters to use their usual modes for commuting trips have had a similar research approach which involved examining the motivating factors in isolation (see e.g., Atasoy et al., 2012; Bamberg, Ajzen, & Schmidt, 2003; Beirao & Cabral, 2007; Cervero, 2002; Ellaway et al., 2003; Ettema et al., 2013; Gardner, 2009). Such studies tended to focus on the role of only one or two factors influencing commuters' mode choices instead of considering several factors in a single study. For example, Aarts and Dijksterhuis (2000a) examined the role of habits, Bamberg, Ajzen, and Schmidt (2003) studied the role of attitudes, social norms, and perceived behaviour control, Beirao and Cabral (2007) researched the influence of utility factors (e.g., time and monetary costs), and Ellaway et al. (2003) focused on the hedonic aspects of commuting. Conceptually, the individualistic approach of such studies may be problematic for two main reasons. Firstly, different types of commuters may respond to different motivating factors. Current studies tend to associate certain types of commuters with specific mode motivating factors. For example, studies on car users often highlighted the role of habits (e.g., Bamberg, Ajzen, & Schmidt, 2003; Bamberg, Rolle, & Weber, 2003; Gardner, 2009; Ouellette & Wood, 1998; Wood et al., 2005), while studies on active commuting often highlighted the role of pleasure or hedonic factors (e.g., Anable & Gatersleben, 2005; Davies et al., 1997; Kroesen & De Vos, 2020; Lades, Kelly, & Kelleher, 2020). In reality, commuters may also be motivated by multiple factors simultaneously, which is the second reason why the individualistic approach is problematic. In the first study of this thesis, I sought to address these conceptual issues by comprehensively examining several motivating factors to understand *why* commuters use their usual modes for commuting trips. In doing this, I hoped to explore how these factors interact to influence various commuters' mode choices.

Moreover, another research gap in current travel research lies in the way these studies examined commuters' mode commitment where they used the concept of 'modality' to refer to mode commitment (see Heinen & Chatterjee, 2015; Lavery et al., 2013; Nobis, 2007; Olafsson et al., 2016; Vij et al., 2013). By referring to Kuhnimhof et al.'s (2006) work on modality styles, these studies typically categorised commuters' mode commitment into one of two categories: unimodality (i.e., using one mode only in a week) and multimodality (i.e., using several modes in a week). However, using categories such as unimodal or multimodal as indicators of mode commitment only indicates that commuters either use one travel mode or several travel modes in a set period. The use of such categories does not provide information on *how often* commuters use their usual modes and other modes for commuting trips. Diana and Pirra (2016) emphasised the need for a way to measure mode commitment that not only considers commuters' use of different modes but also if there are modes that dominate other modes. For example, although drivers tend to use one mode most of the time in a week, they may also be using sustainable modes during their weekly commutes. Knowing the types of sustainable modes drivers use occasionally provides a good indication of their willingness to use those modes which is useful information to encourage successful mode-shift behaviours. Mode-shift interventions that encourage commuters to use modes that they are willing to use can be more successful than interventions that encourage them to use modes that they are not willing to use. In other words, examining how often commuters use their usual modes and other types of travel modes in a week is a better way to evaluate their mode commitment and willingness to use sustainable modes instead of simply categorising them as being either unimodal or multimodal. Thus, in the first study, I measured commuters' commitment to their mode choices using a continuous measure instead of a categorical measure such as modality.

The first study had two aims:

1. To directly compare a range of motivating factors that have been suggested to have an influence on commuters' mode choices between different types of commuters.
2. To use a continuous scale to measure, examine, and directly compare different types of commuters' commitment towards their mode choice.

Research Approach

To fulfil the research aims, I conducted the first study with a wide range of New Zealand commuters (i.e., car drivers, car passengers, bus users, cyclists, and pedestrians). In this study, a sample of commuters completed an online questionnaire measuring several motivating or psychological factors related to mode choice, namely habits, economic decision-making, social norms, status, pleasure, ease-of-use, and ecological beliefs. Then, I asked a subset of these commuters to complete a 1-week travel diary in the form of another online questionnaire, in which they provided details such as their daily commuting trip duration, trip distance, and the travel modes used. In the first questionnaire, I used commuters' intentions to use their usual modes as proxy measures of their actual behaviour. In the second questionnaire (i.e., travel diary), I used the percentages of commuting trips commuters made in a week using their usual modes as a measure of their mode commitment. I hoped that the results of the first study would provide a more comprehensive insight regarding why commuters resort to their mode choices and how committed are they to their mode choices, especially how often car users use the car and other modes for commuting trips. I also expected the results of the first study to be useful in developing appropriate interventions that address commuters' motivating factors and willingness to use sustainable modes.

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Mode choice and mode commitment in commuters

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ABSTRACT

In New Zealand, like many other developed countries, a majority of trips (67%) involve the use of private cars, producing negative effects on the environment and public health. Interventions aimed to reduce car use can be successful if we not only understand the reasons car users drive but also why other commuters use more sustainable alternatives. Although a range of possible motivating factors have been previously identified in the literature, the significance of the present study was to address the question of whether these motivating factors interact with each other to influence commuters' intentions to choose a particular mode for their daily commute. A sample of commuters completed an online survey and a subset completed a 1-week travel diary later. Social norms were a significant predictor of drivers' and car passengers' intentions to use the car, whereas ease-of-use was a significant predictor of drivers' intentions to drive and active commuters' intentions to walk or cycle. All commuters had comparable ecological beliefs and mode-related status which were not related to their intentions to use their travel modes. Although all the commuters were committed to their mode choice for daily commute, drivers and pedestrians were more likely to use only their respective travel modes for daily commute, whereas passengers, bus users, and cyclists were more likely to use a combination of several modes. Future research might productively explore subtypes of car commuters and additional analysis techniques to identify ways of nudging car commuters to reduce their car use in favour of sustainable alternatives.

1. Introduction

A majority of commuter trips involve privately-owned cars and light vehicles and the number of vehicles and trips has continued to grow over time. The number of passenger cars in use globally has increased from 654 million in 2005 to 947 million in 2015 (OICA, 2015). In New Zealand, the number of passenger cars has increased since 2009 (3.1 million) with an accelerated growth from 2013 onwards (3.2 million) to the highest level ever recorded (3.8 million) in 2017. The amount of travel in passenger cars per capita has also continued to grow from 2012 with 8377 km of annual travel to 9265 km in 2017, also the highest ever recorded (Ministry of Transport, 2018). Unfortunately, the domination of car use over sustainable transport modes has negative consequences on the environment. Transportation is a major contributor of greenhouse gas emissions such as carbon dioxide (CO_2), nitrous oxide (N_20), and methane (CH_4) (Samet, 2007). Passenger cars account for 45% of the total energy use and gas emissions in global transportation (Holmberg et al., 2012), and 57.7% in New Zealand transportation (Ministry of Transport, 2018). Therefore, there is a widely acknowledged need to encourage commuters to reduce their car use and increase their use of more sustainable modes such as taking the bus, cycling, and walking.

Several researchers have examined how to encourage commuters to use more sustainable modes for their commute. Most of these attempts involved hard measures such as structural improvements by introducing bus-only lanes and cycling paths (e.g., (Cervero et al., 2009; Jones and Sloman, 2003; Viegas and Lu, 2001) or service improvements by expanding the bus schedule and subsidising bus fares (e.g., Haque et al., 2013; Jones and Sloman, 2003). However, Garling and Schuitema (2007) suggested that hard measures may be more effective if combined with soft measures, such as providing motivational support to change commuting goals, requesting plans for how to change, and providing customised information. Studies from the US and the Netherlands (e.g., Cairns et al., 2002; Shoup, 1997; Touwen, 1999) showed a 20–25% reduction in car use when the researchers combined soft with hard measures, achieving reductions of only 5–15% when only hard measures were used (Cairns et al., 2008). To encourage commuters to change, policy makers and researchers must work together to develop an appropriate suite of measures that address commuters' emotions, attitudes, social norms, personal norms, perceived responsibility, and awareness of the negative impacts of car use (Steg et al., 2001).

Researchers have examined a wide range of influences on

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commuting modes that can broadly describe types of commuters as: habitual commuters, economic commuters, pleasure-seeking commuters, intentional commuters, and environmentally-conscious commuters. In practice, when commuters are faced with making the same trip every day, repetition in an invariant context may lead to a habitual and largely unconscious choice of travel mode. Repetition of a choice of mode leads to an increased likelihood of the same choice in the future (Bamberg et al., 2003a; Gardner, 2009; Ouellette and Wood, 1998). As with any habit, repetition may reduce conscious involvement in choosing a commuting mode. For example, involvement in a cognitively demanding task has been shown to make cyclists more likely to choose cycling as a transport mode, even after they had been asked not to choose cycling (as compared to cyclists who had not completed the task) (Aarts and Dijksterhuis, 2000). The demanding task diminished participants' mental resources available to select an alternative mode and they automatically selected their habitual travel mode. With extended repetition, choice of travel mode can become stereotyped and context-bound such that contextual cues in familiar situations can automatically trigger use of the habitual travel mode (Wood et al., 2005), allowing alternative choices to be considered only in unfamiliar or changed situations such as moving to a new residence (Bamberg, 2006), or a temporary expressway closure (Fujii and Garling, 2003).

Prior to the development of prepotent habits, commuters may choose a travel mode based on economic factors, explicitly considering the costs (time and money) of different modes. The decision-making literature suggests that costs are more salient than gains, and that people tend to be loss averse when making decisions because losses are more salient than gains (Kahneman and Tversky, 1979). In a change from usual car dominance, commuters will choose public transport when traffic is congested because it will take less time than driving (Cervero, 2002; Corpuz, 2007). During off-peak hours, however, commuters were more likely to drive due to less frequent public transport schedules, and less traffic congestion (Corpuz, 2007). Congestion pricing policies have successfully leveraged commuters' loss aversion to reduce car use (Eliasson et al., 2009; Washbrook et al., 2006). Similarly, the costs of car use (maintenance and fuel) are important considerations for some commuters that choose to use the bus (Beirao and Cabral, 2007).

Researchers have also shown that commuters' choice of mode may be based on what makes them feel good or satisfied. Commuters may feel good because a mode fulfils their symbolic motives (e.g., sense of power, prestige, and status) and affective motives (e.g., autonomy, freedom, and control). For example, some commuters may choose to drive because they enjoy being in control of the vehicle and derive a sense of higher status when driving (Steg et al., 2001). Some cyclists find pleasure in improving their traffic skills and their fitness levels (Davies et al., 1997). Pedestrians often report a sense of relaxation and an absence of stress while walking during their commute (Anable and Gatersleben, 2005). Bus users report enjoying qualities specific to bus service such as accurate departure time, punctuality, reliability, and the opportunity to talk to other passengers (Ettema et al., 2012; Friman et al., 2001).

For some commuters, the decision to use a particular mode is reasoned and intentional based on three social psychological factors: attitudes, subjective norms, and perceived behavioural control (PBC). Ajzen (1991) explored the relationship between intention and behaviour and proposed in the Theory of Planned Behaviour (TPB) that intentions to perform a behaviour should precede the behaviour itself. Ajzen (1991) suggested that it is possible to influence behaviour and intention through interventions that significantly affect one or more of the three psychological factors. Several researchers have attempted to use TPB to encourage commuters to use the public transport using an intervention aimed at influencing commuters' attitude, social norms, and PBC towards public transport (Bamberg et al., 2003a,b). After receiving a prepaid bus ticket either alone (Bamberg et al., 2003a) or combined with an information pack (Bamberg et al., 2003b), students were more likely to use public transport and had more positive attitudes, positive subjective norms, higher PBC, and stronger intentions to use public transport. Therefore, interventions targeted at influencing commuters' attitudes, subjective norms, PBC, and intentions can be successful.

Finally, some commuters choose travel modes based on their pro-environmental attitudes. Environmentally conscious commuters may also be economic commuters to the extent they are loss averse with regard to the negative impacts that certain travel modes have on the environment (Flamm, 2009; Thogersen and Olander, 2006). Pro-environmental commuters regularly perform pro-environmental behaviours such as recycling and purchasing organic items. These behaviours are consistent with more frequent use of public transport and reducing car use (Atasoy et al., 2012; Roberts et al., 2018; Thogersen and Olander, 2006; Whitmarsh and O'Neill, 2010). To the degree that pro-environmental attitudes are seen as social norms, commuters' transport choices may also be shaped by these social and personal norms (Hunecke et al., 2001).

As can be seen in this brief review, there are a range of different types of considerations that may influence the commuting modes chosen by different types of commuters. Although there are different views on the degree to which these various considerations influence commuters to choose their travel modes, researchers have tended to examine the factors in isolation, such that each researcher focused on the role of just one or a very few factors influencing commuters' mode choices. Conceptually this may be problematic both because different types of commuters may respond to different influences, and also because commuters may be influenced by multiple factors simultaneously. The present study sought to address this issue by comparing the degree to which commuters' intentions to use their typical travel mode is influenced by a wide range of factors.

We wanted to directly compare the full range of factors that have been suggested to have an influence on commuters' mode choices. Specifically, we identified measures to determine the relative influences of habits, economic decision-making, social norms, status, pleasure, ease-of-use, and ecological beliefs. Our motivation for doing this revolved around the conceptual question of whether these seven potential motivating factors interact with each other to influence commuters' intentions to choose a particular mode for their daily commute. As alluded to earlier, the different sorts of findings previously reported in the literature opens the possibility that users of different commuting modes may have different factors motivating their intentions. We also expected that for some commuters, only one factor may be influential whereas for other commuters, several factors may be influential, an aspect that has not previously been explored to any great degree.

In order to explore the relative influence of these different types of motivational factors we recruited a wide range of different types of commuters; those who regularly chose to drive their private car, use the bus, cycle, walk, or commute as a car passenger, across a wide range of demographic characteristics. We asked these commuters to complete an online survey and then selected a subset of them to complete a 1-week travel diary in which they provided details of their daily commute (e.g., trip duration, trip distance, and mode choice). We hoped to provide a fuller picture of how the range of underlying considerations interact to influence commuters' intentions to choose a particular travel mode for their regular trips to work and school.

2. Method

The methodology for the present research involved recruiting a sample of commuters to complete an online survey followed by asking a subset of the respondents to complete a 1-week travel diary in which they provided details of their daily commute. The data collection for both the online survey and travel diary took place in New Zealand between March and May 2018 (Autumn in New Zealand).

Table 1
Demographic Characteristics of Commuters and Modes for Daily Commute (n = 313).

		Percentage of respondents within each commuter group (%)				
	n	Drivers (n = 191)	Passengers (n = 22)	Bus users (n = 24)	Cyclists (n = 32)	Pedestrians (n = 44)
Gender						
Male	74	20.94	9.09	20.83	56.28	20.45
Female	239	79.06	90.91	79.17	43.75	79.55
Age						
16–24 years	84	21.47	45.45	29.17	6.25	54.55
25–34 years	63	21.99	22.73	20.83	12.50	15.91
35–44 years	67	21.99	18.18	29.17	21.88	15.91
45–54 years	61	20.42	4.55	12.50	40.63	11.36
55–64 years	34	12.57	9.09	8.33	15.63	2.27
65–74 years	4	1.57	–	–	3.13	–
75 years or over	–	–	–	–	–	–
Level of education						
No secondary school qualification	3	1.05	–	–	–	2.27
High school qualification or equivalent	84	22.51	40.91	33.33	9.38	47.73
Tertiary diplomas or certificate	58	20.42	13.64	29.17	9.38	13.64
Bachelor degree or Bachelor with Honours degree	112	42.41	9.09	20.83	40.63	25.00
Master degree or higher	56	13.61	36.36	16.67	40.63	11.36
Occupation*						
Full time student	97	21.99	54.55	37.50	15.63	65.91
Part time student	27	10.47	4.55	12.50	6.25	2.27
Full time worker	183	65.97	40.91	50.00	68.75	31.82
Part time worker	56	19.37	18.18	12.5	18.75	13.64
Casual worker	16	4.71	13.64	4.17	–	6.82
Unemployed or looking for work	12	2.09	4.55	4.17	–	13.64
Looking after home or family	21	8.90	13.64	–	3.13	–
Retired	2	1.05	–	–	–	–
Household type						
Person living alone	24	7.33	–	4.17	6.25	15.91
Married/de facto couple	68	19.90	31.82	8.33	43.75	15.91
Other adults only (e.g., flatmates)	60	17.28	9.09	8.33	12.50	43.18
Family (including extended) with children	94	31.41	31.82	54.17	25.00	13.64
Family with adults only	49	15.71	27.27	25.00	12.50	6.82
Single adults living children	12	5.76	–	–	–	2.27
Other	6	2.62	–	–	–	2.27
Annual household income						
Less than $50,000	82	18.85	27.27	33.33	9.38	65.91
$50,000 to $99,999	113	39.97	36.36	37.50	43.75	13.64
$100,000 to $149,999	65	23.56	22.73	8.33	21.88	13.64
$150,000 or more	48	16.23	9.09	20.83	25.00	4.55
Average daily travel time						
Less than 10 min	24	4.19	18.18	–	12.50	18.18
10–19 min	79	27.23	22.73	8.33	25.00	27.27
20–29 min	69	20.42	22.73	12.50	28.13	29.55
30–39 min	39	13.61	4.55	20.83	12.50	6.82
40–49 min	37	13.09	9.09	25.00	6.25	4.55
50–59 min	24	6.28	13.64	16.67	6.25	6.82
60 min or over	41	15.18	9.09	16.67	9.38	6.82
Average daily travel distance						
Less than 5 km	64	8.90	27.27	8.33	25.00	72.73
5–10 km	78	20.42	31.82	29.17	43.75	25.00
11–15 km	51	18.32	9.09	29.17	18.75	2.27
16–20 km	39	15.71	4.55	20.83	9.38	–
21–25 km	22	10.99	–	–	3.13	–
26–30 km	13	5.76	4.55	4.17	–	–
31–35 km	7	2.62	4.55	4.17	–	–
36–40 km	4	1.05	4.55	4.17	–	–
More than 40 km	34	16.23	13.64	–	–	–

Note. *Respondents could select any option that applied to them. Blanks indicate no response.

2.1. Participants

We recruited respondents 16 years of age and older through notices placed on the intranets of various New Zealand organisations as well as on social media, news media, and through word-of-mouth. Five hundred and eighty-five respondents completed the online survey. The majority of them resided in a single region of New Zealand. We excluded respondents who lived in other regions due to the low number of responses and the availability of idiosyncratic travel modes unique to those areas within New Zealand (e.g., train and Uber). We also excluded respondents who did not use any of the five commuting modes of interest to us. The final regional sample of 313 respondents consisted of 239 women and 74 men, with a wide age range (Table 1). We categorised respondents as drivers, car passengers, bus users, cyclists, or pedestrians based on their responses to one of the questions in the survey. The majority were drivers (n = 191), followed by pedestrians

(n = 44), cyclists (n = 32), bus users (n = 24), and car passengers (n = 22; Table 1).

We invited all of the survey respondents to indicate their willingness to take part in completing an online travel diary. Of the 210 respondents who expressed their interest, we accepted the first 10 participants for each commuting mode (i.e., drivers, car passengers, bus users, cyclists, and pedestrians). Three of these participants did not fully complete their travel diary and the final sample consisted of 47 participants (41 female). Specifically, there were 10 drivers, 8 car passengers, 9 bus users, 10 cyclists, and 10 pedestrians in the final sample of commuters completing a travel diary.

2.2. Materials and procedure

The online survey included questions across 11 topic areas or sections, arranged in a hierarchical structure. Each respondent received a minimum of 10 questions and, depending on their answers, a maximum of 198 questions. The question formats were a mix of check all that apply and forced-choice (see full question set in Appendix A). Of the 198 questions, two were filter questions (commuter mode type) determining the presentation of subsequent questions, ten were questions on demographic characteristics, four were questions on travel characteristics, and 183 were questions corresponding to the various motivating factors (for additional details, see Appendix A).

For the first section, we asked respondents to rate the difficulty of using each of the commuting modes available to them using a 5-point scale (1 = not difficult to 5 = very difficult) (adapted from Berman and Cheng, 2001). Next, we asked respondents two questions on the perceived status associated with the commuting modes on a 7-point scale (1 = *not at all* to 7 = *very much*) (adapted from (Nelissen and Meijers, 2011). In the third section, we asked eight items (adapted from Bamberg et al., 2003a) in which respondents rated their attitudes, subjective norms, PBC, and intentions to use each of the commuting modes available to them. For these items, a 5-point semantic differential response scale was used.

For the next two sections (4 and 5), we asked questions pertaining only to respondents' answers to the filter question "Which of these modes have you used for daily commute to and from work or school?" In Section 4 respondents rated their satisfaction with using each commuting mode using the 9-item Satisfaction with Travel Scale (STS; (Ettema et al., 2011), on a 9-point semantic differential scale. The Cronbach's alpha reported by Ettema et al. (2011) ranged from 0.84 to 0.91 across the three subscales of the STS. In Section 5, respondents rated the perceived autonomy and prestige associated with each mode across five 5-point Likert scale items (1 = *strongly disagree* to 5 = *strongly agree*) (adapted from Ellaway et al., 2003).

As an indication of the role of habit in their choice of commuting mode, Section 6 asked the respondents their frequency of using the travel modes for 10 destinations (e.g., going to the supermarket, visiting a friend in a nearby town), (adapted from Verplanken et al., 1994) Response-Frequency (RF) measure. Section 7 measured pro-ecological beliefs using the 15 item New Ecological Paradigm (NEP) scale (Dunlap et al., 2000). The NEP scale asks respondents to rate their agreement with a series of statements (on a 5-point Likert scale), seven of which are reverse scored to arrive at an overall score indicative of pro environmental beliefs. The NEP scale has a Cronbach's alpha of 0.80 (Dunlap et al., 2000). Section 8 contained nine 5-point Likert scale items from the Maximising Tendency Scale (MTS; Diab et al., 2008) to assess the extent to which the respondents try to optimise their decisions, or are willing to satisfice, making decisions that are just good enough. Diab et al. (2008) reported a Cronbach's alpha of 0.80 for this scale.

Section 9 presented the Risk-Taking Index (RTI; Nicholson et al., 2005), designed to measure respondents' tendencies to engage in or avoid risky behaviour (including driving fast and cycling without a helmet) across 28 items (5-point scale, 1 = *never* to 5 = *very often*). The Cronbach's alpha reported by Nicholson et al. (2005) for all domain subscales ranged from 0.80 to 0.88. In Section 10, respondents provided details of their commute such as estimates of commuting time and distance and in Section 11, they provided details of their demographic and socio-economic characteristics (e.g., gender, age, occupation, etc., see Appendix A).

In the travel diary, we asked respondents for details of each leg of all of their trips taken in a week. They completed one diary entry per day for 7 consecutive days (Monday to Sunday). We first asked how many trip legs (i.e., journeys between stops) they made on that day. The diary format allowed for a possible 15 trip legs each day. If a respondent made more than 15 trip legs, we asked them two more questions on the exact number of trip legs they made in that day and the mode they used most often for those trip legs. For each trip leg, we asked respondents 16 questions on their commute details such as their starting location, destination, estimated distance, estimated time, purpose, and the travel mode used for that trip leg. Out of the 16 questions, three were open-ended and 13 were multiple choice questions.

2.3. Analysis

To assess the role of habit we used the response frequency items and summed the number of times out of 10 that respondents chose their typical commuting mode for the destinations listed in the RF items. The possible range of scores was 0 (*weak*) to 10 (*strong*) habitual use. These scores were normally distributed with majority of the scores lying close to the mean (M = 5.45, 95% CI [5.13, 5.76], range = 9.00).

As a measure of respondents' economic decision-making tendency, we averaged their scores on the RTI and the MTS. Our preliminary analysis indicated a negative correlation between scores on the RTI and the MTS. Therefore, we reverse-scored the items on the MTS before averaging the scores. The possible range of scores was 1 (*low*) to 5 (*high*) economic decision-making tendency. The scores of economic decision-making tendency were normally distributed (M = 1.91, 95% CI [1.88, 1.94], range = 3.12).

To measure respondents' social norms towards their travel modes, we averaged their scores on the two social-norm items from Section 3 relevant to their mode choice. The two items were "Most people who are important to me would support the use of [travel mode] for daily commute next time" and "Most people who are important to me think that I should use [travel mode] for daily commute next time". The possible range of scores was from 1 (*weak*) to 5 (*strong*) social norms. The data were negatively skewed, such that most of the commuters had positive social norms associated with their typical mode (M = 4.21, 95% CI [4.10, 4.31], range = 4.00). We obtained separate Cronbach's alpha values for each commuter: drivers = 0.78, car passengers = 0.84, bus users = 0.97, cyclists = 0.87, and pedestrians = 0.90).

As a measure of respondents' perceived status from using their travel modes, we averaged their scores on the two perceived status (Section 2) and the three perceived prestige (Section 5) items relevant to their mode choice. The possible range of scores was from 1 (*low*) to 5 (*high*) perceived status. Commuters' scores of perceived status were normally distributed (M = 2.55, 95% CI [2.45, 2.64], range = 4.14).

To measure respondents' derived pleasure from using their travel modes, we averaged their scores on the two attitude (Section 3), two perceived autonomy (Section 5), and nine STS (Section 4) items relevant to their mode choice. We converted their average STS scores to a 5-point Likert scale to maintain consistency with the attitude and perceived autonomy scales. Respondents' possible range of scores was from 1 (*not pleasurable*) to 5 (*very pleasurable*). The ratings of pleasure were normally distributed (M = 3.70, 95% CI [3.63, 3.77], range = 3.12). We also obtained separate Cronbach's alpha values for each commuter: drivers = 0.22, car passengers = 0.59, bus users = 0.80, cyclists = 0.31, and pedestrians = 0.50.

We averaged respondents' scores on the two items for PBC (Section 3) and the perceived difficulty (Section 1) item relevant to their mode

Table 2
Parameter Values and Coefficients of Predictors from Multiple Linear Regression of Commuters' Intentions to Use Their Travel Modes.

Predictor variables	Coefficients					Analysis of Variance				
	b	*SE*	95% CI for *b*	*β*	*p*	*F*-value	*df*	*p*	R^2	adj. R^2
Drivers (n = 191)						5.87	7, 183	0.000	0.18	0.15
Constant (Intercept)	2.67	0.64	1.40, 3.93	–	0.000					
Social norms	0.21	0.04	0.13, 0.30	0.36	0.000					
Ease of use	0.19	0.09	0.01, 0.37	0.15	0.04					
Habit	0.02	0.02	−0.01, 0.05	0.08	0.23					
Ecological beliefs	0.08	0.07	−0.06, 0.22	0.08	0.26					
Pleasure	0.01	0.07	−0.12, 0.15	0.01	0.85					
Economic decision-making	−0.07	0.14	−0.35, 0.20	−0.04	0.61					
Perceived Status	−0.02	0.05	−0.12, 0.08	−0.04	0.64					
Passengers (n = 22)						4.12	7, 14	0.01	0.67	0.51
Constant (Intercept)	−0.66	2.32	−5.63, 4.32	–	0.78					
Social norms	0.67	0.29	0.04, 1.31	0.63	0.04					
Pleasure	0.35	0.40	−0.50, 1.20	0.17	0.39					
Ease of use	0.19	0.32	−0.49, 0.88	0.13	0.56					
Ecological beliefs	0.60	0.46	−0.84, 1.15	0.10	0.74					
Economic decision-making	0.11	0.59	−1.16, 1.39	0.04	0.85					
Perceived Status	−0.13	0.29	0.04, 1.31	−0.09	0.67					
Habit	−0.09	0.11	−0.32, 0.15	−0.21	0.43					
Bus users (n = 24)						1.84	7, 16	0.15	0.45	0.20
Constant (Intercept)	1.53	2.41	−3.58, 6.63	–	0.54					
Social norms	0.26	0.19	−0.13, 0.66	0.37	0.18					
Pleasure	0.46	0.42	−0.43, 1.35	0.33	0.29					
Economic decision-making	0.84	0.85	−0.96, 2.64	0.23	0.34					
Habit	0.01	0.10	−0.21, 22	0.01	0.95					
Ease of use	−0.03	0.30	−0.65, 0.60	−0.02	0.93					
Perceived Status	−0.10	0.27	−0.68, 0.47	−0.08	0.71					
Ecological beliefs	−0.22	0.34	−0.93, 0.49	−0.14	0.52					
Cyclists (n = 32)						3.27	7, 24	0.01	0.49	0.34
Constant (Intercept)	2.07	1.78	−1.61, 5.74	–	0.26					
Ease of use	0.86	0.25	0.35, 1.37	0.64	0.002					
Ecological beliefs	0.10	0.19	−0.28, 0.49	0.09	0.60					
Habit	0.02	0.05	−0.08, 0.12	0.07	0.68					
Social norms	−0.03	0.14	−0.31, 0.26	−0.03	0.86					
Perceived Status	−0.05	0.13	−0.32, 0.22	−0.06	0.72					
Pleasure	−0.18	0.28	−0.75, 0.40	−0.10	0.53					
Economic decision-making	−0.36	0.34	−1.07, 0.35	−0.16	0.30					
Pedestrians (n = 44)						11.33	7, 36	0.000	0.69	0.63
Constant (Intercept)	−1.57	1.10	−3.79, 0.66	–	0.16					
Ease of use	0.78	0.25	0.28, 1.29	0.46	0.004					
Pleasure	0.61	0.19	0.21, 1.00	0.40	0.004					
Habit	0.08	0.06	−0.04, 0.21	0.13	0.19					
Perceived Status	0.07	0.11	−0.15, 0.30	0.07	0.50					
Economic decision-making	0.02	0.31	−0.61, 0.66	0.01	0.94					
Social norms	0.01	0.15	−0.30, 0.31	0.01	0.96					
Ecological beliefs	−0.10	0.14	−0.40, 0.19	−0.07	0.47					

choice to obtain their perceived-ease-of-using their respective travel modes. The two PBC items were "For me to use [travel mode] for daily commute next time would be 1 (*difficult*) or 5 (*easy*)" and "My freedom to use [travel mode] for daily commute next time is 1 (*low*) or 5 (*high*)". We reverse-coded respondents' perceived difficulty scores because the items in the perceived difficulty measure ranged from low perceived difficulty (i.e., easy) to high perceived difficulty (i.e., not easy), whereas the items in the PBC ranged from low PBC (i.e., not easy) to high PBC (i.e., easy). The possible range of scores for the perceived-ease-of-use was from 1 (*not easy to use*) to 5 (*very easy to use*). These scores were negatively skewed, such that most of the commuters perceived it was easy for them to commute using their usual mode (M = 4.72, 95% CI [4.66, 4.78], range = 2.50). We obtained separate Cronbach's alpha values for each commuter: drivers = 0.63, car passengers = 0.76, bus users = 0.66, cyclists = 0.53, and pedestrians = 0.52.

To measure respondents' ecological beliefs, we averaged their scores on the 15 items of the NEP (Section 7) after reverse-scoring the seven even-numbered items so that high scores on these items corresponded to pro-ecological beliefs. The possible range of scores was from 1 (*negative*) to 5 (*positive*) ecological beliefs. The data were normally distributed (M = 3.77, 95% CI [3.70, 3.83], range = 2.73.

We also measured respondents' intentions to use their respective travel modes as an outcome variable in the regression analyses. We measured their intentions by averaging their scores on the two intention items from Section 3: "My intention to use [travel mode] for daily commute next time is 1 (*weak*) or 5 (*strong*)" and "I intend to use [travel mode] for daily commute next time" to which respondents answered 1 (*unlikely*) to 5 (*likely*)". The possible range of scores for intention to use their travel mode was from 1 (*weak*) to 5 (*strong*). The intention scores were negatively skewed, such that most commuters had strong intentions to choose their usual mode for their next commute (M = 4.69, 95% CI [4.61, 4.77], range = 4.00. Where we identified missing values (21 responses) we replaced them with the respective mean scores of each commuter type for that particular measure to maintain the largest possible data set.

To examine respondents' commitment towards their travel mode for their daily commute, we computed their percentages of total number of work or school trip legs and non-work or non-school trip legs involving their choice of travel mode over the week. In each daily entry, when a

Table 3
Parameter Values and Coefficients of Each Factor from the one-way ANOVA.

Motivating Factors	Coefficients				Analysis of Variance		
	N	*Mean*	*SE*	95% CI	*F*-value	*p*	$\eta 2$
Social Norms					2.24*	0.07	0.03
Pedestrians	44	4.49	0.12	4.25, 4.73			
Drivers	191	4.24	0.07	4.11, 4.37			
Cyclists	32	4.09	0.17	3.76, 4.42			
Passengers	22	3.94	0.20	3.54, 4.34			
Bus users	24	3.85	0.27	3.33, 4.37			
Ease of Use					4.55*	0.003	0.10
Drivers	191	4.82	0.03	4.76, 4.88			
Pedestrians	44	4.69	0.07	4.55, 4.83			
Cyclists	32	4.68	0.10	4.49, 4.87			
Bus users	24	4.39	0.16	4.08, 4.70			
Passengers	22	4.36	0.14	4.08, 4.64			
Pleasure					27.10	0.000	0.35
Cyclists	32	4.49	0.07	4.35, 4.63			
Pedestrians	44	4.00	0.08	3.83, 4.17			
Passengers	22	3.92	0.10	3.72, 4.12			
Bus users	24	3.51	0.13	3.25, 3.77			
Drivers	191	3.49	0.04	3.41, 3.57			
Habit					72.02*	0.000	0.62
Drivers	191	6.74	0.17	6.40, 7.08			
Passengers	22	5.27	0.51	4.28, 6.26			
Cyclists	32	4.03	0.42	3.20, 4.86			
Bus users	24	2.83	0.39	2.07, 3.59			
Pedestrians	44	2.40	0.20	2.01, 2.79			
Economic decision-making					2.55	0.04	0.03
Drivers	191	1.95	0.02	1.91, 1.99			
Cyclists	32	1.91	0.17	1.58, 2.24			
Pedestrians	44	1.86	0.12	1.62, 2.10			
Passengers	22	1.84	0.07	1.71, 1.97			
Bus users	24	1.79	0.27	1.27, 2.31			
Status					2.17	0.07	0.03
Pedestrians	44	2.85	0.13	2.59, 3.10			
Cyclists	32	2.68	0.16	2.36, 3.00			
Drivers	191	2.48	0.06	2.36, 2.60			
Passengers	22	2.44	0.15	2.12, 2.75			
Bus users	24	2.41	0.15	2.09, 2.73			
Ecological Beliefs					1.36	0.25	0.02
Drivers	191	4.82	0.03	4.76, 4.88			
Pedestrians	44	4.69	0.07	4.55, 4.83			
Cyclists	32	4.68	0.10	4.49, 4.87			
Passengers	22	4.36	0.14	4.08, 4.64			
Bus users	24	4.39	0.16	4.08, 4.70			

Note: *We used Welch's F as the ANOVA statistic because the assumption of homogeneity of variance was violated. Where we used Welch's F, we used the Games-Howell post-hoc analysis for pairwise comparisons.

respondent chose either work or education as the purpose of their trip, we considered their response as a 'work or school trip leg' and considered every other trip purpose as 'non-work or non-school' trip leg. For bus users, we excluded 'change-to-other-mode' trip legs (i.e., walking to and from bus stops) from their total number of trip legs in a week to avoid a low percentage of work or school trip legs involving bus use. High percentages indicate strong commitment towards their travel mode (i.e., large number of trip legs involving their travel mode), whereas low percentages indicate weak commitment. For work or school trip legs, we found a mean of 78.33 (95%CI [70.60, 86.05], range = 100) and for non-work or non-school trip legs, we found a mean of 49.88 (95%CI [42.63, 58.13], range = 100). The commitment data for work or school trip legs were negatively skewed (i.e., many commuters were highly committed to their usual mode) but the commitment data for non-work or non-school trip legs were normally distributed.

3. Results

3.1. Motivating factors predicting intentions to use travel mode for daily commute

In order to identify the motivating factors predicting intentions to use particular travel modes we carried out a multiple regression analysis for each type of commuter. Our regression analyses showed that the social norms measure was a significant predictor of drivers' and passengers' intentions to use a car for their commute. Perceived ease-of-use was a significant predictor of drivers', cyclists' and pedestrians' intentions (to drive, cycle, and walk, respectively) and pleasure was also a significant predictor of pedestrians' intentions to walk for their daily commute. No other motivating factors significantly predicted the commuters' intentions to use their respective modes and none of motivating factors predicted bus users' intentions to use the bus for their daily commute (Table 2).

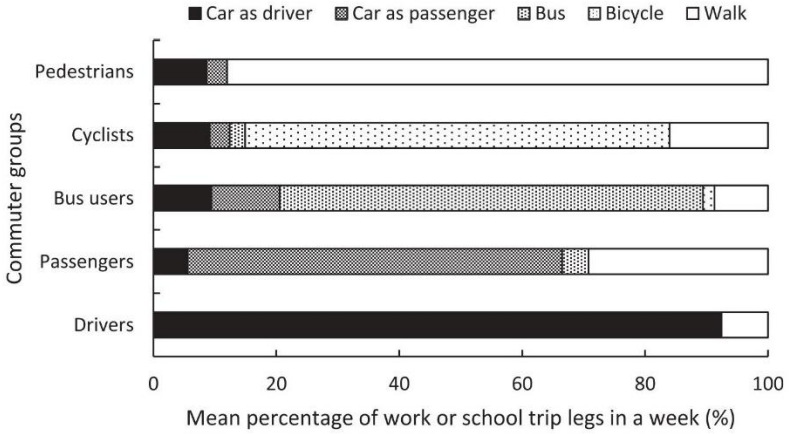

Fig. 1. Mean percentages of each commuter groups' work or school trip legs using various modes over a week.

3.2. Differences in motivating factors between commuters

Another way of looking at the relative influence of the seven motivating factors is to compare them across the different commuter types. To do this, we conducted a one-way, between-subject, ANOVA for each factor, where the independent variable was commuter group with five levels (drivers, passengers, bus users, cyclists, and pedestrians). From Table 3, we see that commuters were significantly different from each other in terms of the ease-of-use, pleasure, economic decision-making, and habit factors. They were not significantly different from each other in terms of the social norms, perceived status, and ecological beliefs factors.

All the commuters had medium to high scores for the social norms measure. For the ease-of-use factor, post-hoc pairwise comparisons (Games-Howell) showed that drivers perceived using their travel mode to be easier than car passengers perceived theirs. Post-hoc pairwise comparisons (Bonferroni-adjusted) for the ANOVA on derived pleasure from using travel modes showed that cyclists' found using their travel mode (i.e., cycling) more pleasurable than all the other commuters did. Passengers found using their travel mode (i.e., car as passenger) more pleasurable than drivers did, whereas pedestrians found using their travel mode (i.e., walking) more pleasurable than bus users did.

As for habit, post-hoc pairwise comparisons (Games-Howell) demonstrated that drivers have a stronger habit of using their travel mode than bus users, cyclists, and pedestrians do. Passengers have a stronger habit of using their travel mode than bus users and pedestrians do, whereas cyclists have stronger habit of cycling than pedestrians do towards walking. Although the ANOVA for economic decision-making indicated an overall significant difference, there were no pairwise differences. All commuters had low scores for the perceived status factor and high scores on the ecological beliefs factor.

3.3. Mode commitment

Another interesting perspective on commuters' use of a particular mode was revealed by examining the degree to which they used one mode, and only that mode for their travel; in other words their commitment to a particular travel mode. So, using the 1-week travel diary data, we identified the commuters' percentage of trip legs involving their travel mode and alternative modes. We considered commuters who used their travel mode most frequently in a week to have higher commitment towards their travel mode. Interestingly, we found that all commuters were committed to their travel modes because they used their respective modes most frequently compared to alternative modes for daily commute.

Fig. 1 shows the five commuter groups' mean percentages of work or school trip legs involving their respective mode choice. Drivers drove most of the time in the week (92.47%) and walked for the remaining

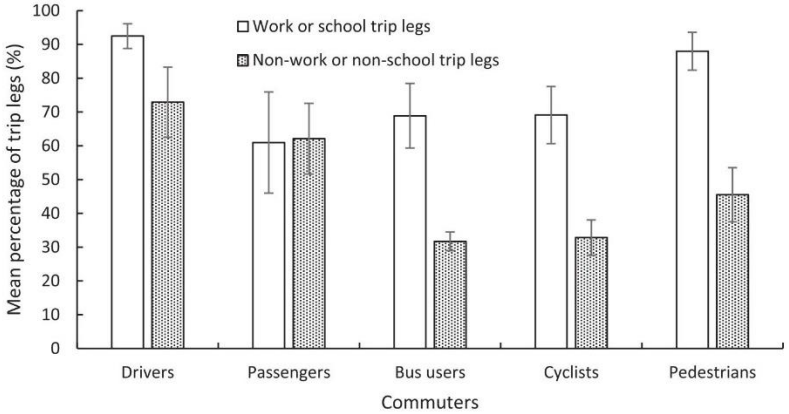

Fig. 2. Mean percentages of respondents' work or school trip legs and non-work or non-school trip legs using their choice of travel mode over a week for five commuter groups. The error bars represent the standard error of the mean.

Table 4
Parameter Values and Coefficients for Repeated Measures t tests Comparing Percent of Trip Legs for Daily vs. Non-daily Commute.

	Percent of work or school trip legs		Percent of non-work or school trip legs				
	M	95% CI	*M*	95% CI	*t*	*p*	*d*
Drivers	92.47	85.30, 99.64	72.90	52.86, 92.92	1.58	0.149	0.79
Car passengers	60.94	31.63, 90.25	62.10	23.19, 64.27	−0.12	0.905	0.04
Bus users	68.89	50.17, 87.61	34.15	26.29, 37.11	3.78	0.005*	1.76
Cyclists	69.08	52.56, 85.60	32.83	22.58, 43.08	5.75	0.000*	1.63
Pedestrians	88.00	76.98, 99.02	45.50	29.8, 61.20	5.24	0.001*	1.94

*Significant based on Bonferroni-adjusted (0.01) *p*-value.

trip legs (7.53%). Passengers used the car as a passenger most of the time (60.94%), followed by walking (29.21%) and taking the bus (4.29%). Most of pedestrians' trip legs involved walking (88.00%) and the rest involved driving (8.67%) and using the car as passenger (3.33%). Bus users used the bus frequently (68.89%) and cyclists cycled for most of their trip legs (69.08%). Car passengers, bus users, and cyclists used all other modes occasionally, whereas drivers and pedestrians used their travel modes for their most of their daily commute trips.

We then wondered whether commuters' commitment levels to their mode choice would be different for non-daily commute trips (i.e., non-work or non-school trips). Therefore, we computed each commuter groups' mean percentages of non-work or school trip legs involving their travel mode in a week. Fig. 2 shows that all commuters, except car passengers, used their travel mode more often for work or school trip legs compared to non-work or non-school trip legs. However, the repeated measures *t*-tests (Table 4) found that the differences were only significant (Bonferroni-adjusted) for bus users, cyclists, and pedestrians, such that these commuters were more likely to use their travel modes for daily commute trips rather than non-daily commute trips. Drivers and car passengers were equally likely to use the car for both types of trips.

4. Discussion

Strongly committed commuters are less likely to use other travel modes for any of their trips (Simma and Axhausen, 2001). In our study, drivers were the most committed towards their travel mode, such that they drove their car for the greatest proportion of their daily trips. Few drivers in our study used other modes, with the exception of a small percentage of trip legs that involved walking. Buehler and Hamre (2016) also reported that walking was the only non-car mode used by the majority of car users. Other researchers have described commitment as either mono-modal when only one travel mode is used for most trips or multi-modal when multiple travel modes are used (Heinen and Chaterjee, 2015; Kuhnimhof et al., 2006; Nobis, 2007). In these terms, Kuhnimhof et al. (20060 reported that car drivers can usually be characterised as mono-modal.

Like drivers, the pedestrians in our study also showed high commitment and used fewer travel modes compared to car passengers, bus users, and cyclists who used a variety of modes for their trips. Certainly part of this pattern may be due to situational constraints, such as when bad weather causes cyclists to use weather-sheltered modes (i.e., car or bus), or very short trip distances that occasion walking. Similarly, non-routine trips often involve a range of destinations (e.g., church, supermarket, gym) encouraging the use of a variety of travel modes. In other words, non-routine or unfamiliar trips may occasion alternative mode choices to be considered (Carrel et al., 2011; Wood et al., 2005).

Looking beyond mode commitment, our results indicated that there are different motivating factors underlying different types of commuters' mode choices. Social norms was the best predictor of drivers' and passengers' intentions. It is also noteworthy that there were no significant differences in the social norm scores of any of the commuter types, reporting relatively neutral to positive social norms for their respective travel modes. Previous studies have found that family members and friends can be a source of inspiration to drivers through observations of car use (Jopson, 2004; Noblet et al., 2014) or conversations around car use (Haustein et al., 2009). This was also the case for car passengers (Teal, 1987) and pedestrians (Schneider, 2011). Therefore, interventions aimed to influence the attitudes of commuters towards sustainable travel modes, could also influence the attitudes of the people in commuters' social networks (e.g., family members, friends, co-workers, and neighbours).

Ease-of-use was a significant predictor of drivers', cyclists', and pedestrians' intentions to use their travel modes. In contrast to social norms, there were significant differences between the commuter groups in terms of their perceptions of ease of using their modes, with drivers reporting the highest score for this factor. Drivers may find it convenient to use the car because they can carry out their daily responsibilities (e.g., transport children from day care, and shopping) (Maxwell and Miller, 2001), and park their cars easily at places that offer convenient parking such as workplaces, universities, and shopping malls (Mackett, 2003). The cyclists in our study also had high scores for this factor. Cyclists in previous studies have demonstrated positive self-efficacy towards cycling (De Gues et al., 2008; Venkatesh and Davis, 1996) and some claimed that having the necessary facilities that complemented their cycling behaviour, such as bicycle lockers and shower rooms made it easier for them to cycle to work or school (Dickinson et al., 2003; Hunt and Abraham, 2007). The pedestrians in our study also reported high perceived ease-of-use, possibly a consequence of the shorter distances of their commutes, an average of less than 5 km a day (Table 1).

Pedestrians' pleasure from walking was also a significant predictor of their intentions to walk for their daily commute. Indeed this intrinsic pleasure in the activity has been previously shown to be important to many pedestrians (Gatersleben and Uzzell, 2007). As with the ease-of-use ratings, we found significantly different pleasurability ratings for the different commuter groups. Cyclists were more likely to find using their travel mode pleasurable than all other commuters. Cycling not only provides physical and mental health benefits, but it also provides fun, such that cyclists can enjoy the view, breathe fresh air, and feel accomplished when they have gone on a long ride (Schneider, 2011). Drivers had the lowest score on this measure, albeit their mean score indicated neutral feelings from driving. One option for encouraging drivers to consider other mode choices may thus be to emphasise the less pleasurable aspects of car use (e.g., traffic congestion and stress) and make the pleasurable aspects of active commuting more apparent (Hennessy and Wiesenthal, 1999; Koslowsky et al., 1995).

Although previous researchers have observed economic influences on mode choice decisions (Beirao and Carbral, 2007; Cervero, 2002; Corpuz, 2007) we were unable to detect any significant influences in our study and there were no appreciable differences between commuter types on these measures. We also examined status as a predictor of commuters' intentions to use their travel modes. Based on previous research that identified status as an important aspect in car use (e.g., Steg et al., 2001; Steg, 2005), we expected to see an influence of

perceived status on commuters' intentions to use their travel modes, particularly in drivers and car passengers. All the commuters in our study had comparably low scores on the perceived-status measure, and this factor did not predict any of their intentions to use their respective travel modes.

Although there is a general consensus that pro-environmental attitudes or beliefs are associated with sustainable travel behaviour (Atasoy et al., 2012; Kahn and Morris, 2009), our measure of ecological beliefs was not a significant predictor of any of the five types of commuters' intentions to use their respective travel modes and there were no significant ecological belief differences between the commuters. Similarly, other researchers found that different types of commuters had similar environmental attitudes (Thomas and Walker, 2015) and their pro-environmental beliefs neither increased their bus use (Heath and Gifford, 2002) nor reduced their car use (Fujii, 2006). We believe that social desirability bias may have influenced our findings, such that respondents answered the ecological belief-related questions so as to appear to have pro-ecological beliefs. Some individuals may overstate their frequency of performing pro-environmental behaviour (e.g., using green travel modes and recycling) to appear pro-environmental (Thogersen and Olander, 2006) or report that they are pro-environmental but actually do nothing to reflect their attitude (Sargisson and McLean, 2015). Therefore, interventions aimed at enhancing commuters' ecological beliefs around active commuting may not be very effective, particularly in our group of commuters because they already have positive ecological beliefs. Further research could potentially look into how to manifest commuters' ecological beliefs into actions that actually support their beliefs and include a social desirability scale to test for this bias explicitly.

The final factor we examined was the amount of previous experience commuters had using their preferred mode (habit strength or response frequency). Although there were significant differences between the commuter groups, the response frequency measure was not a significant predictor of any of the commuters' intentions to use their respective travel modes. Although it may seem counterintuitive to use a response frequency measure of what is often an automatic behaviour (i.e., habit) to predict a controlled, conscious measure of choice (i.e., intention), consistent with previous research drivers had the highest prior experience of using their travel mode and pedestrians the lowest (Bamberg et al., 2003a,b; Ouellette and Wood, 1998).

Despite our interesting findings, our study had several limitations. We used commuters' *intentions* to use their respective travel modes as the proxy outcome variable in the regression analyses of the seven motivating factors, instead of their *actual* behaviour. Commuters' intentions to use their travel mode may not truly reflect the extent to which they actually use the travel modes, as there is evidence of the intention-behaviour gap, such that medium-to-large-sized change in intentions lead to only small-to-medium-sized changes in actual behaviour (Sheeran, 2002; Webb and Sheeran, 2006). So, we asked the respondents to complete a self-report travel diary under the assumption that their travel diary responses would more closely resemble their actual commuting behaviour. Many travel behaviour researchers have used intentions as an outcome measure (e.g., Bamberg, 2000; Bamberg et al., 2003a; Matthies et al., 2002) and have used travel diaries to examine commuters' actual behaviour (e.g., Bamberg et al., 2003b; Garvill et al., 2003; Schlich and Axhausen, 2003).

A second sort of issue arose in the context of our mode commitment results. Specifically, the travel diary participants were comprised of the first ten volunteers from each commuter group, a self-selected sample that may have had high levels of commitment to their commuting practices with some influence on their willingness to complete the travel diary, thus resulting in high commitment levels. This also meant that some of the travel diary participants were from outside the regional sample (11 out of the 47). The potential for self-selection bias, as well as the gender imbalance in our sample (approximately 75% female) was present to some degree in both the online survey and the travel diary portions of the study and represents an ongoing methodological challenge for this research going forward.

Another issue to be addressed going forward would be to use techniques such as structural equation modelling to contrast the competing influences for observed mode choice decisions, instead of stated intentions to choose a particular commuting mode. This analysis approach was not possible in the present study due to the wording of our mode choice questions and the limited number of respondents in some of our commuter groups (Kline, 2011, suggested a sample size of 100 or more for each observation category). In this context, some additional differentiation of types of drivers could also be useful for analysis. In the present study, the sample of drivers was very heterogeneous as reflected in both the demographic variables and in the low predictive values observed in the regression analyses of their mode choice intentions (relative to some of the other commuter groups). This differentiation could lead to a better understanding of drivers' commuting choices and identification of the best ways to nudge them to make more sustainable choices.

Finally, our habit strength measure may not adequately reflect commuters' habit strength of using their respective travel modes because we did not impose a time pressure on our respondents for the RF measure which, according to Verplanken et al. (1994), was essential to capture the element of automaticity of commuters' habitual use of their travel mode.

Overall, our study has created the potential for further studies to understand the influence of the motivating factors on commuters' mode choice in depth and to incorporate them in interventions aimed at reducing the use of cars and increasing the use of sustainable travel modes. The commuters in our study reported conflicting motivating factors related to their intentions to use their respective travel modes, which provides the opportunity to 'nudge' them in different ways to use more sustainable travel modes without forbidding any choice or significantly altering the economic rewards of any choice (see Nudge Theory; Thaler and Sunstein, 2008). We are optimistic that these tailored and well-tested nudge techniques can reduce car use and eventually reduce the emission of poisonous gases that pose a threat to the environment and its inhabitants.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A

Questions Used in the Online Survey

Survey Questions	Response scale	Note
Filter question #1: During your daily commute to work or school, which of the following modes are available to you? (For your understanding, a mode is available to you when you have unrestricted access to it regardless whether you use the mode or not. 1. Private car as driver 2. Private car as passenger 3. Public transport: Bus 4. Bicycle 5. Walking 6. I do not commute		Respondents who selected 'I do not commute' advanced to the demographic questions (Section 10)
Section 1 **Measures of perceived difficulty** 1. Please rate how difficult would it be for you to use [travel mode] for daily commute to and from work or school.	5-point scale 1 = *not difficult* to 5 = *very difficult*	All commuters respond to one item for each mode that they selected in Filter question #1
Section 2 **Measures of perceived status** 1. If I used [travel mode] for daily commute to and from work or school I will have high status 2. If I used [travel mode] for daily commute to and from work or school I will be respected	7-point scale 1 = *not at all* to 7 = *very much*	All commuters respond to two items for each mode that they selected in Filter question #1
Section 3 **Measures of attitude** For me, to use [travel mode] for daily commute next time would overall be: 1. Bad or good 2. Unpleasant or pleasant **Measures of social norms** 1. Most people who are important to me would support the use of [travel mode] for daily commute next time. 2. Most people who are important to me think that I should use [travel mode] for daily commute next time. **Measures of perceived behavioural control** 1. For me to use [travel mode] for daily commute next time would be: difficult or easy 2. My freedom to use [travel mode] for daily commute next time is: low or high **Measures of intentions** 1. My intention to use [travel mode] for daily commute next time is: weak or strong 2. I intend to use [travel mode] for daily commute next time: unlikely or likely	5-point semantic differential scale5-point scale 1 = *disagree* to 5 = *agree*5-point semantic differential scale5-point semantic differential scale	All commuters respond to eight items for each mode that they selected in Filter question #1
Filter question #2: Which of these modes have you used for daily commute to and from work or school? 1. Private car as driver 2. Private car as passenger 3. Public transport: Bus 4. Bicycle 5. Walking 6. None of the above		Respondents who selected 'None of the above' advanced to the demographic questions (Section 10)
Section 4 **Measures of satisfaction with travel** 1. Travelling on [travel mode] is: very hurried or very relaxed 2. When I travel in [travel mode], I'm: very worried I would not be in time or very confident I would be in time 3. When I travel in [travel mode], I'm: very stressed or very calm 4. When I travel in [travel mode], I'm: very tired or very alert 5. When I travel in [travel mode], I'm: very bored or very enthusiastic 6. When I travel in [travel mode], I'm: very fed-up or very engaged 7. Travelling on [travel mode] was the: worst or best I can think of 8. Travelling on [travel mode] had: very low standard or very high standard 9. Travelling on [travel mode] worked: very poorly or very well	9-point semantic differential scale	All commuters respond to nine items for each mode that they selected in Filter question #2
Section 5 **Measures of perceived autonomy** 1. I can travel where I want, when I want by [travel mode] 2. I feel in control when I travel by [travel mode] 3. Travelling in [travel mode] fits in well with the routine of my daily life **Measures of perceived prestige** 1. Most people would like to travel by [travel mode] like the way I do 2. When I travel by [travel mode] it makes me feel I'm doing well in life		
5-point scale 1 = *strongly disagree* to 5 = *strongly agree*5-point scale 1 = *strongly disagree* to 5 = *strongly agree*	Perceived autonomy: All commuters respond to three items for each mode that they selected in Filter question #2 Perceived prestige: All commuters respond to two items for each mode that they selected in Filter question #2	

Section 6 **Measures of habit** Please indicate which travel mode you would choose for the following 10 destinations or trip purposes: 1. Summer excursion with friends to a lake 2. Visit a friend 3. Visit your parents who live 3 km away 4. Engage in sports 5. Stroll through the city 6. Evening visit to a bar 7. A trip on a nice day 8. Routine grocery shopping 9. Eat in a restaurant 10. 10. Go to the movies		Respondents select one of the five modes (i.e., car as driver, car as passenger, bus, bicycle, or walk) All commuters respond to all ten items
Section 7 **Measures of ecological beliefs** 1. We are approaching the limit of the number of people the earth can support 2. Humans have the right to modify the natural environment to suit their needs (R) 3. When humans interfere with nature it often produces disastrous consequences 4. Human ingenuity will ensure that we do NOT make the earth unliveable (R) 5. Humans are severely abusing the environment 6. The earth has plenty of natural resources if we just learn how to develop them (R) 7. Plants and animals have as much right as humans to exist 8. The balance of nature is strong enough to cope with the impacts of modern industrial nations (R) 9. Despite our special abilities humans are still subject to the laws of nature 10. The so-called "ecological crisis" facing humankind has been greatly exaggerated (R) 11. The earth is like a spaceship with very limited room and resources 12. Humans were meant to rule over the rest of nature (R) 13. The balance of nature is very delicate and easily upset 14. Humans will eventually learn enough about how nature works to be able to control it (R) 15. If things continue on their present course, we will soon experience a major ecological catastrophe	5-point scale 1 = *strongly disagree* to 5 = *strongly agree*	All commuters respond to all 15 items
Section 8 **Measures of maximising tendency** 1. No matter what it takes, I always try to choose the best thing 2. I don't like having to settle for "good enough" 3. I am a maximiser 4. No matter what I do, I have the highest standards for myself 5. I will wait for the best option, no matter how long it takes 6. I never settle for second best 7. I am uncomfortable making decisions before I know all of my options 8. Whenever I'm faced with a choice, I try to imagine what all the other possibilities are, even ones that aren't present at the moment 9. I never settle	5-point scale 1 = *strongly disagree* to 5 = *strongly agree*	All commuters respond to all nine items
Section 9 **Measures of risk-taking tendency** We are interested in everyday risk-taking. Please could you tell us if any of the following have ever applied to you, now and in your adult past? 1. Rock Climbing 2. Scuba Diving 3. Smoking 4. Poor diet 5. High alcohol consumption 6. Quitting a job without another to go to 7. Gambling 8. Risky investments 9. Fast driving 10. City cycling without a helmet 11. Standing for election 12. Publicly challenging a rule or a decision	5-point scale 1 = *strongly disagree* to 5 = *strongly agree*	All commuters respond to all 12 items twice (for present and past)
Section 10 **Travel characteristics** 1. Most frequently used mode 2. Mode use period 3. Estimated commuting time in a day 4. Estimated commuting distance in a day		Four questions

Section 11	Nine questions
Demographic characteristics	
1. Gender	
2. Age	
3. Occupation	
4. Education level	
5. Household type	
6. Annual household income	
7. Place of residence	
8. Moving status	
9. Period since last move	

Appendix B. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.tbs.2019.10.007.

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Chapter 3

Study Two

Satisfaction from Satisficing: Understanding Commuters' Satisficing Tendencies[2]

[2] This study was published as a paper with the same title in the Journal of Transportation Research Interdisciplinary Perspectives, 6, 100158, 2020 authored by Rathee D. Sivasubramaniyam, Rebecca J. Sargisson, and Samuel G. Charlton.

Research Gap

In the second study of this thesis, I focused on the decision-making strategy that commuters tend to use when making mode decisions for their regular commutes because one of the questions that emerged from the first study was: why were the commuters so highly committed to their usual modes despite having different motivating factors? As commuters were motivated by different factors (with some overlap), I assumed that their different motivating factors may be reflected in their differences in mode commitment. In other words, I wanted to find out whether certain motivating factors were associated with high or low mode commitment levels. However, in the first study, I could not associate specific motivating factors with each type of commuters' mode commitment for two main reasons. Firstly, as I used a subset of respondents from the larger sample to collect the data on mode commitment, I was not certain whether the subset sample had similar motivating factors as the larger sample of respondents. Secondly, due to the smaller size of the subset sample (i.e., 47 respondents), I did not carry out significance tests (i.e., regression and ANOVA) to examine the relationship between the travel diary respondents' motivating factors and their mode commitment. Thus, to answer the question of 'why are commuters most committed towards their mode choice despite being motivated by different factors?' I decided to examine how commuters decide to use their usual modes and *alternative modes* (i.e., travel modes that commuters use occasionally). Presumably, the commuters in the first study share a similar decision-making strategy which might have contributed to their relatively high mode commitment.

Although the travel decision-making literature suggested that the bounded rationality approach of understanding travellers' decisions is more realistic than the rational choice approach (see e.g., Gifford & Checherita-Westphal, 2009; Jou et al., 2010), there appears to be less focus on the concept of 'satisficing' itself. In travel-related studies adopting the

bounded rationality approach, the researchers often referred to satisficing as an outcome of the bounded rationality decision-making approach (see Avineri & Prashker, 2006; Ben-Elia et al., 2008; Jou et al., 2010; Mahmassani & Chang, 1987). However, satisficing can also be referred to as a decision-making strategy (see Schwartz et al., 2002). Commuters' tendencies to evaluate fewer travel alternatives and select a 'good enough' alternative (see e.g., Avineri & Prashker, 2006; Jou et al., 2010; Mahmassani & Jou, 1998) may imply that they adopt the satisficing decision-making strategy when making decisions related to their regular commutes. Understanding satisficing as a decision-making strategy can be useful in developing more effective mode-shift interventions. Current mode-shift interventions such as the provision of financial incentives and free bus tickets, improvement of bus and cycling facilities, and temporary closure of roads have shown success in the short term (e.g., Ben-Elia & Ettema, 2011; Jakobsson et al., 2002) but not in the long term (e.g., Fujii et al., 2001; Fujii & Kitamura, 2003). Thus, interventions that target commuters' decision-making approach may lead to long-term mode-shift behaviours. In the second study, I sought to address the lack of focus on satisficing as a decision-making strategy by examining commuters' tendencies to satisfice when making regular commuting decisions.

Another gap in travel-decision studies is the lack of comparison between commuters who adopt different decision-making strategies. Previous studies tend to use either the rational choice approach (e.g., Ben-Akiva & Lerman, 1985; Domencich & McFadden, 1975; McFadden, 1976) or the bounded rationality approach (e.g., Gifford & Checherita-Westphal, 2009; Jou et al., 2010) when examining how commuters make travel-related decisions. This poses a problem because the studies offer a one-sided perspective on commuters' decision-making process. The rational choice approach suggests that commuters are rational beings who make the best decisions all the time (Becker, 1976; De Palma, 1998), while the bounded rationality approach suggests that commuters make decisions that are good enough for them

(Simon, 1976). Conceptually, this is problematic because some individuals are more likely to make the best decisions while others are more likely to make good-enough decisions (Schwartz et al., 2002). Furthermore, individuals may have different decision-making strategies for various types of commuting decisions (e.g., departure time, travel costs, travel routes, etc.) Thus, examining the differences between commuters who are more likely to satisfice and those who are less likely to satisfice will not only address the lack of comparison between commuters who use different decision-making strategies for their regular commute decisions, but also highlight the psychological and commuting aspects that differentiate them from each other.

The second study had two aims:

1. To examine whether commuters adopt the satisficing decision-making strategy when deciding to use their usual travel modes.
2. To compare between the psychological and travel characteristics of commuters who are more likely to adopt the satisficing decision-making strategy and those who are less likely to adopt the satisficing decision-making strategy.

Research Approach

To fulfil the research aims, in the second study, I recruited a wide range of New Zealand commuters and asked them to complete an online questionnaire on their satisficing tendencies and their travel and psychological characteristics. To investigate whether commuters adopt the satisficing decision-making strategy when making mode decisions, I measured and compared their tendencies to satisfice when deciding to use their usual modes and when deciding to use their alternative mode. I then split the sample of commuters into two groups using the percentile scores of their satisficing tendencies: those with high tendencies to satisfice when making mode decisions (i.e., high satisficers) and those with low

tendencies to satisfice (i.e., low satisficers). After reviewing the nature of satisficing travel decisions and behaviours as presented in several travel studies (e.g., Aarts & Dijksterhuis, 2000a; Jou et al., 2010; Verplanken et al., 1997; Verplanken et al., 1994), I decided to compare low and high satisficers' (1) effort when making travel decisions, (2) travel habits, (3) travel-related decision reinvestment, and (4) feelings of regret after making travel decisions. I also compared between high and low satisficers' travel characteristics. I hoped that the results of the second study would not only confirm that commuters are indeed adopting the satisficing decision-making strategy when making mode decisions, but also reveal the characteristics that differentiate high satisficers from low satisficers. I also expected that the findings would be useful in developing appropriate interventions targeting commuters' decision-making strategies, which might result in long-term mode-shift success.

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Satisfaction from satisficing: Understanding commuters' satisficing tendencies

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ABSTRACT

Satisficing is the tendency to make 'good enough' decisions. Consumers tend to satisfice when making routine decisions (e.g., grocery shopping). Commuters also make routine decisions about their daily commute. Our goals were to investigate whether, like consumers, commuters tend to satisfice when deciding to use the modes they typically use for commuting and to understand the psychological and travel characteristics that distinguish commuters with strong from those with weak tendencies to satisfice. A sample of New Zealand commuters (n = 313) completed an online questionnaire measuring their satisficing scores, psychological and travel characteristics. A factor analysis revealed two measures of satisficing such that commuters may satisfice when deciding to use (decision-satisficing) and when using (behaviour-satisficing) their usual modes for their daily commute. Commuters tend to satisfice when deciding to use modes that they use frequently (usual modes) compared to modes that they use infrequently (alternative modes). Commuters with high satisficing tendencies (decision and behaviour) tend to be more positive and more satisfied with their usual-mode commutes compared to commuters with low satisficing tendencies. Cyclists had the strongest decision-satisficing tendencies while solo drivers had the weakest decision-satisficing tendencies. We demonstrated that commuters do satisfice during their daily commutes and there are some differences between high- and low-satisficing commuters. Mode-shift interventions could target commuters' satisficing decision-making strategy to encourage the use of sustainable modes.

1. Introduction

Traditional decision-making approaches assume that people are rational and always make the "best" decisions. One such approach is the *rational choice approach* which suggests that people seek to maximise their gains (i.e., utility) by engaging in an exhaustive search for all possible options before choosing the best option (Becker, 1976; De Palma, 1998; Simon, 1955). In everyday life, however, people do not always have all the information to make the best decision and often make decisions under uncertain and biased conditions (Ajzen, 1977; Thaler, 1991). Simon's (1957) alternative decision-making approach, *bounded rationality*, assumes that people are generally "satisficers" who achieve satisfaction by making "good enough" as opposed to the best decisions. Making good enough decisions (i.e., satisficing) tends to be less rigorous and involves fewer alternatives than making the best decisions (Simon, 1957).

In other words, "satisficing" can be a more efficient decision-making strategy, making it more likely to be used in everyday decisions, such as travel mode decisions (Simon, 1979). Travel mode decisions have both environmental and social implications. Road vehicles in particular tend to be the biggest contributor of poisonous gases leading to air pollution, which in turn affects the quality of public health (see Fisher et al., 2002; IEA, 2019). Therefore, there is an imminent need to reduce the use of road vehicles such as the car. To do so, it is essential to understand the decision-making strategy that commuters use to decide on a travel mode and one possible strategy is satisficing. There are several key aspects to the satisficing decision-making strategy and we will discuss four of them.

Firstly, satisficing is a low-effort decision-making process where satisficers tend to invest minimal cognitive effort and time in the decision-making process. One of the ways satisficers minimise their effort and time is by setting some criteria around their preferences and needs, such that they evaluate their possible options against their criteria and tend to pick the first option that meets the minimum level of their set criteria (Simon, 1957). The low-effort decision-making process is evident in consumers who make routine purchases (e.g., Cole and Balasubramaniam, 1993; Dickson and Sawyer, 1990; Sproles, 1985). For example, grocery shoppers tend to compare only two or three cereal options before making a decision

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instead of evaluating all of the possible cereal options (Cole and Balasubramaniam, 1993). Commuting also involves making routine decisions such as deciding which route to take, which travel mode to use, and what time to depart for work or school. Commuters use criteria such as travel times, distances, and costs, accessibility, and parking fees before making their satisficing travel choices (Avineri and Prashker, 2006; Fujii and Kitamura, 2000; Jou et al., 2010; Mahmassani and Jou, 1998). For example, some travellers are only willing to use a new route if the length of travel time they can save meets the minimum length of time they are willing to travel (Di et al., 2017). Therefore, consumers' and commuters' tendencies to evaluate fewer options and then choose an option that meets the minimum level of their criteria may imply that satisficing is a low-effort decision-making strategy.

Another way of understanding the satisficing decision-making strategy is to examine the role of habits in the decision-making process. Habits are decisions or behaviours performed repeatedly to achieve certain goals (Aarts and Dijksterhuis, 2000; Verplanken et al., 1997). With constant repetition, the association between the goal and the decision (or behaviour) becomes stronger, which increases individuals' familiarity with the decision (or behaviour) (Wood et al., 2002). As a result, individuals are less likely to evaluate other alternatives when executing the same decision or behaviour in the future (Aarts and Dijksterhuis, 2000). The low effort nature of habitual decisions or behaviours is also shared by the low effort nature of satisficing decisions or behaviours (see Gifford and Checherita-Westphal, 2008). Consumers and commuters tend to be dependent on their habits as they rely on their automatic thinking and avoid searching for alternatives (e.g., Fazio et al., 2000; Fujii et al., 2001; Wang et al., 2015). For example, Wang et al. (2015) found that consumers tend to purchase items that they have consistently purchased in the past from manufacturers they are familiar with, while Verplanken et al. (1997) found that habitual cyclists tend to search less for information about alternative travel modes before making travel choices for their daily commute. Therefore, consumers' and commuters' strong tendencies to resort to their habitual and familiar decisions or behaviours is another possible indication of their satisficing decision-making tendencies.

A third way of examining the satisficing decision-making strategy is to take into account the role of reinvestment – the propensity to consciously monitor and evaluate decision-making processes (i.e., decision-specific reinvestment). Kinrade et al.'s (2010b) Decision Specific Reinvestment Scale has two factors: decision reinvestment and decision rumination. Decision reinvestment reflects an individual's tendency to consciously monitor the decision-making process, while decision rumination refers to the tendency to consciously reflect on the poor decisions made in the past. Individuals with high tendencies to consciously monitor their decisions (high reinvesters) tend to perform slower in various tasks compared to low reinvesters possibly because of the time consuming nature of the reinvestment process (Kinrade et al., 2010a; Malhotra et al., 2018). As satisficing behaviour tends to be less time-consuming, it could imply that satisficers are less likely to consciously monitor their decisions. In the context of commuting, Aarts and Dijksterhuis (2000) demonstrated the automatic nature of choosing travel modes for commuting trips, such that commuters' decisions to use a particular mode (e.g., bicycle and car) are under the direct control of their automatic travel-goal-behaviour associations instead of their conscious reasoning. In other words, as commuting decisions have become automatic over time, commuters are less likely to reinvest in their decisions to use their preferred commute modes (Aarts et al., 1998; Verplanken et al., 1997). Therefore, the satisficing decision-making strategy can also be characterised by the lack of decision reinvestment.

Another point to consider when understanding the satisficing decision-making strategy is the role of negative emotions. Decision-makers who tend to ruminate on their poor past decisions (see Kinrade et al., 2010b) are susceptible to experiencing regret - negative feelings associated with the belief that one's decision could have brought a more desirable outcome (Roese et al., 2009). As satisficers are less likely to ruminate over their past decisions, they are less likely to experience regret because they tend to make decisions that meet the minimum levels of their criteria namely, something that is good enough for them (Schwartz et al., 2002). Consequently, they are less inclined to regret their decisions even if there are better alternatives (Iyengar et al., 2006; Schwartz et al., 2002; Simon, 1957). Mao et al. (2016) suggested that habitual commuters tend to be highly satisfied with their commutes possibly because of their low expectations with their habitual mode choices where, they tend to trivialise any negative emotions they experience if the outcomes were unsatisfactory (Simon et al., 1995). Like habitual commuting, habitual purchase is also related to higher satisfaction with the product or brand and lower tendency to regret the purchase decisions (Chowdhury et al., 2009; Liao et al., 2017; Tsiros and Mittal, 2000). In short, satisficing decisions and behaviours are more likely to be satisfying but less likely to result in feelings of regret.

As can be seen in this brief review, when understanding the satisficing decision-making strategy, it is important to consider the low-effort and habitual nature of satisficing decisions and the extent to which satisficers reinvest in their decisions and experience negative feelings such as regret after making decisions. However, travel behaviour studies examining commuters' satisficing tendencies (e.g., Avineri and Prashker, 2006; Fujii and Kitamura, 2000; Jou et al., 2010; Mahmassani and Jou, 1998) have focused on commuters' tendencies to establish some criteria and to evaluate alternatives when making decisions after presenting them with a series of hypothetical and real-world problems. Conceptually, this may be problematic because 'satisficing' is more than just a series of tendencies to do certain things. In fact, commuters may satisfice by putting in less effort, resorting to their habits, reinvesting less in their decisions and wanting to experience less regret about their decisions to achieve overall satisfaction with their commuting decisions. These tendencies may be able to explain the findings of our previous study where we found that drivers, car passengers, bus users, cyclists, and pedestrians used their usual modes most of the time in a week (i.e., strong commitment) despite being motivated by different factors (Sivasubramaniyam et al., 2020). It is possible that these commuters were satisficing when deciding to use their modes regardless of the different reasons for using their respective modes.

Therefore, we wanted to identify whether commuters tend to satisfice when deciding to use travel modes that they use most often for their daily commute (i.e., usual modes). Specifically, we measured and compared commuters' satisficing scores when deciding to use their usual modes to their satisficing scores when deciding to use modes that they do not usually use (i.e., alternative modes) because we wanted to compare commuters' satisficing tendencies for a mode which they frequently use to their satisficing tendencies for a mode which they occasionally use. Frequently performed behaviour or decisions have been associated with high satisficing tendencies because of their low-effort and habitual nature (see Simon, 1979). We also wanted to distinguish between commuters with high and low satisficing tendencies based on their psychological and travel characteristics. Our motivation for doing this revolved around the question of whether commuters with high tendencies to make good enough commuting decisions (i.e., high-satisficing commuters) are different to commuters with low tendencies to make good enough commuting decisions (i.e., low-satisficing commuters). We were interested in comparing travel and psychological characteristics which were not limited to the four aspects of the satisficing decision-making strategy: effort, habits, reinvestment, and regret. The travel characteristics that we were interested in were commuters' trip frequencies, trip distances and time, and preferred travel modes. By conducting this study, we hoped to get a better understanding of the decision-making process underlying commuters' decisions to use certain modes, particularly the car, for their commuting trips and that the findings of the study will be useful for designing and implementing effective travel behaviour interventions and policies.

2. Method

2.1. Participants

We recruited 575 respondents who were 16 years and older between June and October (2019), winter and spring in New Zealand, through notices placed on the intranets of various organisations as well as on social

media and through word-of-mouth. The study received ethical approval from the Human Research Ethics Committee of the School of Psychology at the University of Waikato. After excluding respondents who did not complete the entire online questionnaire, our final sample was 313 respondents; 198 women, 114 men, and 1 respondent of undisclosed gender. The final sample had a mean age of 42.72 years (SD = 12.62). Table 1 shows the demographic characteristics of the sample. We used a convenience sample to get a broad representation of New Zealanders in our study, however, women and degree holders were more highly represented in our study. In terms of travel modes, a majority of our respondents were car drivers, which was also the case for the whole of New Zealand, where 74% of New Zealanders tend to drive to work (Ministry of Transport, 2018).

Table 2 shows the percentages of commuters who used various types of alternative modes (i.e., modes that commuters use for their commuting trips when it is not possible to use their usual modes for unexpected reasons) for their commuting trips. Commuters who drove solo for their usual commute tended to ride-share for their alternative commute. The majority of ride-sharers who used alternative modes drove solo for their daily commute. Cyclists and commuters of 'other' modes also tended to drive solo for their alternative commutes. Commuters who usually took the bus tended to use other modes such as scooters, motorbikes, and skateboards as their alternative commuting method.

Table 1
Demographic characteristics of respondents (N = 313).

	Percentage of respondents (%)
Employment status	
Full-time work (30 h or more per week)	84.30
Part-time work (<30 h per week)	9.60
Casual/Sporadic work	1.30
Unemployed/looking for work	1.00
Looking after home and family	1.30
Retired	0.30
Other	2.20
Education status	
Not studying	84.30
Secondary school	0.60
Full-time university/polytech/other	6.40
Part-time university/polytech/other	8.60
Education level	
No secondary school qualification	1.00
High school qualification or equivalent	9.60
Tertiary diplomas or certificate	18.20
Master degree or higher	24.90
Household type[a]	
Person living alone	9.90
Married/de facto couple only	27.80
Other adults only (e.g., flatmates)	9.90
Family (including extended) with children	37.10
Family with adults only	9.90
Single adult living with children	1.90
Other	3.20
Income[b]	
$50,000 or less	53.90
$50,001–$100,000	23.60
$100,001–$150,000	1.30
More than $150,000	7.70
Prefer not to say	12.80
Recently moved status in the last 12 months	
Yes	21.70
No	78.30
Travel mode used most of the time	
Drive solo	45.70
Ride share	12.50
Bus	7.70
Bicycle	19.80
Other modes (i.e., scooter, motorcycle, skateboard, etc.)	14.40

Note.
[a] One missing response.
[b] Two missing responses.

Table 2
Percentages of commuters using alternative modes for daily commute.

Usual modes used by commuters	Percentages of commuters using alternative modes (%)					
	Drive solo	Ride-share	Bus	Bicycle	Other modes	Never used alternative modes
Drive solo	–	37.06	17.48	6.29	13.29	25.87
Ride-share	25.64	–	23.08	5.13	17.95	28.21
Bus	16.67	29.17	–	8.33	33.33	12.50
Bicycle	35.48	9.68	37.10	–	16.13	1.61
Other modes	26.67	20.00	22.22	8.89	4.44	17.78

2.2. Materials and procedure

When completing the questionnaire, each respondent received a minimum of eight items and, depending on their answers, a maximum of 147 items, all in forced-choice format. Of the 147 items, two were filter items, four were items on travel characteristics, 134 on psychological variables, and seven on demographic characteristics (Refer to Appendix A for additional details on the items and their respective response scales).

The first filter item asked respondents for the mode they used most often. This item was followed by four items on travel characteristics corresponding to respondents' usual-mode commutes (i.e., commuting trips involving the use of usual modes). We asked for the percentages of all types of trips and commuting trips made in the last 7 days, the average one-way commuting distance (in kilometres), and the average one-way commuting time (in minutes). The second filter item asked respondents for the alternative mode they used most often for their commuting trips (i.e., second filter item in the questionnaire).

The 134 items measuring psychological variables can be divided into three main categories: mode-specific items (78 items), general travel items (26 items), and non-travel-related items (30 items). The mode-specific items measured specific psychological aspects related to respondents' usual-mode commutes. We measured their satisficing scores of deciding to use their usual modes (adapted from Turner et al., 2012), satisfaction scores from using their usual modes (adapted from Singleton, 2017), and their habit strength of using their usual modes (adapted from Verplanken and Orbell, 2003). In addition to Turner et al.'s (2012) adapted scale, we constructed a 3-item satisficing scale as a straightforward or explicit way of measuring satisficing. We worded two of the items to directly refer to the nature of satisficing decisions; that a commuter's use of their usual mode is: (1) good enough and (2) meets one's basic needs. We worded the third item to refer to the opposite nature of satisficing decisions; that a commuter's use of their usual mode is (3) the best in all respects. We also had mode-specific items for respondents' alternative-mode commutes where we only measured their satisficing scores of deciding to use their alternative modes using the 10 items adapted from Turner et al. (2012) and the 3-item satisficing scale that we created. For the hedonic characteristics of their usual-mode commutes, we asked respondents to rate the extent to which they experienced 20 types of emotions (a combination of positive and negative emotions) during their usual-mode commutes (10 items were adapted from Thompson, 2007 and 10 items were adapted from Singleton, 2017), the extent to which they like their usual-mode commutes (adapted from Singleton, 2017), and their overall positive or negative impression of their usual-mode commutes (adapted from Singleton, 2017).

The general travel items measured the psychological aspects of respondents' general travel experience regardless of what mode they use. We obtained measures of how difficult it is for respondents to make general travel decisions (adapted from Turner et al., 2012), how likely they are to experience regret when making general travel decisions (adapted from Schwartz et al., 2002), and how satisfied they are with their general travel experience (adapted from Singleton, 2017). High scores on the travel difficulty scale indicate high effort when making travel decisions and vice versa.

We also examined respondents' general psychological traits using the non-travel-related items. We measured how difficult it is for them to

make general (i.e., non-travel-related) decisions (adapted from Turner et al., 2012), how likely they are to engage in decision reinvestment and decision rumination (adapted from Kinrade et al.'s, 2010b, Decision-specific Reinvestment scale) and, how likely they are to experience regret when making general decisions (adapted from Schwartz et al.'s, 2002, Regret and Maximisation scale). High scores on the general decision difficulty scale indicate high effort when making general decisions and vice versa. Finally, we asked respondents their gender, age, employment status, education status, education level, annual income for the last 12 months, and residential relocation status in the last 12 months (for additional details on the items, see Appendix A).

2.3. Analysis

We ascertained the validity and reliability of the satisficing measure by conducting a factor analysis on Turner et al.'s (2012) 10 adapted items and the three items of the satisficing scale that we created. We first reverse-coded respondents' scores on the third item of the satisficing scale that we created (i.e., commuting using my usual mode is the best in all respect) as it reflects the opposite nature of satisficing.

Next, we compared satisficing scores for usual-mode commutes to satisficing scores for alternative-mode commutes by conducting a paired-samples *t*-test. We obtained commuters' satisficing scores by calculating their mean scores across the adapted 10 items from Turner et al.'s (2012) satisficing measure. To identify whether commuters' satisficing tendencies vary based on the type of modes they usually use for their commuting trips, we carried out a one-way ANOVA on commuters' satisficing scores with five levels corresponding to the five types of commuters (i.e., solo drivers, ride sharers, bus users, cyclists, and other-mode users).

As the secondary aim of our study was to distinguish between high- and low-satisficing commuters we then categorised commuters who scored at or below the 25th percentile on their satisficing score as low satisficers and commuters who scored at or above the 75th percentile as high satisficers. Then, we carried out several independent *t*-tests comparing their scores on 13 psychological variables. For each of the 13 psychological variables, we obtained commuters' mean scores by averaging their scores across the respective number of items in each of the measures. We also compared their travel characteristics to identify the travel differences that may exist between high and low satisficers.

3. Results

3.1. Measuring commuters' satisficing tendencies

As a measure of satisficing tendencies, we not only modified an existing satisficing measure (see Turner et al., 2012) to fit the context of making commuting mode decisions, but also constructed a 3-item scale to supplement the 10-item satisficing scale. To ensure the validity of the modified scale, we carried out a factor analysis with the adapted 10 items and the three items that we created. We expected all 13 items to load onto a single factor, indicating that the two scales were measuring the same construct: commuters' satisficing tendencies when deciding to use their usual modes.

The Kaiser-Meyer-Olkin (KMO) measure verified the sampling adequacy for the factor analysis, KMO = 0.76, and the KMO values for all 13 items were well above 0.50. Table 3 shows the factor matrix of the 13 items after a varimax rotation, which revealed a four-factor structure. The three items we created loaded onto a single factor (Factor 1) while the 10 adapted items from Turner et al.'s (2012) satisficing scale loaded across the remaining three factors (Factors 2, 3, and 4). Interestingly, after suppressing coefficients of < 0.30, none of the adapted 10 items loaded onto the same factor that our three items loaded onto (i.e., Factor 1).

After examining all 13 items, we decided that the wording for our 3-item scale reflected the behavioural aspects of respondents' usual-mode commutes, whereas the 10 adapted items may have reflected the decision-making aspects associated with respondents' usual-mode commutes. In other words, one scale appeared to be measuring commuters' "behaviour-satisficing" scores while the other was measuring commuters' "decision-satisficing" scores. The Cronbach's alpha (0.77) and the face validity of the modified items further confirmed that the 10-item scale was a measure of commuters' decision-satisficing scores for their usual modes. We also found a weak positive correlation between the decision- and behaviour-satisficing scores, $r(311) = 0.16$. Thus, we incorporated the two types of satisficing measures in all analyses: decision- and behaviour-satisficing tendencies. A high score on the decision-satisficing measure indicates a tendency to satisfice when *deciding* to use their usual mode and a high score on the behaviour-satisficing measure indicates a tendency to satisfice when *using* their usual mode for their daily commutes.

Table 3
Rotated factor matrix of the factor analysis on 13 items.

Items	Factor			
	1	2	3	4
Additional satisficing items				
1. Commuting using my usual mode is good enough for me	0.89			
2. Commuting using my usual mode meets my basic needs	0.69			
3. Commuting using my usual mode is the best in all respect (R)	−0.59			
Turner et al.'s (2012) Satisficing items				
4. I usually try to find a couple of good travel options and then choose between them		0.47	0.50	
5. At some point, you need to make a decision about how to travel		0.62	0.32	
6. I try to make the most of whatever travel method I choose		0.58		
7. There are usually several good travel options in a commuting decision situation		0.33	0.61	
8. I try to gain plenty of information before I make a commuting decision, but then I go ahead and make it		0.69		
9. Good things can happen when commuting even if things don't go right at first		0.36		
10. I can't possibly know everything before making a commuting decision				0.42
11. All commuting decisions have pros and cons				0.63
12. I know that if I make a mistake in a commuting decision that I can choose a different method next time			0.69	
13. I accept that commuting often has uncertainty				0.67

Extraction Method: Principal Axis Factoring.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.
b. Coefficients below 0.30 were suppressed for clarity.

3.2. Comparing between satisficing scores of usual- and alternative-mode commutes

We compared commuters' satisficing scores (decision and behaviour) for their commute using their usual and their alternative modes. We obtained their mean behaviour-satisficing scores by reverse-coding their score on the third item of the satisficing scale that we created and then averaging scores on all three items. Fig. 1 shows commuters' decision-satisficing scores (left) and commuters' behaviour-satisficing scores (right) when using their usual and alternative modes for commuting trips. Commuters had higher decision-satisficing scores when deciding to use their usual modes, $t(262) = 6.24, p < .001, d = 0.41$, compared to when deciding to use their alternative modes. There were no significant differences in commuters' behaviour-satisficing scores when using their usual modes and when using their alternative modes, $t(265) = -0.69, p = .49, d = 0.06$.

3.3. Comparing the psychological and travel characteristics of low and high satisficers

Our secondary aim was to differentiate the characteristics of high- and low-satisficing commuters. We categorised commuters as low- and high-decision satisficers using the decision-satisficing percentile scores for usual-mode commutes ($Q_1 = 3.00$; $Q_3 = 4.00$) and as low and high-behaviour satisficers using the behaviour-satisficing percentile scores for usual-mode commutes ($Q_1 = 3.33$; $Q_3 = 4.00$).

Fig. 2 shows their scores on the five psychological variables that showed significant differences at the Bonferroni-adjusted critical significance level of 0.004 per test (0.05/13). Table 4 shows the results of the independent *t*-test analyses comparing low and high satisficing scores on all 13 psychological variables. Both high-decision and high-behaviour satisficers tended to be more satisfied with their usual-mode commutes, had a more positive overall impression of their usual-mode commutes, and liked their usual-mode commutes more than both low-decision and low-behaviour satisficers. Additionally, high-decision satisficers tended to feel more positive towards their usual-mode commutes and were more satisfied with their general travel experience compared to low-decision satisficers. Although there were other psychological differences with moderate effect sizes between low and high (decision and behaviour) satisficers, they were not statistically significant after the application of Bonferroni correction.

Fig. 3 shows low and high satisficers' scores (decision and behaviour) on four travel characteristics. High-decision satisficers had a lower mean percentage of all types of trips in a week using their usual modes compared to low-decision satisficers, $t(166) = 4.24, p < .001, d = 0.65$, and a shorter one-way usual-mode commuting distance than low-decision satisficers, $t(125.79) = 4.70, p < .001, d = 0.72$. There were no significant differences between low- and high-decision satisficers' mean percentages of commuting trips in a week using their usual modes, $t(132.19) = 2.59, p = .01, d = 0.65$, or their mean one-way commuting time, $t(166) = 0.36, p = .72, d = 0.07$. High-behaviour satisficers had a shorter one-way usual-mode commuting distance compared to low-behaviour satisficers, $t(53.42) = 3.74, p < .001, d = 0.76$. We did not find any significant differences between low- and high-behaviour satisficers' mean percentages of commuting trips made in a week using their usual modes, $t(128) = 0.75, p = .46, d = 0.14$, their mean percentages of all types of trips made in a week using their usual modes, $t(128) = 2.06, p = .04, d = 0.39$, or their mean one-way usual-mode commuting time, $t(128) = 2.56, p = .01, d = 0.47$.

We counted the number of low and high (decision and behaviour) satisficers who drove solo, ride-shared, took the bus, cycled, or used other modes for their daily commute. Two 2-x-5 chi-square tests of independence revealed an unequal number of low- and high-decision satisficers, $\chi 2\ (4, N = 168) = 40.64, p < .001$, Cramer's $V = 0.49$, and an unequal number of low- and high-behaviour satisficers using one of the five travel modes, $\chi 2\ (4, N = 130) = 11.65, p = .02$, Cramer's $V = 0.30$.

Table 5 shows the percentages of low- and high-decision and low- and high-behaviour satisficers who use one of five travel modes. A majority of low-decision satisficers (65.90%) drove solo for their commute while a majority of high-decision satisficers (31.0%) cycled. However, a majority of low- (69.0%) and high-behaviour satisficers (43.2%) tended to drive solo for their commute. Although a majority of solo drivers were high-behaviour satisficers, there was almost an equal distribution of commuters using travel modes other than driving solo. In other words, high-behaviour satisficers were almost equally likely to ride-share, take the bus, cycle, or use other modes. In contrast, there was a clear and strong preference to drive solo or ride-share amongst low-behaviour satisficers.

3.4. Comparing satisficing tendencies of various commuters

Another way of examining commuters' satisficing tendencies concerning their mode choices is to compare the decision- and behaviour-satisficing tendencies of solo drivers, ride sharers, bus users, cyclists, and other mode users (Table 6). We conducted two separate one-way, between-subjects ANOVA to determine whether there were any significant differences between the five types of commuters' decision- and behaviour-satisficing scores. For their decision-satisficing scores, there were significant differences between the five types of commuters, $F(4, 312) = 11.32, p < .001, \eta^2 = 0.13$. Post-hoc pairwise comparisons (Tukey's HSD) with a Bonferroni-adjusted critical significance level of 0.003 per test (0.05/20) showed that cyclists had higher decision-satisficing scores than solo drivers ($p < .001, d = 0.89$) when deciding to use their usual modes. Other mode users had higher decision-

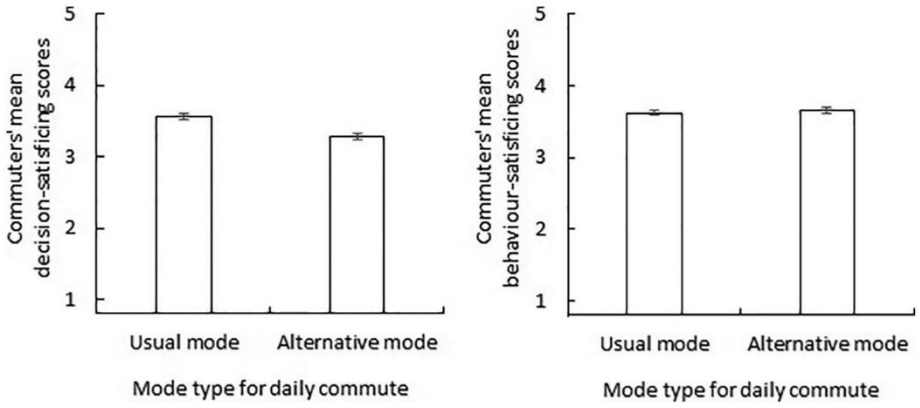

Fig. 1. Commuters' mean satisficing scores. The error bars represent the standard error of the mean.

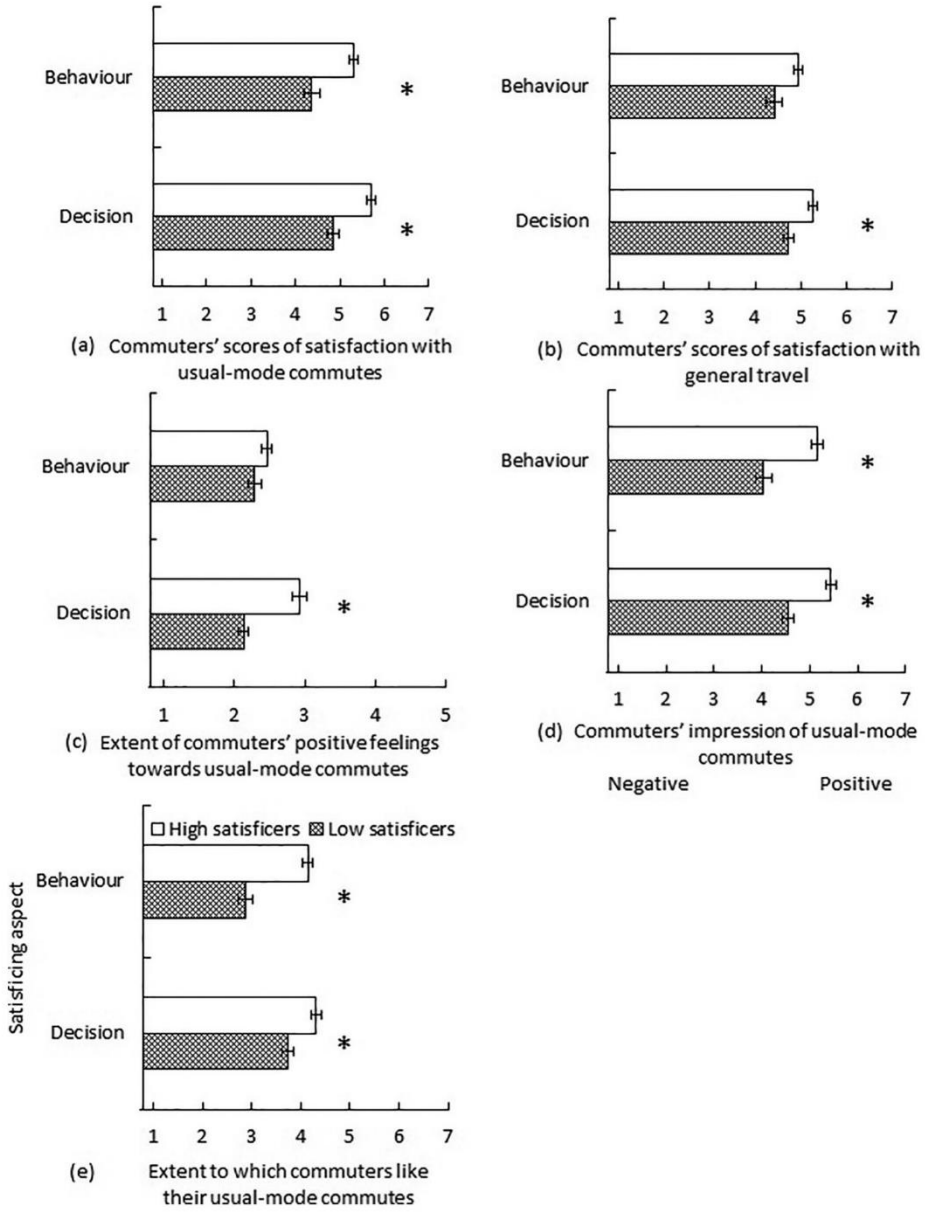

Fig. 2. A series of significant comparisons between low- and high-decision satisficers and low- and high-behaviour satisficers on five psychological variables: (a) satisfaction with usual-mode commutes, (b) satisfaction with general travel experience, (c) extent of positive feelings towards usual mode commutes, (d) impression of usual-mode commutes and, and (e) extent to which commuters like their usual-mode commutes. The error bars represent the standard error of the mean. *t-Test comparisons that surpassed the Bonferroni-adjusted critical significance level of 0.004.

satisficing tendency scores than solo drivers ($p < .001$, $d = 0.68$) when deciding to use their usual modes. For behaviour-satisficing scores, there were no significant differences between the five types of commuters, Welch's $F(4, 92.59) = 1.57$, $p = .19$, *est.* $\omega^2 = 0.003$.

4. Discussion

In this study, we took a novel approach to examine satisficing as a decision-making strategy rather than merely a decision outcome. To do this, we constructed a 3-item scale to supplement an existing 10-item decision-satisficing scale, which we adapted to fit the context of commuting behaviour. To investigate the extent to which the three items are supplementary of the 10 items, we carried out a factor analysis on all 13 items that revealed both scales were measuring different aspects of satisficing tendencies: decision and behaviour. The decision aspect of satisficing refers to commuters' tendencies to satisfice when *deciding* to use their usual modes, whereas the behaviour aspect refers to commuters' tendencies to satisfice when *using* their usual modes.

In terms of their decision-satisficing tendencies, we found that commuters were more likely to satisfice when deciding to use their usual

Table 4
Independent *t*-test results on 13 psychological variables.

Psychological variables	Low- vs. high decision satisficers (n = 168)			Low- vs. high behaviour satisficers (n = 130)		
	t	*p*	*d*	*t*	*p*	*d*
		Mode-specific variables				
1. Satisfaction with usual mode	−5.22	<0.001[a]	0.80	−4.93	<0.001[a]	0.89
2. Habit strength of using usual mode	1.58	0.12	0.24	−0.89	0.38	0.17
3. Positive feelings towards usual mode	−6.41	<0.001[a]	1.00	−1.21	0.23	0.24
4. Negative feelings towards usual mode	−0.02	0.98	0.02	2.54	0.01	0.46
5. Overall impression of usual mode	−5.30	<0.001[a]	0.83	−5.79	<0.001[a]	1.06
6. How much commuters like their usual modes	−3.59	<0.001[a]	0.55	−6.88	<0.001[a]	1.30
		General travel variables				
7. Satisfaction with general travel experience	−3.50	0.001[a]	0.54	−2.88	0.005	0.52
8. Feelings of regret after making travel decisions	−2.62	0.01	0.40	0.94	0.35	0.17
9. Difficulty when making travel decisions	−1.88	0.06	0.30	2.21	0.03	0.44
		Non-travel-related variables				
10. Difficulty in when making general decisions	−1.88	0.06	0.29	0.79	0.43	0.15
11. Feelings of regret after making general decisions	−0.19	0.85	0.03	−0.24	0.81	0.04
12. Tendency to engage in decision reinvestment	−0.71	0.48	0.11	0.04	0.97	0.00
13. Tendency to engage in decision rumination	1.52	0.13	0.24	1.10	0.28	0.20

Note.
[a] Significant at the Bonferroni-adjusted critical significance level of 0.004 per test (0.05/13).

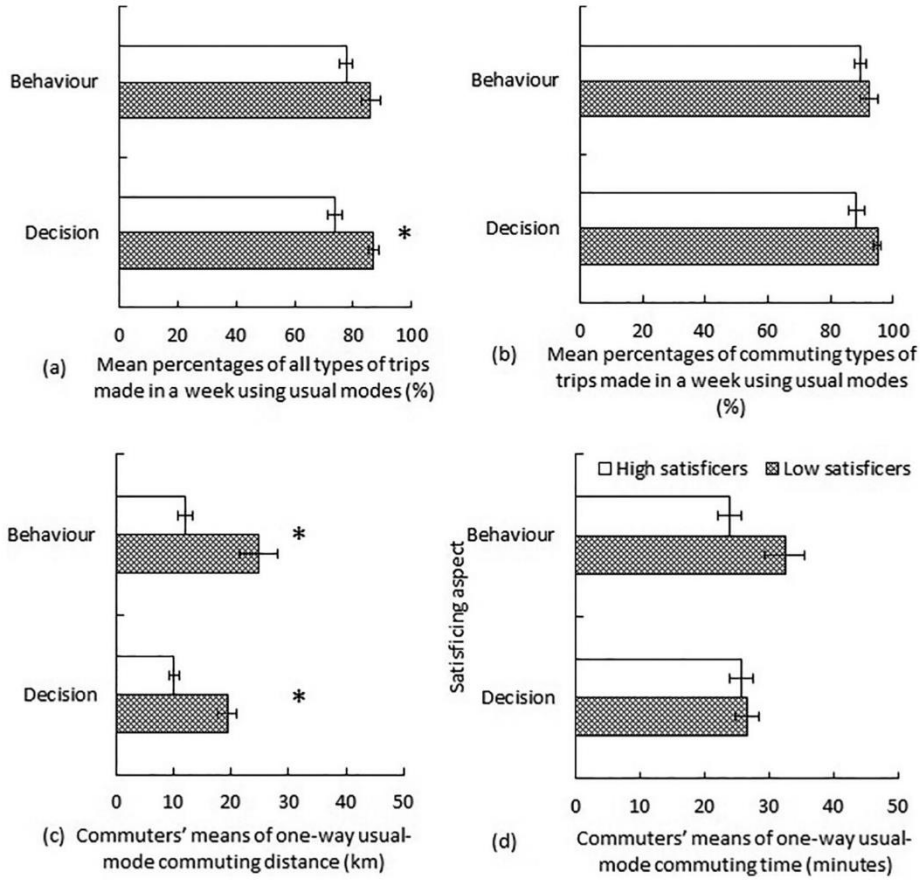

Fig. 3. A set of comparisons between low- and high-decision satisficers' and low- and high-behaviour satisficers' scores on four travel characteristics: (a) mean percentages of all types trips made in a week using their usual modes, (b) mean percentages of commuting trips made in a week using their usual modes, (c) mean one-way usual-mode commuting distances, and (d) mean one-way usual-mode commuting times. The error bars represent the standard error of the mean. *t-Test comparisons that surpassed the Bonferroni-adjusted critical significance level of 0.01 per test (0.05/4).

Table 5
Percentages of commuters using one of five travel modes for their daily commute.

Usual travel modes	Percentage of commuters using one of the five travel modes (%)			
	Low-decision satisficers (n = 85)	High-decision satisficers (n = 83)	Low-behaviour satisficers (n = 42)	High-behaviour satisficers (n = 88)
Drive solo	65.9	29.0	69.0	43.2
Ride-share	20.0	8.0	16.7	13.6
Bus	3.5	12.0	7.1	11.4
Bicycle	5.9	31.0	4.8	19.3
Other modes	4.7	20.0	2.4	12.5

modes compared to when deciding to use their alternative modes. The findings support the idea that frequently-performed behaviour such as using one's usual mode is strongly associated with high satisficing tendencies (see Simon, 1979). One possible reason why commuters' decisions to use their usual modes is associated with their high satisficing tendencies is the repetitive and low-effort nature of their decisions. When commuters make decisions to use the same travel modes for their daily commute, they are unintentionally strengthening the association between their travel modes and their travel goals (i.e., to get to work or school). The stronger the association, the more familiar commuters become with their decisions (see Aarts and Dijksterhuis, 2000; Verplanken et al., 1997). Thus, the next time commuters need to get to work or school, they are more likely to decide to use the travel modes that are familiar because they do not need to invest effort in looking for other alternatives. Resorting to familiar decisions may suggest that their decisions to use their usual modes are good enough for their daily commute. In contrast, commuters' decisions to use their alternative modes are decisions that they do not make frequently and repeatedly. Therefore, the associations between their decisions to use their alternative modes and their goals of getting to work or school are weak and unfamiliar to them. As a result, commuters' decisions to use their alternative modes are less likely to be good enough for them. However, while habit may seem like an a priori explanation, there may be other factors that contribute to higher satisficing tendencies for usual modes and also the development of habits in the first place. One such factor could be that commuters' usual modes may have been an easier or dominating choice, which required less engagement with the decision-making process. In contrast, their alternative modes may have been a less easy choice, which possibly required greater effort and information search in the decision-making process. Unfortunately, we did not investigate this aspect in our study which could be potential for future research.

Furthermore, we found several differences between high- and low-satisficing commuters with regards to their psychological and travel characteristics. High (decision and behaviour) satisficers were more satisfied with their usual-mode commute experience, more likely to have a positive impression of their usual-mode commutes, and like their usual-mode commutes more than low satisficers. This is expected as satisficers are typically satisfied with their good-enough decisions and therefore tend to feel good about their decisions and behaviours (Álvarez et al., 2014; Baník and Vargová, 2019; Schwartz et al., 2002; Simon, 1957). Schwartz et al. (2002) demonstrated that individuals with high tendencies to satisfice are less likely to experience negative emotions compared to individuals with low tendencies to satisfice. One possible reason is that people with strong tendencies to satisfice are only concerned with seeking something good enough for them and not necessarily the best for them. As a result, when they find an alternative that seems better than their current choice, they are less likely to regret their original choice (Schwartz et al., 2002). In the context of commuting, high-decision satisficers may believe that their decisions to use their usual modes are good enough for them and, thus they do not regret choosing their usual modes over better alternatives.

Table 6
Decision- and behaviour-satisficing scores of five types of commuters.

Commuters	Decision-satisficing score		Behaviour-satisficing score	
	M	95% CI	M	95% CI
Drive solo	3.28	3.18, 3.39	3.55	3.47, 3.64
Ride share	3.34	3.12, 3.56	3.58	3.41, 3.75
Bus	3.78	3.55, 4.01	3.67	3.41, 3.94
Bicycle	3.80	3.66, 3.93	3.69	3.62, 3.77
Other modes	3.72	3.52, 3.93	3.64	3.55, 3.73

The low satisficing scores of low (decision and behaviour) satisficing commuters may imply that they are more likely to seek the best alternative (i.e., maximising) instead of a good-enough alternative. As a result, they tend to feel negative about their decisions to use their usual modes because they feel they might have missed out on a better alternative by deciding to use their usual modes (see Iyengar et al., 2006, Schwartz et al., 2002). Though not travel-related, Iyengar et al. (2006) found that graduate students with low satisficing tendencies (i.e., maximisers) were less satisfied with their jobs and were more likely to be pessimistic, stressed, worried, and depressed throughout their job-search process. One possible reason is that maximisers tend to have high expectations with their decisions and so, they may feel negative and less satisfied with their choices if their choices do not meet their high expectations. The low satisficing commuters in our study may have had high expectations for their daily commute but their usual-mode commutes have not matched their expectations effectively. As a result, they were less likely to be satisfied with their usual-mode commutes, less likely to have a positive impression of their usual-mode commutes compared to the high satisficing commuters and do not like their usual-mode commutes as much as high satisficing commuters like theirs. Therefore, we conclude that there are psychological differences between high- and low-satisficing commuters, particularly with regards to how they feel about, and how satisfied are they with their usual-mode commutes.

Apart from psychological differences, there are also some travel-related differences between high- and low-satisficing commuters. We found that low-decision satisficers used their usual modes more often than high-decision satisficers for all kinds of trips in a week. Although not significant at the Bonferroni-adjusted significance value, low-decision satisficers made more commuting trips using their usual modes in a week than high-decision satisficers (significant at p = .05). Low-decision satisficers also commuted over longer distances than high-decision satisficers. In other words, commuters who were more likely to make good-enough decisions tended to make fewer trips and commute over shorter distances using their usual modes. We attribute these travel differences to the types of travel modes that high and low satisficers usually use for their daily commute. By a plurality of 31%, high-decision satisficers tended to cycle, whereas by a majority of 65.9% low-decision satisficers tended to use the car for their daily commute. Several studies (e.g., Kuhnimhof, Chlond, and von der Ruhren, 2006; Simma and Axhausen, 2001; Sivasubramaniyam et al., 2020) have found car users tend to use their mode most of the time instead of using a combination of several modes. So, the low-decision satisficers in our study tended to make more trips using their usual modes possibly because they are mostly car users as shown in our chi-square analyses. High-decision satisficers were largely represented by cyclists, and several studies (e.g., Clifton et al., 2012; Gatersleben and Uzzell, 2007; Winters, Brauer, Setton, and Teschke, 2010) have shown that cyclists tended to travel over shorter distances and make fewer trips in a week compared to solo drivers (Sivasubramaniyam, et al., 2020).

Other than being highly represented in the high-decision satisficing group, cyclists also tended to have the highest decision-satisficing scores compared to other commuters, while solo drivers had the lowest. In other words, cyclists were more likely to make good-enough decisions when commuting with their usual modes compared to other commuters, particularly solo drivers. Baník and Vargová (2019) demonstrated that satisficers are more positive and more satisfied with their outcomes because they are more likely to enjoy the benefits of their good-enough choices. Several studies (e.g., Gatersleben and Uzzell, 2007; Schneider, 2011; Sivasubramaniyam et al., 2020) have shown that cyclists tend to find cycling satisfying and pleasurable, which may

stem from their perceived health benefits of cycling (Singleton, 2019). In contrast, solo drivers tend to find their commute stressful (Schaeffer, Street, Singer, and Baum, 1998), not pleasurable (Sivasubramaniyam et al., 2020), and therefore, not good enough for them. One source of stress for car users could be their tendencies to engage in social comparisons and to make commuting decisions that make them seem superior to others. Social norms have been found to be associated with drivers' intentions to drive for their daily commute (Bamberg, Ajzen, and Schmidt, 2003; Sivasubramaniyam et al., 2020). In other words, individuals with low tendencies to satisfice (i.e., maximisers), such as the solo drivers in our study, tend to rely on their social standards when making decisions and when they fail to reach these standards they are more likely to seek the best option (see Lyubomirsky and Ross, 1997). Overall, cyclists have high satisficing tendencies possibly because they enjoy cycling and are highly satisfied with their commute, whereas solo drivers have low satisficing tendencies possibly because they find driving stressful, not satisfying, and require social validation from others.

Despite our interesting findings, our study has several limitations. Firstly, we had unequal sample sizes of various commuters such that, the majority of our commuters were solo drivers. As drivers tend to be different from other commuters in terms of their travel characteristics, psychological variables, and their commitment towards their mode (see Sivasubramaniyam et al., 2020), it is essential to take caution in interpreting some of the results of the analyses. Gender imbalance (approximately 63% female) was also present in our sample. Several studies (e.g., Curtin, Presser, and Singer, 2000; Moore and Tarnai, 2002; Singer, Hoewyk, and Maher, 2000) have shown that women are more likely to participate in surveys than men. Our sample also seems to be more educated than the general New Zealand population. While 24.9% of our sample had at least a master's degree, only 10.7% of New Zealanders have attained a post-graduate qualification (Statistics New Zealand, 2019). Some studies (e.g., Curtin et al., 2000; Singer et al., 2000) have identified that more educated and more affluent individuals are more likely to take part in surveys than less educated and less affluent individuals.

In spite of the limitations, our results have not only demonstrated that commuters are more likely to adopt the satisficing decision-making strategy for their usual-mode commutes compared to their alternative-mode commutes, but also that commuters with strong tendencies to satisfice are different to commuters with weak tendencies to satisfice in terms of their psychological (e.g., feelings, impression, and satisfaction) and travel characteristics (e.g., trip frequencies, commuting distance, and travel modes). As a result, further research could develop interventions to encourage mode shift of commuters by targeting their decision-making strategies because encouraging commuters to use more sustainable modes is not only beneficial for the environment but also for their wellbeing (Scheepers et al., 2014). As cycling is associated with high satisficing tendencies and tends to have many affective and hedonic benefits (e.g., Gatersleben and Uzzell, 2007; Schneider, 2011; Singleton, 2019; Sivasubramaniyam et al., 2020), future research can encourage commuters to make satisficing decisions by activating goals of experiencing positive feelings and satisfaction through the use of sustainable commuting modes (see goal priming; Papies, 2016). Furthermore, as commuters' decisions to use their usual modes tend to be 'good enough' for them, another type of intervention to consider is self-persuasion (see Aronson, 1999), where car users in particular, can be asked to generate their own reasons for using more sustainable modes and reasons for not using the car. By doing so, car users will be encouraged to think that their car use may not be good enough after all, especially with regards to the environment and societal implications. Moreover, policy-makers can create policies that support commuters' satisficing decision-making strategies in ways that will provide them with a satisfying, emotionally-rewarding, and yet sustainable commuting experience. For example, placing special emphasis on designing routes and exclusive bus lanes, will not only provide traffic priority for buses, faster connections, and more reliable departures, but also may increase commuters' willingness to use public transport and belief that public transport is good enough for them. Taking into consideration the results of our current study and the possible future directions, we are optimistic that interventions to encourage mode shift that target commuters' satisficing decision-making strategy may not only be useful for the environment, but also for the commuters themselves.

Author contributions

The study described in this manuscript was undertaken by the first author (RDS) in partial fulfilment of the requirements for the degree of Doctor of Philosophy in Psychology and was supervised by the second (RJS) and third authors (SGC). The manuscript was jointly prepared by all three authors.

Data availability

The data analysed for this study are not publicly available due to lacking of participants' consent for open data-sharing, but the data are available from the first author upon reasonable request.

Funding

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Ethical approval

All participant recruitment and test procedures were approved by the Human Research Ethics Committee of the School of Psychology at the University of Waikato, Hamilton, New Zealand. Informed consent was obtained from all of the participants in the study.

Declaration of competing interest

The authors declare that they do not have any competing interests.

Acknowledgments

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Appendix A. Questions used in the online survey

Questions Used in the Online Survey

Survey Questions	
First filter item	
Assuming that you had a regular working or schooling week, which method of travel did you use most often to get to work or school in the last seven days (i.e., usual mode)?	
1. I drove alone	
2. I shared a ride with one or more people	
3. I took the bus	
4. I cycled	
5. I used other methods (Please specify):	
6. I do not commute [1]	
Travel characteristics of usual modes	
1. In the last 7 days, what percentage of all your trips involved using your usual method of travel (i.e., your response to Question 1)?	0 – 100%
2. In the last 7 days, what percentage of your commuting trips (i.e., travel to work or school) involved using your usual method of travel?	0 – 100%
3. How far (in kilometres) do you travel for your one-way regular commute using your usual method?	0 – 100 km [2]
4. How long (in minutes) does your one-way regular commute take using your usual method?	0 – 120 min [3]
Mode-specific items for usual modes	
Instructions: For the next set of questions we want you to think about yourself and your regular commuting trips using your usual method of commuting.	

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(*continued*)

Survey Questions
Measure of commuters' satisficing tendencies
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
1. I usually try to find a couple of good travel options and then choose between them.
2. At some point, you need to make a decision about how to travel.
3. I try to make the most of whatever travel method I choose.
4. There are usually several good travel options in a commuting decision situation.
5. I try to gain plenty of information before I make a commuting decision, but then I go ahead and make it.
6. Good things can happen when commuting even when things don't go right at first.
7. I can't possibly know everything before making a commuting decision.
8. All commuting decisions have pros and cons.
9. I know that if I make a mistake in a commuting decision that I can go and choose a different method next time.
10. I accept that commuting often has uncertainty.
Measure of commuter's satisfaction
7-point Semantic-differential scale
During my most recent trip to work or school using my usual method of travel,
1. I was very: tensed – relaxed
2. I was very: bored – enthusiastic
3. I was very: sad – happy
4. I was very: tired – energised
5. I was very: distressed – content
6. I was: worried I wouldn't arrive on time – confident I would arrive on time
7. My trip was: the worst I can imagine – the best I can imagine
8. My trip went: poorly – smoothly
My trip was: displeasing – enjoyable
Measure of commuter's habit strength
7-point Likert scale (1 = strongly disagree, 7 = strongly agree)
The way I get to work or school using my usual method of commuting is something:
1. I do frequently
2. I do automatically
3. I do without having to consciously remember
4. That makes me feel weird if I do not do it
5. I do without thinking
6. That would require effort not to do it
7. That belongs to my daily routine
8. I would find hard not to do
9. I have no need to think about doing
10. That's typically "me"
11. I have been doing it for a long time
Direct measure of commuters' satisficing tendencies
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
Please indicate the extent to which you agree or disagree with the following statements:
1. Commuting using your usual method is good enough for you.
2. Commuting using your usual method meets your basic needs.
3. Commuting using your usual method is the best method to commute in all respects [4]
Hedonic characteristics of usual modes
. Please indicate to what extent you felt the following feelings and/or emotions while commuting:
5-point Likert scale (1 = not at all, 2 = a little, 3 = moderately, 4 = quite a bit, 5 = extremely)
a. 10 items adapted from Thompson (2007): upset, hostile, alert, ashamed, inspired, nervous, determined, attentive, afraid, and active.
b. 10 items adapted from Singleton (2017): excited, strong, vulnerable, proud, angry, bold, frustrated, timid, calm, stressed.
2. How much did you like commuting using your usual method?
5-point Likert scale (1 = strongly disliked, 2 = somewhat disliked, 3 = neither liked nor disliked, 4 = somewhat liked, and 5 = strongly liked)
3. Please select the choice that best corresponds to your overall impression of using your usual method for commuting.
7-point Semantic-differential scale
a. Slow – Fast
b. Expensive – Affordable
c. Inconvenient – Convenient
d. Unpredictable – Reliable

(*continued*)

Survey Questions
e. Risky – Safe (from traffic collisions and injuries)
f. Vulnerable – Secure (from crime or violence)
Second filter item
If there was a time you had to use an alternative method to get to work or school due to various reasons (e.g., bad weather, you missed the bus, your car broke down, your bicycle tyres were punctured, you recently moved, etc.) what was the alternative method you used most often?
1. I drove alone
2. I shared a ride with one or more people
3. I took the bus
4. I cycled
5. I used other method (Please specify):
6. I never had to use an alternative method [5]
Mode-specific items for alternative modes
Instructions: For the next set of questions we want you to think about yourself and your regular commuting trips using your alternative method of commuting.
Measure of commuters' satisficing tendencies
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
1. I tried to find a couple of good travel alternatives and then choose between them.
2. At some point I had to make a decision about travel alternatives.
3. I tried to make the most of whatever travel alternative I used.
4. There were several good travel alternatives in the decision situation.
5. I tried to gain plenty of information before I made the decision, but then I went ahead and made it.
6. Good things happened during the trip even when things didn't go right at first.
7. I can't possibly know everything before making the decision to use the alternative method.
8. The decision to use the alternative method had pros and cons.
9. I knew that if I made a mistake in the decision to use the alternative method, I can go and choose a different method next time.
10. I accepted that commuting using the alternative method often has uncertainty.
Direct measure of commuters' satisficing tendencies
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
1. Commuting using your alternative method is good enough for you.
2. Commuting using your alternative method meets your basic needs.
3. Commuting using your alternative method is the best method to commute in all respects. [6]
General travel items
Instructions: For the next set of questions we want you to think about your experience travelling by any method for any trip purpose.
Measure of the tendency to experience difficulty when making travel decisions
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
1. I usually have a hard time making even simple travel decisions
2. I am usually worried about making a wrong travel decision.
3. I often wonder why travel decisions can't be more easy
4. I often put off making a difficult travel decision until a deadline
5. I often experience 'buyer's remorse' when travelling
6. I often think about changing my mind after I have already made my travel decision
7. The hardest part of making a travel decision is knowing I will have to leave the choice I didn't choose behind.
8. I often change my mind several times before making a travel decision.
9. It's hard for me to choose between two good alternatives
10. Sometimes I procrastinate in deciding even if I have a good idea of what travel decision I will make
11. I find myself often faced with difficult travel decisions
12. I agonize over travel decisions
Measure of the tendency to experience regret when making travel decisions
7-point Likert scale (1 = strongly disagree, 7 = strongly agree)
1. Whenever I make a travel decision, I'm curious about what would have happened if I had decided differently.
2. Whenever I make a travel decision, I try to get information about how the other alternatives turned out.
3. If I make a travel decision and it turns out well, I still feel like something of a failure if I find out that another travel decision would have turned out better.
4. When I think about how I'm doing in life, I often assess the travel opportunities I have passed up.
5. Once I make a travel decision, I don't look back (R). [7]
Measure of satisfaction with travel
7-point Semantic-differential scale
Whenever I travel:

(*continued*)

Survey Questions
1. I feel very: tensed – relaxed
2. I feel very: bored – enthusiastic
3. I feel very: sad – happy
4. I feel very: tired – energised
5. I feel very: distressed – content
6. I feel very: worried I wouldn't arrive on time – confident I would arrive on time
7. It is: the worst I can imagine – the best I can imagine
8. It has always worked: poorly – smoothly
9. It is: displeasing – enjoyable
Non-travel-related items
Instructions: For the next set of questions, we want you to think about things outside of your commuting or travelling experiences and indicate the extent to which you strongly disagree or strongly agree with the following items.
Measure of the tendency to experience difficulty when making general decision
5-point Likert scale (1 = strongly disagree, 5 = strongly agree)
1. I usually have a hard time making even simple decisions
2. I am usually worried about making a wrong decision.
3. I often wonder why decisions can't be more easy
4. I often put off making a difficult decision until a deadline
5. I often experience buyer's remorse
6. I often think about changing my mind after I have already made my decision
7. The hardest part of making a decision is knowing I will have to leave the item I didn't choose behind.
8. I often change my mind several times before making a decision.
9. It's hard for me to choose between two good alternatives
10. Sometimes I procrastinate in deciding even if I have a good idea of what decision I will make
11. I find myself often faced with difficult decisions
12. I agonize over decisions
Measure of the tendency to engage in decision reinvestment and decision rumination
5-point Likert scale (1 = extremely uncharacteristic, 5 = extremely characteristic)
Decision Reinvestment
1. I'm always trying to figure out how I make decisions
2. I'm concerned about my style of decision-making
3. I'm constantly examining the reasons for my decisions
4. I sometimes have the feeling that I'm observing my decision-making process
5. I am alert to changes in how much thought I give to my decisions
6. I'm aware of the way my mind works when I make a decision
Decision Rumination
7. I remember poor decisions I make for a long time afterwards
8. I get "worked up" just thinking about poor decisions I have made in the past
9. I often find myself thinking over and over about poor decisions that I have made in the past
10. I think about better decisions I could have made long after the event has happened
11. I rarely forget the times when I have made a bad decision, even about the minor things
12. When I am reminded about poor decisions I have made in the past, I feel as if they are happening all over again
13. I'm concerned about what other people think of the decisions I make
Measure of the tendency to experience regret after making general decisions
7-point Likert scale (1 = strongly disagree, 7 = strongly agree)
1. Whenever I make a choice, I'm curious about what would have happened if I had chosen differently.
2. Whenever I make a choice, I try to get information about how the other alternatives turned out.
3. If I make a choice and it turns out well, I still feel like something of a failure if I find out that another choice would have turned out better.
4. When I think about how I'm doing in life, I often assess opportunities I have passed up.
5. Once I make a decision, I don't look back (R).[8]
Demographic items
1. Gender
2. Age
3. Current employment status
4. Current education status
5. Highest education level
6. Total personal income in the last 12 months
7. Moving status

Notes

[1] Respondents who selected 'I do not commute' advanced to the demographic questions

[2] An option of > 100 km is provided

[3] An option of > 120 minutes is provided

[4] Item 3 needs to be reverse-coded when scoring

[5] Respondents who selected 'I never had to use an alternative method' advanced to the demographic questions

[6] Item 3 needs to be reverse-coded when scoring

[7] Item 5 needs to be reverse-coded when scoring

[8] Item 5 needs to be reverse-coded when scoring

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Chapter 4

Study Three

Super-tailoring: Using Self-persuasion to Reduce Drivers' Car Use[3]

[3] This study was published as a paper with the same title in the Journal of Transportation Research Interdisciplinary Perspectives, 10, 100359, 2021 authored by Rathee D. Sivasubramaniyam, Samuel G. Charlton, and Rebecca J. Sargisson.

Research Gap

In the second study, I found that commuters tend to satisfice when making decisions to use travel modes that they use frequently compared to travel modes that they use less frequently. Despite having weaker tendencies to satisfice compared to cyclists, solo drivers' tendencies to satisfice imply that their decisions to drive to work are 'good enough' for them. Results from the second study also revealed that commuters who are more likely to satisfice tend to be more satisfied and happier with their regular commutes compared to commuters who are less likely to satisfice. The results could explain why it is challenging for policymakers and researchers to encourage solo drivers to reduce their car use and use more sustainable modes. Thus, the key question that emerged from the second study was: what is the best way to convince car drivers to reduce their car use while taking into account their tendencies to make good enough mode decisions?

Existing mode-shift interventions have shown mixed results in encouraging the use of more sustainable modes (e.g., Cooper, 2007; Fujii & Taniguchi, 2005; Kristal & Whillans, 2020; Schlag & Teubel, 1997). Structural interventions such as providing free bus tickets (e.g., Fujii et al., 2001; Fujii & Kitamura, 2003; Kristal & Whillans, 2020) and psychological interventions such as providing tailored information to commuters (e.g., Fujii & Taniguchi, 2005; Tertoolen et al., 1998) did not manage to reduce commuters' car use, especially in the long term. One possible reason why such interventions were not very successful is that the interventions were typically implemented by third-party stakeholders (e.g., government, researchers, and policymakers; see e.g., Bamberg, 2006; Carran-Fletcher et al., 2020; Rodriguez et al., 2009; Tertoolen et al., 1998; TfL, 2019) who have been encouraging commuters to make sustainable transport choices instead of the commuters encouraging themselves do so. To put it differently, current mode-shift interventions tend to adopt a direct method of persuasion. Direct methods of persuasion can be ineffective because individuals

often recognise the persuasive nature of the interventions and may perceive the interventions as threats to their freedom of choice (Wakefield et al., 2010). Consequently, they may reject the persuasion attempts or interventions to maintain their freedom of choice (Ringold, 2002). In the case of mode-shift interventions, car users may be aware that the structural and psychological interventions introduced to them are attempts to discourage their car use and encourage the use of sustainable modes. As a result, they may feel that they no longer have the freedom to decide on their travel modes. Therefore, they continue to use their cars and do not respond to mode-shift interventions. An alternative to the conventional direct persuasion methods adopted by many mode-shift interventions is 'self-persuasion', where individuals are placed in situations where they have to motivate themselves to change their attitudes and/or behaviours by generating arguments in support of an issue (Aronson, 1999). Studies have shown that people are more likely to change their attitudes and/or behaviours when they generated arguments for themselves compared to when other people generated and provided arguments to them (e.g., Briñol, McCaslin, & Petty, 2012; Higgins, McCann, & Fondacaro, 1982; Maio & Thomas, 2007; Vogel, Bohner, & Wanke, 2002).

One possible reason why self-persuasion can be more effective than direct persuasion is that when people start persuading themselves to do something that they do not usually do (e.g., reducing car use or using sustainable modes), they are confronted by their hypocrisy (Aronson, 1999). In other words, they are making themselves mindful of the fact that they are not practising what they are preaching, which causes feelings of dissonance. So, to reduce the feelings of dissonance, they start behaving in ways that match their beliefs. Another reason why self-persuasion can be more effective than direct methods of persuasion is the fact that the individuals themselves are the sources of the argument (Baldwin, Rothman, Vander Weg, & Christensen, 2013). Individuals' arguments can change their attitudes and/or behaviours because they tend to place greater value on their ideas or beliefs (Kahneman, Knetsch, &

Thaler, 1991) and believe that their opinions are better than the opinions of others (Dunning, Heath, & Suls, 2004). Additionally, being the source of one's arguments is an effective way for someone to tailor the most convincing messages for themselves or other people because they can match their arguments to their unique needs and characteristics (see Baldwin et al., 2013; Briñol et al., 2012; Greenwald & Albert, 1968; Loman, Müller, Beverborg, van Baaren, & Buijzen, 2018; Slamecka & Graf, 1978). In other words, individuals can generate the most compelling arguments to change their attitudes and/or behaviours if they produce their own arguments. As a result, they are more likely to be motivated by their idiosyncratic arguments leading to changes in their attitudes and/or behaviours. Self-persuasion has been successful in various behaviour domains such as encouraging safer sex practices (e.g., Aronson, Fried, & Stone, 1991; Stone, Aronson, Crain, Winslow, & Fried, 1994), conserving water (e.g., Dickerson, Thibodeau, Aronson, & Miller, 1992), ceasing smoking (e.g., Müller et al., 2009), providing gratuities for services (e.g., Bernritter, van Ooijen, & Müller, 2017), and cleaning the environment (e.g., Damen, Müller, van Baaren, & Dijksterhuis, 2015). However, self-persuasion has not been tested in the domain of travel behaviour as a potential mode-shift intervention. Thus, in the third and final study of this thesis, I tested self-persuasion as an intervention to reduce drivers' car use for daily commute.

The aim of the third study was:

1. To investigate the effectiveness of self-persuasion on drivers' car use intentions, behaviours, and attitudes.

Research Approach

To fulfil the research aims of the third and final study, I recruited and asked a sample of New Zealand drivers who drive to work regularly to complete two online questionnaires at least 2 weeks apart. In the first questionnaire, I asked the drivers to provide details such as

their current travel characteristics, their attitudes towards reducing car use, and their intentions to reduce car use. Then, I randomly assigned the drivers to one of three conditions, namely self-persuasion, direct persuasion, and control. I asked the drivers in the self-persuasion condition to generate arguments on the benefits of reducing car use, drivers in the direct-persuasion condition to read arguments on the benefits of reducing car use, and drivers in the control condition to complete a different travel-related task. Then, I measured drivers' intentions to use their car for commuting trips before and after the intervention. To investigate the long-term effectiveness of the intervention, I invited the drivers to complete a shorter online questionnaire two weeks after completing the first questionnaire. In the second questionnaire, I asked them to rate their intentions to use the car, weekly car use percentages (for commuting and non-commuting trips), and attitudes towards reducing car use in the last 2 weeks. I compared the differences in drivers' car use intentions, weekly car use, and car reduction attitudes before and after the intervention using one-way, between-subjects ANOVAs. I hoped that the results of this study would provide insights into the effectiveness of self-persuasion on reducing commuters' car use, which will be useful for policymakers and future researchers who intend to encourage mode-shift behaviours. More importantly, I expected the results of the third study to make a significant contribution to the field of transportation psychology by testing an intervention that has never been tested before in the domain of travel behaviour to reduce car use.

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Super-tailoring: Using self-persuasion to reduce drivers' car use

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ABSTRACT

Car use is a common travel mode in many societies but it has negative impacts on the environment and public health. There have been various interventions to reduce car use but self-persuasion has not been tested as a potential intervention. Self-persuasion involves asking people to generate arguments in favour of a specific issue. Our goal was to investigate the effectiveness of self-persuasion in changing drivers' car use attitudes and behaviours. A sample of New Zealand drivers (n = 183) completed two online questionnaires; one immediately after and one at least 2 weeks after the intervention. We randomly assigned the drivers to one of three conditions: self-persuasion (generating arguments on the benefits of reducing car use), direct-persuasion (reading arguments on the benefits of reducing car use), and control (completing a different travel-related task). There were no significant differences between the three groups of drivers on car use intentions for commuting trips, weekly car use for commuting and non-commuting trips, or attitudes towards reducing car use. We attributed the ineffectiveness of self-persuasion to the average quality of arguments generated, the effortful nature of reducing car use, and the COVID-19 situation in New Zealand. Although self-persuasion may not be an appropriate intervention in the travel behaviour domain, future research needs to continue identifying new ways to reduce car use to reduce its detrimental effects.

1. Introduction

In the last 30 years, up to 74% of New Zealanders' journeys to work have involved driving, and in the last 18 years, ownership of light passenger vehicles has increased from 0.65 to 0.80 per head of population (Ministry of Transport, 2018, 2019). Frequent car use is associated with high levels of emissions of poisonous gases such as carbon dioxide (CO_2) and nitrogen oxides (NO_x). On a global scale, road vehicles account for nearly 75% of transport-related CO_2 emissions (IEA, 2019) and, in New Zealand, road vehicles are the biggest contributor of NO_x, which is one of the leading causes of air pollution in New Zealand (Statistics New Zealand, 2018). There are also health consequences, as people can die from exposure to road-vehicle emissions (Fisher et al., 2002). To address this situation, there need to be effective and long-lasting interventions to promote the use of sustainable modes and to reduce commuters' reliance on single-occupant cars and trucks.

There have been many attempts to encourage people to use their cars less and switch to more sustainable modes of transport. One such approach has involved education-based interventions, where commuters receive personalised information regarding the use of sustainable modes (e.g., Bamberg, 2006; Mutrie et al., 2002; Thøgersen, 2009). Providing personalised travel-related information is also part of Travel Feedback Programs (TFPs; Fujii and Taniguchi, 2005). Some of the most common TFPs include individualised marketing where only participants who are keen to change their travel behaviours are provided personalised travel information (see Cairns et al., 2004) and travel blending, where participants receive booklets describing why an individual's travel behaviour is important (see Taniguchi, Hara, Takano, Kagaya, and Fujii, 2003). Other researchers used financial incentives to promote the use of sustainable modes (e.g., Ben-Elia and Ettema, 2011; Jakobsson et al., 2002; Kristal and Whillans, 2020). Other than education- and financial-based interventions, Travel Demand Management (TDM) has also been used. TDM refers to the application of strategies, policies, or initiatives to reduce travel demand or redistribute the demand across multiple travel modes (Carran-Fletcher et al., 2020). Some examples include increasing parking prices (e.g., Litman, 2018), implementing congestion charges (e.g., Croci, 2016), promoting bike-share schemes and improving bicycle lanes, footpaths, rail networks, and public transport systems (e.g., Handy et al., 2013; Midgley, 2011; Parker et al., 2013; Rodriguez et al., 2009; TfL, 2019).

Another way of encouraging commuters to reduce their car use is to change their attitudes towards car use. Using the Elaboration Likelihood Model (ELM), Petty and Cacioppo (1986) suggested that a

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person's likelihood of changing their attitude depends on their tendency to elaborate upon an issue or an argument. According to the ELM, there are two routes to attitude change. The central route involves the person carefully and thoughtfully considering the argument content and quality, whereas the peripheral route involves the person relying on factors or cues unrelated to the argument content, such as the attractiveness of the communicator (Friedrich, 1990). When a person is highly motivated and receives compelling arguments, they are more likely to respond via a central route of persuasion (Chaiken et al., 1989; Chaiken and Maheswaran, 1994; Petty and Cacioppo, 1986). Whereas when a person is not motivated or receives weak arguments, they are more likely to respond to a peripheral route of persuasion (Petty and Cacioppo, 1986). Petty and Cacioppo (1986) claimed that the central route of persuasion is more likely to lead to enduring attitude and behaviour changes because it involves the processing of arguments under high elaboration conditions (i.e., high motivation, strong arguments). Thus, to effectively persuade attitude change, psychological interventions should target individuals' central routes by encouraging them to elaborate arguments.

One way to increase elaboration is tailoring arguments or messages to the individuals (i.e., message tailoring; Petty et al., 2009). Message tailoring involves developing a specific intervention based on the assessment of an individual's characteristics and needs (Kreuter et al., 2000, 1999; Lustria et al., 2009). Message tailoring promotes greater engagement with the message (i.e., reading, attending to, and recalling the message content) and deeper and elaborative processing of the message (Cortese and Lustria, 2012). As individuals become more motivated to process the information and perceive it to be compelling (i.e., high elaboration), they are more likely to change their attitudes and behaviours (Cesario et al., 2004; Noar et al., 2007; Petty and Cacioppo, 1979). An effective way to tailor messages or arguments to the individual is to explicitly instruct individuals to generate their own arguments about an issue or a decision option (Baldwin et al., 2013; Lemmen et al., 2020; Loman et al., 2018). This is known as self-persuasion. Aronson (1999) defined self-persuasion as placing people in situations where they are motivated to persuade themselves to change their own attitudes and behaviours.

Direct persuasion methods involve providing individuals with messages or arguments to persuade them to change their attitudes and behaviours. However, self-persuasion can be more effective than direct persuasion methods. Firstly, individuals tend to be more responsive to information that is generated internally than information that is provided externally (Mussweiler and Neumann, 2000; Wilson and Brekke, 1994) because they believe that their opinions are better than the opinions of others (see Dunning et al., 2004; Kahneman et al., 1991). Secondly, there is no psychological reactance when individuals generate their own arguments because their freedom of choice is not restricted (cf., direct persuasion, see Wakefield et al., 2010). Thirdly, individuals tend to generate compelling arguments as they match their arguments to their unique needs, characteristics, and situations (Baldwin et al., 2013; Briñol et al., 2012; Greenwald and Albert, 1968; Slamecka and Graf, 1978). Asking people to generate arguments can be thought of as 'super-tailoring', as people will tend to generate idiosyncratic reasons that are relevant to their own lives. Self-persuasion methods have been found to be more effective than direct persuasion methods, for example, in encouraging smoking cessation (e.g., Baldwin et al., 2013; Müller et al., 2009), healthy dietary behaviours (e.g., Pierce and Stoltenberg, 1990; Stice et al., 2008), safer sex practices (e.g., Stone et al., 1994), and pro-environmental behaviours (e.g., Damen et al., 2015; Lemmen et al., 2020).

To our knowledge, self-persuasion has not been used as an intervention in the domain of travel behaviour. This is presumably due to the dominating influence of direct methods of persuasion, such as providing commuters travel-related information or arguments to encourage them to make more sustainable mode choices (e.g., TFPs; see Cairns et al., 2004; Fujii and Taniguchi, 2005; Taniguchi et al., 2003). While using TFPs can be useful in the short run, especially under ambiguous travel conditions where commuters require more information for their commutes, it is not very useful in the long run because when commuters' travel conditions are no longer ambiguous, their sensitivity to travel information decreases and they rely on habitual travel behaviours (Ben-Elia and Avineri, 2015). Additionally, a tailored direct persuasion intervention requires segmentation – that is, messages must target specific sectors of the population. However, research on which types of persuasive car-reduction messages are effective for different segments is still ongoing (e.g., Andersson et al., 2020). In their study, Andersson et al. (2020) found that the car-reduction messages did not motivate devoted car users but had some positive effects on car contemplators (i.e., travellers with a low-car accessibility), image improvers (i.e., travellers who use the car as a way of self-expression), and malcontent motorists (i.e., travellers who do not like to drive). A self-persuasion intervention could circumvent the need for segmentation and segmented messaging by disseminating the same message to all segments of travellers, and relying on individuals to tailor their own arguments to their specific situations. Thus, there are two main shortcomings that we intended to address in our study: (1) the role of self-persuasion in encouraging behaviour change has yet to be studied closely in the domain of travel behaviour and (2) the long-term effectiveness of current interventions to encourage sustainable travel behaviour is not very promising or consistent across various studies. Testing the effectiveness of self-persuasion could introduce a new intervention technique in the context of travel behaviour that encourages longer-term travel behaviour changes.

In the current study, we tested whether self-persuasion can reduce drivers' car use in favour of sustainable travel behaviour. The self-persuasion intervention in our study involved asking drivers to generate arguments on the benefits of reducing car use (i.e., super-tailoring). We hypothesised that asking drivers to generate their own arguments would be more effective than providing them with arguments as previous researchers have done (e.g., Bamberg, 2006; Kristal and Whillans, 2020; Mutrie et al., 2002; Thøgersen, 2009). Using two online questionnaires, we compared self-persuasion (generating arguments) and direct persuasion (reading arguments) to a control task in their effectiveness to reduce the strength of the participants' intentions to use private cars for their commuting and other regular trips. We hypothesised that drivers in the generate-argument condition would have a larger decrease in intentions to use the car (i.e., weaker intentions) compared to drivers in the read-argument and control conditions (H1). We administered the second questionnaire 2 weeks after the first to assess longer-term effects of the interventions. We hypothesised that drivers in the generate-argument condition would have the largest reduction in car use (H2) and that these drivers would have a more positive attitude towards reducing car use (i.e., more favourable attitude) compared to drivers in the read-argument and control conditions (H3). We hoped that the findings of the study would reveal whether self-persuasion is an appropriate tool to encourage sustainable travel behaviour amongst drivers and whether it can lead to long-term behaviour changes.

2. Method

2.1. Design

We adopted a between-subjects design to compare the three groups of drivers (generate-argument, read-argument, and control) on four main dependent variables associated with car use (intentions to use the car for commuting trips, attitudes towards reducing car use, weekly car use for commuting trips, and weekly car use for non-commuting trips). We carried out the intervention via Qualtrics (www.qualtrics.com/). The participants were randomly assigned to

these three groups just prior to beginning the first questionnaire, which contained the manipulation. We assessed the participants' intentions and attitudes again in a second questionnaire administered at least 2 weeks later.

2.2. Participants

We recruited regular commuters between July and August 2020 (winter in New Zealand) who were 16 years and older through notices placed on the intranets of various organisations as well as on social media and through word-of-mouth. The study was conducted immediately after the New Zealand government lifted the nationwide lockdown due to COVID-19. We received ethical approval from the Human Research Ethics Committee of the Division of Arts, Law, Psychology, and Social Sciences at the University of Waikato.

Of the 390 respondents who completed the first online questionnaire, 251 (64.36%) were regular car drivers (i.e., driving for more than 50% of commuting trips in a week). We excluded 68 car drivers from the analyses because they either did not complete the intervention that they were assigned to, did not provide the main dependent measure of the first questionnaire (intention to use the car for commuting trips), or did not provide their demographic details. Our final sample was 120 women, 62 men, and one respondent of undisclosed gender. Of the 183 respondents, 58 were assigned to the generate-argument condition, 66 to the read-argument condition, and 59 to the control condition. The final sample had a mean age of 43.20 years (SD = 14.80). Table 1 shows the demographic characteristics of the sample. On average, the drivers took 23.19 min (SD = 17.83) and travelled 19.86 km (SD = 20.39) to work and spent NZ$215.71 ($SD$ = 159.39) per month on transportation. We invited the respondents to complete a second questionnaire any time 2 weeks after completing the first questionnaire. The final sample for the second questionnaire was 70 women and 35 men with a mean age of 45.54 years (SD = 14.45). Of the 105 respondents, 36 were in the generate-argument condition, 34 in the read-argument condition, and 35 in the control condition.

2.3. Materials and procedure

2.3.1. First questionnaire

The first questionnaire had six sections (Refer to Appendix A for additional details on the items and their respective response scales). The first question of the first section was a filter question where respondents indicated their usual mode for commuting before the nationwide lockdown (i.e., any travel mode used for more than 50% of commuting trips in a week) and only respondents who selected 'drive' continued. The remaining two questions of the first section asked respondents for their average travel time (in minutes) and distance (in kilometres) when commuting to work during a regular week before the lockdown.

In the second section, we asked respondents for the percentage of commuting trips made in a regular week using the car and if they had made any effort to reduce their car use during a regular commuting week. We asked respondents who indicated 'yes' to select their methods of reducing car use from a given list. We then asked them how likely were they to reduce their car use once the travel restrictions due to COVID-19 have been completely removed on a 7-point Likert scale (1 = *extremely unlikely*, 7 = *extremely likely*). We also asked respondents to indicate any other travel purposes for which they used their car before the lockdown by selecting from a list of travel purposes (i.e., shopping, personal appointment/services, social visit/entertainment, sport & exercise, education, and accompanying someone). Then, respondents indicated, on a scale of 0 to 100%, how often they used their cars in a week for each of the travel purposes selected in the previous question.

The third section measured respondents' attitudes towards reducing car use. We adapted three items, each answered on a 7-point scale, from Loukopoulos et al.'s (2005) scale. High scores indicated positive attitudes towards reducing car use while low scores indicated negative attitudes.

The fourth section asked respondents to complete one of three intervention tasks. After completing Sections 2 and 3, we randomly assigned respondents to one of three experimental conditions: generate-argument, read-argument, and control. The respondents in the generate-argument condition were asked to provide as many arguments as they could think of as to why reducing car use can be beneficial, and read-argument respondents received a list of 10 benefits of reducing car use (adapted from NZTA, 2019) and then both groups rated how convincing they found the arguments on a 7-point scale (1 = *extremely unconvincing*, 7 = *extremely convincing*). Respondents in the control condition described their daily car use experience before the nationwide lockdown due to COVID-19.

In Section 5, respondents indicated their intentions to use their cars for commuting trips and any other trips selected in Section 2 once the travel restrictions had been completely removed. Respondents' answers to the questions in Section 5 served as their post-intervention car use intention scores. Finally, in Section 6, we asked respondents for their gender, age, employment status, education status, education level, household type, annual income for the last 12 months, and residential relocation status in the last 12 months.

Table 1
Demographic Characteristics of the Drivers in the Sample (N = 183).

Demographic characteristics	Percentage of drivers (%)
Employment status	
Full-time work (30 h or more per week)	71.6
Part-time (less than 30 h per week)	15.3
Casual/sporadic work	5.5
Unemployed/looking for work	1.1
Looking after home and family	1.1
Retired	2.7
Other	2.7
Education status	
Not attending, studying or enrolled anywhere	73.2
Secondary school	0.5
Full-time University/Polytech/other	8.2
Part-time University/Polytech/other	13.1
Other	4.9
Highest level of education completed	
No secondary school qualification	0.5
High school qualification or equivalent	18.6
Tertiary diplomas or certificate	29.5
Bachelor degree or Bachelor with Honours degree	37.7
Master degree or higher	13.7
Household type	
Person living alone	10.4
Married/de facto couple only	30.6
Other adults only (e.g., flatmates)	13.7
Family (including extended) with children	30.6
Family with adults only	9.8
Single adults living with children	2.2
Other	2.7
Annual income	
Zero	0.5
$1 - $25,000	7.7
$25,001 - $50,000	20.8
$50,001 - $75,000	23.0
$75,001 - $100,000	20.2
$100,001 - $125,000	8.7
$125,001 - $150,000	6.0
More than $150,000	2.7
Prefer not to say	10.4
Recently moved status in the last 12 months	
Yes	20.2
No	79.8

2.3.2. Second questionnaire

The second questionnaire had three sections and respondents' answers to the questions in these sections served as their post-intervention car use behaviour and attitude scores (Refer to Appendix B for additional details on the items and their respective response scales). For the first question in the first section, respondents indicated how often they used their car for commuting trips in a regular commuting week on a scale of 0 to 100%. Then, we asked respondents if they had reduced their car use in the last 2 weeks and respondents who indicated 'yes' were asked to select their methods of reducing car use from a given list. In the next section, respondents indicated any other travel purposes they had used their car for in the last 2 weeks by selecting them from a list of travel purposes similar to Section 2 of the first questionnaire. Then, respondents indicated on a scale of 0 to 100%, how often they used their cars in a regular commuting week for each of the travel purposes selected in the previous question. In the final section, we again measured respondents' attitudes towards reducing car use using the adapted three items from Loukopoulos et al.'s (2005) study. Respondents answered on a 7-point Likert scale for each of the three items.

2.4. Analysis

We carried out a one-way, between-subjects ANOVA to compare the three groups of drivers on each of the four dependent variables. The independent variables in each ANOVA were intervention type with three levels (i.e., generate-argument, read-argument, and control). With an a priori estimation of statistical power of 0.8 and an estimated medium effect size Cohen's d of 0.25 (see Cohen, 1988), a minimum of 159 respondents was required for this study.

For the first dependent variable, we measured drivers' car use intentions for commuting trips before and after the intervention using a single-item measure twice in the first questionnaire. We then calculated drivers' differences in intentions by subtracting their intentions before the intervention from their intentions after the intervention. A positive difference score indicated an increase in drivers' intentions to use the car for commuting trips after the intervention whereas a negative difference score indicated a decrease.

We measured drivers' attitudes towards reducing car use before the intervention, and at least 2 weeks later, using a 3-item measure. We calculated drivers' differences in attitudes towards reducing car use by subtracting their attitudes before the intervention from their attitudes after. A positive difference score indicated a more favourable attitude after the intervention and a negative difference score indicated a less favourable attitude.

We measured drivers' weekly car use percentages for commuting trips before and after the intervention using a single-item measure. We then calculated drivers' differences in weekly car use for commuting trips by subtracting their weekly car use percentages before the intervention from their weekly car use percentages after. A positive difference score indicated an increase in drivers' weekly car use for commuting trips after the intervention whereas a negative difference score indicated a decrease.

For the fourth dependent variable, we obtained drivers' weekly car-use percentages for non-commuting trips before and after the intervention by averaging their percentages of weekly car trips for six travel purposes (i.e., shopping, personal appointment/services, social visit/entertainment, sport & exercise, education, and accompanying someone). We then subtracted drivers' average weekly car use percentages for non-commuting trips before the intervention from their average weekly car use percentages after. A positive difference score indicated an increase in drivers' weekly car use for non-commuting trips after the intervention and a negative difference score indicated a decrease.

We calculated the percentages of drivers who responded 'yes' and 'no' before and after the intervention for the item asking whether they have made any effort to reduce their car use in the last 1 week of their regular commute (see Section 2 of the first questionnaire and Section 1 of the second questionnaire). According to Field (2018), a McNemar's test is appropriate when looking for changes in individual's scores by comparing the proportion of individuals who responded in one direction (i.e., increase in scores) to the number of individuals who responded in the other direction (i.e., decrease in scores) and when there are two related dichotomous variables. Thus, we carried out a McNemar's test for each group of drivers (i.e., generate-argument, read-argument, and control) to determine whether the proportion of drivers who reduced their car use (as opposed to not reducing their car use) before the intervention increased after the intervention.

3. Results

3.1. Effect of self-persuasion on drivers' car use intentions, behaviours, and attitudes

Our first hypothesis was that drivers in the generate-argument condition would have a larger reduction in car use intentions (i.e., weaker intentions) compared to drivers in the read-argument and control conditions. Fig. 1a shows that drivers in all three groups reported reductions in their intentions to use the car for commuting trips regardless of the type of intervention that they completed. There was no significant effect of type of intervention on differences in intentions to use

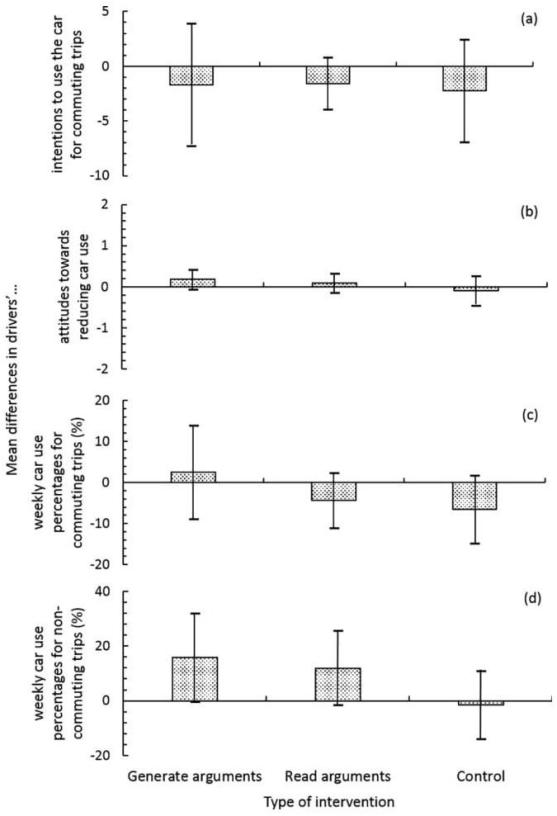

Fig. 1. Mean differences in scores of drivers who either generated arguments, read arguments, or completed a control task for four dependent measures: (a) intentions to use the car for commuting trips, (b) attitudes towards reducing car use, (c) weekly car use percentages for commuting trips, and (d) weekly car use percentages for non-commuting trips. Error bars represent 95% confidence intervals.

the car after controlling for attitudes and intentions, $F(2, 178) = 0.02$, $p = .98$, $n^2 = 0.00$. Thus, the results did not support our first hypothesis. To check whether our results were non-significant due to a lack of statistical power, we conducted a post-hoc power analysis using GPower 3.1 (Faul and Erdfelder, 1992; for a full description, see Erdfelder et al., 1996) with the current sample size ($n = 183$) and found that the ANOVA had a statistical power of 0.94. An a priori estimation of statistical power of 0.8 and an estimated medium effect size Cohen's d of 0.25 (see Cohen, 1988) indicated that a minimum of 159 respondents was required for this study. Thus, a lack of statistical power was not the reason for our failure to find differences between the groups, so we evaluated the variability of the intentions to use the car for drivers in all three conditions. As shown in Fig. 1a, drivers in the generate-argument condition had the highest variation in their ratings of intentions to use the car ($SD = 21.28$) followed by drivers in the control condition ($SD = 17.96$). Drivers in the read-argument condition had the lowest variation in their scores of mean differences ($SD = 9.65$).

Our second hypothesis was that drivers in the generate-argument condition would have the strongest positive attitude change towards reducing car use. Fig. 1b shows very little change in attitudes towards reducing car use for any group, $F(2, 101) = 0.94$, $p = .40$, $n^2 = 0.02$. Thus, the results did not support our second hypothesis.

Our third hypothesis was that drivers in the generate-argument condition would have a larger reduction in car use for commuting trips compared to drivers in the read-argument and control conditions. Fig. 1c shows that drivers in the generate-argument condition had a positive mean difference in their weekly car-use percentages (i.e., increased car use) for commuting trips while drivers in the read-argument and control conditions had a negative mean difference (i.e., decreased car use). Nevertheless, there was no significant effect of the type of intervention on drivers' differences in weekly car use percentages for commuting trips after controlling for intentions towards reducing car use, $F(2, 101) = 1.09$, $p = .34$, $n^2 = 0.02$. Thus, our third hypothesis was also not supported.

Fig. 1d shows that drivers in the generate- and read-argument conditions had positive mean differences in their weekly car-use percentages for non-commuting trips (i.e., increased car use) compared to drivers in the control condition. The one-way ANOVA, however, failed to reveal any significant effect of the type of intervention on drivers' differences in weekly car use percentages for non-commuting trips after controlling for their intentions towards reducing car use, $F(2, 101) = 1.63$, $p = .20$, $n^2 = 0.03$.

3.2. Effect of self-persuasion on drivers' car-use reduction behaviour

Fig. 2a and 2c show no changes in the percentage of drivers who reduced their car use after the intervention. Fig. 2b shows a slight increase in the percentage of drivers in the read-argument condition who reduced their car use after the intervention. Nonetheless, the McNemar's tests failed to reveal any significant differences in the proportion of drivers who reduced car use before and after the intervention for drivers in the generate-argument ($n = 35$, $p = 1.00$), read-argument ($n = 34$, $p = 0.22$), or control conditions ($n = 35$, $p = 1.00$).

3.3. Methods used by drivers to reduce their car use

By a plurality of 36.84%, working and/or studying from home was the most common method used by drivers to reduce their car use before the intervention, while using public transport was the least common method (Table 2). By a plurality of 31.82%, walking was the most common method used by drivers after the intervention, while using other methods such as electric bicycles or scooters was the least common method.

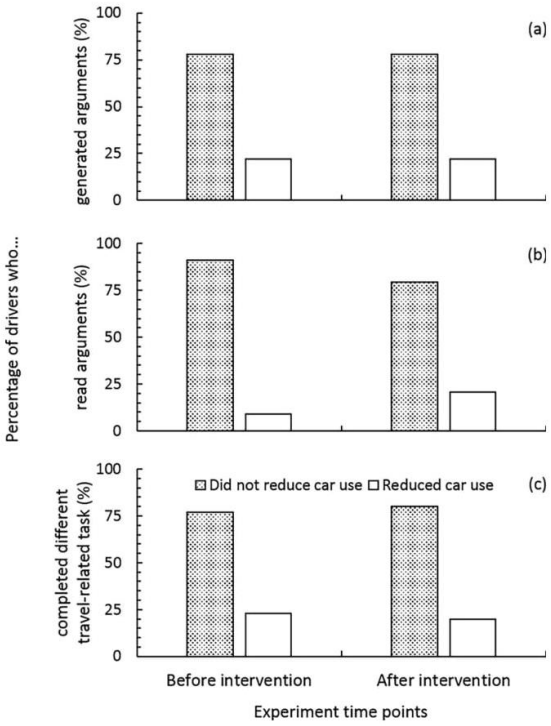

Fig. 2. Percentage of drivers who did and did not reduce their car use before and after completing one of three interventions: (a) generating arguments on the benefits of reducing car use, (b) reading arguments on the benefits of reducing car use, and (c) completing a different travel-related task.

Table 2
Percentages of Drivers Who Used Various Methods to Reduce Their Car Use for Commuting Trips before (n = 19) and after the Intervention (n = 22).

Method of reducing car use for commuting trips	Percentage of drivers who used this method before the intervention (%)	Percentage of drivers who used this method after the intervention (%)
1. I walk whenever I can	10.53	31.82
2. I ride my bicycle whenever I can	21.05	6.90
3. I take public transport when possible	5.26	9.68
4. I share a ride with family/friends instead of driving alone	21.05	8.82
5. I use ride-sharing services like Uber	–	2.70
6. I work or study from home whenever I can	36.84	31.58
7. I plan my trips ahead so that I visit different places all at once instead of making several trips	26.32	22.0
8. I use a shorter route so that I travel less with my car	–	3.28
9. Other (e.g., use e-bike, electric scooter)	15.79	1.59

Note. Respondents selected any method that applied to them.

3.4. Comparing ratings of argument convincingness

An independent t test revealed no significant difference between the ratings of convincingness of drivers who generated arguments (M = 4.97, 95% CI [4.54, 5.39]) and drivers who read arguments (M = 4.85, 95% CI [4.31, 5.39]), $t(118.18) = 0.34, p = .73, d = 0.06$.

3.5. Arguments generated by drivers in self-persuasion condition

Finally, we examined the arguments that the drivers in the generate-argument condition generated. One of the most common arguments was the reduced costs associated with reduced car use. Some drivers mentioned a reduction in fuel costs, while others mentioned a reduction in maintenance and parking costs. Consider the following examples from different drivers:

"Save money on petrol, car maintenance and parking"
"Don't have to repair or replace car parts, e.g., tyres as often, less money spent on petrol, have to clean the car less"
"…reduces tax/road user charges, registration, insurance, WOF, maintenance costs"

Another common benefit of reducing car use provided by drivers in the generate-argument condition was the positive impacts on the environment. Specifically, the drivers were concerned with the reduction in poisonous gas emissions and noise pollution resulting from extensive car use. Some drivers mentioned improvement in the quality of air and stormwater. Consider the following examples from different drivers:

"Reduce harmful pollution, reduce greenhouse gases…"
"Less fossil fuels released into the environment"
"Cleaner air and urban stormwater…"

Other drivers mentioned the health benefits of reducing car use. According to these drivers, reducing car use can be seen as an opportunity to improve one's fitness by getting more exercise. Some even mentioned the improvement of one's mental health as a benefit of reducing car use.

"Health benefits [as a result of] walking to destinations more, rather than using a car for walkable distances"
"…more physical movement for better health. We should never use cars for short distance if we can really get to our destination on foot, such as going to church on Sunday"
"Improved health [through the] reduction in emissions, potential increase in walking/cycling [and] mental health improvements [through] socialising/human contact, sense of belonging to a community, getting outdoors/in touch with nature if walking/cycling"

Some drivers mentioned the safety-related advantages of reducing car use. For these drivers, reducing car use can result in safer roads, fewer road accidents, and safer active commutes such as cycling and walking to work.

"Reduce the number of deaths and injuries"
"Less crashes [and] more confidence in riding on the road without fear"
"…safer roads for active modes of transport"

Other than the typical or generic benefits provided by drivers in the generate-argument condition, a few of the drivers in the generate-argument condition provided more idiosyncratic benefits. According to some drivers, reducing car use can make them more efficient and make their day more productive:

"Get more time to prepare in the morning on public transport. Makes me more time efficient and transporting with a purpose."
"Don't have to find a carpark [and] better time management"

For another driver, reducing car use made them feel that their tax money is being put to good use as there is an opportunity to improve road conditions when there are fewer cars on the road. The same driver also mentioned that reducing car use provides employment opportunities:

"Less traffic on the roads therefore the roads are sustainable for longer - I'm not sure if that is a real fact but I would like to think my tax dollar would go further in that respect. [By reducing car use] we keep people in employment i.e., bus drivers and other driving services"

Another driver mentioned the opportunity for local governments to improve the public transport infrastructure when people reduce their car use:

"Encourage local/central government to invest in improved public transport"

Based on the arguments provided by drivers in the generate-argument condition, it is evident that drivers provided a mix of typical and idiosyncratic benefits of reducing car use. It is also worth noting that there were more typical benefits than idiosyncratic ones and the typical benefits provided by drivers closely resembled the benefits that we provided to drivers in the read-argument condition (Appendix A).

4. Discussion

We tested self-persuasion as an intervention to encourage commuters to reduce their car use by asking a group of New Zealand car drivers to either generate or read arguments on the benefits of reducing car use, or complete a different travel-related task. We hypothesised that drivers who generated arguments would have (1) a larger decrease in their car use intentions (i.e., weaker intentions), (2) a larger reduction in their car use for commuting trips, and (3) a larger positive difference in attitudes towards reducing car use (i.e., more favourable attitudes) after the intervention, compared to drivers in the read-argument and control conditions. Statistical analyses failed to detect significant differences between drivers in the three conditions on any of these hypotheses. Moreover, the proportion of drivers in each group who reduced their car use before the intervention did not increase after the intervention, which also implies that the intervention did not affect drivers' car-use reduction behaviour. Overall, our results revealed no evidence that self-persuasion influenced drivers' car use intentions, behaviours, and attitudes.

There are several potential reasons why self-persuasion was not effective in the current study. Firstly, the arguments generated by drivers in the self-persuasion condition were not very different from the arguments that we provided to the drivers to the direct-persuasion condition. Both sets of arguments included benefits such as improved environmental conditions, lower transportation costs, better quality of life, and enhanced transportation infrastructure. Furthermore, drivers in the self-persuasion condition were no more likely to rate their arguments as being convincing than drivers in the direct-persuasion condition, which implies that the generated arguments were similar to the provided arguments in persuasiveness. However, both groups of drivers had relatively high ratings of argument convincingness. Drivers who generated arguments may have had high ratings because they were biased towards their arguments (ownership effect; Beggan, 1992), while drivers who read provided arguments may have believed that the source of the arguments (i.e., NZTA) had high expertise (see Chaiken and Maheswaran, 1994). While drivers in both conditions may have had different reasons to rate the arguments favourably, the similarities in the types of arguments and ratings of argument convincingness in both persuasion conditions could explain why neither self-persuasion nor direct persuasion was able to influence car users' intentions, behaviours, and attitudes.

Furthermore, neither providing nor reading arguments on why one should reduce their car use was more effective than simply describing one's daily commute experience. It can be said that the arguments in both persuasion conditions were not very good presumably because they were not specific or tailored to the drivers' personal needs and circumstances to change their attitudes and/or behaviours. Research has shown that arguments that are specific to one's circumstances or needs are compelling enough to promote greater engagement and elaborative processing (i.e., high elaboration; Cortese and Lustria, 2012) which tends to lead to attitudes and/or behaviours changes (Cesario et al., 2004; Noar et al., 2007; Petty & Cacioppo, 1979; see e.g., Evans and Petty, 2003). However, generating or reading non-tailored benefits did not encourage message elaboration, presumably similar to describing one's daily commute experience. Thus, the lack of message elaboration in all three conditions may be a reason why there were no significant differences in car use intentions, behaviours, and attitudes between drivers in all three conditions.

It is unclear why drivers in the self-persuasion condition generated typical benefits instead of idiosyncratic or personalised ones inasmuch as we randomly assigned them to complete the self-persuasion intervention. We believe this could be due to the ambiguous target of persuasion, such that we asked drivers to provide benefits of reducing car use without specifying whether they had to convince themselves or others. As a result, most drivers generated general or typical benefits of reducing car use instead of unique ones. Focusing on the self as targets of persuasion is more effective because individuals tend to view themselves are being more important, valuable, and worthy targets of persuasion and believe that their opinions are better than the opinions for others (e.g., Dunning et al., 2004). By prioritising the way they feel and think, they will invest more effort to generate and process the arguments that are relevant to themselves (Briñol and Petty, 2006; Petty and Cacioppo, 1979; Petty et al., 2000). For example, Lemmen et al. (2020) found that participants who were asked to provide arguments as to why they should follow the no-luring rule at a zoo were more likely to comply with the rule compared to the participants in the control group. Asking participants why they should change their behaviour provided them the opportunity to generate idiosyncratic reasons which were effective. In the current study, we assumed that the arguments generated by drivers in the self-persuasion condition were not self-relevant because the arguments generated in the self-persuasion condition were very similar to the arguments provided in the direct-persuasion condition. Thus, the ambiguous target of persuasion in the self-persuasion condition could explain the ineffectiveness of the self-persuasion intervention.

Another reason why self-persuasion was not effective in the current study could be because reducing one's car use requires high effort and comes at the expense of drivers' sense of convenience. Self-persuasion has been shown to be ineffective at changing high-effort behaviours (e.g., physical exercise) but effective at changing low-effort behaviours (i.e., increasing one's fruit and vegetable consumption; Stavrositu and Kim, 2018). According to Diekmann and Preisendörfer's (2003) low-cost hypothesis, psychological variables such as environmental attitudes, concerns, and norms are more likely to influence behaviours that are easy to perform or that cause little inconvenience to the individuals (i.e., low-cost behaviours). Therefore, attitude and/or behaviour interventions may be more effective for low-cost or easy behaviours compared to high-cost or effortful behaviours. Reducing one's car use is a high-effort or high-cost behaviour because using the car itself is a low-effort behaviour for many drivers (Jensen, 1999; Maxwell, 2001; Sivasubramaniyam et al., 2020; Steg, 2005) and reducing car use involves giving up the convenience and pleasure of car use (Ünal et al., 2019). Furthermore, for some drivers, reducing car use is effortful because of the physical effort required to use alternative modes such as active commuting (e.g., Loukopoulos and Gärling, 2005) and public transport (e.g., Gardner and Abraham, 2007).

One way to encourage high-effort behaviour change (e.g., reducing car use) is to break the behaviours down into small, low-effort behaviours and encourage individuals to perform these low-effort behaviours instead. Much health-related research refers to this as the small-changes approach (e.g., Foster et al., 2005; Lutes et al., 2008). Encouraging small behavioural changes can be more effective than encouraging large behaviour changes because small, low-effort behaviour changes are more realistic and feasible to achieve and maintain (Hills et al., 2013). Furthermore, attitude and/or behaviour interventions are more likely to predict whether individuals engage in low-effort behaviours compared to high-effort behaviours (see low-cost hypothesis; Diekmann and Preisendörfer, 2003). With regards to car use, interventions should focus on encouraging low-effort behaviours that contribute to the overall reduction of car use. If low-effort, easy behaviours are performed consistently, they could result in large overall effects at population levels. In the current study, some of the drivers' popular methods of reducing their car use were working and/or studying from home and sharing rides with family or friends, which imply that these behaviours could be low-effort or low-cost behaviours. Therefore, instead of generally asking drivers to reduce their car use, it might be more effective to ask them to work from home once a week or even carpool once a week.

There are also several issues related to the execution of the study that may have obscured any underlying effects of self-persuasion. Firstly, we started collecting data soon after the New Zealand government lifted domestic travel restrictions due to COVID-19 (i.e., early July; Cheng, 2020), which is a limitation because drivers' lack of commuting or their reluctance to commute due to concerns regarding COVID-19 may have influenced their car use. Furthermore, as we stopped collecting data after the New Zealand government re-implemented localised travel restrictions (i.e., mid-August; Wade and Cheng, 2020), there is a possibility that drivers may have reduced their car use due to the travel restrictions instead of the intervention. Another limitation was that we did not impose a duration for drivers to complete the interventions and did not measure how long they took to complete their respective interventions. As the drivers in our study may have spent different periods of time completing the interventions, time is a potential confounding variable. To detect the effectiveness of self-persuasion, it is imperative to ensure that time spent on the intervention task is equal across all experimental conditions (Stavrositu and Kim, 2018). Another time-related issue to consider is the time period to measure the effects of self-persuasion. In the current study, we examined drivers' car use intentions immediately after they completed the self-persuasion intervention and examined their car use attitudes and behaviours at least 2 weeks after the intervention. Stavrositu and Kim (2018) suggested that in the case of high-effort behaviours (e.g., reducing car use), it is best to examine the effects of self-persuasion over a longer period (e.g., 1 month or longer). So, we suggest future research examine the effects of self-persuasion on drivers' attitudes and behaviours at least 1 month after the intervention. Additionally, our study suffered from participant mortality, which poses a threat to the internal validity of our study. Of the 185 drivers who completed the first questionnaire, only 105 completed the second questionnaire. The low number of drivers in the second questionnaire reduced the statistical power of the analyses.

Overall, as self-persuasion was not an effective intervention in our study, we conclude that encouraging drivers to motivate themselves to reduce their car use by generating arguments on the benefits of reducing car use may not be an appropriate intervention in the domain of travel behaviour. We have outlined potential reasons why self-persuasion was not effective in our study. As car use is becoming increasingly popular (Chowdhury et al., 2018) and has negative consequences on the environment and public health (Fisher et al., 2002; IEA, 2019), there is an imminent need to try as many interventions as possible to reduce car use, especially in car-dependent societies. We tested self-persuasion as a potential intervention to encourage sus-

tainable travel behaviour and promote long-term behaviour changes. While self–persuasion is a rapidly growing technique, the main limitation of our research remains that self-persuasion was not effective at encouraging sustainable travel behaviour. However, we believe that our research has highlighted the importance of developing and testing new interventions in the domain of travel behaviour. Researchers have been testing new types of interventions to promote sustainable travel behaviour, such as gamification (e.g., Yen et al., 2019), motivational-stage based approaches (e.g., Friman et al., 2019), and low-cost physical changes to the environment (e.g., Benton et al., 2021). Regardless of whether the interventions were effective or not, the testing of new and innovative interventions can provide insights into how susceptible people are to change and the factors that need to be considered to promote successful behaviour changes. In our study, although our intervention did not significantly affect behaviour, future researchers could build on our study by improving the methodology, and investigating factors that may influence individuals' susceptibility to persuasion interventions (e.g., personality types; see Wall et al., 2019). Our study has emphasised the importance of a well-thought-out self-persuasion intervention and the execution of the intervention itself.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A:. Questions used in the first online questionnaire

Questionnaire Items
Section 1
1. Prior to the level 4 lockdown due to COVID-19, what was your usual mode of getting to work? (Note: Usual mode refers to the mode that you use for more than 50% of your regular commuting trips in a week).
a. I drive a car
b. I share a car ride with someone else
c. I take the bus
d. I cycle
e. I walk
f. I use another mode (Please specify)[1]
2. Prior to the level 4 lockdown due to COVID-19, how long did it take you (in minutes), on average, to reach your workplace in a regular commuting week using your usual mode? (0 – 120 min[2])
3. Prior to the level 4 lockdown due to COVID-19, how far did you travel (in kilometres), on average, to get to your workplace in a regular commuting week, using your usual mode? (0 – 120 km[3])
Section 2
1. Prior to the level 4 lockdown due to COVID-19, in a regular commuting week, what percent of your commuting trips (i.e., travel to work or school) involved using the car? (0 – 100%)
2. Prior to the level 4 lockdown due to COVID-19, in a regular commuting week, have you reduced your car use? (Some common ways of reducing your car use include using another travel mode, working or studying from home, using a shorter route, or sharing a ride with someone else).
a. Yes, I have
b. No, I have not
3. If yes, which of the following means have you used to reduce your car use for commuting trips? Please select all that apply.
a. I walk whenever I can
b. I ride my bicycle whenever I can
c. I use the bike-share program that is available in my city
d. I take public transport when possible
e. I share a ride with friends instead of driving alone
f. I use ride-sharing services like Uber
g. I work or study from home whenever I can
h. I plan my trips ahead so that I visit different places all at once instead of making several trips
i. I use a shorter route so that I travel less with my car
j. Other: Please specify
4. After the travel restrictions due to COVID-19 have been removed completely, on a scale of 0 to 100%, what are the chances you would use your car for your regular commute?
5. After the travel restrictions due to COVID-19 have been removed completely, how likely are you to reduce your car use for your regular commute? (1 = *extremely unlikely*, 7 = *extremely likely*)
6. Prior to the level 4 lockdown due to COVID-19, other than commuting trips, which of the following trip purposes have you used your car for? Please select all that apply.
a. Shopping (i.e., travelling with the intention to purchase goods, includes window shopping)
b. Personal appointment/services (i.e., travelling with the intention to purchase services instead of goods, such as visiting a doctor, dentist, hairdresser, or bank)
c. Social visit/entertainment (i.e., travelling to visit friends, going to the movies, going out for a meal)
d. Sport, recreation, and exercise (i.e., travelling with the intention to perform physical activity in a designated location, such as going to the gym, attending yoga classes, going to the lake for a run, etc.)
e. Education (i.e., travelling with the intention to pursue education in various education institutions, such as universities, colleges, and schools)
f. Accompany someone (i.e., travelling with the intention to drop off or pick up someone)
7. Prior to the level 4 lockdown due to COVID-19, on a scale of 0 to 100%, how often did you use the car for the following trips in a week?[4]
Section 3
1. My opinion of reducing the rate of car use in New Zealand is… (1 = *extremely negative*, 7 = *extremely positive*)
2. I think that reducing the rate of car use in New Zealand is… (1 = *extremely bad*, 7 = *extremely good*)
3. The very idea of reducing the rate of car use in New Zealand is… (1 = *extremely unappealing*, 7 = *extremely appealing*)
Section 4[5]*Generate-arguments condition*According to the New Zealand Transport Agency (NZTA), over the last 70 years, New Zealanders have become dependent on their private cars to meet their travel needs. While using private cars can provide some level of flexibility and convenience, it is not sustainable. As result, the NZTA has come up with a plan to improve New Zealanders' travel choices and reduce their car dependency.
1. Could you provide some benefits of reducing car use? You may provide as many benefits as you wish.

Appendix A: (*continued*)

Questionnaire Items
2. Looking back at the answers that you provided above, how convincing, did you find the benefits of reducing car use? (1 = *extremely unconvincing*, 7 = *extremely convincing*)*Read-arguments condition*According to the New Zealand Transport Agency (NZTA), over the last 70 years, New Zealanders have become dependent on their private cars to meet their travel needs. While using private cars can provide some level of flexibility and convenience, it is not sustainable. As result, the NZTA has come up with a plan to improve New Zealanders' travel choices and reduce their car dependency. In preparing this plan, the NZTA has listed from benefits of using private cars less frequently.Here are some benefits of reducing car use. - It can ease the financial burdens of buying and owning a car. - It is economically efficient, such that public transport, walking, and cycling can move people with less fuel and land resources. - It can improve the quality of life and strengthen community cohesion when people meet friends and acquaintances on the streets while commuting. - It saves time through a more efficient and attractive public transport system. - It can reduce vehicle emissions by increasing the share of travel by public transport, walking and cycling. - It can reduce traffic volumes and congestion as there will be less cars on the road. - It can promote better health as there will be an improvement in the air quality and an increase in physical activity. - It can improve road safety as there will be fewer cars on the road and better safety measures have been implemented for public transport and cycling facilities. - It is kinder to the planet by reducing the emissions of poisonous gases from cars. - It reduces car-parking problems, as there are fewer cars, which allow a more effective parking management to take place.
1. Looking back at the list provided above, how convincing, did you find the benefits of reducing car use? (1 = *extremely unconvincing*, 7 = *extremely convincing*)*Control condition*Can you please describe your daily experience of using the car prior to the level 4 lockdown due to COVID-19? An example is provided below but you may describe your experience in your own words.*On an average day, I leave home around 7 pm and drive to work. It takes me about 12 min to get to my office. There is not much traffic at that time. I leave work around 4.30 pm and I usually stop by the supermarket to get a few groceries and household items before heading home. Once at home, I get ready to go to the gym around 6 pm. My drive to the gym takes about 15 min. After my workout around 8 pm, I go home.*
Section 5
1. After the travel restrictions due to COVID-19 have been removed completely, on a scale of 0 to 100%, what are the chances you would use the car for the trip purpose(s) listed below?[6] a. Shopping (i.e., travelling with the intention to purchase goods, includes window shopping) b. Personal appointment/services (i.e., travelling with the intention to purchase services instead of goods, such as visiting a doctor, dentist, hairdresser, or bank) c. Social visit/entertainment (i.e., travelling to visit friends, going to the movies, going out for a meal) d. Commuting (i.e., travelling to get to work) e. Sport, recreation, and exercise (i.e., travelling with the intention to perform physical activity in a designated location, such as going to the gym, attending yoga classes, going to the lake for a run, etc.) f. Education (i.e., travelling with the intention to pursue education in various education institutions, such as universities, colleges, and schools) g. Accompany someone (i.e., travelling with the intention to drop off or pick up someone)
Section 6
1. Please indicate your gender. a. Male b. Female c. Prefer to self-describe d. Prefer not to say
2. Please indicate your age (in years). (0 – 110 years)[7]
3. What is your current employment status? a. Full-time work (30 h or more per week) b. Part-time work (less than 30 h per week) c. Casual/sporadic work d. Unemployed/looking for work e. Looking after home and family f. Retired g. Other
4. Are you attending, studying or enrolled at school or anywhere else? a. No b. Secondary school c. Full-time University/Polytech/other d. Part-time University/Polytech/other e. Other
5. Please indicate the highest level of education you have completed. a. No secondary school qualification b. High school qualification or equivalent c. Tertiary diplomas or certificate d. Bachelor degree or Bachelor with Honours degree e. Master degree or higher
6. Please indicate your household type. a. Person living alone b. Married/de facto couple only c. Family (including extended) with children d. Family with adults only e. Single adult living with children f. Other
7. Prior to the level 4 lockdown due to COVID-19, what was your total personal income in a year, before tax or anything else was taken out? (Please note: you may provide an estimate if you are not sure) a. Zero income b. $1 - $25,000 c. $25,001 - $50,000 d. $50,001 - $75,000 e. $75,001 - $100,000 f. $100,001 - $125,000 g. $125,001 - $150,000 h. More than $150,000 i. Prefer not to say

(*continued on next page*)

Appendix A: (*continued*)

Questionnaire Items
8. Prior to the level 4 lockdown due to COVID-19, how much (in New Zealand dollars) did you spend, on average, on transportation over a typical month? (Please note: you may provide an estimate if you are not sure). (0 - $1000)[8]
9. Prior to the level 4 lockdown due to COVID-19, have you moved to another residence in the last 12 months? a. Yes b. No
Notes
1. Respondents who selected any other option than option 'a' reached the end of the questionnaire and were told that we were only interested in car drivers who commute on a regular basis
2. An option of 'longer than 120 min' is provided
3. An option of 'more than 120 km' is provided
4. Respondents only responded to the trip purposes selected from the list in Q6 of Section 2
5. Respondents were randomly assigned to one of the three conditions using the Qualtrics randomiser tool
6. Respondents received the commuting trip purpose and only the trip purposes that they selected in Q6 from Section 2
7. There is a 'prefer not to say' option
8. There is a 'more than $1000 per month' option

Appendix B:. Questions used in the second online questionnaire

Questionnaire Items
Section 1
1. In a regular commuting week in the last 2 weeks, what percent of your commuting trips (i.e., travel to work or school) involved using the car? (0 – 100%)
2. In a regular commuting week in the last 2 weeks, have you reduced your car use? (Some common ways of reducing your car use include using another travel mode, working or studying from home, using a shorter route, or sharing a ride with someone else). a.Yes, I have b.No, I have not
3. If yes, which of the following means have you used to reduce your car use for commuting trips? Please select all that apply. a. I walk whenever I can b. I ride my bicycle whenever I can c. I use the bike-share program that is available in my city d. I take public transport when possible e. I share a ride with friends instead of driving alone f. I use ride-sharing services like Uber g. I work or study from home whenever I can h. I plan my trips ahead so that I visit different places all at once instead of making several trips i. I use a shorter route so that I travel less with my car j. Other: Please specify
Section 2
1. In the last 2 weeks, which of the following trip purposes have you used your car for? Please select all that apply. a. Shopping (i.e., travelling with the intention to purchase goods, includes window shopping)

Appendix B: (*continued*)

Questionnaire Items
b. Personal appointment/services (i.e., travelling with the intention to purchase services instead of goods, such as visiting a doctor, dentist, hairdresser, or bank) c. Social visit/entertainment (i.e., travelling to visit friends, going to the movies, going out for a meal) d. Sport, recreation, and exercise (i.e., travelling with the intention to perform physical activity in a designated location, such as going to the gym, attending yoga classes, going to the lake for a run, etc.) e. Education (i.e., travelling with the intention to pursue education in various education institutions, such as universities, colleges, and schools) f. Accompany someone (i.e., travelling with the intention to drop off or pick up someone)
2. In a regular week in the last 2 weeks, on a scale of 0 to 100%, how often have you used your car for the following trip purposes?[1]
Section 3Please answer the following attitude questions while considering your regular commute in the last 2 weeks.
1. My opinion of reducing the rate of car use in New Zealand is… (1 = *extremely negative*, 7 = *extremely positive*)
2. I think that reducing the rate of car use in New Zealand is… (1 = *extremely bad*, 7 = *extremely good*)
3. The very idea of reducing the rate of car use in New Zealand is… (1 = *extremely unappealing*, 7 = *extremely appealing*)
Notes
1. Respondents only responded to the trip purposes selected from the list in Q1 of Section 1

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Chapter 5

General Discussion

The goal of this thesis was to focus on four key aspects of mode choice for daily commute: mode motivating factors, mode commitment, mode decision-making strategy, and mode-shift interventions. Though it may seem that I decided to focus on these four aspects prior to conducting the three studies, it was not the case. The decision to study these four aspects evolved throughout the research process. In other words, I started the research process with the first two aspects (i.e., mode motivating factors and mode commitment) and the results of the first study led to questions around mode decisions in which I explored in the second study. Subsequently, the results of the second study led to the interest in testing a new mode-shift intervention (i.e., self-persuasion). Figure 2 not only demonstrates the evolution of the aspects explored in this thesis but also revisits Figure 1 by showing the research questions for each of the three studies and adds the key findings of each study.

I conducted the first study to gain a better understanding of the psychological reasons why commuters use their usual modes frequently for commuting trips. Specifically, I examined several motivating factors influencing various commuters in a single study instead of one or two factors as adopted by various research on mode motivating factors (e.g., Atasoy et al., 2012; Bamberg, Ajzen, & Schmidt, 2003; Beirao & Cabral, 2007; Cervero, 2002; Ellaway et al., 2003; Ettema et al., 2013; Gardner, 2009). It was essential to evaluate several psychological factors in a single study because commuters may be motivated by more than one factor and different commuters may share similar reasons for using their usual modes. I used an online questionnaire to examine the influence of seven psychological factors on five types of commuters' mode choices for daily commute. Results from the online questionnaire revealed that commuters are motivated by different factors and some commuters are

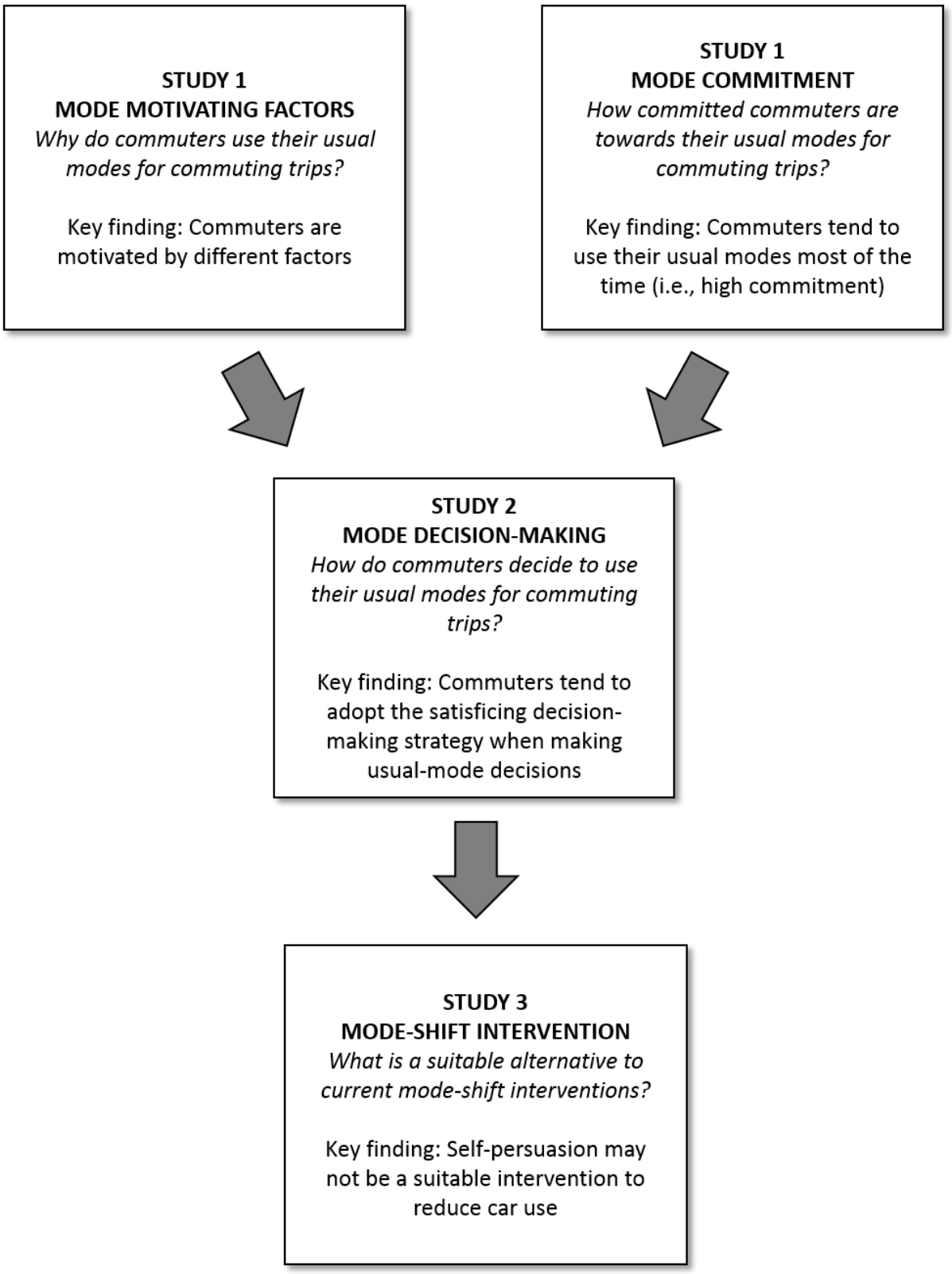

Figure 2. Summary of research questions and key findings of each study in this thesis.

motivated by more than one factor. Specifically, car drivers and car passengers were more likely to be motivated by social norms, while cyclists and pedestrians were more likely to be motivated by their perceived ease of using those modes. The findings are consistent with previous research that has highlighted the role of strong social norms in car users' intentions to drive for commuting trips (Chen & Chao, 2011; Donald et al., 2014), particularly the influence of family members and friends who tend to be significant sources of inspiration for car users (Jopson, 2004; Noblet, Thogersen, & Teisl, 2014; Teal, 1987). Active commuters, on the other hand, tend to find cycling and walking convenient especially for commuting purposes, which contributes to their overall commuting satisfaction (Lades et al., 2020). Their perceived ease of use depends on the quality of the cycling and walking infrastructure available to them (Zhou, Che, Koh, & Wong, 2020). The findings also revealed that car drivers' intentions are strongly predicted by their perceived ease-of-use as demonstrated in previous research (e.g., Kang, Jayaraman, Soh, & Wong, 2019; Maxwell, 2001). Drivers may find driving convenient due to the flexibility of using the car for various activities (e.g., working, socialising, and parenting; Buys & Miller, 2011; Kent, 2014). Overall, the findings of the first study showed great importance and novelty because they provide more than one perspective on why commuters tend to resort to their mode choices for daily commute.

The main implication from the results of the online questionnaire is that different psychological factors will require different types of interventions to encourage commuters to use more sustainable modes and/or to reduce their car use. Interventions targeting different psychological factors can be more effective than one-size-fits-all interventions because as shown in the first study, commuters are motivated by different factors. For instance, as social norms play a significant role in car users' intentions to use the car, car reduction interventions could focus on strengthening the social norms around the use of more environmental-friendly

modes. One way to do so is to convince car users that other commuters are using sustainable modes more frequently than cars. For example, Goldstein, Cialdini, and Griskevicius (2008) displayed messages like "Do you know most of your fellow guests hang their towels on the rack?" to encourage hotel guests to save laundry which showed better effects than simply presenting pro-environmental arguments to their hotel guests. Similar interventions were also successful in encouraging energy conservation (e.g., Allcott, 2011) and civic behaviour (e.g., John et al., 2013). Furthermore, as family members can be sources of inspiration for many car users, mode-shift interventions should involve them, especially parents, who can encourage their children to use more sustainable modes by using those modes themselves and/or introducing sustainable travel choices in their children's lives as early as possible. Given that children tend to imitate their parents' behaviours (e.g., daily mode choice), parents can set the right example for their children from a young age by using sustainable modes themselves (Susilo & Liu, 2015). Studies have shown that parents who support active commuting are more likely to encourage their children to walk or cycle to school (e.g., Faulkner, Richichi, Buliung, Fusco, & Moola, 2010; Mah et al., 2017; Nevelsteen, Steenberghen, Van Rompaey, & Uyttersprot, 2012; Wilson, Marshall, Wilson, & Krizek, 2010). Millstein and Litt (1990) argued that healthy habits such as active commuting that are developed during adolescence can have significant impacts in the long term. Thus, family members, especially parents, should promote active commuting in their children as early as possible so that their children would be more willing to walk and/or cycle when they are older.

Other than social-norms-based interventions, there could also be convenience-based interventions that focus on commuters' ease of using their usual modes. Given that active commuting is associated with positive perceptions of convenience, interventions to promote cycling and walking amongst commuters could consider ways to make it easy for commuters

to cycle and walk for their daily commutes. Zhou et al. (2020) suggested that active commuters' perceptions of convenience typically depend on the infrastructure available to them to the point that building cycling- and walking-friendly infrastructure can make active commuting attractive or even 'irresistible'. For example, as a result of a fully segregated network of bi-directional cycling paths, there has been an increase in the number of cyclists, a modal shift from private cars to public transport and bicycle, and a reduction in the percentage of cyclists' collisions with motor vehicles (Marqués, Hernández-Herrador, Calvo-Salazar, & García-Cebrián, 2015; Pucher & Buehler, 2008). In other words, segregated infrastructures (from motorised traffic) can make cycling easy and comfortable, which encourages frequent cycling behaviour (e.g., Barnes, Thompson, & Krizek, 2006, January; Cleaveland & Douma, 2009, January; Dill & Carr, 2003; LeClerc, 2002; Nelson & Allen, 1997; Parkin, Wardman, & Page, 2008; Pucher & Buehler, 2005). A similar infrastructure model for pedestrians with the addition of well-maintained and well-lit pedestrian footpaths can also make it convenient and safe for commuters to walk more often (Pooley et al., 2013). Thus, interventions encouraging cycling and walking behaviour should consider ways to make it convenient for commuters to cycle or walk for commuting trips and one such way is developing user-friendly cycling and walking infrastructure. In summary, in addressing the research question of why do commuters use certain modes for commuting trips, it is clear that different commuters have different reasons and they may have more than one reason behind their mode choices. Thus, there is a need for interventions that target various psychological reasons.

I also conducted the first study to develop a better understanding of commuters' mode commitment. I evaluated commuters' mode commitment using a continuous scale that measured how often they use their usual modes and other modes instead of using the

categorical measure of modality used in many research on mode commitment (e.g., Heinen & Chatterjee, 2015; Lavery et al., 2013; Nobis, 2007; Olafsson et al., 2016; Vij et al., 2013). Knowing how often commuters use various modes, especially sustainable ones, gives valuable information on commuters' willingness and capability to use sustainable modes. I used a 1-week travel diary to measure car drivers', car passengers', bus users', cyclists', and pedestrians' mode commitment. Results from the 1-week travel diary suggested that all the commuters used their usual modes most of the time for commuting trips in a week (i.e., more than 50% of their weekly commuting trips) which imply that commuters are committed to their mode choice regardless of the type of mode they use. Further analyses revealed that drivers and pedestrians are more likely to use one or two modes for their commuting trips, whereas car passengers, bus users, and cyclists are more likely to use three or more travel modes for their commutes. The findings are consistent with previous research implying that drivers tend to drive for most of their commuting trips (e.g., Nobis, 2007; Olafsson et al., 2016; Stradling, 2007; Vij et al., 2013) and active commuters tend to use several travel modes for their commuting trips (e.g., Lavery et al., 2013; Olafsson et al., 2016). While active commuters tend to use a combination of various modes that best fit their commuting circumstances (e.g., time constraints, lack of sidewalks, concerns about traffic safety, and difficult terrain; Bopp, Kaczynski, & Bessenyi, 2012), drivers tend to use the car most of the time possibly due to their strong driving habits (see e.g., Bamberg, Ajzen, & Schmidt, 2003; Gardner, 2009). Another interesting finding was that both car drivers and passengers were equally committed to their cars for both commuting and non-commuting trips, presumably due to their strong car use habits (e.g., Bamberg, Ajzen, & Schmidt, 2003; Gardner, 2009) and perceptions of the convenience of using the car for non-work trips (Kent, 2014). Overall, by studying mode commitment on a continuous scale, I gained a better understanding of

commuters' willingness to use not only their usual modes but also other modes that they do not use as often.

The main implication of the mode commitment findings is that mode-shift interventions should focus on encouraging commuters to use sustainable modes that they are willing to use instead of modes that they are not willing to use or never use at all for their weekly trips. As results from the current study indicate that car users (i.e., car drivers and passengers) tend to walk occasionally during their daily commute, it can be assumed that drivers are able and willing to commute by foot. So, for these car users, it will be more effective to encourage them to walk more often than to encourage them to take the bus or cycle as they did not use these modes during their weekly commute. It is also unrealistic to believe that car users with no experience of using certain environmental-friendly modes will be motivated to use them immediately after simply being told to use such modes (Bamberg, 2007). Furthermore, it is also more effective to encourage them to walk in addition to driving as opposed to forcing them to give up driving entirely. Forcing car users to give up their car use entirely may have a countereffect as they may feel that they no longer have the freedom to decide on their travel modes (see Ringold, 2002). Therefore, car users are not likely to respond to mode-shift interventions and continue to use their cars. One way to encourage walking amongst car users without restricting their freedom to use their cars is to pedestrianise city centres by developing safe, convenient, and user-friendly walking infrastructures (Ferrer & Ruiz, 2013). Doing so will encourage car users to believe that walking is convenient and safe; thus they are more likely to walk more often (Pooley et al., 2013). Overall, as measuring mode commitment using a continuous scale can be useful in providing information on people's willingness or motivation to use sustainable modes it is advised that policymakers and researchers first evaluate commuters' willingness to use

sustainable modes and motivate them accordingly instead of forcing them to completely stop using their current non-sustainable modes.

From the first study, I learnt two things: (1) commuters have different reasons for using their usual modes and (2) commuters tend to be highly committed to their mode choice regardless of the type of mode. Thus, I concluded that all types of commuters tend to be committed to their mode choice despite having different mode motivating factors. I then questioned the following: why were the commuters highly committed to their usual modes if they had different reasons to use them? One possible explanation of why commuters with different motivating factors have strong mode commitment lies in the way they decide to use those modes (i.e., mode decision-making). Thus, the key findings of the first study provided a compelling reason to investigate the decision-making strategy that commuters often use when making mode decisions for their daily commute. It is also worth noting that the way commuters make decisions also influences their mode choices (e.g., Ben-Akiva & Lerman, 1985; Domencich & McFadden, 1975; McFadden, 1976; Small & Winston, 1999). While current mode-decision research adopting the bounded rationality approach tends to examine the concept of 'satisficing' as an outcome (see Avineri & Prashker, 2006; Ben-Elia et al., 2008; Jou et al., 2010; Mahmassani & Chang, 1987), in my second study, I examined satisficing as a decision-making strategy that commuters tend to use when deciding to use their usual modes.

I used an online questionnaire to measure commuters' tendencies to satisfice when making mode decisions and other psychological factors that could differentiate commuters with high tendencies to satisfice from commuters with low tendencies. The results from the online questionnaire showed that commuters tend to adopt the satisficing decision-making strategy for their usual-mode commutes more than for their alternative-mode commutes. As

commuters repeat their usual-mode decisions daily, these decisions become effortless and good enough for them over time (see Aarts & Dijksterhuis, 2000a; Verplanken et al., 1997). Meanwhile, as commuters use their alternative modes occasionally due to personal reasons (e.g., bad weather, missed the bus, punctured tyres, etc.), their lack of experience with their alternative modes do not make their alternative-mode commutes seem easy and good enough for them. Furthermore, consistent with previous research (e.g., Álvarez, Rey, & Sanchis, 2014; Schwartz et al., 2002; Simon, 1957), commuters with high tendencies to satisfice are generally more satisfied and positive towards their everyday commutes compared to commuters with low tendencies to satisfice. There are several reasons why this might be the case. Firstly, individuals with strong satisficing tendencies often make decisions without expecting positive outcomes as they are mainly concerned with making good-enough decisions to achieve satisfactory or adequate results (Polman, 2009). Secondly, the satisfactory outcomes of satisficing decisions tend to make people happy (see Parker, de Bruin, & Fischhoff, 2007; Schwartz et al., 2002). Thirdly, individuals with high tendencies to satisfice are less likely to regret their decisions and choices even though they are aware that there may be better alternatives because they can tolerate the negative or neutral outcomes of their decisions and choices (Iyengar et al., 2006; Polman, 2009; Roets, Schwartz, & Guan, 2012; Schwartz et al., 2002). In sum, by studying satisficing as a decision-making strategy rather than a decision outcome, the second study revealed that commuters tend to adopt the satisficing decision-making strategy for their usual-mode commuting decisions and those who are more likely to adopt this strategy tend to be more likely to be satisfied and positive towards their daily commutes compared to their counterparts.

The main implication of the findings from the online questionnaire is that interventions aiming to reduce car use and/or to encourage the use of sustainable modes

should take into account the role of commuters' decision-making strategy on their decisions to use certain modes for their daily commute. It is evident that commuters tend to satisfice when deciding to use travel modes that they use most often compared to travel modes that they use occasionally. So, in the case of car users with high satisficing tendencies, it might be useful to motivate them to believe that using sustainable modes can be just as good enough or satisfactory for them. One way to do this is to provide car users with a range of real-time results of their pro-environmental behaviour change. As people tend to choose options that have immediate outcomes, providing car users with information such as how much money they can save by taking the bus, cycling, or walking to work instead of driving, can persuade them that using sustainable modes is good enough for them (see Ampt, 2004). The use of personalised information to foster voluntary travel behaviour change has been successful in reducing car use and increasing bicycle and public transport use (e.g., Cairns et al., 2004; Haq, Whitelegg, Cinderby, & Owen, 2008). Furthermore, it might be even more effective to assist car users in measuring their behaviour change themselves (see Ampt, 2004). For example, developing a smartphone application that measures how much money and time car users save or how much carbon footprint they have reduced from using sustainable modes and providing this information in real-time while car users commute to work can convince them that using certain sustainable modes might be good enough for them. Smartphone applications have been used extensively to promote sustainable travel behaviour (e.g., Andersson, Hiselius, & Adell, 2018; Jariyasunant et al., 2015; Jylhä, Nurmi, Sirén, Hemminki, & Jacucci, 2013). Therefore, taking into account car users' high satisficing tendencies for their usual commutes, policymakers and researchers should identify ways to motivate car users to believe that using sustainable modes can also be good enough for them and consider using persuasive technology to do so.

From the second study, I learnt two things: (1) commuters tend to satisfice when deciding to use their usual modes and (2) commuters' high satisficing tendencies tend to be associated with hedonic aspects of their commutes. Thus, the main conclusion of the second study is that all types of commuters tend to adopt the satisficing decision-making strategy when it comes to their mode choice decisions and they tend to be satisfied and happy with their regular commutes. However, if drivers, in particular, tend to make 'good enough' decisions and are happy with these decisions, it may be challenging to motivate them to use sustainable modes. So, I asked the following question: what is the best way to motivate satisficing car users to reduce their car use? One possible way is to get car users to believe that their car use may not be good enough for them and reducing car use has more benefits than using the car. Thus, the key findings of the second study provided a compelling reason to identify and test a new way of encouraging commuters to reduce their car use. While there are various types of mode-shift interventions (e.g., provision of travel information, incentivisation of sustainable travels, improvement of commuting structures, implementation of congestion charges, etc.), there are still questions and concerns surrounding the effectiveness of these interventions (see Ben-Elia & Ettema, 2011; Jakobsson et al., 2002) presumably due to the direct-persuasion nature of these interventions. Direct methods of persuasion can be ineffective because individuals may perceive the interventions as threats to their freedom of choice (Wakefield et al., 2010). Thus they reject the persuasion attempts or interventions to maintain their freedom of choice (Ringold, 2002). An alternative to the direct persuasion method is 'self-persuasion', where individuals are placed in situations where they have to motivate themselves to change their attitudes and/or behaviours by generating arguments in support of an issue (Aronson, 1999). In my second study, I examined the effectiveness of self-persuasion as an intervention to reduce drivers' car use, especially for daily commutes.

I used two online questionnaires to carry out the intervention by first randomly assigning car drivers into one of three groups (i.e., self-persuasion, direct-persuasion, and control conditions) and then measuring their car use intentions, behaviours, and attitudes. Based on the positive results of previous self-persuasion studies (e.g., Bernritter et al., 2017; Damen et al., 2015; Müller et al., 2009), I expected drivers who generated arguments on why reducing car use is beneficial (i.e., self-persuasion) to have weaker intentions to use the car for commuting trips, to have reduced their weekly car use (for commuting and non-commuting trips), and to be more favourable towards car reduction compared to drivers who read arguments on the benefits of car use (i.e., direct persuasion) and drivers who described their daily commute experience (i.e., control condition). However, I did not find any significant differences between the three groups of drivers in terms of their car use intentions, behaviours, and attitudes. In other words, while self-persuasion was a successful intervention promoting certain health behaviours (e.g., Aronson et al., 1991; Müller et al., 2009; Pierce & Stoltenberg, 1990; Stice, Marti, Spoor, Presnell, & Shaw, 2008; Stone et al., 1994), it was not an effective intervention in the current study. I expected self-persuasion to be effective because asking drivers to persuade themselves by generating their own arguments on the benefits to reduce car use allows drivers to generate compelling arguments that match their unique needs and circumstances (see Baldwin et al., 2013; Briñol et al., 2012; Greenwald & Albert, 1968; Slamecka & Graf, 1978) which can then change their attitudes and/or behaviours (see Cesario, Grant, & Higgins, 2004; Noar, Benac, & Harris, 2007; Petty & Cacioppo, 1979). I presented several reasons why self-persuasion did not have any effect on drivers' car use intentions, behaviours, and attitudes in the third study. Some of the reasons were the types of arguments in both persuasion conditions were fairly similar, the target of persuasion in the self-persuasion condition was not clear, and the act of reducing one's car

use may be costly and effortful for many drivers. Thus, I conclude that self-persuasion may not be an appropriate intervention in the domain of travel behaviour.

The main implication of the results of the third study is that more research is needed to find ways to encourage drivers to reduce their car use. As shown in the third study, it is not easy to do so. Reducing car use can be costly behaviour for most drivers because their car use has been very useful and convenient for them. The results of the first study support this conclusion such that drivers' perceived ease of using the car was a strong predictor of their car use intentions possibly because drivers not only use their cars for work purposes but also social and parenting purposes (Buys & Miller, 2011; Kent, 2014). Thus, reducing car use would mean that drivers may not be able to use their cars for many purposes, which is a large cost for many drivers. The results of the first study also support drivers' strong dependency on their cars such that drivers had the strongest commuting habits and were the most committed to their mode choice for both commuting and non-commuting trips compared to the other commuters. Drivers' strong dependency on their cars is also consistent with previous research on car use habits (e.g., Bamberg, Ajzen, & Schmidt, 2003; Gardner, 2009) and drivers' unimodality (e.g., Nobis, 2007; Olafsson et al., 2016; Stradling, 2007; Vij et al., 2013). As a result of their strong habits and perceptions of convenience, driving becomes a 'good enough' option for drivers as demonstrated in the second study, which makes it hard to reduce car use.

According to Guagnano, Stern, and Dietz's (1995) description of the A-B-C model (first developed by Stern & Oskamp, 1987), psychological factors such as one's attitudes, personal norms (i.e., feeling of obligations to perform or refrain from specific behaviours; Schwartz & Howard, 1981), and beliefs only predict moderate-cost behaviours, not low- and high-cost behaviours. The reason behind this is that for low-cost behaviours, people will

perform the behaviour regardless of whether they believe the behaviour is beneficial or not and for high-cost behaviours, people will not perform the behaviour even if they believe that behaviour is beneficial. Reducing one's car use can be thought of as a high-cost behaviour because even though drivers believe reducing car use is beneficial (as demonstrated by the arguments generated by the drivers in the self-persuasion condition), the self-persuasion intervention to change their attitudes did not affect their car reduction behaviour. One solution to influence high-cost behaviours is to reduce the costs of such behaviours so that people will start to perform the behaviours by acting in line with their attitudes, personal norms, and beliefs. So, instead of generally asking drivers to reduce their car use (i.e., high-cost behaviour), it might be more effective to ask them to take the bus at least once a week, to cycle to work at least once when the weather is conducive or to work from home at least one day a week (i.e., low-cost behaviours). Although performing low-cost behaviours would reduce the high costs associated with reducing one's car use by a small margin, with constant repetition, the small changes (or reductions) in one's overall car use can lead to large overall reductions (see e.g., Glasgow, Vogt, & Boles, 1999). For example, Brög, Erl, Funke, and James' (1999) estimated that to increase 406 Australian commuters' share of walking by 15% in a year, each commuter needs to make an additional 24 walking trips per year. That means each commuter only needs to make two walking trips per month; for example, to work and back. Brög et al. (1999) also estimated that if each commuter cycles for two trips (there and back) per month, there will be an increase of 75% of commuters' cycling behaviour in a year. In other words, as small individual changes in travel behaviour can produce a significant population-level decrease in car usage, future research could test the effects of self-persuasion on such small, low-cost travel behaviour changes and then evaluate the effectiveness on large, high-cost behaviours such as reducing one's car use.

Strengths

There are several aspects of this thesis that are different and unique in comparison to existing mode-choice research. One of the strengths of the first study is that I examined several motivating factors as opposed to one or two factors; the factors were habits, economics, pleasure, convenience, social norms, status, and ecological beliefs. By considering several factors in a single study, I found that commuters tend to be motivated by more than one factor. For example, I now know that while car users (i.e., drivers and passengers) tend to be motivated by the social norms surrounding car use, active commuters (i.e., cyclists and pedestrians) tend to be motivated by their perceived ease of cycling and walking, respectively. Furthermore, while existing research also tended to focus on one or two groups of commuters (e.g., Bamberg, Rolle, & Weber, 2003; Ettema et al., 2012; Ettema et al., 2013), I focused on five types of commuters; car drivers, car passengers, bus users, cyclists, and pedestrians. Doing so allowed me to conclude that commuters may share the same motivating factors. For example, I am now aware that drivers, cyclists, and pedestrians are more likely to use their respective modes when they believe using those modes are easy for them. Thus, I highly recommend that future researchers consider studying several types of commuters and evaluate several factors in a single study.

Furthermore, another strength of the first study is that I examined commuters' mode commitment using a single continuous measure instead of the typical categorical measure of modality (i.e., unimodality vs. multimodality; see e.g., Kuhnimhof et al., 2006; Scheiner, Chatterjee, & Heinen, 2016; Ton et al., 2020; Vij et al., 2013). Diana and Pirra (2016) emphasised the need for a way to measure multimodality which not only considers how often commuters use several different modes but also if there are modes that dominate other modes. By using a scale of 0 to 100% to measure commuters' mode commitment, I not only

found that all types of commuters are committed to their usual modes as they used their modes most of the time in a week (i.e., more than 50% of the weekly trips) but I also found that some commuters tend to use one or two modes while others tend to use a combination of several modes, which is a good indicator of commuters' willingness and ability to use sustainable modes (e.g., taking the bus, cycling, and walking). For example, I am now aware that car users are willing to walk to work for a portion of their weekly trips. If I had simply concluded that car users are unimodal commuters, I would not have known that car users are willing and able to walk for their commute. On the other hand, if I simply concluded bus users and cyclists as being multimodal, I would not know the exact number of travel modes they use and how often they use their usual modes in a week along with other modes. So, I strongly suggest future researchers identify a way to measure mode commitment that takes into account commuters' frequency of using their usual mode and other modes too.

The strength of the second study was that I evaluated bounded rationality's concept of 'satisficing' as a decision-making strategy instead of a decision outcome as done in previous research (see e.g., Avineri & Prashker, 2006; Ben-Elia et al., 2008; Jou et al., 2010; Mahmassani & Chang, 1987). By considering satisficing as a decision-making strategy, I found that commuters tend to satisfice when deciding to use their usual mode for regular commutes. Knowing about commuters' satisficing strategy highlights the importance of policymakers and researchers to also consider the decision-making strategy that various commuters use apart from the motivating reasons behind their mode choices. Another strength of the second study was that I evaluated the psychological characteristics associated with high-satisficing tendencies and found that commuters' strong tendencies to satisfice were associated with hedonic factors such as positive feelings and high satisfaction levels with their everyday commutes. I consider this as a strength because existing mode-decision

research adopting the rational choice approach typically associate non-hedonic-based factors such as time and monetary costs with commuters' mode decisions (e.g., Avineri & Prashker, 2006; Jou et al., 2010; Mahmassani & Chang, 1987). In other words, by studying the psychological aspects of commuters' regular commutes, I have established a connection between commuters' decision-making strategy and their hedonic commuting experience. Thus, I suggest researchers and policymakers who are developing interventions targeting the hedonic aspects of commuters' mode choice to consider how those factors may interact with the way commuters decide to use their usual modes.

Although the final study did not show any effects of self-persuasion on drivers' car use intentions, behaviours, and attitudes, one strength of the study is that I tested an intervention that has not been used before in the domain of travel behaviour. After reviewing the effectiveness of self-persuasion in encouraging health-related behaviours such as cessation of smoking (e.g., Müller et al., 2009), proper dietary behaviours (e.g., Pierce & Stoltenberg, 1990; Stice et al., 2008), and safer sex practices (e.g., Aronson et al., 1991; Stone et al., 1994), I decided to use self-persuasion to encourage drivers to reduce their car use. Reducing one's car use can be thought of as a health-related behaviour as there are many health benefits of reducing car use (see Andersson, 2020; He, Fei, & He, 2020). Although the intervention was not successful, I have paved the way for various researchers to address the methodological issues in the study and/or develop and test more persuasion-based interventions. Furthermore, another strength of the third study is the type of reasons provided by drivers in the direct-persuasion condition which were mostly on the high monetary cost of car use and the negative impacts on the environment and public health. Based on the types of reasons provided by drivers to reduce car use, it can be assumed that drivers are indeed aware

of the benefits of reducing car use. Thus, there is always an opportunity to motivate them to reduce their car use and more research is needed to develop suitable mode-shift interventions.

Limitations and Recommendations for Future Research

Notwithstanding the novel approaches that I used in this thesis to examine the four aspects of commuters' daily mode choice, there were several limitations in each of the three studies that must be considered. Firstly, in examining the various mode motivating factors in the first study, it is still unclear whether a particular factor is more important to one type of commuter than to another type of commuter. In other words, while I did find that the five types of commuters used their modes for different reasons, it would have been more useful to compare the influence of each factor between the five types of commuters. For example, knowing that drivers, cyclists, and pedestrians share a similar mode motivating factor (i.e., perceived ease of using their respective modes) is useful, but it is still unclear whether active commuters are more likely to be motivated by this factor compared to drivers. This is also the case with both car drivers and car passengers who were motivated by social norms around car use but it is unclear whether drivers are more likely to be motivated by social norms compared to passengers. I consider this a limitation because comparing the importance or influence of each factor between various commuters creates more potential for policymakers and researchers to develop and carry out tailored interventions. For example, if social norms is a more important factor for drivers than passengers, then social-norm-based interventions should be directed at car drivers more frequently than at car passengers. Thus, future research should focus on investigating the importance of each psychological factor to each type of commuter and one way to do so might be to carry out structural equation modelling (SEM) because the SEM can provide the variance explained by each factor for each type of commuter (Schumacker & Lomax, 2010).

Another limitation of this thesis is that I was not able to establish a relationship between commuters' mode motivating factors and their mode commitment. As various factors were related to commuters' self-reported intentions to use their usual modes, knowing whether their mode commitments are related to their motivating factors can either confirm or deny the relationship between their motivating factors and mode intentions. Furthermore, studying the influence of motivating factors on commuters' mode commitment will not only be a novel approach for studying travel behaviour, but also provide insights into how the motivating factors may play a role in commuters' willingness and ability to use sustainable travel modes. However, I was not able to do this because only a small subset of commuters completed the travel diary which I used to measure commuters' mode commitment. The small sample size posed a challenge to carry out the necessary analyses. Therefore, a suggestion for future research would be to use a targeted or stratified sampling method to recruit more commuters who use public transport and active travel modes to complete the travel diary and then carry out the appropriate analyses to examine whether the motivating factors influence commuters' mode commitment the same way the factors influence their intentions to use their respective modes. If the factors influence mode commitment the same way as they influence mode intention, then it can be assumed that the mode intention measure used in the first part of the study was a good proxy measure of commuters' travel behaviour. If not, more research will be needed to identify why the motivating factors did not have the same effect on mode commitment.

Furthermore, in the study on commuters' satisficing tendencies, it may have been premature to conclude that commuters tend to adopt the satisficing decision-making strategy without evaluating their tendency to maximise or make the best decisions. In other words, it might have been better to measure commuters' maximising tendencies when making both

usual- and alternative-mode decisions and compare their maximising tendencies to their satisficing tendencies. If commuters' satisficing scores are higher than their maximising scores when making usual-mode decisions, it could further strengthen the conclusion that commuters tend to adopt the satisficing decision-making strategy. However, if commuters' satisficing scores are lower than their maximising scores when making usual-mode decisions, then it may not be appropriate to conclude that commuters tend to adopt the satisficing decision-making strategy. Furthermore, while the results of the second study showed that commuters tend to satisfice when making usual-mode decisions, it may be problematic to assume that drivers tend to satisfice because further analyses demonstrated that drivers have a lower satisficing tendency than other commuters. Further research is needed to ascertain whether drivers typically have low satisficing tendencies or they simply have lower tendencies relative to other commuters. One solution would be to measure and compare the maximising tendencies between all types of commuters. If drivers have higher maximising tendencies than all commuters, it may explain why their satisficing tendency scores were low relative to other commuters. Thus, when examining commuters' decision-making strategy, it may be more useful to compare their tendencies to satisfice and maximise to gain a better understanding of their decision-making strategies and to avoid making unwarranted conclusions.

There were many limitations in the third study and most of them were related to the execution of the study itself. However, one major limitation was the ambiguous target of persuasion for drivers in the self-persuasion group. I intended for the drivers to be the targets of their own persuasion by generating arguments on the benefits of reducing car use because focusing on the self can promote healthy behaviours (e.g., Baldwin et al., 2013; Stice et al., 2008; Stone et al., 1994). By focusing on the self as targets of persuasion, people invest more

effort to generate arguments that are relevant to themselves as they view themselves as being more important (Briñol & Petty, 2006; Petty & Cacioppo, 1979; Petty, Wheeler, & Bizer, 2000) and they value their opinions more than the opinions of others (e.g., Dunning et al., 2004). As a result, their own arguments will be compelling enough to encourage attitude and/or behaviour changes (Briñol et al., 2012). Focusing on the self as targets of persuasion involves providing instructions to drivers to think about themselves and provide arguments to convince themselves why they should reduce their car use. However, the instructions for the drivers in the self-persuasion group was not clear as I asked drivers to list a few benefits of reducing car use. As a result, the drivers provided general arguments on the benefits of reducing car use, which could be one of the main reasons why self-persuasion was not effective in the third study. I suggest future research attempting to test self-persuasion as a mode-shift intervention to clearly specify the target of persuasion so that participants generate unique and idiosyncratic arguments instead of general ones.

Conclusion

In this thesis, I set out to gain a better understanding of the dynamicity of commuters' mode choices for their daily commutes by carrying out three studies that focused on four aspects of mode choice: mode motivating factors, mode commitment, mode decisions, and mode-shift interventions. The three studies have contributed novel insights about mode choice in daily commute. While current research tends to associate certain factors with certain commuters, according to Study 1, commuters can be motivated by more than one psychological factor and different types of commuters may share the same reason for using their modes. Furthermore, while research on car users' habits shows that drivers tend to be committed to driving, the first study also revealed that car passengers, bus users, cyclists, and pedestrians are also committed to their commuting mode choice. Study 2 revealed that this

may be due to the satisficing decision-making strategy that commuters tend to adopt when deciding to use their usual modes. Commuters' satisficing decision-making strategy could be a reason why it can be challenging to motivate car users to reduce their car use. Thus, Study 3 involved the use of self-persuasion as a potential alternative to current mode-shift interventions aiming to reduce drivers' car use. Notwithstanding the ineffectiveness of self-persuasion in the third study, the findings in each of the three studies provided insights into commuters' mode choices. More importantly, the findings also affirmed the dynamicity of mode choice in daily commute such that various psychological factors and decision-making strategies play important roles in commuters' mode choices.

Although this thesis does not represent the complete dynamic picture of mode choice, as a whole, this thesis has contributed to the growing and evolving knowledge about commuters' mode choice in terms of why commuters use their modes, how often they use their modes, how they decide to use their modes, and how to encourage them to reduce their car use. Policymakers and researchers need to carry out continuous and rigorous research to further understand the various aspects of mode choice which will contribute to the development of appropriate mode-change interventions. These interventions should ideally target the psychological motivations behind various commuters' mode choices and the commuting decision-making strategy that commuters depend on, while also accounting for other sources of variation such as individual characteristics and the availability of travel modes. Overall, it is hoped that the targeted interventions on segmented groups of commuters can reduce the harmful effects of our car use on the environment and the public.

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Appendix: Publication Co-Authorship Forms

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Co-Authorship Form

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Chapter 2, Study One
Published article: Sivasubramaniyam, R. D., Charlton, S. G., & Sargisson, R. J. (2020). Mode choice and mode commitment. Travel Behaviour and Society, 19, 20-32.

Nature of contribution by PhD candidate	Rathee Siva developed the research questions and study methods in collaboration with the co-authors; collected all of the data; analysed the data with advice from co-authors; and wrote the manuscript with advice and feedback from co-authors.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Samuel G. Charlton	Assistance developing research questions and methods; advice regarding analysis; review of drafts
Dr Rebecca J. Sargisson	Assistance developing research questions and methods; advice regarding analysis; review of drafts

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

Name	Signature	Date
Professor Samuel G. Charlton		20 November 2020
Dr Rebecca J. Sargisson		20/11/2020

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Co-Authorship Form

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Chapter 3, Study Two
Published article: Sivasubramaniyam, R. D., Sargisson, R. J., & Charlton, S. G. (2020). Satisfaction from satisficing: Understanding commuters' satisficing tendencies. Transportation Research Interdisciplinary Perspectives, 6, 100158.

Nature of contribution by PhD candidate	Rathee Siva developed the research questions and study methods in collaboration with the co-authors; collected all of the data; analysed the data with advice from co-authors; and wrote the manuscript with advice and feedback from co-authors.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Samuel G. Charlton	Assistance developing research questions and methods; advice regarding analysis; review of drafts
Dr Rebecca J. Sargisson	Assistance developing research questions and methods; advice regarding analysis; review of drafts

Certification by Co-Authors

The undersigned hereby certify that:

- the above statement correctly reflects the nature and extent of the PhD candidate's contribution to this work, and the nature of the contribution of each of the co-authors; and

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Chapter 4, Study Three
Manuscript under review: Sivasubramaniyam, R. D., Charlton, S. G., & Sargisson, R. J. (2020). Super-tailoring: Using self-persuasion to reduce drivers' car use. Manuscript under review.

Nature of contribution by PhD candidate	Rathee Siva developed the research questions and study methods in collaboration with the co-authors; collected all of the data; analysed the data with advice from co-authors; and wrote the manuscript with advice and feedback from co-authors.
Extent of contribution by PhD candidate (%)	80%

CO-AUTHORS

Name	Nature of Contribution
Professor Samuel G. Charlton	Assistance developing research questions and methods; advice regarding analysis; review of drafts
Dr Rebecca J. Sargisson	Assistance developing research questions and methods; advice regarding analysis; review of drafts

Certification by Co-Authors

The undersigned hereby certify that:

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