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Are men or women happier commuters? A study on the determinants of travel mode dissonance and travel satisfaction for dual-earner couples with school-age children in Ganyu, China

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ABSTRACT

The extent to which people can travel by their preferred mode (travel mode consonance) and its impact on travel satisfaction has received increased interest in recent years. However, how travel mode consonance and satisfaction differ between spouses has not been investigated. Also, research in this domain from non-western contexts is still limited. Using survey data collected from dual-earner couples with school-age children in Ganyu, a small Chinese city, this research provides a deeper investigation into the extent to which female and male partners are able to travel by their preferred travel mode and whether this impacts their travel satisfaction for the commute. Descriptive analysis revealed that only about half of the couples commute by their preferred travel mode, whereas the remaining couples were those where one or both partners were unable to use their preferred travel mode, mostly due to travel distance. Multivariate analysis indicates that travel satisfaction for both couples is more influenced by the travel mode used by individuals rather than whether the chosen travel mode is preferred or not. Moreover, the level of travel satisfaction is significantly associated with perceptions of the environment and traffic congestion during the trip, and this effect differs between women and men.

1. Introduction

Travel satisfaction has received increasing attention in the transportation research field during the last decade (De Vos et al., 2013; Ettema et al., 2010; Ma et al., 2021; Mokhtarian, 2019). Many studies have investigated how trip characteristics (e.g., activity and experiences during travel, travel time, and travel mode choice) are associated with travel satisfaction (Chatterjee et al., 2020; Ettema et al., 2016; Ettema et al., 2012). Studies have shown that people who use active travel modes (e.g., walking or cycling) tend to have higher levels of travel satisfaction, while public transport users report the lowest levels (Friman et al., 2017; St-Louis et al., 2014; Ye & Titheridge, 2017).

Attitudes also play an important role in travel satisfaction. Positive attitudes towards a certain travel mode can result in positive travel experiences when using that mode, which in turn contributes to higher levels of travel satisfaction (De Vos et al., 2016; Susilo & Cats, 2014). In addition, attitudes influence travel satisfaction indirectly by way of travel mode choice. People with certain attitudes often choose to use a preferred travel mode (Heinen et al., 2011), and as a result, tend to have higher levels of travel satisfaction (De Vos, 2018). However, as people cannot always travel with their preferred mode due to limited travel options, a dissonance between preferred and chosen travel modes may result, which is termed "travel mode dissonance." Consequently, individuals who cannot use their preferred mode for travel may not experience a higher level of travel satisfaction (De Vos & Singleton, 2020). De Vos (2018) found that most dissonant travelers have below-average travel satisfaction levels.

However, whether or not individuals who use their less-preferred mode tend to have lower levels of travel satisfaction has mainly been examined in Western contexts (De Vos, 2018; De Vos & Singleton, 2020). Findings may be different if such a relationship was examined in other parts of the world (e.g., China), as individuals' freedom to choose travel modes also depends on socio-economic and cultural contexts. In addition, travel mode choices are often the outcome of household decisions. The extent to which a dissonance between a preferred and chosen travel mode occurs may differ among each member within a multi-member household. This mainly arises from household allocation decisions, where the travel needs and preferences of each member cannot always simultaneously be satisfied and met due to limited transportation resources (e.g., the availability of a car). For instance, in a

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one-car household where both partners prefer to drive, the allocation decision to one of them could consequently make one partner become consonant while the other dissonant, unless they share a car. Consequently, relationship between travel mode dissonance and travel satisfaction could also differ among different household members.

Emerging research on the occurrence of travel mode dissonance and how it impacts travel satisfaction has been restricted to the individual level. It remains unknown how, based on household-level decisions about vehicle allocation and differences in travel preferences, the occurrence of travel mode dissonance and its impact on travel satisfaction differs among different household members. Moreover, the aforementioned relationship may work differently in the context of small Chinese cities but has received limited attention in travel behavior research. Using data collected from dual-earner couples with school-age children, this research aims to reduce these gaps by exploring patterns of travel mode dissonance and its relations to travel satisfaction within households living in Ganyu, a small Chinese city. Factors that impact travel satisfaction for women and men within the household were also explored. We focused on one of the most important daily travel behaviors: morning commutes to the workplace, and answer the following research questions:

(1) Within a dual-earner household, to what extent could women and men use their preferred commute mode and how does this relate to the availability of travel options and trip distances?
(2) Does a household member have a lower level of travel satisfaction if the less-preferred travel mode was used for commuting?
(3) What are the underlying determinants of travel satisfaction and how does this differ by gender within a household?

The remainder of this paper contains the following: Section 2 first presents a literature review on the origins of travel mode dissonance, the determinants of travel satisfaction from a household perspective, and travel behavior and satisfaction research in small Chinese cities. Next, the data collection process and the methods we used for the analysis are presented in Section 3. Section 4 presents the results—both descriptive and modeling—while Section 5 ends the paper with the conclusion.

2. Literature review

2.1. Travel mode dissonance and travel satisfaction

Travel mode dissonance mainly depends on whether or not people can freely choose a travel mode based on their attitudes and preferences (De Vos & Singleton, 2020). In many cases, people cannot make use of their preferred travel mode due to limited travel options; this is usually the result of an absence of travel options, living in transport-poor areas, or household vehicle allocation (De Vos, 2018). A growing number of recent studies have found a certain percentage of such travel mode dissonance which ranges from 20.9 % (Zarabi et al., 2019) to approximately 50 % (De Vos, 2018). In addition, transport resistance factors (e.g., distance, cost, and effort) may also contribute to the occurrence of travel mode dissonance but have received limited attention in transportation research. For instance, a person who likes walking and cycling may become travel mode dissonant if they have to travel a long distance by car or public transport.

Based on cognitive dissonance theory (Festinger, 1957), the inability to use a preferred travel mode may result in feelings of discomfort and dissatisfaction. This is confirmed by three recent studies (De Vos, 2018; Stark et al., 2019; Ye & Titheridge, 2019). However, travel mode dissonance may not always contribute to lower levels of travel satisfaction; this additionally depends on the mode used to travel. For example, Humagain et al. (2021) found that car and transit users tend to have a slightly higher level of travel satisfaction if they commute on foot or by bicycle, although pedestrians and cyclists are less satisfied with their trips if the car or transit is chosen as an alternative mode. Also, De Vos (2018) found that while consonant travelers are more satisfied with their trips than dissonant travelers in terms of bicycle, car, and public transport use, there is no significant difference in travel satisfaction between consonant and dissonant pedestrians. One possible reason is that walking as an activity can contribute to higher levels of satisfaction, regardless of whether or not it is favored. In addition, as some travel mode dissonance comes from transport resistance, people may understand and accept certain travel conditions that preclude the use of a preferred travel mode (Beirão & Cabral, 2007). For example, long-distance commuting by car may be acceptable despite a preference for active travel modes (i.e., walking and cycling), as travel by foot or bicycle is not possible for long-distance trips. In this way, very low levels of travel satisfaction are not necessarily a result of non-preferred travel modes.

2.2. Travel patterns, travel mode dissonance, and travel satisfaction within couples

Household resources (e.g., a car) as well as tasks and activities are often jointly allocated and distributed among each household member to meet the needs of each other under certain social, spatial, and resource constraints (Ho & Mulley, 2015). Within a household, women carry out a larger part of housework and childcare responsibilities than men, and tend to work closer to home as a way to connect all kinds of daily activities (Ettema et al., 2007; Kwan, 2000; Schwanen et al., 2007). In contrast, men tend to be career-oriented and work farther from home (Hjorthol & Vågane, 2014; Surprenant-Legault et al., 2013; Wheatley, 2014). Consequently, more men than women use the household car (Anggraini et al., 2012).

The distribution of work locations among different members within a household, together with household car allocation decisions, creates different travel routes and the use of different travel modes; this in turn contributes to different travel experiences. Although very limited research has explored the determinants of travel experience and satisfaction at the household level, any gendered differences could provide interesting insights into this issue. Some studies have shown that women may experience more travel stress than men (Chatterjee et al., 2020; Roberts et al., 2011). This mainly comes from women's prime responsibility for household tasks and childcare, which imposes a considerable amount of mental stress during trips to and from the workplace (Schwanen et al., 2008). Nonetheless, the findings are mixed regarding differences in travel satisfaction by gender. Many studies have found no significant difference in travel satisfaction between women and men (Ettema et al., 2012; Olsson et al., 2013). In contrast, one study found that women are more satisfied with certain trips: Mouratidis et al. (2019) found for example that women experience higher satisfaction levels than men during commutes; there is no such difference with travel for other purposes however.

As a result of limited household resources (e.g., the inability to purchase a car for each member), the wants and needs of each member cannot be met simultaneously, resulting in the occurrence of travel mode dissonance for some household members. However, a household member may adjust their travel attitudes and preferences based on their chosen travel mode (McCarthy et al., 2021; Van Wee et al., 2019), which reduces the degree of travel mode dissonance. Nonetheless, an individual may also become dissonant in some specific travel circumstances (e.g., longer travel distances—see the above section), which further complicates the distribution of travel mode dissonance at the household level. In general, the distribution of travel mode choices across different household members, together with different travel attitudes and preferences among them, lead to different distributions of travel mode dissonance within a household. While recent intra-household transport research has included travel-related attitudes in the analysis (e.g., Gao et al., 2022; Guan & Wang, 2019; Janke, 2021), the occurrence of travel mode dissonance and its impact on travel satisfaction at the household level remains underexplored. As car use usually involves intra-

household decisions, the extent to which a household member could use their preferred travel mode differs among different members. Exploration of this issue at the household level could further differentiate the role of attitudes in travel mode choice as well as travel satisfaction among different members.

2.3. Travel behavior and travel satisfaction in small Chinese cities

Travel behavior research in China has received increased attention during recent years, yet most focus has been paid to big cities, leaving the situation in smaller cities underexplored. In China, small cities are those with a population of <500,000 inhabitants which is quite small when compared with big cities such as Beijing (pop. ~ 21 million), Shanghai (pop. ~ 26 million), and Shenzhen (pop. ~ 13 million). Despite this however, the total population of all small cities in China is not that small: 45.7 % of mainland China's population lives in county-level cities (i.e., small and medium cities) (Ministry of Housing and Urban-Rural Development, 2020). Given this context, understanding travel behavior and travel satisfaction in China's small cities is quite important for promoting sustainable travel behavior and improving individual well-being in China.

In small Chinese cities, residents generally travel short distances. This is not only attributed to the size of a city, but also because of compact and high-density land use policies in China which keep most small-city destinations within reasonable cycling distance. Consequently, electric bicycles (e-bikes) and motorcycles are popularly used in small Chinese cities (Hu et al., 2018; Hu et al., 2021; 2022). Moreover, traveling by transit bus—which is generally less attractive than cycling or e-cycling—is mainly used for long-distance commutes (Hu et al., 2021). In particular, Hu et al. (2018) found that <10 % of residents travel by bus in Changting, a small Chinese city. This is mainly because transit bus travel is less efficient for shorter trips than cycling or e-cycling in terms of travel time, which is quite often the case in small Chinese cities.

Regarding the relationship between travel mode choice and travel satisfaction, many studies have found that active travelers tend to have the highest levels of travel satisfaction while public transport users experience the lowest levels (Ettema et al., 2016; St-Louis et al., 2014). Compared to active travelers, car users have been found to experience lower levels of travel satisfaction. Yet, when car users are compared to public transport commuters, research has found slightly higher levels of travel satisfaction (Friman et al., 2013) or equal levels (Olsson et al., 2013). However, knowledge in this domain mainly arises from the Western context; the relationship between mode choice and travel satisfaction may be different in small Chinese cities, which has not been thoroughly investigated. In particular, as traffic volume is lighter in smaller Chinese cities, car users may experience less serious traffic congestion and may therefore not have a lower level of travel satisfaction. Moreover, such a specific context may also affect the role of attitudes in the level of travel satisfaction.

3. Methodology

3.1. Data collection

A city named Ganyu, located in the eastern part of China, was chosen as the research location. With approximately 200,000 residents in its central area, Ganyu is considered a small city in China (State Council of China, 2014). The city's residential areas mainly consist of two parts: the old city (the traditionally central areas of the city), and the new developed city. More information regarding urban structure and land use patterns in Ganyu can be found in Hu et al. (2022). As the city of Ganyu is central to the Ganyu metropolitan area,[1] City residents tend to work throughout the metropolitan area.

As it is very difficult to conduct a random sampling survey with both spouses simultaneously on a workday, local schools were contacted as the starting point for the survey. To initiate the survey, parents received an invitation to participate in the survey from their children; who were sent home with an envelope containing two copies of the questionnaire—one copy each for the student's father and mother respectively. To cover residents from different geographical contexts and ages, four schools in different locations in Ganyu were contacted: a primary school and junior high school in the centrally located old city, and two counterparts in the more peripheral new city. Data collection focused on parents with children; elderly couples or couples without children were not included. The survey contained relevant questions regarding socio-economic attributes; residential and work locations; the amount of time worked; level of travel satisfaction and commute experiences; travel mode availability; and travel-related attitudes.[2]

In December 2019, 2372 envelopes were distributed among the four schools. We only considered questionnaires that were returned with complete information; we also only accepted questionnaires showing different handwriting styles between spouses as this provides, to a certain extent, evidence of independent participation in the survey. As a result, the valid response rate was 55.9 % (or 1325 households). The first-round of data cleaning reduced the pool to 987 dual-earner couples. All in all, we analyzed data from 839 dual-earner households after excluding couples where either one partner traveled by transit bus, company shuttle bus, or motorbike. That is because these are marginal travel modes in our research context of Ganyu,[3] which may further complicate the analysis of dissonant/consonant travelers. For more information, please see Hu et al. (2022) for a complete description of the survey process.

3.2. Travel mode choice, socio-economic attributes, and trip characteristics

Commute modes, referring to the main and the most frequently used mode of travel to the workplace, were divided into three types (Table 1): foot/bicycle, e-bike, and car. As a very small share of residents chose to commute on foot or by bicycle, these two travel modes were merged into one group for the analysis. Despite the differences between walking and cycling, both were considered active travel modes. In contrast, e-bikes—a kind of electric two-wheeler that differs from pedal-assisted cycling and is usually controlled with a hand throttler—were not considered to be an active travel mode in China (Hu et al., 2021). We used Autonavi Map to calculate commute durations; by providing origins (i.e., residential locations) and destinations (i.e., work locations), we could calculate the amount of time required for each travel mode given the local travel environment. More detailed information regarding the distribution of residential and work locations of respondents can be found in Hu et al. (2022). As the map did not provide e-bike travel time, this mode was calculated based on the travel time of bicycles and the ratio of the average speed of bicycles and e-bikes (11 km/hour (km/h) and 14.5 km/h, respectively, in the Chinese context) (Cherry, 2007).

As presented in Table 1, roughly two-thirds of women chose to commute by e-bike while around two-thirds of men commuted by car. Such distribution of travel mode choice might have come from car ownership and work location choice among couples. In our sample, male spouses acted as breadwinners and tended to work far from home, while

[1] The Ganyu metropolitan area refers to the administrative district of Ganyu, including Ganyu City and its satellite towns and rural areas.

[2] More questions were included in the questionnaire; only the questions used in this study are listed here.

[3] For instance, among 987 dual-earners in our sample, only 3.0% of women and 1.7 % of men commuted by transit bus.

Table 1
Sample characteristics.

Variables	Definition	Women	Men
		%/Mean (Std. Dev.)	
Commute mode choice			
Foot/Bicycle		6.7	6.1
E-bike	Electric bicycle	67.7	26.0
Car	Driving a car or riding as a passenger	25.6	67.9
Age			
25_35	Respondent 25–35 years old	30.5	21.9
36_40	Respondent 36–40 years old	35.9	36.4
>40	Respondent over 40	33.6	41.7
Income			
<50 k	Respondent's annual income less than RMB50k	42.1	12.3
50 k or more	Respondent's annual income RMB 50 k or more	57.9	87.7
Number of working days/week			
5 or less		47.9	39.7
6		26.6	25.7
7		25.5	34.6
Number of working hours/day			
8 or less		73.2	60.8
>8		26.8	39.2
Number of children			
1	Only one child within the household	17.2	
>1	More than one child within the household	82.8	
Travel perceptions			
Environment	What do you think of the scenery during the commute? Very unpleasant Average Very beautiful ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7	4.12 (1.26)	4.13 (1.15)
Congestion	Using a 7-point scale, please indicate the level of street congestion Very congested Average Not congested at all ☐1 ☐2 ☐3 ☐4 ☐5 ☐6 ☐7	4.74 (1.32)	4.68 (1.25)
Commute duration (mins)		9.88 (8.68)	13.17 (10.34)
Travel mode consonance and dissonance			
Consonance		78.1	62.3
Dissonance		21.9	37.7

female spouses worked nearer to home and spent more time on household maintenance activities. One explanation is that men generally have higher levels of education and income, work longer hours (i.e., over eight hours per day and seven days per week), and have longer commute times than women (Table 1). In this context, cars are usually used by men for long-distance commutes, while e-bikes are mainly used by women for short-distance commutes.

3.3. Travel attitudes and preferences

Attitudes about travel modes were determined through a series of statements presented in a five-point Likert scale. Regarding attitudes about cars, we presented the following statements: (1) "I need a car to do some of the things I like to do"; (2) "Getting to work without a car is a hassle"; (3) "To me, a car is a status symbol"; (4) "I like driving"; (5) "Traveling by car is overall safer than cycling or e-cycling"; and (6) "Traveling by car is overall safer than walking". Statements to determine active travel attitudes included: (1) "I prefer walking to e-cycling"; (2) "I prefer walking to driving"; (3) "Walking is overall safer than e-cycling"; (4) "I prefer cycling to driving"; (5) "I prefer cycling to e-cycling"; and (6) "Cycling is overall safer than e-cycling". Finally, we presented the following statements to determine e-bike attitudes: (1) "I like riding an e-bike"; (2) "E-cycling is easier for me than driving"; (3) "E-cycling could help me reach the destination quickly"; and (4) "E-cycling is more environmentally friendly". For the reliability of the measurement of attitudes towards each travel mode, the value of Cronbach's alpha for each travel mode for both women and men is over 0.8; this suggests very good consistency in terms of items within each attitude dimension.

The average score of the items in each dimension was calculated to denote the value of attitudes for each travel mode (active travel, e-bike, and car use); women and men show different scores. Female partners tend to have a higher e-bike score compared to car and active travel, regardless of which travel mode they chose to commute (Table 2). By contrast, male partners only have a higher e-bike score compared to the two other modes when e-bikes are chosen for the commute.

Table 2 compares attitudinal scores across the different travel modes. We found no significant difference if the attitudinal score of a certain travel mode is higher than another mode at 0.1 magnitudes. Hence, as there are three travel modes, we assumed that one has a preference for a certain travel mode if this person's attitudinal score for this travel mode is higher than both of the other two travel modes at a magnitude of 0.2 or more ($\geq$0.2) (Fig. 1). However, if both of the attitudinal scores are higher than the other at a magnitude of 0.2 or more ($\geq$0.2) and if the difference between these two attitudinal scores is<0.2, we assumed that this person has a preference for both of these two travel modes. We additionally assumed that a person has a preference for all three travel modes if the difference in attitudinal scores between these three modes is<0.2 magnitude. In special circumstances, the criteria on the right side within Fig. 1 were used for classification. Specifically, for score differences between modes A, B, and C: if the score of travel mode A is higher than the score for travel mode C at a 0.2 magnitude or more, but is not higher than travel mode B at 0.2 magnitude, the preference definition depends on if the mode B score is closer to the score of modes A or C. If the difference between B (Score) and C (Score) is smaller than that between B (Score) and A (Score), we assumed that this person prefers travel mode A. Otherwise, we assumed that the person likes both A and B travel modes.

3.4. Classification of travel mode consonance and dissonance

Based on previous research (De Vos, 2018; De Vos & Singleton, 2020), travel mode consonance and dissonance were defined based on whether travel preferences are matched or mismatched with the chosen travel mode (Fig. 2). If the chosen travel mode belongs to one's preferred travel mode, this person can be defined as a consonant traveler (i.e., travel mode consonance), otherwise as a dissonant traveler (i.e., travel mode dissonance).

3.5. Satisfaction with travel scale

The Satisfaction with Travel Scale (STS), developed by Ettema et al. (2010), was used to measure how satisfied individuals are with morning

Table 2
Value distribution of travel attitudes among chosen commute modes.

Travel attitudes Chosen commute mode	Car attitudes		E-bike attitudes		Active travel attitudes	
	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Women						
Active travel	2.18 [ab]	0.73	4.04[b]	0.68	3.57	0.72
E-bike	2.21 [ab]	0.63	4.09[b]	0.56	3.02	0.68
Car	3.12 [a]	0.72	3.46[b]	0.69	3.03	0.64
Men						
Active travel	2.42 [ab]	0.73	3.68	0.75	3.68	0.77
E-bike	2.37 [ab]	0.66	3.88[b]	0.61	3.13	0.71
Car	3.29[b]	0.69	3.21[b]	0.73	3.09	0.66

a. Significantly different from e-bike attitude score (two-tailed *t*-test at <0.1).
b. Significantly different from active travel attitude score (two-tailed *t*-test at <0.1).

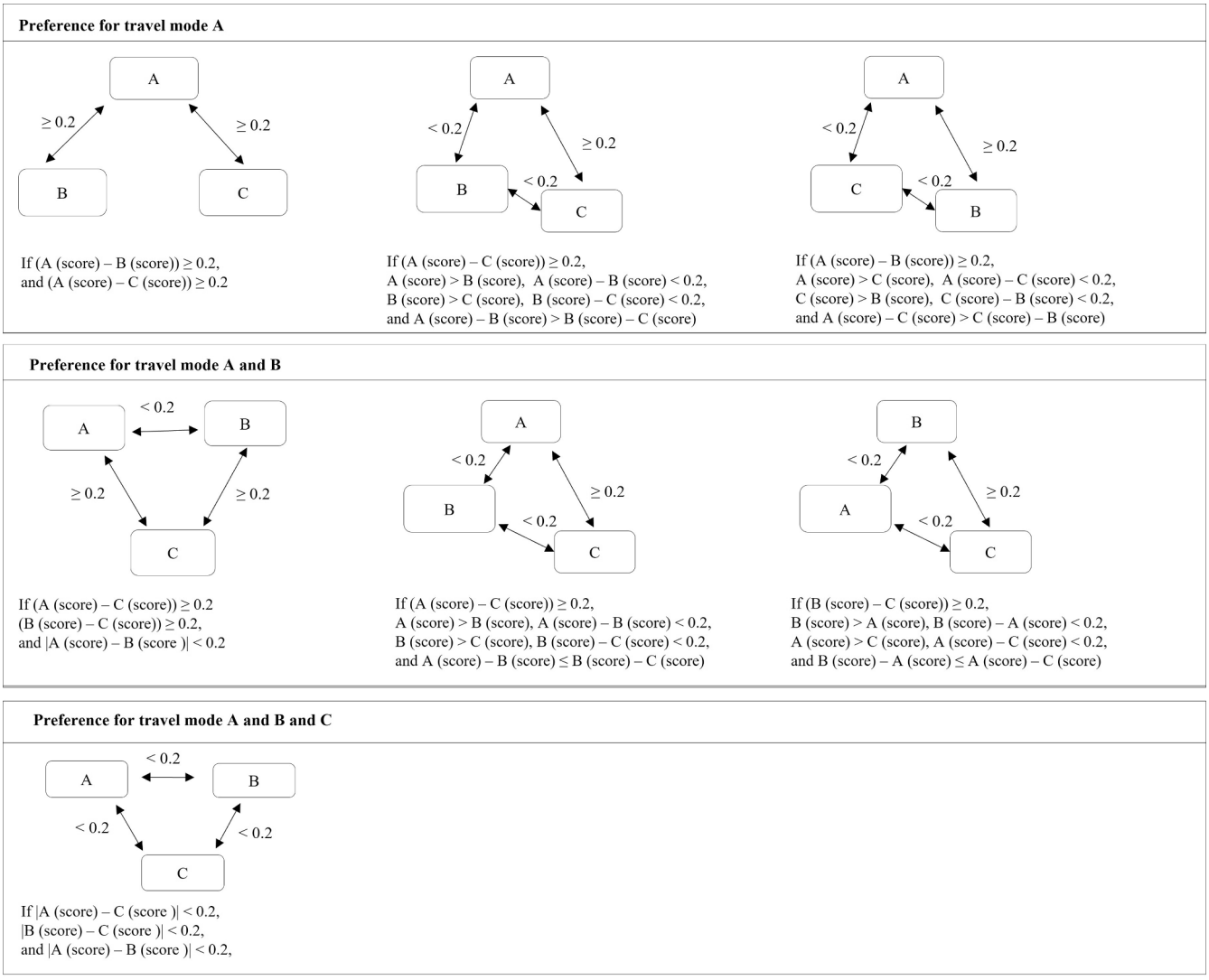

Fig. 1. Definition of travel preferences.

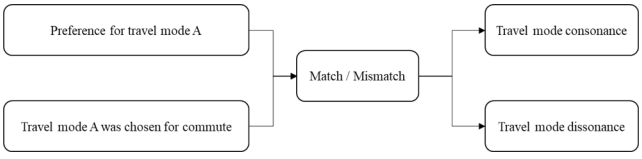

Fig. 2. Classification of travel mode consonance and dissonance.

trips from home to their workplace. STS consists of three dimensions: (1) Positive activation, which distinguishes emotions ranging from negative de-activation (e.g., tired) to positive activation (e.g., alert); (2) Positive de-activation, which distinguishes emotions between negative activation (e.g., hurried) and positive de-activation (e.g., relaxed); and (3) Cognitive evaluation, which pertains to an individual's cognitive assessment of the general quality of travel. STS consists of nine items with scores varying from −3 to 3, and with three items per dimension. The reliability of STS with two affective and one cognitive dimension has been tested in previous research (Ettema, Gärling, Olsson, Friman, & Moerdijk, 2013; Friman et al., 2013; Olsson et al., 2013).

Cronbach's alpha was used to test the consistency of the items in each dimension; the value is >0.8 which suggests good reliability for the measurement in each dimension. The average score across three items in each dimension was used to denote the value of each travel mode. As seen in Table 3, both women and men are positive with travel in all three dimensions of STS. For the positive activation dimension, female partners have a slightly higher score than male partners; this is not the case in the two other dimensions.

3.6. Modeling approach

A linear regression model was used to explore the impact of travel mode dissonance on travel satisfaction. The average scores of items in each dimension of the STS were used to represent positive activation, positive de-activation, and cognitive evaluation, which were also used as the dependent variables for Model 1 (a and b), Model 2 (a and b), and Model 3 (a and b) respectively. Independent variables included socio-economic attributes, working time, trip characteristics (i.e., perceptions around road environment and traffic congestion, commute mode choice and commute duration), and travel mode dissonance, which are listed in Table 1. Models 1a, 2a, and 3a are original models with no interaction item. In order to examine the differing impacts of the factors on travel satisfaction by gender, each independent variable except "gender" was multiplied by "men" to get a new interaction item, which enters Models 1b, 2b, and 3b respectively. Multicollinearity was also checked among independent variables via the indicator "Variance

Table 3
STS with nine items for women and men.

	Women		Men		Mean difference between spouses (Women-Men)
	Mean (std. dev.)	Mean (each dimension) (std. dev.)	Mean (std. dev.)	Mean (each dimension) (std. dev.)	
STS items 1–3 (positive activation)					
Very bored/ enthusiastic	0.6 (1.08)	0.51(0.9)	0.47 (1.06)	0.45(0.9)	0.06**
Very tired/ alert	0.45 (1.03)		0.44 (1)		
Vert fed up/ engaged	0.49 (0.93)		0.44 (0.91)		
STS items 4–6 (positive de-activation)					
Very stressed/ calm	0.47 (1.37)	0.24(1.31)	0.42 (1.42)	0.50(1.27)	−0.25***
Very hurried/ relaxed	−0.08 (1.52)		0.25 (1.44)		
Very worried/ confident	0.34 (1.7)		0.81 (1.57)		
STS items 7–9 (cognitive valuation)					
My trip was the worst/ best I can imagine	0.38 (0.88)	0.79(0.84)	0.43 (0.94)	0.77(0.88)	0.02
My trip was low/high standard	1.08 (0.99)		0.99 (1.01)		
My trip worked very poorly/well	0.93 (1)		0.89 (0.98)		

Paired sample *t*-test for the item of the male and female partners; **p < 0.05 (one-tailed *t*-test).

Inflation Factor" or VIF. The VIF of the selected independent variables among models without interaction items was checked, with its value ranging from one to three, which suggests no multicollinearity within the data (Craney & Surles, 2002). Besides, robust standard errors were chosen in the model to address the non-constant variance of error terms (i.e., homoskedasticity) (Greene, 2003; Wooldridge, 2010).

4. Results

4.1. Travel mode consonance and dissonance

4.1.1. Distribution of travel preferences

As illustrated in Table 4, the percentage of respondents with a preference for a certain travel mode was calculated; a large share of female respondents (70.1 %) preferred e-bike use only; very few women preferred traveling by car (8 %) or by active travel modes (5.4 %) only. For male partners, the largest respondent group preferred e-bike use only (37.7 %), followed by those who only preferred the car (27.1 %) and then those who preferred both e-bike and active travel modes simultaneously (12.4%). The distribution of travel preferences suggests that e-bikes were favored by most respondents, especially women, while more men than women preferred car use.

4.1.2. Distribution of consonant and dissonant travelers

From a household perspective, only 424 couples (or 50.5 %) were able to commute by their preferred travel modes; the remaining couples had at least one dissonant traveler in the partnership (Fig. 3). In only 10.1 % of couples, no spouse was able to choose their preferred travel modes. In addition, 78.1 % of female partners were able to choose their preferred travel mode for the commute, compared to only 62.3 % of men (Table 1). This suggests that women can more easily select their preferred mode for commuting compared to men.

Most e-bike users are consonant travelers: 95.4 % female e-bike users and 89.0 % male e-bike users preferred to commute by e-bike (Table 4). The very small percentage of dissonant e-bike travelers are mainly those who had a preference for active travel. The average commute distances of those people were about two km for women and three km for men. Although these people preferred to walk and cycle, they tended to use e-bikes for such commute distances (i.e., 2–3 km).

Compared with e-bike users, more car users were dissonant travelers. Only 43.3 % of female car users and 52.1 % of male car users preferred to drive to work. Dissonant car users were mainly those who preferred to use e-bikes but instead traveled by car. This is not due to the unavailability of an e-bike, as most of the dissonant car users— both women and men—had access to an e-bike. People preferred to use e-bikes but chose to commute by car instead because of the long commuting distances; in fact, the average commute distance for dissonant car users who prefer e-bike travel was about 9.5 km for women and 7.7 km for men. Although people did not prefer to use a car, a car was required for long-distance commutes (i.e., 7.7–9.5 km).

When it comes to walking and cycling, travel mode dissonance occurs differently for women and men. For example, 64.3 % of female active travelers (i.e., pedestrians or cyclists) were dissonants while only 37.3 % of male counterparts were dissonants. Most dissonant active travelers preferred to use an e-bike. However, choosing an active travel mode here is not because e-bikes were not available; most were able to access an e-bike. People with a preference for e-bike travel tended to commute on foot or by bicycle if the commute distance was short. As shown in Table 4, the average commute distances of dissonant active travelers with a preference for e-bike use was about 0.6 km for women and 0.8 km for men. Dissonant active travelers might think it is unnecessary to use e-bikes for such short distances (i.e., 0.6–0.8 km).

4.2. Travel satisfaction of consonant and dissonant travelers

Table 5 shows that some consonant travelers tended to have higher than average scores than dissonant travelers in each STS dimension, but not many consonant travelers' scores are significantly higher than dissonant travelers' scores. For women, only consonant active travelers had a significantly higher average score than dissonant active travelers in the aspect of positive de-activation of STS; there does not exist such a difference in terms of car or e-bike use. For men, consonant car users had a significantly higher average score than dissonant car users in the positive de-activation and cognitive evaluation dimensions, while there was no such difference for the other two travel modes.

For the difference in STS between different travel modes, active travelers had a significantly higher satisfaction level than e-bike users for both women and men in all three STS dimensions, while there was no significant difference in most of the STS dimensions between e-bike users and car users for both women and men. In addition, female active travelers had higher satisfaction levels than female car users in all three dimensions of STS, while male active travelers had higher satisfaction levels than male car users only in the cognitive evaluation dimension.

4.3. Modeling results

After controlling for socio-economic attributes and trip characteristics, men and women showed different levels of travel satisfaction across the different STS dimensions. Table 6 (Model 1a, 2a, 3a) shows that men have lower scores in the positive activation of STS, but higher scores in the positive de-activation of STS than women. This suggests that female partners within the household were more enthusiastic, engaged, and alert than male partners during the morning commute to work, but they felt more stressed, worried, and hurried than male partners. More stress experienced by women than men during the commute aligns with previous findings (Chatterjee et al., 2020; Roberts et al., 2011; Wener et al., 2005). Moreover, there was no significant difference in terms of cognitive evaluation between spouses.

Three dimensions of STS are influenced by how individuals perceive

Table 4
Distribution of commute distance and availability of travel modes according to travel mode preferences and chosen travel modes for women and men respectively.

Chosen mode	Active travel				E-bike				Car			
	N	Commute distance (mean)	N-Car availability	N-E-bike availability	N	Commute distance (mean)	N-Car availability	N-E-bike availability	N	Commute distance (mean)	N Car availability	N-E-bike availability
Women's preference												
Car	1	0.54	0	1	3	3.72	0	3	63	5.74	63	50
E-bike	35	0.62	8	34	465	2.44	92	465	88	9.5	88	81
Active	6	0.31	1	4	20	2.07	2	20	19	7.74	19	16
Car-e-bike	0	--	--	--	7	2.76	4	7	11	8.53	11	9
Car-active	0	--	--	--	3	2.23	0	3	6	3.55	6	4
E-bike-active	14	1.16	3	12	61	2.1	10	61	15	8.19	15	14
All modes	0	--	--	--	9	2.72	3	9	13	9.07	13	13
Total	56				568				215			
Men's preference												
Car	2	0.97	1	0	7	5.56	1	7	218	7.89	218	173
E-bike	17	0.83	12	14	151	2.66	50	151	148	7.69	148	109
Active	16	1.01	5	12	16	2.97	4	16	69	7.67	69	48
Car-e-bike	0	--	--	--	0	--	--	--	25	9.87	25	17
Car-active	1	0.22	1	1	1	1.22	1	1	23	7.37	23	16
E-bike-active	10	0.86	6	4	38	3.07	16	38	56	8.85	56	39
All modes	5	0.92	3	4	5	2.01	3	5	31	5.56	31	20
Total	51				218				570			

Dissonant traveler
Consonant traveler

Commute distance (kilometers).
***N*-Car availability:** The number of respondents who could access a car; Access was based on self-reporting of car availability and allocation within a household; Car was also available for one person if they commuted by car as a passenger.
***N*-E-bike availability:** The number of respondents who could access an e-bike. We assume that an e-bike was available for one person when there was at least one e-bike available within the household, excluding the e-bike usage of the partner.

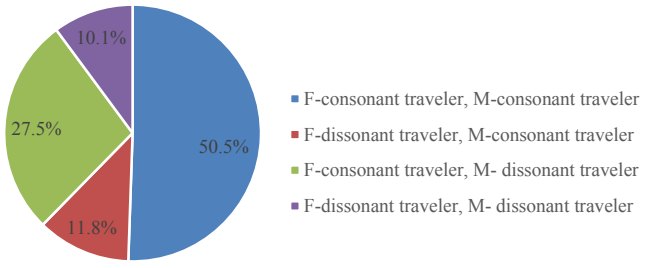

Fig. 3. The distribution of consonant and dissonant travelers at the household level("F" denotes "Female"; "M" denotes "Male").

the travel environment and congestion levels during the trip. Specifically, a better road environment and less congestion significantly increase the level of all three dimensions of STS. Moreover, travel mode choice plays an important influencing role in terms of satisfaction levels in most STS dimensions. Active travelers tended to have higher travel satisfaction than car users, in terms of both positive de-activation and cognitive evaluation of STS. It is very interesting to notice that e-bikes contributed to lower travel satisfaction in each aspect of STS, which is consistent with previous transport research in urban China (Ye & Titheridge, 2017). This might be related to the uniqueness of e-bike use in China: e-bike use does not consume any energy but users are sometimes subject to adverse weather and travel conditions. E-bikes can thus be less comfortable than a car.

Commute frequency and commute time also influence the level of travel satisfaction. People who work for six or seven days per week usually have lower levels of travel satisfaction in both positive activation and de-activation aspects of STS. This is because more working days suggests higher commute frequency, which contributes to more repetitiveness and tiredness with travel and therefore lower levels of travel satisfaction. Moreover, as expected, commute time had a negative impact on two dimensions (i.e., positive de-activation and cognitive evaluation) of STS.

For the impact of socio-economic attributes, people aged between 36 and 40 were less satisfied with travel than older people in the positive activation of STS. In addition, people with higher incomes were less satisfied than those with lower incomes in the positive de-activation of STS. This might be because people with higher incomes in small cities tended to work in government or at companies, schools or hospitals; these respondents must be punctual which leads to higher commute stress. In contrast, low-income commuters tended to be self-employed or freelancers and so had more flexibility in terms of commute time and so experienced less stress and a reduced sense of urgency during the trip.

For impacts related to the interaction items, very few variables showed differing impacts by gender. Table 6 (Model 1b, 2b, 3b) shows that the level of travel satisfaction for women and men is influenced differently by socio-economic and trip-related variables. For the positive activation dimension, the satisfaction levels of men are more positively associated with their evaluation of the environment during the commute than that of women. For the positive de-activation aspect, the satisfaction level of men is more sensitive to the number of working hours per day than that of women. It is also very interesting to notice that in this regard high income contributed to lower levels of travel satisfaction for women but higher levels of travel satisfaction for men. For cognitive evaluation, satisfaction for men is more heavily influenced by perceived congestion than women. This mainly results from the fact that more men in our sample than women chose to commute by car which means that their travel experiences could be more easily affected by traffic volume and road congestion.

After controlling for the impact of socio-economic attributes and trip characteristics, we found that travel mode dissonance contributed to lower levels of satisfaction in only two STS dimensions (positive de-activation and cognition). However, this impact was marginally significant (at around $t \geq 1.5$–1.65 level), suggesting that individuals who commuted with their less-preferred travel mode tended to have lower levels of travel satisfaction, but this was not a strong tendency. This may partly be due to a certain level of correlation between travel mode dissonance and trip characteristics such as commute duration (i.e., some individuals tended to be dissonant car users if they have longer commute distances), which reduces the impact of dissonance on travel satisfaction.

Table 5
Average travel satisfaction levels of consonant and dissonant travelers according to selected mode.

	Positive activation		Positive de-activation		Cognitive evaluation	
		Mode total		Mode total		Mode total
Women						
Dissonant active travelers	0.91	0.89 [ab]	0.57	0.76 [ab]	1.07	1.1 [ab]
Consonant active travelers	0.87		1.1		1.15	
Dissonant e-bike users	0.49	0.45[b]	0.27	0.19	0.76	0.78
Consonant e-bike users	0.45		0.18		0.78	
Dissonant car users	0.53	0.58	0.24	0.27	0.73	0.74
Consonant car users	0.65		0.3		0.75	
Men						
Dissonant active travelers	0.25	0.52 [a]	0.47	0.72 [a]	1.02	1.03 [ab]
Consonant active travelers	0.69		0.86		1.03	
Dissonant e-bike users	0.35	0.31[b]	0.5	0.45	0.58	0.74
Consonant e-bike users	0.31		0.44		0.76	
Dissonant car users	0.46	0.49	0.36	0.49	0.68	0.76
Consonant car users	0.53		0.62		0.84	

Note for grey boxes: average scores of consonant travelers are significantly higher than those of dissonant travelers at $p < 0.1$ (t-test)
a. Significantly different from e-bike users (t-test)
b. Significantly different from car users (t-test)

Note for grey boxes: average scores of consonant travelers are significantly higher than those of dissonant travelers at $p < 0.1$ (*t*-test).
a. Significantly different from e-bike users (*t*-test).
b. Significantly different from car users (*t*-test).

5. Conclusion

During recent years, the role of attitudes has received more attention in travel behavior and well-being research. The extent to which an individual is able to choose their preferred mode has been considered to play an influencing role in travel experiences and well-being. However, existing research regarding this issue mainly comes from the individual level and thus lacks a household perspective, especially in a non-western context. Using survey data collected from couples in Ganyu (a small Chinese city), this research explored the extent to which spouses could choose their preferred travel modes within a household, and whether a dissonance between the preferred and actual chosen travel mode contributed to lower levels of travel satisfaction.

Although positive attitudes towards a certain mode contributed to a high tendency to choose that mode, many individuals were unable to travel by their preferred travel mode all the time. Our study found that in only about half of the couples (or 50.5 %), both spouses could commute by their preferred travel mode. The remaining couples were those where one or both partners were unable to use their preferred travel mode. Compared with female partners (21.9 %), more male partners (37.7 %) were unable to use their preferred travel mode, and most dissonant travelers were car users with a preference for e-bikes.

We also found that the occurrence of travel mode dissonance was unrelated to travel mode availability but instead to travel distances. People tended to drive to work if the commute distance was long, despite the fact that some respondents did not like traveling by car; this creates dissonant car users. To some extent, this explains the higher percentage of dissonant travelers that are men. In particular, men tended to have longer commute distances than women, but not many of them preferred car use, which resulted in a considerable percentage of male dissonant travelers. Similar to dissonant car users, if the commute distance was short, some people who do not like active travel may walk or cycle to work and therefore become dissonant active travelers. Based on the average commute distance of dissonant travelers, we found that 600 m was acceptable for most female dissonant active travelers while 800 m was acceptable for most male active dissonant travelers. For most dissonant e-bike travelers, this number was about two km for women and three km for men. Finally, for most dissonant car users, 9.5 km was acceptable for women and 7.7 km was acceptable for men.

Additionally, while travel mode dissonance contributed to lower levels of travel satisfaction, its impact was marginally significant compared with travel mode choice, which is significantly related to travel satisfaction. This suggests that travel satisfaction is more influenced by the travel mode used by individuals rather than whether the chosen travel mode is preferred or not. People who commuted with their less-preferred travel mode tended to have lower levels of travel satisfaction, but this was not a strong tendency. This can also be seen in Table 5, where dissonant travelers do not have lower levels of satisfaction than consonant travelers, except pedestrians and cyclists for women and car users for men. This finding is consistent with Pedersen, Friman, and Kristensson (2011) who found that people may not be able to predict their experience based on their attitudes and preferences, indicating a fundamental difference between attitude and subjective experience. The traffic environment in our study area (a small Chinese city) may contribute to the explanation for this phenomenon. The popularity of e-bikes combined with less traffic congestion in our research context creates a better driving environment for car use. As a result, people—especially those who dislike driving—will not be annoyed by the road environment or less traffic congestion and so will not be dissatisfied with the trip if they have to commute for a long distance by car. However, dissonant travelers tend to have lower levels of travel satisfaction than consonant travelers if they are commuting in a big Chinese city where serious traffic congestion is common, which was confirmed in a recent study conducted in Xi'an (Ye & Titheridge, 2019). Another possible explanation comes from the modeling specification: the travel duration, a factor significantly associated with the occurrence of travel mode dissonance, may attenuate the effect of travel mode dissonance on travel satisfaction, as it has been found to exert such an impact regarding the relationship between travel mode choice and travel satisfaction in a recent study by De Vos, Le, and Kroesen (2022). Moreover, the

Table 6
Regression analyses results.

	Positive activation				Positive de-activation				Cognitive evaluation			
	Model 1a		Model 1b		Model 2a		Model 2b		Model 3a		Model 3b	
	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value	Coef.	*t*-value
Gender (ref: Women)												
Men	**−0.12**	**−2.74**	**−0.50**	**−3.06**	**0.28**	**4.16**	0.12	0.89	−0.01	−0.27	**−0.40**	**−2.61**
Age (ref: >40)												
25–35	−0.04	−0.82	−0.04	−0.82	0.01	0.14	0.02	0.21	0.04	0.78	0.04	0.75
36–40	**−0.08**	**−1.82**	**−0.08**	**−1.71**	−0.09	−1.40	−0.10	−1.45	0.01	0.22	0.01	0.19
Income (ref: <50 k)												
50 k or more	0.03	0.60	0.03	0.60	**−0.15**	**−2.04**	**−0.24**	**−2.63**	0.01	0.23	0.002	0.05
Number of children (ref: 1)												
> 1	0.02	0.42	0.02	0.41	−0.10	−1.27	−0.11	−1.32	0.05	1.10	0.06	1.11
Number of working hours/day (ref: 8 or less)												
> 8	−0.01	−0.22	−0.01	−0.14	**−0.32**	**−4.26**	**−0.20**	**−1.99**	−0.05	−1.21	−0.05	−1.19
Number of working days/week (ref: 5 or less).												
6	−0.05	−0.98	−0.05	−0.99	**−0.16**	**−2.09**	**−0.17**	**−2.23**	0.01	0.28	0.01	0.25
7	**−0.16**	**−2.75**	**−0.16**	**−2.83**	0.02	0.22	0.02	0.23	−0.08	−1.43	**−0.08**	**−1.53**
Commute duration (mins)	−0.002	−0.83	−0.002	−0.73	**−0.01**	**−2.80**	**−0.01**	**−2.62**	**−0.01**	**−2.45**	**−0.01**	**−2.44**
Perceived congestion (From very congested to not congested at all)	**0.11**	**5.80**	**0.11**	**5.85**	**0.29**	**11.31**	**0.29**	**11.3**	**0.28**	**16.89**	**0.24**	**10.86**
Perceived environment (From very unpleasant to very beautiful)	**0.28**	**13.45**	**0.23**	**8.67**	**0.14**	**5.35**	**0.14**	**5.39**	**0.18**	**10.45**	**0.18**	**10.58**
Commute mode of choice (ref: Car)												
Active	0.15	1.48	**0.15**	**1.53**	**0.22**	**1.67**	**0.23**	**1.71**	**0.23**	**2.51**	**0.22**	**2.45**
E-bike	**−0.19**	**−3.40**	**−0.19**	**−3.38**	**−0.28**	**−3.49**	**−0.27**	**−3.26**	**−0.11**	**−2.16**	**−0.11**	**−2.22**
Travel mode consonance and dissonance (ref: consonance)												
Dissonance	−0.05	−1.11	−0.05	−1.04	**−0.12**	**−1.63**	−0.11	−1.5	**−0.07**	**−1.51**	−0.06	−1.39
Gender * Income												
Men * 50 k or more			——	——			**0.30**	**2.06**			——	——
Gender* Number of working hours/day (ref: 8 or less)												
Men * >8			——	——			**−0.22**	**−1.69**			——	——
Men *Perceived congestion			——	——			——	——			**0.08**	**2.63**
Men *Perceived environment			**0.09**	**2.32**			——	——			——	——
Constant	**−0.92**	**−6.75**	**−0.76**	**−5.10**	**−1.08**	**−5.54**	**−1.08**	**−5.39**	**−1.18**	**−9.56**	**−0.99**	**−6.84**
R square	0.21				0.16		0.16		0.30			
			0.22								0.30	

Variables significant at t > 1.5 are bolded in the table.
"——" denotes those interaction items not significant at t > 1.5; these variables and other non-significant interaction items were not included in the model.

categorization of travel mode dissonance into binary variables may obscure some differences in travel satisfaction, if the dissonance degree plays a larger role in explaining travel satisfaction.

This study also provides deeper insight into the level of travel satisfaction among spouses within a household. We found that women and men have different scores in the three STS dimensions. Specifically, women experienced more stress and pressure than men during the commute, which is in line with previous studies (Roberts et al., 2011). However, female partners tended to be more enthusiastic, alert, and engaged than male partners during the morning commute; there was no significant difference between spouses in the cognitive evaluation of STS. Besides, the different levels of perception around traffic congestion and environment during travel for women and men are the key to understanding the differences in travel satisfaction between spouses. Compared to women, the extent to which men are satisfied with their commute is more sensitive to how they perceived the environment and the level of congestion on roads.

This research has some limitations. The measurement of attitudes towards various travel modes is more general and so did not consider different attitude dimensions such as affective and cognitive aspects (Ajzen, 2001; Crites et al., 1994). Commuters may cognitively accept a certain travel mode but dislike it in the affective aspect. In addition, because data collection was restricted to the parents of students, the research did not analyze couples without children or elderly couples; our results therefore cannot be applied to the whole population. In particular, based on the census in local areas, the segment of the population aged 15 to 59[4] only accounts for 56.4 % of the whole; the findings of this study mainly reveal the situation for couples with school-age children who belong to this age-range group. Moreover, the sample obtained from our selected four urban-area schools does not represent couples with children in rural schools, although our sample also includes a few rural residents. Hence, a stricter random sampling process with the whole population is required in future research to contribute to a more general conclusion. Moreover, findings in this study only reveal the conditions in a small Chinese city; whether or not individuals tend to have a lower level of travel satisfaction when using their less preferred travel mode might differ in different geographical contexts. More comparison studies (e.g., big cities versus small cities) are recommended for future research to understand the role of geographical context in the relationship between attitudes, travel mode choice, and satisfaction.

CRediT authorship contribution statement

Yang Hu: Conceptualization, Funding acquisition, Investigation, Data curation, Methodology, Writing – original draft, Writing – review & editing. **Anae Sobhani:** Methodology, Formal analysis. **Dick Ettema:** Conceptualization, Methodology, Formal analysis, Writing – review & editing.

[4] The official census does not provide population information with further categorization based on age.

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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