



# Examining the roles of transport captivity and travel dissonance in travel satisfaction

Xiaodong Guan<sup>a</sup>, Donggen Wang<sup>b,\*</sup>

<sup>a</sup> Faculty of Geosciences, Utrecht University, Utrecht, the Netherlands

<sup>b</sup> Department of Geography, Hong Kong Baptist University, Hong Kong, China

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## ABSTRACT

Despite the increasing studies examining the determinants of travel satisfaction, the role of individuals' transport mobility (i.e., access to different mobility tools) in travel satisfaction has not received much research attention. Previous travel satisfaction studies mostly consider travel as a free choice. However, travel satisfaction may also depend on the availability of travel options, which is supposed to be limited especially for captive travelers. Such travel captivity may affect the perception of travel either directly by shaping the expectations and feelings in travel, or indirectly via the resulted travel mode consonance/dissonance. It may also influence people's sensitivity to travel features by determining one's travel experiences, which serve as reference points in travel evaluation. This paper aims to identify the role of mobility in travel satisfaction by investigating both the independent and joint effects of travel captivity and travel mode dissonance on travel satisfaction using data from a household travel survey conducted in 2018 in Shanghai, China. Descriptive analyses show that travel captivity and travel dissonance are positively associated for car commuters, but not transit commuters. We then develop linear regression models and find that travel captivity has a negative effect on transit commuters' travel satisfaction, but no or positive impact on that of car commuters. Besides, captive transit commuters are more tolerant to travel mode dissonance when rating travel satisfaction, while the opposite holds true for car commuters. The research findings highlight the importance of mobility in travel satisfaction and provide support to the development of multimodal transport systems.

## 1. Introduction

Subjective well-being offers a direct measurement of people's cognitive and affective judgement of life in general as well as in different domains such as travel (Kahneman et al., 1997; Ettema et al., 2010). Travel satisfaction or wellbeing has become a new objective of developing transportation infrastructure and services and the determinants of travel satisfaction have received much research attention in the past decades. Besides personal and environmental attributes, travel characteristics (such as transport mode, trip duration, and level of services) are assumed to have impacts on travel satisfaction (St-Louis et al., 2014; Morris and Zhou, 2018). More recently, many studies highlight the role of travel dissonance or the cognitive dissonance between the chosen travel option (e.g., transport mode) and travel attitude (e.g., transport mode preference) in travel satisfaction (De Vos, 2019; Ye and Titheridge, 2019; Humagain and Singleton, 2020; Ma et al., 2021).

\* Corresponding author.

E-mail addresses: [x.guan@uu.nl](mailto:x.guan@uu.nl) (X. Guan), [dgwang@hkbu.edu.hk](mailto:dgwang@hkbu.edu.hk) (D. Wang).

However, the role of individuals' transport mobility in travel satisfaction has not received much research attention even though scholars have widely acknowledged its positive impact on subjective well-being of life (Currie and Delbosc, 2010; Vella-Brodric and Stanley, 2013; Ma et al., 2018). Transport mobility is defined as the "potential" for movement, conditioned on one's access to different mobility tools, including car, public transport, cycle, etc. (Spinney et al., 2009). Most of travel satisfaction research examines the satisfaction with a chosen option of travel (e.g., transport mode) and treats travel as a free choice, neglecting the fact that travel satisfaction may also depend on the availability of travel options (Mao et al., 2016), which can be limited for some population groups (Humagain et al., 2021). The inability to travel by desired transport modes is denoted as travel captivity (Handy et al., 2005), which may play a role in travel satisfaction because travel captivity could directly influence people's travel experiences or expectations (Mao et al., 2016; Abenoza et al., 2019) and indirectly through travel dissonance due to their limited travel choices (Botti and Iyengar, 2006). Further, it is not unusual that individuals may evaluate trips with reference to past travel experiences by other transport modes (Schwartz, 2004). It is thus reasonable to assume that people with different levels of transport mobility may respond to the same trip differently because of the various reference points they may use (Abenoza et al., 2019). In other words, travel captivity may play a moderation role in the links between trip characteristics and travel satisfaction.

For all the reasons discussed above, we argue that travel satisfaction studies should consider two important and related factors: transport mobility and cognitive dissonance. For transport mobility, whether the travel is a free choice (i.e., travel captivity) or not is supposed to influence the traveler's travel satisfaction. Further, as existing studies have revealed, whether the travel matches the traveler's preferences (i.e., travel consonance/dissonance) or not should explain travel satisfaction. Identifying and comparing the independent effects of these two factors on travel satisfaction have great policy implications. If travel dissonance plays a more important role in travel satisfaction than travel captivity does, improving the attractiveness of the existing transport modes (e.g., bus, rail transit, etc.) would be more important than developing multimodal transport systems and offering more transport options for travel satisfaction improvement. However, while recent studies have investigated the travel satisfaction effect of travel dissonance, very few have explored the role of travel captivity (Mao et al., 2016; Handy and Thigpen, 2019), and none of them have examined these two factors together.

This paper aims to fill this gap by exploring the roles of travel dissonance and travel captivity in travel satisfaction using travel survey data from Shanghai, China. The remainder of this paper is structured as follows. Section 2 reviews the current literature on travel satisfaction and travel captivity and based on which develops the study's conceptual framework. Section 3 introduces the data source and explains the measurements of variables. Section 4 presents the modelling approaches and results and discusses policy implications. Section 5 summarizes the main findings, makes conclusions, and provides directions for future studies.

## 2. Literature review

### 2.1. The influential factors of travel satisfaction

Travel satisfaction is regarded as a type of middle-term domain of subjective well-being, which is differentiated from the short-term trip satisfaction and long-term life satisfaction (Diener et al., 1999). Travel satisfaction is an assessment about how satisfied people are with their overall daily travel or a particular type of trip such as commuting (De Vos and Witlox, 2017). Previous studies have examined a wide range of factors explaining travel satisfaction, including the built environment, trip characteristics, personal socioeconomics, and travel attitudes (St-Louis et al., 2014).

Travel satisfaction with regard to a specific transport mode has been a research focus recently. Regardless of the spatial context, studies generally found the highest level of travel satisfaction with active transport modes (e.g., walking or cycling), followed by car passengers and drivers, while public transit users reported the lowest travel satisfaction (St-Louis et al., 2014; Mao et al., 2016; Ye and Titheridge, 2017; Liu et al., 2022). Besides transport mode, travel satisfaction may also be influenced by other trip characteristics like cost, duration, distance, frequency, purpose, and travel time reliability (Ettema et al., 2010; Sukhov et al., 2021). Trip cost, duration, and distance were found to have negative impacts on travel satisfaction in many studies (e.g., Higgins et al., 2018; De Vos et al., 2019; Olsson et al., 2020; Wang et al., 2020). More frequent travelers were reported being less satisfied with travels than their counterparts, especially for public transport and private car users (Susilo & Cats, 2014; Waygood et al., 2019; Li et al., 2022). Regarding trip purpose, commuting trips are generally associated with lower satisfaction levels than other trip purposes (Zhu and Fan, 2018; Chen et al., 2022), while the opposite holds true for recreational trips (Ettema et al., 2013; Chen et al., 2022). Besides, elements like departure time (Morris and Hirsch, 2016), trip companionship (Zhu and Fan, 2018), seasonal and weather conditions (Willis et al., 2013; Ettema et al., 2017), and activities performed during the trip (Ettema et al., 2012; Tang et al., 2018) are also significant determinants of travel satisfaction.

Relatively fewer studies have examined the built environment's influence on travel satisfaction and the research findings are inconsistent. While some studies found that residential built environment had no significant direct effect on travel satisfaction (Ye and Titheridge, 2019; Handy and Thigpen, 2019), others revealed that some dimensions of residential built environment like location (De Vos et al., 2016), access to bus stops (Ettema et al., 2011), intersection density (Kim et al., 2014), and infrastructures for physical activities (Cao and Ettema, 2014) explain travel satisfaction. It has also been reported that residential built environment indirectly influenced satisfaction with commuting trips through transport mode choices (Ye and Titheridge, 2017; Mouratidis et al., 2019). A recent study by Wang et al. (2020) provided longitudinal evidence on the built environment impact on travel satisfaction. Based on a two-wave panel travel survey in Beijing, China, they found that improved destination accessibility and physical design around home (resulted from residential relocation) contributed to the increase in travel satisfaction.

Travel satisfaction research has widely examined the influence of personal attributes like socioeconomics (e.g., age, gender,

income, etc.), but they were found not to be very predictive in many studies (Bergstad et al., 2011; Olsson et al., 2013). Nevertheless, personal capability constraints like health (or functional) limitations have significant and negative effects on travel satisfaction (Mokhtarian et al., 2015; Ye and Titheridge, 2017; Zhu and Fan, 2018). The ownership of mobility instruments (bicycles or private cars) showed no (Li et al., 2022) or negative (Cao and Ettema, 2014; De Vos et al., 2021) impact on travel satisfaction. Social comparison also plays a role in travel satisfaction. People tend to be more satisfied with their trips if they spend relatively shorter commuting time than their peers (Abou-Zeid & Ben-Akiva, 2011). Besides, individuals' life satisfaction was found to positively impact the satisfaction level with travels using non-motorized transport modes (St-Louis et al., 2014).

The role of travel attitudes in travel satisfaction has also attracted research attention. It has been reported that travel-liking attitude (Cao and Ettema, 2014; De Vos and Witlox, 2016) and preference for driving (Cao and Ettema, 2014; Ye and Titheridge, 2017) are associated with higher travel satisfaction. In addition to its direct impact, travel attitudes may also influence travel satisfaction indirectly through the built environment (De Vos and Witlox, 2017; Li et al., 2022) or travel behavior (Ye and Titheridge, 2017; Li et al., 2022) because of residential self-selection (for a review, see Guan et al., 2020a). Besides, a few studies have examined the interaction effect between travel attitude and the built environment on travel satisfaction. De Vos et al. (2016) classified individuals into residential dissonants (whose preferred and actual residential locations are mismatched) and residential consonants (those matched) and compared their travel satisfaction levels. They found that preference for living in urban neighborhoods mattered for travel satisfaction in urban areas, but not in suburban areas. Cao and Ettema (2014) found significant interaction effects between attitudes (prefer transit or not) and neighborhood type (transit corridor or not) on travel satisfaction.

In addition to residential dissonance, the cognitive dissonance between travel attitudes and travel behavior is another factor significantly explaining travel satisfaction. Some earlier studies found that a positive attitude towards a transport mode increases the satisfaction with trips by that mode (Abou-Zeid et al., 2012; St-Louis et al., 2014; De Vos et al., 2016), implying that individuals have higher travel satisfaction when they use their preferred transport mode. De Vos (2019) argued that travel mode dissonance (i.e., the extent to which the chosen and preferred modes are mismatched) is a more important determinant of travel satisfaction than transport mode and the attitude towards the transport mode. He classified the travelers by each mode into consonants (if the mode is preferred) and dissonants (if not), compared their travel satisfaction, and found that consonant travelers had much higher travel satisfaction than dissonant travelers, regardless of the used transport mode (De Vos, 2018). Ye and Titheridge (2019) further confirmed the negative impact of travel mode dissonance on travel satisfaction, while a more recent study suggested that travel mode dissonance has very limited influence on travel satisfaction in a small Chinese city (Ganyu, Hu et al., 2023). The cognitive dissonance in terms of travel duration also matters in travel satisfaction. A few studies included the gap between actual and ideal commuting time (i.e., commute time dissonance) in the commuting satisfaction models and showed that compared with commuters travelling with ideal commuting time, people whose actual commute time was longer than the ideal time were significantly less satisfied with commuting (Humagain and Singleton, 2020; Ye et al., 2020; Ma et al., 2021). More recently, De Vos et al. (2021) conducted a longitudinal study on the impact of travel dissonance on travel satisfaction. Based on the quasi-longitudinal survey data from 1650 recently relocated residents in the city of Ghent, Belgium, they found that people's travel satisfaction increased greatly if their travel mode dissonance level decreased after relocation, while the opposite direction of influence was found for the link between travel time dissonance and travel satisfaction.

## 2.2. Travel captivity and travel satisfaction

Although the studies above have examined many factors that affecting travel satisfaction, they typically assumed travel as a free choice, neglecting the role of travel captivity. Travel captivity may be resulted from different reasons: people may not be able to travel by private car because they do not have a driver's license and do not have access to private cars; one may not use rail transit for daily travel because he/she lives far away from transit stations. Travel captivity is widely evident in different cities around the world (e.g., Maitra et al., 2015; Brown, 2017; Guan et al., 2020b). Researchers have investigated its role in different aspects of transportation, such as mode choice (Srinivasan et al., 2007), route choice (Wang et al., 2020), and transit users' perception of (Cheranchery and Maitra, 2018) and loyalty (Zhao et al., 2014) to public transport services.

Travel captivity may influence travel satisfaction in both directions. A positive effect could be expected because captive travelers may have low expectation for travel due to the limited choices of alternative transport modes (Abenoza et al., 2019). The gap between ideal and real travel experiences would then be relatively small for captive travelers. In addition, the existence of "forgone" alternatives (i.e., alternatives that were considered but not chosen) can lead to a sense of regret in post-choice valuation (Inman et al., 1997), which may enlarge travelers' dissatisfaction over the chosen transport mode (Mao et al., 2016). For both reasons, captive travelers could have a higher travel satisfaction than non-captive travelers. Nevertheless, a negative impact of travel captivity on travel satisfaction is also plausible. Captive travelers may feel constrained in travel choices and thus be less likely to have positive feelings (such as freedom and pleasantness) during the trip. St-Louis et al. (2014) found that transit users who wanted to drive more were significantly less satisfied with commuting than others. Studies have also found that monomodal travelers and transport disadvantaged groups are less satisfied with their lives (Currie and Delbosc, 2010; Delbosc and Currie, 2011a, 2011b; Ma et al., 2018; Makarewicz and Németh, 2018) and daily travels (Kim et al., 2020) than others.

There are a few studies that have explored the impact of travel captivity on travel satisfaction, but their measures of travel captivity and findings are inconsistent. Abenoza et al. (2017) classified people without a driver's license or access to private cars as captive public transport riders in Sweden and found that they had a higher satisfaction with public transport than others. But the availability of other transportation modes (such as cycling) was not considered in the study. Handy and Thigpen (2019) addressed this limitation by collecting information on self-reported mode availability in their study in Davis, United States. They defined 'mode constrained' or captive commuters as those who could use only one transport mode for commuting and found that captive commuters were more

satisfied with commuting trips than commuters with two or more transport modes available. Instead of mode availability, [Mao et al. \(2016\)](#) defined travel captivity using “modal flexibility”, which is measured by self-reported degree of difficulty to adjust transport mode for commuting (on a 5-point scale). They found that trips with either very high or very low modal flexibility were more satisfying than those with medium modal flexibility, which supports both hypotheses discussed above. Inspired by these studies, we defined travel captivity as the “inability to adjust the commuting mode to any other transport modes” in this research.

There is hardly any existing study simultaneously considering the roles of travel captivity and travel dissonance in travel satisfaction. We argue that it is important to examine the effects of both travel captivity and travel dissonance on travel satisfaction. On the one hand, captive travelers may have a higher probability to be travel mode dissonants because of the limited choices of alternative transport modes ([Botti and Iyengar, 2006](#)). Consequently, the observed negative influence of travel captivity on travel satisfaction may be partially explained by the mediation role of travel dissonance and similarly the impact of travel dissonance on travel satisfaction may be confounded by travel captivity. On the other hand, as suggested by a few scholars, a negative link between travel captivity and travel dissonance is also plausible because of self-selection or self-report bias. Individuals may choose to live in the environment that with their most preferred transportation mode exclusively ([Abenoza et al., 2017](#)) or tend to report all transport modes other than the most preferred and used one as unavailable in the survey ([Mao et al., 2016](#)), thus become captive but consonant travelers. If so, travel consonance would at least to some extent explain the positive effect of travel captivity on travel satisfaction reported in previous studies ([Abenoza et al., 2017](#)). In both cases, it would be impossible to ascertain the real trigger(s) of travelers’ dissatisfaction when travel dissonance and travel captivity were examined separately, as in previous studies. This motivates us to investigate the travel satisfaction impacts of these two factors jointly in this research.

Further, there are possible interaction effects between travel captivity and travel dissonance on travel satisfaction. Recent research has highlighted the moderation role of travel captivity in travel satisfaction. For example, [Abenoza et al. \(2019\)](#) and [Fang et al. \(2021\)](#) found that the impacts of service attributes on travel satisfaction differ between the captive and non-captive riders of public transport. Captive riders might be more tolerant to travels by undesired mode than non-captive riders because they have no alternative options to compare with ([Abenoza et al., 2019](#); [Mao et al., 2016](#)) and hence be less sensitive to travel dissonance when evaluating travel satisfaction. An opposite interaction effect is also possible. The negative impact of travel dissonance on travel satisfaction could be smaller for non-captive travelers because they choose the travel mode based on both travel preferences and other considerations like the need for escorting a child. The emotional loss from cognitive dissonance may thus be lessened by the utility of achieving other travel purposes. Some have considered the interaction between travel captivity and travel dissonance when classifying travelers ([Jacques et al., 2013](#); [van Lierop and El-Geneidy, 2016](#)): travelers are classified into four (2\*2) categories by dichotomizing the two variables. A captive traveler could be either travel dissonant (true captive traveler), or travel consonant which is in accord with “dedicated users” in [Jacques et al. \(2013\)](#) or “captive-by-choice riders” in [van Lierop and El-Geneidy \(2016\)](#). Similarly, non-captive travelers having access to multiple transportation modes can be travel consonants who choose the one they prefer (true choice traveler) or travel dissonants or “utilitarian users” ([Jacques et al., 2013](#)) who have to choose the one they do not prefer. For instance, an individual preferring active transport mode for travel may commute by private car because of its convenience for daily shopping. However, no research has gone further to examine whether and how travel captivity and travel dissonance could interact with each other and influence travel satisfaction.

In sum, the existing travel satisfaction research has not thoroughly investigated the role of travel captivity in travel satisfaction, nor the effects of the interaction between travel captivity and travel dissonance. Our study aims to fill this research gap by including both

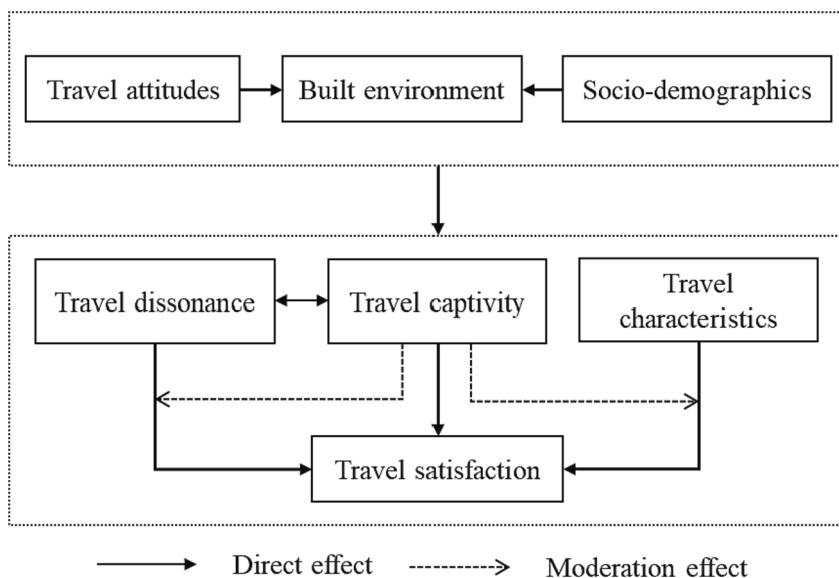


Fig. 1. Conceptual framework.

travel captivity and travel dissonance in the study of travel satisfaction and simultaneously examining their independent and interaction effects. The research findings will help clarify the roles of transport mobility, mode choice, and travel attitudes in travel satisfaction.

### 3. Methodology

#### 3.1. Conceptual framework

Fig. 1 illustrates the conceptual framework that guides the research design of this study. We are interested in the determinants of satisfaction towards travel. As suggested by previous studies, travel satisfaction is explained by external factors like the built environment (Ettema et al., 2011; Wang et al., 2020) and internal factors including socio-demographics and travel attitudes (Cao and Ettema, 2014; Li et al., 2022). At the trip level, we assume that three types of travel-related factors impact travel satisfaction: 1) trip characteristics, such as mode choice and travel duration (St-Louis et al., 2014; De Vos et al., 2019); 2) travel captivity — whether the trip is a free choice or not (Mao et al., 2016; Handy and Thigpen, 2019); and 3) travel dissonance — whether the trip features match the individual's preferences (De Vos, 2018; Ye and Titheridge, 2019). It is also hypothesized that travel captivity could moderate the effects of travel dissonance and other travel characteristics on travel satisfaction (Abenoza et al., 2019). Some other links are also possible. For example, personal and environmental attributes are likely to influence trip-level factors and thus confound their independent effects on travel satisfaction, which further highlights the necessity of controlling for personal and environmental variables in travel satisfaction models. Besides, low levels of travel satisfaction (De Vos, 2019) and high levels of travel dissonance (Kroesen et al., 2017; De Vos and Singleton, 2020; De Vos et al., 2022) may trigger the change in travel attitudes, though such feedback effects are not considered in this study because they are out the scope of our research focus.

#### 3.2. Data

This research used the data from a household travel diary survey conducted from August to October 2018 in Shanghai, China. Shanghai is the most populous city in China with 24.75 million people at the year of survey (National Bureau of Statistics of China). It has relatively high car ownership level (3.02 million private cars in 2018) among Chinese cities and well-equipped public transport systems, making it an ideal setting for investigating the impact of transport mobility on subjective well-being. To ensure geographical representation, a stratified multistage sampling approach was adopted to recruit the households in all the sixteen urban and suburban districts in Shanghai (excluding Chongming Island, which is a rural area separated with the urban core by the Yangtze River). Data were collected through face-to-face interview with household members that aged over 12 years old, which include information on personal socio-demographics, work environment and commuting trips (if applicable), a two-day activity-travel diary (one weekday and one weekend), as well as statements regarding perceived residential and work environments, travel-related attitudes, and subjective wellbeing. Household information including household-level socio-economic characteristics, car ownership level, and the objective measures of residential built environment were provided by household head. The final sample consists of 2144 respondents from 1046 households. This study makes use of data collected from the 1692 employed individuals from the sample. In general, comparing with Shanghai's general population, our respondents are overrepresented by young, well-educated, and also relatively high-income groups (please refer to Mao et al., 2022 for more detailed information about the sample characteristics).

**Table 1**

Measurements of overall travel satisfaction and commuting satisfaction.

Overall travel satisfaction (STS)
<i>Negative activation – positive deactivation</i>
Time pressed (1) – relaxed (7)
Worried I would not be in time (1) – confident I would be in time (7)
Stressed (1) – Calm (7)
<i>Negative deactivation – positive activation</i>
Tired (1) – Alert (7)
Bored (1) – Enthusiastic (7)
Fed up (1) – Engaged (7)
<i>Cognitive evaluation</i>
My daily travel was low (1) – high standard (7)
My daily travel worked well (1) – worked poorly (7)
My daily travel is the worst (1) – best (7) I can think of
Commuting satisfaction
Time was pressed (1) – Time was relaxed (7)
Worried (1) – Enjoyed (7)
Stressed (1) – Calm (7)
Tired (1) – Alert (7)
Bored (1) – Enthusiastic (7)
Fed up (1) – Engaged (7)

### 3.3. Variables and measurements

Table 1 describes the measurements of travel satisfaction variables in our study. Respondents' satisfaction with daily travel is measured using the Satisfaction with Travel Scale (STS) developed by Ettema et al. (2011). This measure consists of nine items and captures both affective and cognitive components related to daily travel. For the affective component, three items distinguish between negative activation (i.e., I "felt time was pressed/worried I would not be in time/was stressed" in daily travel) and positive deactivation (i.e., I "felt time was relaxed/was confident I would be in time/was calm" in daily travel) and three other items distinguish between negative deactivation (i.e., tired, bored, fed up) and positive activation (i.e., alert, enthusiastic, engaged). Three additional items measure the cognitive evaluation of daily travel: 1) the environment of my daily travel is low – high standard; 2) my daily travel worked well – worked poorly; 3) my daily travel is the worst – best I can think of. All items are assessed using the 7-point Likert-scale, with higher scores indicating more positive affection or evaluation. We develop four travel satisfaction variables from these nine measurement items: one on total STS including all nine items and three on each of the three sub-scales respectively, namely positive deactivation, positive activation and cognitive evaluation. Cronbach's alpha is 0.89, 0.78, 0.77, and 0.81 for the four travel satisfaction variables respectively, which indicate that all the scales are reliable for further analysis.

We have also collected the data on the commuters' satisfaction with daily commuting trips, the affective component of which is measured using the following items: 1) I felt time was pressed – relaxed during the commute; 2) I felt worried – enjoyed during the commute; 3) I was stressed – calm during the commute; 4) I was tired – alert during the commute; 5) I was bored – enthusiastic during the commute; 6) I was fed up – engaged during the commute. All the items are on a 5-point Likert-scale from "strongly disagree" to "strongly agree". We created the commuting satisfaction variable using all the six items, with Cronbach's alpha equals to 0.82.

Variables on attitudes towards travel modes are derived from the 14 attitudinal statements (in 5-Likert scale) using factor analysis. We used principal axis factoring with oblique rotation to identify the latent constructs in SPSS version 28.0 (Aditjandra et al., 2012). The criterion "Eigenvalue > 1" was used to determine the number of factors. As shown in Table 2, the factor analysis revealed four latent constructs of attitudes toward different transportation modes: pro-driving, pro-transit, pro-cycling, and pro-walking. Following the study of Ye and Titheridge (2019), we created a "travel dissonance" dummy variable by interacting travel mode attitudes and commuting mode choice. We dichotomized travel mode attitudes using the mean value of zero since they are standardized factor scores. The variable "travel dissonance" equals to one if the commuter had a negative attitude towards the most frequently used commuting mode, otherwise it equals to zero.

Travel characteristics are measured by travel mode choice, travel duration, and departure time, which were found to be important determinants of travel satisfaction in previous studies (St-Louis et al., 2014; Morris and Hirsch, 2016; Ye et al., 2020). We asked the respondents to report the most frequently used commuting mode and categorized them into four types: driving (including private cars, taxi, and carsharing), public transport (including bus and metro), cycling (including both private and shared bikes), and walking. Given the low proportions of cycling and walking commuters in the sample, we merged these two categories as "non-motorized commuters" in following descriptive analyses. Travel duration is measured by the one-way commuting time using such mode. We also collected the departure time of commuting trips, which is measured by a dummy variable taking the value '1' if the trips started during peak hours (from 8:00 am to 9:00 am) or '0' otherwise. Besides, previous studies have suggested that work characteristics like flexible working hours also matter in commuting mode choice (Maat and Timmermans, 2009; Guan and Wang, 2019). It is also likely that more flexible working hours would help the commuter feel less time pressure, which should contribute to commuting satisfaction. Therefore, we asked the commuter "if the working hours are fixed" and included this variable in the following modeling analyses.

To capture the impact of travel captivity on travel satisfaction, we asked commuters "if you are able to adjust your commuting mode to another one?". Commuters could answer "yes" or "no" for different modes, including cars, bus, metro, cycling, and walking (except the transport mode currently used for commuting). The "travel captivity" dummy variable is used to capture the answers on these questions, which equals to one if the respondent has no alternative mode available for commuting and zero otherwise (Handy and Thigpen, 2019).

The built environment variables are included as confounders. Numerous studies have suggested the impact of the built environment on travel behavior (Ewing and Cervero, 2010) and travel satisfaction (Cao and Ettema, 2014; Handy and Thigpen, 2019). Since this study focuses on commuters, the built environment at both residential and work locations are considered and measured using three variables: walking time from home (or workplace) to the nearest bus station/metro station and the perceived convenience of parking at the residential neighborhood (or workplace). Two additional variables are used to capture the street design at the residential location: 1) if the cycle lane is separated from traffic lane; 2) if the sidewalk is separated from traffic lane. We did not include similar street design attributes around the workplace because such information was unfortunately not collected.

Further, personal and household socio-economics including age, gender, monthly income, the presence of child, and car ownership, are included as control variables. In addition, *Hukou* or household registration is added for it has been found to be an important institutional factor explaining people's daily travel in urban China (Yao and Wang, 2018). Education level and the presence of elderly in the household were examined but not included in the final models because none of them were statistically significant in any travel satisfaction models. Table 3 presents the descriptive characteristics of the variables included in the modeling works.

## 4. Empirical analyses and findings

Earlier we argued that travel dissonance and travel captivity should be examined in travel satisfaction models at the same time because of their association and potential interaction effect on travel satisfaction. To investigate this hypothesis, in section 4.1, we first conduct some descriptive analyses concerning the distribution of captive (vs. choice) and dissonant (vs. consonant) travelers in our

**Table 2**  
Factor loadings for travel mode attitudes.

Description	Factor loading			
	Pro-driving	Pro-transit	Pro-cycling	Pro-walking
I like driving	<b>0.452</b>			
Getting to work without a car is a hassle	<b>0.478</b>	−0.247		
Traveling by car is safer overall than walking	<b>0.562</b>			
Traveling by car is safer overall than cycling	<b>0.748</b>			
Traveling by car is safer overall than public transit	<b>0.549</b>			
I like public transit		<b>0.479</b>		
I prefer to take public transit rather than drive whenever possible		<b>0.679</b>		
Public transit can sometimes be more convenient for me than driving		<b>0.408</b>	0.201	
I like cycling			<b>0.636</b>	
I prefer to bike rather than drive whenever possible			<b>0.729</b>	
Cycling can sometimes be more convenient for me than driving			<b>0.587</b>	
I like walking			0.279	<b>0.303</b>
I prefer to walk rather than drive whenever possible				<b>0.816</b>
Walking can sometimes be more convenient for me than driving				<b>0.531</b>
<i>Cronbach's Alpha</i>	0.69	0.69	0.66	0.64

Notes. Extraction method: Principal Axis Factoring. Rotation method: Oblimin with Kaiser Normalization.

Total variance explained: 40.19 %. Items with loading smaller than 0.2 are omitted.

**Table 3**  
Sample profile.

Variable	Description	Mean (%) / Standard deviation			
		Full sample (N = 1692)	Car commuter (N = 855)	Transit commuter (N = 699)	Non-motorized commuter (N = 138)
<b>Socio-demographics</b>					
Age	Age of the respondent	34.78/7.19	36.46/7.03	32.77/6.35	34.60/9.29
Gender (male)	1: male; 0: female.	54 %	61 %	45 %	60 %
Income	Personal income per month (thousand <i>yuan</i> )	18.9/16.9	23.81/20.73	14.15/9.00	13.21/10.93
Hukou	1: with Shanghai Hukou; 0: No.	76 %	90 %	61 %	66 %
The presence of child	1: live with child under 18; 0: No.	40 %	46 %	33 %	35 %
Car ownership	1: car owners; 0: car non-owners.	66 %	95 %	38 %	34 %
<b>Built environment</b>					
Parking convenience (home)	“It is convenient to park near home”: 1 (strongly disagree) to 5 (strongly agree)	3.84/0.88	3.81/0.87	3.86/0.89	3.98/0.87
Distance to bus (home)	Distance from home to the nearest bus station (mins in walking)	10.25/6.79	10.60/7.32	10.26/5.93	8.09/7.03
Distance to metro (home)	Distance from home to the nearest metro station (mins in walking)	15.42/18.69	14.64/14.50	15.09/18.93	21.94/33.62
Separated cycle lane (home)	1: cycle lane is separated from traffic lane; 0: No	88 %	89 %	89 %	75 %
Separated sidewalk (home)	1: sidewalk is separated from traffic lane; 0: No.	90 %	90 %	91 %	85 %
Parking convenience (work)	“It is convenient to park near the workplace”: 1 (strongly disagree) to 5 (strongly agree)	3.88/0.80	3.89/0.79	3.84/0.81	4.02/0.81
Distance to bus (work)	Distance from the workplace to the nearest bus station (mins in walking)	11.08/10.40	11.77/13.57	10.82/5.42	8.20/5.00
Distance to metro (work)	Distance from the workplace to the nearest metro station (mins in walking)	14.94/12.92	15.33/13.24	14.02/11.34	17.25/17.34
<b>Trip characteristics</b>					
Commuting mode	1. driving	51 %	N/A	N/A	N/A
	2. public transport	41 %			
	3. cycling	5 %			
	4. walking	3 %			
Commuting time	Duration of the commuting trip (mins)	26.97/13.69	24.42/11.02	31.63/15.28	19.21/12.38
Departure in peak hours	1: start commuting trips between 8 am to 9 am; 0: otherwise	70 %	74 %	68 %	54 %
Fixed working time	1: fixed working time; 0: flexible working time.	69 %	61 %	78 %	72 %
<b>Travel captivity and travel dissonance</b>					
Travel captivity	1: has no alternative mode available for commute; 0: otherwise.	27 %	25 %	30 %	24 %
Travel dissonance	1: commute by non-preferred mode; 0: otherwise.	44 %	49 %	40 %	36 %

sample, and shed light on the relationship between these two factors. Sections 4.2–4.3 will present and discuss the results of models that examined the variables contributing to commuting satisfaction and daily travel satisfaction. For each of the five travel satisfaction measures, we estimated a linear regression model for the full sample ( $N = 1692$ ), car commuters ( $N = 855$ ), and public transit commuters ( $N = 699$ ) respectively, resulting in fifteen models in total (De Vos et al., 2016).<sup>1</sup> We did not run separate models for non-motorized commuters due to the small size of sample who commuted by walking or cycling ( $N = 138$ ). Independent variables include the socio-demographics, built environment attributes, travel characteristics, travel dissonance, and travel captivity showed in Table 3. The variable “commuting time” was transformed into logarithm because it is right-skewed. Besides, we added the interaction term between travel dissonance and travel captivity (which equals to 1 for respondents who were both captive and dissonant travelers and 0 otherwise) into the models to investigate the potential joint effect of them on travel satisfaction. We checked the multicollinearity among independent variables via the indicator “Variance Inflation Factor (VIF)”, which ranges from 1 to 2.8 for all the independent variables, suggesting no multicollinearity within the data (Mason, 2003). We also checked the heteroskedasticity with plots of residuals against the predicted value. The trends in plots did not show a serious heteroskedasticity that may bias the model estimation.

To help verify the necessity of modelling travel dissonance and travel captivity jointly in travel satisfaction research, we run two additional groups of models for comparison: one with travel dissonance kept but travel captivity (and the interaction term) removed in the model, and the other group of models follow the opposite design. All the models were estimated with ordinary least square (OLS) method in SPSS version 28.0. Because the three groups of models differed only in the travel captivity and travel dissonance variables, it was not surprising to find that most estimated coefficients of the three groups of models were quite similar. For this reason, except the ones on travel captivity and travel dissonance, only the coefficients in the full models are reported in the following subsections.

#### 4.1. Does travel captivity lead to travel dissonance?

Table 3 shows that a significant percentage of respondents experienced travel captivity or travel dissonance in our sample. Specifically, there are 27 % commuters who had no alternative mode and be captive travelers. This proportion is much higher than that found by Handy and Thigpen (2019) in Davis, United States (8.5 %), who adopted a similar definition of “captive commuters”. The proportion of captive travelers shows no large difference among commuters by different modes. Transit commuters suffered most from travel captivity (30 %), followed by car (25 %) and non-motorized commuters (24 %). This result suggests that a significant percentage of transit (or car) commuters lived far from the workplace with no access to private cars (or public transport). Notably, these motorized commuters may suffer from even higher travel captivity when other constraints in commuting is considered. Some of them may report that cycling or walking is “available” theoretically, but could seldom commute by these non-motorized modes due to constraints in time or physical ability. Meanwhile, much more people experienced travel dissonance. Nearly half of car commuters (49 %) had a lower-than-average preference for driving, while the proportion of dissonant travelers is relatively lower for commuters by public transport (40 %) and walking/cycling (36 %). This is in accord with previous findings that non-motorized travelers tend to have higher travel satisfaction than others (St-Louis et al., 2014).

As mentioned before, we classified travelers into four categories by the interaction between travel captivity and travel dissonance. Fig. 2 illustrates the distribution of each category for commuters by different modes. Travel captivity and travel dissonance show a positive relationship for commuters by driving. There are 64 % of captive car commuters were dissonant travelers, while this proportion is only 44 % for choice car commuters. However, similar distribution was not found for commuters by other modes. This result rejects the hypothesis about the negative link between travel captivity and travel dissonance resulted from self-selection or self-report bias (Mao et al., 2016; Abenoza et al., 2017) in our study area, and is in line with previous findings about limited self-selection in the Chinese context (Wang and Lin, 2014). On the contrary, travel captivity did lead to more travel dissonance for car commuters, which highlights the existence of quite a number of residents who have to drive for commuting but dislike driving. The Chi-square test between travel captivity and travel dissonance further confirms their significant and positive association in the full sample and car commuters. This finding justifies our argument about the necessity to jointly examine these two factors’ independent impacts on travel satisfaction.

#### 4.2. Travel dissonance, travel captivity, and travel satisfaction

Table 4 and 5 present the results of linear models on commuting satisfaction, total STS, and the three components of STS (deactivation, activation, and cognitive evaluation). Both travel dissonance and travel captivity show significant effects on travel satisfaction factors when they are examined separately. However, once both are involved into models, the effect of travel dissonance on commuting satisfaction becomes non-significant. In line with the finding of Handy and Thigpen (2019), we found that captive car commuters were more satisfied with commuting trips than choice car commuters, which supports the hypothesis that travel captivity improves travel satisfaction because of the absence of alternative travel modes as reference points. However, travel captivity is found to be negatively associated with commuting satisfaction for transit commuters, which indicates that transit commuters tend to have more negative feelings if they have no alternative choices. For car commuters, travel captivity and travel dissonance also show a negative interaction effect on commuting satisfaction, as shown in Fig. 3a. It suggests that travel dissonance matters in car traveler’s

<sup>1</sup> For comparison, we also estimated all the models with Tobit regressions to address the censoring characteristic of the dependent variables (Ye and Titheridge, 2019). This resulted in very similar coefficients with those in simple linear regression models. We thus reported the latter in this paper since they can more easily be interpreted.

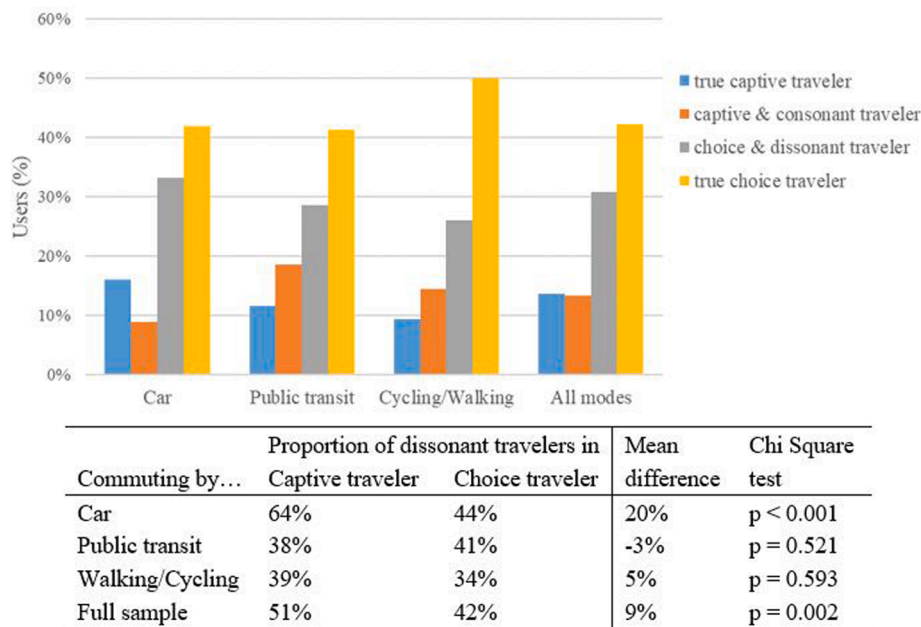


Fig. 2. The distribution of captive and dissonant commuters by different modes.

commuting satisfaction only if they have no choice but to drive.

Travel dissonance plays a more significant role in the evaluation of daily travel, as it shows an negative independent impact on all daily travel satisfaction factors for both car and transit commuters (De Vos, 2018; Ye and Titheridge, 2019). Again, travel captivity reduces transit riders' satisfaction with daily travel, but not for that of car commuters. Similar with that in the commuting satisfaction model, the interaction effect between travel dissonance and travel captivity is negative for car commuters (though it is marginally significant only in the activation model). However, the interaction term is significantly positive for transit commuters in all models on daily travel satisfaction. These findings revealed that captive car commuters are more sensitive to travel dissonance while captive transit commuters are more tolerant to that when rating travel satisfaction, as shown in Fig. 3b and 3c, respectively.

#### 4.3. Effects of socio-economics, built environment, and trip features on travel satisfaction

As shown in Table 4 and Table 5, socio-economics show more effects on travel satisfaction factors for car commuters than for transit commuters in general. Elderly people tend to reported lower travel satisfaction regardless of the chosen commuting mode, which is in line with previous studies in China (Mao et al., 2016). Male car commuters were more satisfied with commuting than female drivers, probably because of their higher preference for driving. However, they had relatively lower satisfaction (especially the cognitive evaluation) with daily travel than female drivers. This might be explained by that males tend to be the driver of household joint travels by car. Personal income also shows opposite effects on satisfaction with commuting trips and daily travel. While high-income people reported higher satisfaction with daily travel than others, they were less satisfied with commuting probably due to greater working stress. People with local Hukou had much higher commuting satisfaction than others possibly because they had greater sense of belongings to the city. Interestingly, we found that car commuters with children were more satisfied with commuting trips than those without. This could be explained by the utility of escorting children when driving to work. Finally, in accord with previous findings (De Vos, et al., 2021), we found that car ownership is negatively associated with all travel satisfaction factors.

In terms of the built environment, parking convenience at both residential and work locations contribute to higher daily travel satisfaction for all commuters, and the former also increases commuting satisfaction for car commuters. As expected, the proximity to metro stations (at the residential location) increases transit commuters' satisfaction with daily travel, while opposite associations are found between metro access (at both home and work locations) and car commuter's travel satisfaction factors. The effect of bus services on travel satisfaction is mixed. People who lived/worked close to bus stops reported higher daily travel satisfaction regardless of the commuting mode. This might be explained by the concentration of shopping or recreation services around bus stops. Meanwhile, access to bus services at residential and work locations shows opposite effects on commuting satisfaction, which deserves further exploration. About street design, we found that separated cycle or pedestrian lanes did not contribute to higher commuting satisfaction. The presence of cycle lane even lowers transit commuters' evaluation of daily travel. One possible reason is that cycle lanes occupied the space of traffic lanes and thus led to more congestions. Nevertheless, separated sidewalks did help improve daily travel satisfaction (STS), especially for car commuters. This is in accord with previous findings on the positive effect of walkability on travel satisfaction (Kim et al., 2014).

Align with many previous research (St-Louis et al., 2014; Ye and Titheridge, 2017), we found that commuters by walking/cycling

**Table 4**

Linear regression results on commuting satisfaction and daily travel satisfaction (STS).

Sample: commuting by...	Commuting satisfaction			Daily travel satisfaction (STS)		
	All modes	Car	Transit	All modes	Car	Transit
<i>constant</i>	2.984***	2.983***	3.053***	3.639***	3.663***	4.471***
<b>Socio-demographics</b>						
Age	−0.003	−0.008**	−0.001	−0.001	−0.003	−0.011**
Gender (male)	0.055	0.091*	0.020	−0.058	−0.085*	−0.004
Income	−0.003**	−0.002*	−0.003	0.002	0.002*	0.000
Hukou	0.195***	0.300***	0.044	−0.020	0.118	−0.010
The presence of child	0.047	0.157***	−0.046	0.058	0.026	0.075
Car ownership	−0.169***	−0.173	−0.067	−0.171***	−0.182*	−0.115*
<b>The built environment</b>						
Parking convenience (home)	0.049**	0.072**	0.026	0.145***	0.129***	0.158***
Distance to bus (home)	0.008***	0.003	0.016***	−0.012***	−0.015***	−0.012**
Distance to metro (home)	0.000	0.003*	0.002	0.000	0.007***	−0.004**
Separated cycle lane (home)	−0.166**	−0.093	−0.162	−0.109	0.045	−0.302**
Separated sidewalk (home)	−0.151**	−0.048	−0.196	0.172**	0.162*	0.185
Parking convenience (work)	0.015	0.014	−0.018	0.119***	0.098***	0.087**
Distance to bus (work)	−0.009***	−0.006*	−0.018***	−0.008**	−0.009**	−0.003
Distance to metro (work)	0.009***	0.010***	0.003	0.006***	0.009***	0.004
<b>Travel characteristics</b>						
Commuting by car	0.157***	—	—	0.325***	—	—
Commuting by cycling	0.447***	—	—	0.284***	—	—
Commuting by walking	0.449***	—	—	1.007***	—	—
Commuting by transit	Ref.	—	—	Ref.	—	—
Commuting time	−0.005	−0.033	0.089	−0.030	−0.036	−0.028
Fixed working time	0.166***	0.198***	0.158**	0.047	0.233***	−0.154**
Departure in peak hours	−0.162***	−0.198***	−0.185***	−0.084**	−0.007	−0.140**
<b>Travel captivity/dissonance</b>						
Travel dissonance <sup>a</sup>	0.006	−0.050	0.081	−0.240***	−0.180***	−0.350***
	(−0.013)	(−0.085*)	(0.097*)	(−0.213***)	(−0.226***)	(−0.217***)
Travel captivity <sup>b</sup>	−0.005	0.150*	−0.208***	−0.176***	−0.009	−0.360***
	(−0.036)	(0.038)	(−0.188***)	(−0.134***)	(−0.134**)	(−0.187***)
Travel captivity*dissonance	−0.064	−0.171*	0.051	0.118	−0.158	0.439***
Observations	1,692	855	699	1,692	855	699
Adjusted R2	0.112	0.107	0.084	0.175	0.182	0.138

Notes. All coefficients are unstandardized. \*P < 0.1; \*\*P < 0.05; \*\*\*P < 0.01. a. The coefficients in bracket come from the model without travel captivity and the interaction term.

b. The coefficients in bracket come from the model without travel dissonance and the interaction term.

reported the highest satisfaction level with both commuting and daily travel, followed by car commuters, while transit riders have lowest travel satisfaction. Although commuting time shows no significant effect on commuting satisfaction or total STS in our models, we still found that long commuting reduces the cognitive evaluation of daily travel for all groups in Table 5 (Higgins et al., 2018; De Vos et al., 2019). As expected, people who started commuting during peak hours tend to have lower commuting satisfaction due to congestions, and transit commuters during peak hours were also less satisfied with their daily travels (Mao et al., 2016; Waygood et al., 2019). Fixed working time is positively linked with commuting satisfaction for all groups, which is out of expectation. This result might suggest that people had more positive feelings in routine commuting trips than in flexible ones. At the same time, transit commuters with fixed working time reported lower STS score, which may due to the uncertainty of time that people faced when travelling by public transit.

## 5. Discussion

Our research findings confirmed that travel satisfaction is determined by transport mobility and cognitive dissonance simultaneously, as both travel captivity and travel dissonance show an independent impact on (daily) travel satisfaction. Context difference was identified regarding the role of travel captivity in travel evaluation. We found that captive travelers do not necessarily have higher travel satisfaction, as previous studies in Western context concluded (Abenoza et al., 2017; Handy and Thigpen, 2019). Instead, they may have either more positive or more negative travel evaluation than non-captive travelers, depending on the chosen mode. This also suggests that lower mobility can result in both lower expectations for travel and more negative feelings in travel, and the role of these two influence mechanisms differs across population groups. These context-different findings may be relevant with the mobility culture in urban China, where private cars are commonly viewed as a symbol of social status. Captive transit riders are likely to consider themselves as in a lower social status, feeling more stressful or depressed when travelling, while captive car users are less likely to do so.

This study also highlights the necessity of examining travel captivity and travel dissonance jointly in travel satisfaction studies. On the one hand, the significant effect of travel dissonance on commuting satisfaction diminished and became non-significant after

Table 5

Linear regression results on different components of daily travel satisfaction.

Sample: commuting by...	Positive deactivation			Positive activation			Cognitive evaluation		
	All modes	Car	Transit	All modes	Car	Transit	All modes	Car	Transit
<i>constant</i>	3.418***	4.154***	3.208***	3.569***	3.200***	4.942***	3.930***	3.635***	5.261***
<b><i>Socio-demographics</i></b>									
Age	0.000	−0.008**	0.002	−0.003	−0.002	−0.017***	−0.001	0.001	−0.018***
Gender (male)	−0.062	−0.084	−0.004	−0.067	−0.075	−0.053	−0.044	−0.095	0.044
Income	0.002	0.002*	−0.001	0.002*	0.003**	−0.002	0.001	0.001	0.001
Hukou	−0.014	0.152	−0.068	−0.018	0.101	0.010	−0.028	0.101	0.028
The presence of child	0.073	0.045	0.057	0.043	−0.006	0.073*	0.060	0.038	0.096
Car ownership	−0.152**	−0.248*	−0.072	−0.138**	−0.165	−0.064	−0.225***	−0.134	−0.208**
<b><i>The built environment</i></b>									
Parking convenience (home)	0.114***	0.092***	0.152***	0.127***	0.131***	0.100***	0.193***	0.165***	0.223***
Distance to bus (home)	−0.012***	−0.017***	−0.009	−0.011***	−0.014***	−0.011*	−0.013***	−0.013***	−0.017**
Distance to metro (home)	−0.001	0.005***	−0.003*	−0.001	0.007***	−0.005***	0.001	0.010***	−0.003
Separated cycle lane (home)	−0.145***	0.013	−0.331**	−0.054	0.163	−0.307**	−0.128	−0.040	−0.268*
Separated sidewalk (home)	0.138*	0.085	0.175	0.154*	0.098	0.221	0.224***	0.303***	0.158
Parking convenience (work)	0.120***	0.072**	0.120***	0.115***	0.121***	0.084**	0.124***	0.101***	0.057
Distance to bus (work)	−0.016***	−0.017***	−0.010	−0.004	−0.006	0.001	−0.003	−0.003	−0.002
Distance to metro (work)	0.007***	0.011***	0.004	0.005***	0.006**	0.005	0.007***	0.009***	0.002
<b><i>Travel characteristics</i></b>									
Commuting by car	0.321***	—	—	0.352***	—	—	0.308***	—	—
Commuting by cycling	0.263**	—	—	0.353***	—	—	0.237**	—	—
Commuting by walking	1.067***	—	—	1.144***	—	—	0.809***	—	—
Commuting by transit	Ref.	—	—	Ref.	—	—	Ref.	—	—
Commuting time	0.047	−0.050	0.164**	0.021	0.067	−0.067	−0.158***	−0.125**	−0.181**
Fixed working time	0.100**	0.312***	−0.122	0.015	0.188***	−0.114	0.017	0.199***	−0.226**
Departure in peak hours	−0.041	0.069	−0.038	−0.075	0.034	−0.190***	−0.137***	−0.124*	−0.193**
<b><i>Travel captivity/dissonance</i></b>									
Travel dissonance <sup>a</sup>	−0.214***	−0.131**	−0.302***	−0.243***	−0.178***	−0.327***	−0.262***	−0.230***	−0.420***
	(−0.206***)	(−0.172***)	(−0.202***)	(−0.219***)	(−0.242***)	(−0.186***)	(−0.214***)	(−0.263***)	(−0.261***)
Travel captivity <sup>b</sup>	−0.101	−0.056	−0.287***	−0.216***	0.015	−0.396***	−0.211***	0.013	−0.398***
	(−0.093*)	(−0.151**)	(−0.157**)	(−0.176***)	(−0.154*)	(−0.213***)	(−0.132**)	(−0.097)	(−0.192**)
Travel captivity*dissonance	0.044	−0.122	0.330**	0.115	−0.230*	0.465***	0.196*	−0.120	0.524***
Observations	1,692	855	699	1,692	855	699	1,692	855	699
Adjusted R2	0.143	0.158	0.095	0.123	0.116	0.089	0.145	0.158	0.136

Notes. All coefficients are unstandardized. \*P &lt; 0.1; \*\*P &lt; 0.05; \*\*\*P &lt; 0.01.a. The coefficients in bracket come from the model without travel captivity and the interaction term.

b. The coefficients in bracket come from the model without travel dissonance and the interaction term.

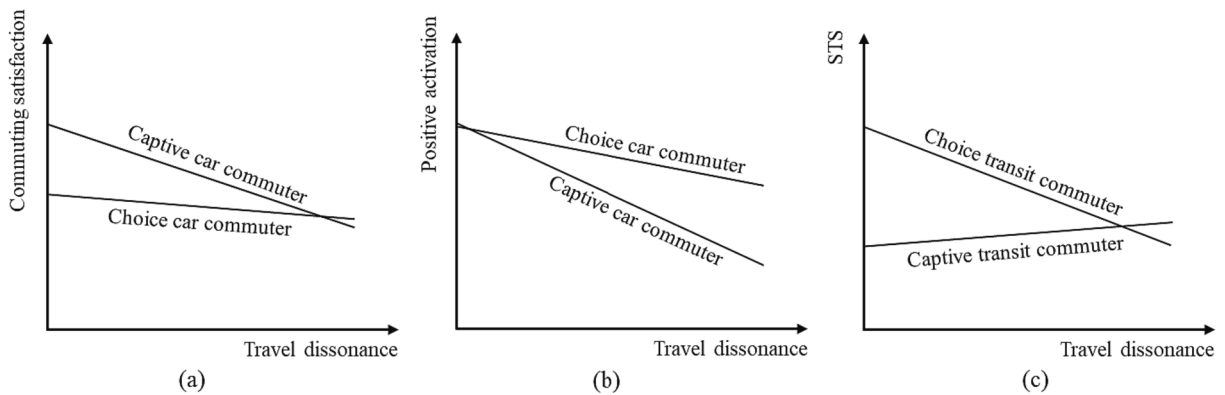


Fig. 3. Joint effects between travel captivity and travel dissonance on travel satisfaction.

controlling for travel captivity, and this is also the case for the other way around in some daily travel satisfaction models (e.g., the total STS model for car commuters). Their independent impacts on travel satisfaction will easily be misestimated without a joint consideration. On the other hand, the significant interaction effects between them also suggest a joint modelling with both factors in future travel satisfaction research.

Our research findings generate some insights for future development of transportation system regarding its wellbeing impact. The improvement of transit riders' travel satisfaction requires multi-faceted efforts. First, it is still necessary to upgrade the quality and attractiveness of public transit services, since transit users still have the worst travel experience compared with others. Second, it's also helpful to increase people's preference for public transport by social media, as suggested by the direct negative impact of travel dissonance on travel satisfaction in our models. Third, because captive transit users share a much lower travel satisfaction regardless of their own preference (as Fig. 3c shows), mobility is also of vital importance for transit users' subjective wellbeing. Therefore, transit-oriented development itself may not be enough to improve transit users' travel satisfaction. Other transport services should better be developed at the same time to help increase their mobility level, such as shared mobilities (e.g., carsharing and bikeshare services).

Although travel captivity matters less for car users' travel satisfaction, the development of multimodal transport services still has the potential to improve their subjective wellbeing by enabling them to use alternative modes. As suggested by the negative effect of car ownership on travel satisfaction in models, and the significant proportion of "captive and dissonant" car commuters in descriptive analysis, many residents in Shanghai tend to consider the ownership and use of private cars as a burden. Multimodal transport system would enable these true captive car users to use more preferred travel modes and get rid of the maintenance/driving burden of cars. Even if they still choose to drive afterwards (for any other considerations), they will still experience an increase in travel satisfaction once mobility level is increased and be less sensitive to the cognitive dissonance regarding driving (as Fig. 3b shows). Lastly, metro system should be the priority of development than bus services to attract more transit users and improve their travel satisfaction, as metro access has a clear positive (or negative) effect on transit (or car) users' travel satisfaction, while the effects of bus access are mixed.

This research has several limitations. First, we have not examined the travel satisfaction of non-motorized commuters due to the limited sample size, which surely deserves further analyses once relevant data is available. Second, cognitive dissonance concerning travel duration (e.g., commuting time dissonance) may also affect travel satisfaction significantly (Ye et al., 2020; Ma et al., 2021). Unfortunately, we cannot include this factor into models because our survey has no information on ideal travel time. Third, as illustrated in the conceptual model, travel captivity may also moderate the impact of trip characteristics on travel satisfaction. We left this effect as a direction for future research considering that this paper focuses on the joint roles of travel captivity and travel dissonance. Fourth, as suggested by previous literature (De Vos and Witlox, 2017), people's satisfaction with certain trips (i.e., commuting satisfaction) could be interrelated with daily travel satisfaction. Our survey data also verified this — commuting satisfaction has a positive and significant coefficient when it was included into the total STS model (the effects of travel captivity and travel dissonance kept similar while coefficients were slightly diminished). However, considering that their relationship might be bidirectional, we did not include commuting satisfaction into the final daily travel satisfaction models to avoid potential endogenous bias. Future studies should try to address the interrelations between different levels of travel satisfaction measures by methods like recursive structural equation models. Besides, people's travel attitudes and mobility levels may have changed in response to the emerging transport services (e.g., ridesharing) since we collected data five years before. Studies based on more recent survey data are recommended to validate the research findings in nowadays context. Finally, similar analyses based on longitudinal data are necessary to provide more casual evidence on our research question, and address the potential feedback affect from travel satisfaction to travel behavior and attitudes (De Vos, 2018b).

## 6. Conclusions

Despite the growing travel satisfaction studies in recent years, the role of mobility in it is still less understood, especially how it may interact with cognitive dissonance on determining travel satisfaction. To fill this gap, this paper investigates both the independent and

joint effects of travel dissonance and travel captivity on travel satisfaction using a household travel survey data in 2018 from Shanghai, China. We found that both factors have an independent and negative impact on daily travel satisfaction for transit commuters, while only travel dissonance matters for that of car commuters. Travel captivity and travel dissonance can also interact with each other to influence travel satisfaction. In general, captive transit users tend to be more tolerant to travel dissonance when rating travel satisfaction, while the opposite is true for car commuters. The findings highlight the important role of mobility in subjective wellbeing and generate implications for future development of multimodal transport system. Besides, the modelling results also reveal the different determinants of travel satisfaction for travelers by different modes, suggesting a multi-group model design in future subjective wellbeing studies.

### CRedit authorship contribution statement

**Xiaodong Guan:** Conceptualization, Data curation, Writing – original draft, Writing – review & editing, Investigation, Methodology, Validation, Formal Analysis. **Donggen Wang:** Conceptualization, Funding acquisition, Writing – review & editing, Investigation, Methodology, Supervision, Resources, Project administration.

### 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.

### Data availability

The data were collected with the support of research grants

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