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# Dynamic Analysis of Holiday Travel Behaviour with Integrated Multimodal Travel Information Usage: A Life-Oriented Approach

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## Abstract

The Integrated Multimodal Travel Information (IMTI) plays an important role in the evolution process of holiday travel behaviour, which is seldom investigated. To fill this gap, this study analyses holiday travel behaviour dynamics with IMTI usage, based on the life-oriented approach. IMTI usage is taken as a separate life domain in this study, and a two-way relationship between holiday travel biography and IMTI usage biography over the life course, is examined after controlling for the effects of residential, household structure, employment/education, and car ownership biographies. Based on the web-based life history survey data, statistical characteristics of mobilities in each life biography are first analysed. Then, different random-effects ordered logistic models are established to investigate the biographical interdependencies from three aspects: intra-domain interdependency, inter-domain interdependency and outer-domain interdependency. The results show that the life biography is not only affected by a personal life course, but also affected by external background of the times. Under the interaction of inner individual factors and outer environment factors, there is an obvious dynamic two-way relationship between holiday travel biography and IMTI usage biography. Meanwhile, residential, household structure, employment/education and car ownership biographies have significant effects on these two life biographies. Especially, the influence of long-term state dependence for different life domains, over the life course, is much more obvious when explaining holiday travel behaviour dynamics and IMTI usage mobilities. Therefore, the life-oriented approach provides a valid method for analysing the dynamics of holiday travel behaviour with IMTI usage.

**Keywords:** Dynamic analysis; Holiday travel behaviour; Integrated Multimodal Travel Information (IMTI) usage; Biographical interdependence; Life-oriented approach; State dependence

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## 1. Introduction

With the expansion of transport infrastructure and the improvement of people's living standards in China, holiday travel demand is increasing significantly. According to official statistics, the number of domestic tourists reached 3262 million person-times in 2013, with an average growth rate of 14.3% per year from 2004 to 2013 (Shao, 2014). Gradually, holiday travel has become an inevitable part in people's lives in China, but its spatiotemporal characteristics are more concentrated in time and space. Chinese people have an average paid annual leave of 11 days per year, which is less than many other countries (Dahlgreen, 2015). That makes them prefer to arrange their holiday travel in statutory holidays.

Moreover, most tourist attractions, or commercial centers, locate in big cities or tourism cities, thus holiday traffic congestion becomes more and more serious in large commercial centers and tourist attractions during statutory holidays (China News, 2014). As a large number of travellers pouring into their destinations, people's activities and travel scheduling become more diverse and complex (Liu and Sharma, 2008). Therefore, it is necessary to study the characteristics of holiday travel behaviour and analyse the influencing factors for the dynamic evolution process of holiday tours, in order to make an appropriate travel demand management (TDM) policy and alleviate traffic congestion in holidays.

Holiday travel behaviour has different properties, compared with commuting on workdays. Firstly, holiday travel demand is elastic with more flexibility in time and space, thus the destination, departure time, travel mode and travel route in holidays, are not fixed. Secondly, a holiday travel union is usually a group, rather than an individual, so the holiday travel decision process involves multiple facets or portfolio choices concerning the group needs (Dellaert et al., 1998; Grigolon et al., 2013a). Meanwhile, holiday travel choices may take a longer decision-making process and establish long-term agendas. Thirdly, there are many statutory holidays in a year. Some occur in January, some take place in March, and some are celebrated in December. So different holidays occur at different time points, which are discrete in time. Moreover, the vacation time is usually very short, some holidays only have one day off. Thus, it is difficult to investigate holiday travel behaviour dynamics in the short-term (day to day dynamics for one week or several weeks). Therefore, this study analyses the dynamics of holiday travel behaviour in the long-term (year to year dynamics through one's lifetime after 18 years old), and establishes a dynamic evolution model for holiday travel behaviour considering multiple dimensional choices of elastic travel demand.

The dynamic evolution of holiday travel behaviour is a process of activity and travel scheduling changing over time, which results from the interaction of inner individual factors and outer environment factors. From the perspective of an individual level, individual travel behaviour may change in response to the variation of socio-demographic characteristics and self-selection issues in different life domains (Cosenza and Davis, 1981; Zhang, 2014a). On the social environment level, the dynamic balance of holiday travel choices may be broken by external forces in the long-term, such as transport infrastructure expansion and Intelligent Transportation System (ITS) construction (Wang et al., 2015a). Moreover, inner individual factors and outer environment factors are not independent, but inter-related with each other. However, most studies separate these two factors and focus on the influence of certain, or partial variables. Few studies investigate the interdependences between these influencing factors and analyse their overall

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87 effects on holiday travel behaviour. Therefore, the life-oriented approach is proposed to fill this  
88 gap.

89 According to the life-oriented approach, the dynamic travel choice results from dynamic  
90 influencing factors covering various life domains (e.g. residence, job, education, family life,  
91 leisure and recreation, as well as relevant travel behaviour) (Zhang, 2016). Moreover, with the  
92 rapid development of information technology, information usage plays an important role in our  
93 daily lives. It influences all aspects of people's work, study, and other life domains, and these life  
94 choices also affect their information usage at the same time. Similarly to travel behaviour,  
95 information usage results from different life choices and life choices are also affected by  
96 information usage too. Therefore, this study takes Integrated Multimodal Travel Information  
97 (IMTI) usage as a separate life domain, and investigates the two-way relationship between the  
98 holiday travel behaviour domain and the IMTI usage domain, after controlling for the effects of  
99 residential, employment/education, household structure, and car ownership domains over the life  
100 course.

101 IMTI is defined as a variety of activity and travel information covering all kinds of the trip  
102 modes, which can be divided into qualitative information (e.g. real-time traffic accident location,  
103 traffic control section, heavy traffic roads, etc.), quantitative information (e.g. queue length,  
104 vehicle speed, bus/metro arrival time, total travel time, etc.) and advisory message (e.g. route  
105 choice suggestion, departure time suggestion, alternative transfer information, etc.). IMTI usage  
106 mainly refers to the number of IMTI queries, query method and the influence degree of IMTI.  
107 There are a variety of ways to disseminate IMTI in holidays in China, including web portals,  
108 traffic radio, Variable Message Sign (VMS), call centres, Short Messaging Service (SMS)  
109 platforms, mobile communication terminals, electronic information boards, etc. (Wang et al.,  
110 2015a).

111 Many studies focus on the information influence on travel decisions, such as mode choice,  
112 destination choice and route choice, and take commuting as the research object (Grotenhuis et al.,  
113 2007; Liu et al., 2013; Parvaneh et al., 2012). However, very few studies investigate the two-way  
114 relationship between holiday travel behaviour and IMTI usage. Moreover, most studies only  
115 consider the influencing factors in one life domain, and neglect the influence of other life domains.  
116 In reality, IMTI is a critical factor that may influence and constrain holiday travel behaviour  
117 significantly, and holiday travel behaviour also has significant effects on IMTI usage at the same  
118 time. Therefore, understanding their two-way relationship will help to provide an effective IMTI  
119 service to induce the traveller's behaviour in holidays, and alleviate holiday traffic congestions  
120 effectively.

121 In light of the demonstration above, the contribution of this study is three-fold: (1) It makes  
122 an initial attempt to apply the life-oriented approach to analyse holiday travel behaviour dynamics  
123 in the long-term. (2) Extending the major life domains of Zhang (2015) and taking IMTI usage as  
124 a separate life domain. The two-way relationship between holiday travel behaviour biography and  
125 IMTI usage biography is investigated after controlling for the effects of the other life biographies.  
126 (3) Enriching the life-oriented approach and providing the research framework for analysing  
127 holiday travel behaviour dynamics, considering biographical interdependencies among different  
128 life domains from three aspects: intra-domain interdependency, inter-domain interdependency and  
129 outer-domain interdependency.

130 This study is organised as follows. Section 2 briefly reviews the literature on holiday travel

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131 behaviour dynamics and the life-oriented approach. It also indicates the shortage of existing  
132 research and then clarifies the content and object of this study. Section 3 proposes the research  
133 framework and describes the modelling approach and model variables used in this study. Section 4  
134 contains the survey and sample, and a statistical analysis for data is then presented in Section 5.  
135 Section 6 presents model results with detailed discussion, and finally, important findings and  
136 related policy suggestions are summarised.

137

## 138 **2. Literature review**

### 139 **2.1 Research on travel behaviour dynamics**

140 With the deepening of travel behaviour research, the static activity-travel model exposes its  
141 limitations and cannot fulfil the increasing research needs, then the focus shifts from the cross  
142 sectional modelling to the dynamic modelling gradually (Sharmen, 2014). Meanwhile, the  
143 research perspective is changing from short-term dynamics to long-term dynamics (Srinivasan and  
144 Bhargavi, 2007).

145 The research on travel behaviour dynamics can be divided into micro dynamics research and  
146 macro dynamics research. The micro dynamics consider the generation process of daily activity  
147 travel scheduling, and explain the formation and allocation of different activities within a day  
148 (Arentze et al., 2011; Ettema and Timmermans, 2003; Krygsman et al., 2006; Srinivasan and  
149 Athuru, 2005).

150 On the other hand, the macro dynamics investigate the dynamic evolution process of travel  
151 behaviour over time, which can be investigated from the perspective of short-term or long-term. In  
152 the short-term, day to day dynamics are investigated between different workdays for different  
153 types of activities (Habib and Miller, 2008; Roorda and Ruiz, 2008). The role of household  
154 members and space-time constraints can be considered into the day to day dynamic analysis of  
155 travel behaviour (Kang and Scott, 2010; Neutens et al., 2012). In the long-term, year to year  
156 dynamics of travel behaviour are investigated using panel data between consecutive years. The  
157 persistent inertia factor and state dependence are also considered in the long-term dynamic models  
158 (Golob, 1990; Roorda and Ruiz, 2008; Srinivasan and Bhargavi, 2007). Besides, there is a group  
159 of scholars utilising the process modelling to provide an insight into the dynamic transfer process  
160 of travel behaviour choices (Goulias, 1999; Vij et al., 2013; Xiong and Zhang, 2015). However,  
161 most of these studies take the commuting as the research object, and very few studies investigate  
162 the dynamics of holiday travel behaviour.

163 Several studies analyse travel behaviour dynamics from the perspective of an individual life  
164 course. Representative approaches include the life cycle approach (Fried et al., 1977; Vij et al.,  
165 2013; Zimmerman, 1982) and the life course (or life trajectory or life event) approach (Lanzendorf,  
166 2003; Oakil, 2013). Within these theoretical frameworks, travel behaviour is changing over  
167 longitudinal trajectories of individual life course, in terms of key events that bring in major  
168 changes. Kitamura and Kostyniuk (1986) suggested that life course accounts for as much or more  
169 variation, in travel, than socio-demographic characteristics. Ortúzar and Willumsen (2011) also  
170 identified the life cycle as an important factor affecting the decision-making of travel behaviour.

171 The analysis of travel behaviour choices over the life course covers various aspects, including  
172 tourism choices (Collins and Tisdell, 2002; Fodness, 1992; Gibson and Yiannakis, 2002),

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173 destination choices (Oppermann, 1995; Oppermann, 1998), and transport mode choices (Davison  
174 and Reley, 2013; Huby and Burkitt, 2000). Other studies have focused on a specific life cycle  
175 stage, and some take the student's vacation behaviour as the study object (Carr, 2002; Grigolon et  
176 al., 2012; Peercy and McCleary, 2011; Ross, 1993; Sung, 2004). However, most studies simply  
177 consider certain (age) or partial factors as the explanatory variables to describe the relationship  
178 between the travel behaviour choice and life course, and the variation of explanatory variables  
179 over time is seldom considered in their models.

180 The travel behaviour decision process involves multiple facets or portfolio choices for  
181 travellers to fulfil their travel needs. The portfolio choices cover all aspects of travel behaviour  
182 characteristics, including travel time, travel distance, travel mode, number of companions, activity  
183 durations and so on (Chu, 2003; Van Acker et al., 2007). The influencing factors for travel  
184 behaviour choices have been studied from various aspects. Some studies explore the relationship  
185 between land use and travel behaviour (Maat and Timmermans, 2006; Van Acker and Witlox, 2011;  
186 Van Acker et al., 2014), and some researchers think personal preferences, socio-demographic  
187 characteristics and the built environment could influence people's activity choices (Grigolon et al.,  
188 2013b; Jenelius et al., 2011; LaMondia and Bhat, 2012; Van Acker et al., 2012). Moreover, some  
189 investigate how recreation travel is influenced by the family lifecycle (Grigolon et al., 2013a), and  
190 some indicate that IMTI has a significant effect on holiday travel behaviour (Wang et al., 2015b).

191 However, few studies investigate the interdependence among these influencing factors  
192 comprehensively and analyse their overall effects on the evolution process of travel behaviour.  
193 Moreover, the research framework is lacking with regard to analysing holiday travel behaviour  
194 dynamics. Therefore, this study provides the research framework for the dynamic analysis of  
195 holiday travel behaviour, based on the life-oriented approach, and analyses the two-way  
196 relationship between holiday travel biography and IMTI usage biography, considering the  
197 interaction of inner individual factors and outer environment factors.

## 199 2.2 The life-oriented approach

200 The life-oriented approach is proposed by Zhang in 2010, which argues that people's  
201 decisions on various life domains are not independent with each other and an understanding of life  
202 choices should not be constrained by the boundary of any single discipline (Zhang, 2010; Zhang,  
203 2012; Zhang, 2015; Zhang 2016).

204 In general, this theory puts forward four main points: (1) People's life choices in various  
205 domains, e.g. residence, neighbourhood, health, education, work, family life, leisure and  
206 recreation, finance, and travel behaviour, are interdependent with each other (Zhang, 2014a). (2)  
207 Travel behaviour results from various life decisions, and any understanding of travel behaviour is  
208 secondary to a fundamental understanding of life choice decisions (Zhang, 2014b). (3) There is a  
209 two-way relationship between travel behaviour and the other life domains (Zhang et al., 2014). (4)  
210 People's life choices are closely related with the quality of life (QOL), which should be improved  
211 by the collaboration of different governmental sectors (Zhang et al., 2012; Xiong and Zhang,  
212 2014). Existing research has verified the rationality of this theory, but related empirical studies are  
213 very limited.

214 The essential difference between the activity-based approach and life-oriented approach is  
215 that: the former argues that the travel demand is derived from activity participation, and the latter

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216 argues that the travel demand is derived from life decisions (Bowman, 1998; Zhang, 2014b). The  
217 former takes tours as the study object, while the latter takes life domains as the study object  
218 (Primerano et al., 2008). Therefore, the life-oriented approach provides a new method for  
219 understanding the dynamics of holiday travel behaviour with IMTI usage.

220 The life-oriented approach applies a life history analysis to understand people's long-term  
221 decisions on travel behaviour, which incorporates interdependences between different life domains  
222 (Zhang, 2014b). However, in the current life-oriented approach, Internet usage has only been  
223 regarded as an explanatory variable for the leisure and recreation domain (Zhang, 2014a). Actually,  
224 the development of ITS influences people's travel habits and changes their travel behaviour  
225 choices significantly (Ben-Elia et al., 2013; Bekhor and Albert, 2014; Farag and Lyons 2012).  
226 Especially, IMTI has significant effects on individual activity travel scheduling and decisions  
227 under elastic demand (Grotenhuis et al., 2007; Wang et al., 2015b). Therefore, this study takes  
228 IMTI usage as a separate life domain, and different random-effects ordered logistic models are  
229 built to analyse the long-term dynamics of holiday travel behaviour with IMTI usage based on the  
230 research framework.

231 In this study, "holiday" refers to the statutory holidays in China, and "holiday travel" means a  
232 travel or outing for one day, or several days, during this specific period. There are seven statutory  
233 holidays for all citizens in China, and this study only considers four statutory holidays, i.e. the  
234 Spring Festival in January or February, Tomb-Sweeping Day in April, May Day in May and  
235 National Day in October. The reason can be explained as: (1) The Spring Festival, May Day and  
236 National Day are the first approved national statutory holidays in China and the Tomb-Sweeping  
237 Day was formally executed in 2008. (2) They are called "Major Holidays" in China, which have  
238 longer days off compared with the other statutory holidays. From 1999 to 2007, the Spring  
239 Festival, May Day and National Day all have seven days off. From 2008 to now, the Spring  
240 Festival, and National Day have seven days off, and the Tomb-Sweeping Day and May Day have  
241 three days off. (3) The Spring Festival, Tomb-Sweeping Day, May Day and National Day are the  
242 first and only approved national statutory holidays, when all of the national highways are free  
243 during these periods.

244 Therefore, holiday travels in these four statutory holidays have similar characteristics, which  
245 have strong representativeness among holiday activity and travel scheduling.

246

## 247 **3. Methodology**

### 248 **3.1 Research framework**

249 Six life biographies are considered in this study: residential biography, household structure  
250 biography, employment/education biography, car ownership biography, holiday travel biography  
251 and IMTI usage biography. Biography is defined as a series of mobilities in each life domain over  
252 the life course, and mobility indicates a change occurring in each domain, which is similar to a life  
253 event that brings major changes. A series of mobilities divide the life course into a sequence of  
254 episodes, and the episode duration is the period between two consecutive mobilities (Zhang et al.,  
255 2014). It is easy to understand that the episode duration is the lasting time of a state. In the  
256 long-term dynamics, the time points of mobilities are recorded in years. Therefore, a life  
257 biography is able to demonstrate how the state of a life domain changes year by year, over the life

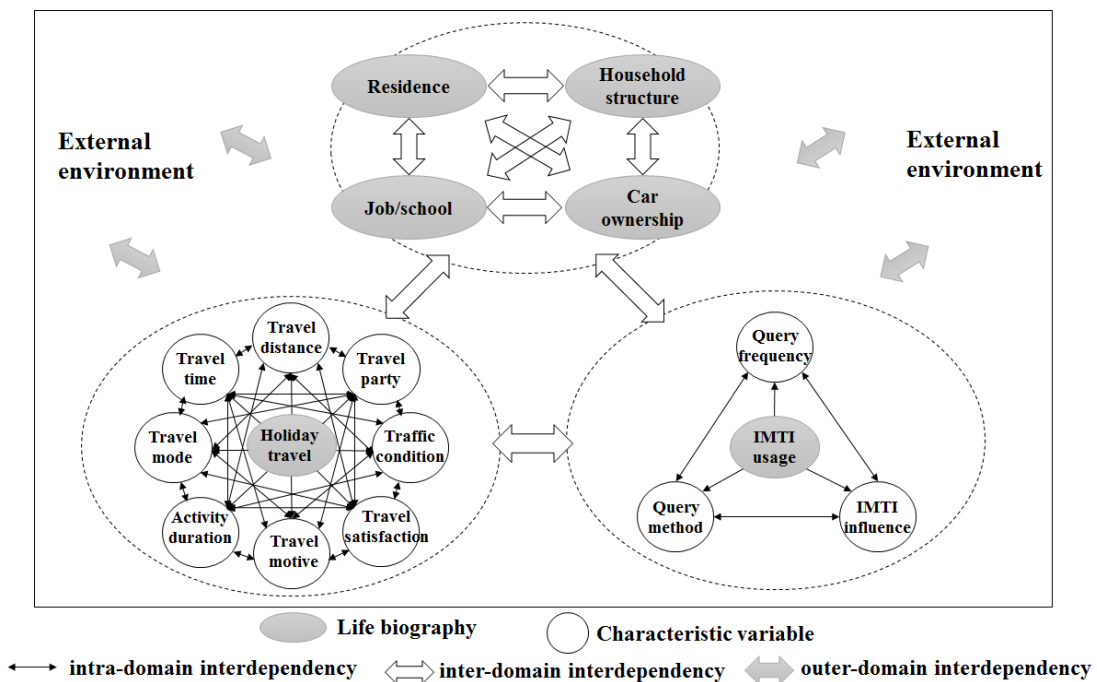
258 course, and the state of a year is called a scenario.

259 Analysing the biographical interdependencies among different life domains over the life  
260 course, is the key interest of this study, which includes the intra-domain interdependency,  
261 inter-domain interdependency and outer-domain interdependency. Intra-domain interdependency  
262 considers multiple facets or portfolio choices for a life domain, which describes the dynamic  
263 relationships between multiple facet choices of this life domain. For example, the intra-domain  
264 interdependency for the holiday travel biography includes multiple choices of holiday travel  
265 behaviour, such as travel time, travel distance, number of companions, activity durations and so on.  
266 Moreover, the historical experience (state dependency) can be considered in the intra-domain  
267 interdependency analysis.

268 On the other hand, the inter-domain interdependency indicates the two-way relationship  
269 between different life domains. A mobility in one life domain may affect the other life biographies  
270 over the life course, so the co-occurrence of different life biographies should be analysed through  
271 the inter-domain interdependency. Moreover, the state dependence or lag effects can also be  
272 considered in the inter-domain interdependency analysis.

273 Furthermore, the outer-domain interdependency mainly describes the two-way relationship  
274 between the external environment and life domains. Obviously, the development of society and  
275 economy affects people's self-selection issues in different life domains. At the same time,  
276 individual life choices could influence the development process of social environment, such as the  
277 relationship between the land use and urban transport system. Therefore, the proposed research  
278 framework of this study is shown in Fig. 1.

279



280

281

Fig. 1. Research framework.

282

283 In order to investigate the dynamic evolution process of holiday travel behaviour with IMTI  
284 usage, this study focuses on the inter-domain interdependency between holiday travel biography  
285 and IMTI usage biography, after controlling for the effects of residential, household structure,

286 employment/education, and car ownership biographies. In the meantime, the intra-domain  
 287 interdependency and outer-domain interdependency of these two life biographies are also  
 288 considered in the models. However, this study only considers the one-way influence of external  
 289 environment factors on holiday travel and IMTI usage biographies, to prove the existence of the  
 290 outer-domain interdependency.

### 291 3.2 Random-effects ordered logistic model

292 In order to capture the evolution process of holiday travel behaviour in the long-term, the  
 293 panel data or longitudinal data is required. Panel data is traditionally obtained through tracking the  
 294 behaviour of a group of individuals in consecutive periods. It combines the advantages of cross  
 295 section data and time series data, and can provide more information on individual travel behaviour  
 296 dynamics. Therefore, this study uses the panel data to analyse the biographical interdependences  
 297 between different life biographies over the life course.

298 Qualitative response models have been a growth industry in econometrics, particularly in the  
 299 area of panel data analysis, which combines probabilities with econometric tools to make  
 300 probabilistic statements about the occurrence of events (Green, 2011). The advantage of this kind  
 301 of model is allowing the model builder to learn about economic processes, while accounting for  
 302 both individual heterogeneity and dynamic effects that are not visible in cross sections.

303 A random-effects ordered logistic model is such a model, which has two or more ordered  
 304 responses. The biggest difference between a random-effects ordered logistic model and a standard  
 305 ordered logistic model is the former considers the individual specific heterogeneity in the dynamic  
 306 analysis. Individual life choices are discrete choices, because people are usually faced with two or  
 307 more options. Moreover, the values of some variables follow a certain order. Therefore, this study  
 308 applies the random-effects ordered logistic model to analyse the dynamic interrelationships among  
 309 different life biographies.

310 The random-effects ordered logistic model is a multinomial response model, where the  
 311 responses are irrelevant and ordered (Wooldridge, 2010). The observed ordered variables  $y_{it}$  can  
 312 be derived from latent continuous variables  $y_{it}^*$ , such that

$$313 \quad y_{it} = \begin{cases} 1, & \text{if } y_{it}^* \leq \mu_1 \\ 2, & \text{if } \mu_1 < y_{it}^* \leq \mu_2 \\ \vdots & \\ K, & \text{if } y_{it}^* > \mu_{k-1} \end{cases} \quad (1)$$

314 where  $i = 1, 2, \dots, N$  for panels, and  $t = 1, 2, \dots, T$  for observed periods.  $K$  is the number  
 315 of possible values of  $y_{it}$ , and  $y_{it}^*$  is a latent continuous variable. The relationship between  $y_{it}$   
 316 and  $y_{it}^*$  is decided by a set of utility cut points  $\mu_1, \mu_2, \dots, \mu_{k-1}$ . Assuming the latent variables  $y_{it}^*$  is  
 317 determined by

$$319 \quad y_{it}^* = \alpha_i + \beta x_{it} + \varepsilon_{it} \quad (2)$$

320 where  $\alpha_i$  are independent and identically distributed  $N(0, \sigma_v^2)$ , which represent  
 321 unobservable individual effects that do not change with time. The error term  $\varepsilon_{it}$  are distributed as  
 322 logistic with  $E(\varepsilon_{it}) = 0$ ,  $Var(\varepsilon_{it}) = \pi^2 / 3$ , which are independent of  $\alpha_i$ .  $x_{it}$  is the explanatory  
 323 variable changed with individual and time, which could be life choice variable or lag variable for  
 324 different life biographies.  
 325



In this study,  $y_{it}^*$  refers to the holiday travel biography or IMTI usage biography, which has a linear relationship with explanatory variables. Based on the research framework, the latent variable model can be expressed as

$$y_{it}^* = \alpha_i + \beta_1 Intra_{it} + \beta_2 Intra_{it-5} + \beta_3 Inter_{it} + \beta_4 Inter_{it-5} + \beta_5 Outer_{it} + \varepsilon_{it} \quad (3)$$

where  $Intra_{it}$  refers to the intra-domain independent variable, and  $Intra_{it-5}$  refers to the 5<sup>th</sup>-order lag variable for intra-domain interdependency. Similarly,  $Inter_{it}$  and  $Inter_{it-5}$  refer to the inter-domain independent variable and 5<sup>th</sup>-order lag variable for inter-domain interdependency, respectively.  $Outer_{it}$  is the outer-domain independent variable.

The parameters are estimated via Maximum Likelihood Estimation (MLE), and the conditional distribution of the dependent variable, given the random effects, is assumed to be multinomial with success probability determined by the logistic cumulative distribution function. Such that

$$\begin{aligned} \Pr(y_{it} = k | \mu, x_{it}, \alpha_i) &= \Pr(\mu_{k-1} < \alpha_i + \beta x_{it} + \varepsilon_{it} \leq \mu_k) \\ &= \Pr(\mu_{k-1} - \beta x_{it} - \alpha_i < \varepsilon_{it} \leq \mu_k - \beta x_{it} - \alpha_i) \\ &= H(\mu_k - \beta x_{it} - \alpha_i) - H(\mu_{k-1} - \beta x_{it} - \alpha_i) \\ &= \frac{1}{1 + \exp(-\mu_k + \beta x_{it} + \alpha_i)} - \frac{1}{1 + \exp(-\mu_{k-1} + \beta x_{it} + \alpha_i)} \end{aligned} \quad (4)$$

where  $\mu_0$  is taken as  $-\infty$  and  $\mu_k$  is taken as  $+\infty$ .  $H(\cdot)$  is the logistic cumulative distribution function. The Wald chi-square test is used to estimate the overall significance of the model, with  $p$  value of 0 indicating an overall significant model (Zhou et al., 2011). A likelihood-ratio test is also applied to compare the random-effects ordered logistic regression with the standard ordered logistic regression.

### 3.3. Model variables

To eliminate the multicollinearity problem, the significant influencing variables should be screened out from primary indicators for dependent variables. Multicollinearity is a common problem in the regression analysis, which will lead to larger standard deviations of regression coefficients and lower accuracy estimates. In statistics, stepwise regression is one method for elimination multicollinearity, in which the choices of predictive variables are carried out by an automatic procedure (Draper and Smith, 2014; Hocking, 1976). The forward selection is the basic method of stepwise regression, which introduces variables into the model one by one with a sequence of F-tests and t-tests. The detailed procedure is: a simple linear regression is conducted first for all explanatory variables, and the biggest contributed variable is selected out as the basic variable for the model. Then the other variables are introduced into the model one by one, which will be chosen, or not decided, by the significance of the t values. The process is repeated until all of the reserved variables are significant for the simple linear regression equation without multicollinearity (Efroymson, 1960).

In order to select better and fewer variables for the random-effects ordered logistic model, this study uses the forward selection method to remove multi-collinear variables first. The holiday travel time, travel distance, number of IMTI queries and IMTI query method are taken as dependent variables, respectively, and the explanatory variable which is significant for all of these dependent variables will be reserved for the following analysis. Strictly speaking, it is not so appropriate to take ordinal variable as a dependent variable for simple linear regression. However,

368 the stepwise regression provides an effective method for minimisation of the number of  
 369 explanatory variables for this study. Finally, 24 explanatory variables are selected from primary  
 370 indicators, which include 8 lag factors and 16 real time factors.

371 Especially, the travel time, travel mode and traffic condition only record the actual travel  
 372 situations occurring in Beijing. The options of the “Query method” are sorted by the accuracy of  
 373 IMTI. The larger the option number is, the more accurate IMTI are provided, and the more  
 374 advanced the IMTI query method will be. When people’s main query method for IMTI is “asking  
 375 someone else”, the IMTI accuracy only depends on the respondent’s experience. It may be right or  
 376 wrong. Even if people have their own reliable travel experience, they cannot know all of the other  
 377 alternative routes like a map. Moreover, a map cannot provide real-time accurate IMTI like traffic  
 378 radio and navigation, and navigation is more powerful and advanced than traffic radio.

379 The detailed explanation of these variables is shown in Table 1.

380

381 **Table 1**

382 Definition of variables.

<i>Independent variables</i>	Variable name (symbol)	Explanation (unit)
Outer environment biography	Year (year)	$\geq 0$ integers
Residential biography	Residence type (residencetype)	1= other; 2= company/school dormitory; 3=renting; 4= self-purchased house
	Residence type 5 years ago (L5.residencetype)	1= other; 2= company/school dormitory; 3=renting; 4= self-purchased house
Household structure biography	Family size (householdnumb)	$\geq 0$ integers
	Family size 5 years ago (L5.householdnumb)	$\geq 0$ integers
Car ownership biography	Car possession quantity (carnumb)	$\geq 0$ integers
Employment/education biography	Work/school location (workplace)	1= urban districts; 2= suburban districts; 3= outer suburb districts
	Work/school location 5 years ago (L5.workplace)	1= urban districts; 2= suburban districts; 3= outer suburb districts
	Job/school satisfaction (worksatisf)	>0 integers (10-point scale with 1 being the worst and 10 being the best)
	Job/school satisfaction 5 years ago (L5.worksatisf)	>0 integers (10-point scale with 1 being the worst and 10 being the best)
Holiday travel biography	Number of companions (travelnumb)	$\geq 0$ integers
	Activity duration (activityduration)	$\geq 0$ integers (hour)
	Activity duration 5 years ago (L5.activityduration)	$\geq 0$ integers (hour)
	Travel time within Beijing (traveltime)	$\geq 0$ integers (hour)
	Travel distance (traveldis)	1= intra-city travel; 2= inter-city travel; 3= travel to

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		Hong Kong, Macao or Taiwan; 4= travel abroad
	Travel modes within Beijing (travelmode)	1= combined modes of public transport/slow traffic; 2= car; 3= taxi; 4= parking and ride (P&R)
	Travel modes within Beijing 5 years ago (L5.travelmode)	1= combined modes of public transport/slow traffic; 2= car; 3= taxi; 4= parking and ride (P&R)
	Traffic condition within Beijing (trafficcondi)	1= no congestion; 2= slight congestion; 3= part of the ring roads and main roads are congested; 4= many ring roads and main road are congested; 5= most of the roads are congested
	Traffic condition within Beijing 5 years ago (L5.trafficcondi)	1= no congestion; 2= slight congestion; 3= part of the ring roads and main roads are congested; 4= many ring roads and main road are congested; 5= most of the roads are congested
	Travel satisfaction (travelsatisf)	>0 integers (10-point scale with 1 being the worst and 10 being the best)
IMTI usage biography	Number of queries (querytimes)	≥0 integers
	Query method (querymethod)	1= asking someone else; 2= experience; 3= map; 4= traffic radio; 5= navigation (vehicle/mobile)
	IMTI influence (informationinflu)	1= no effect; 2= general effect; 3= great effect
	IMTI influence 5 years ago (L5.informationinflu)	1= no effect; 2= general effect; 3= great effect

*Dependent variables*

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Holiday travel biography	Travel time within Beijing (traveltime2)	1= 0-1; 2= 1-2; 3= 2-3; 4= 3-4; 5= above 4 (hour)
	Travel distance (traveldis)	1= intra-city travel; 2= inter-city travel; 3= travel to Hong Kong, Macao or Taiwan; 4= travel abroad
IMTI usage biography	Number of queries (querytimes2)	1=zero time; 2=one time; 3=two times; 4=three times; 5=four times; 6=above four times
	Query method (querymethod)	1= asking someone else; 2= experience; 3= map; 4= traffic radio; 5= navigation (vehicle/mobile)

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383

## 384 4. Survey and sample

### 385 4.1 Survey implementation

386 This study conducted a web-based life choice survey, considering the variation of different  
387 life domains over the life course. The life history survey can obtain similar data structure like  
388 panel survey, which uses a retrospective approach to ask respondents to recall major events, such  
389 as their long-term mobility decisions (Belli, 1998; Cervero and Day 2008; Freedman et al., 1988;  
390 Zhang et al., 2014). It is easier to carry out and can save a lot of time, compared with panel  
391 surveys (Beige and Axhausen 2012; Gärling and Axhausen, 2003). However, the reliability of

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392 retrospective data is influenced by the accuracy of the memory. Therefore, some authors argue that  
393 it is appropriate to let people recall major events better, such as residence moving and household  
394 structure changes (Hollingworth and Miller, 1996).

395 With the above consideration, the web-based life history survey of holiday travel behaviour  
396 was carried out in February 2016 in Beijing. The Internet survey can provide a relaxed and  
397 comfortable environment for people to recall their life experience. Moreover, the other members  
398 in the household could help the respondent to regain his/her memories. It is worth mentioning that  
399 the biggest holiday in China, the Spring Festival, was on February 8<sup>th</sup>, 2016. The memory of the  
400 past experience in the holidays would become clearer as relatives and friends reunite in this big  
401 holiday.

402 The survey was implemented with the assistance of a major Chinese Internet survey company,  
403 which has more than 2.6 million registered survey panels. After pre-treatment and cleaning for the  
404 data, 326 completely valid questionnaires, with 5424 scenarios, were obtained from respondents  
405 aged from 19 to 72 years old, who had settled in Beijing for more than one year. The sample  
406 covers 16 districts of Beijing, including 2 central urban districts (Xicheng district and Dongcheng  
407 district), 4 suburban districts (Chaoyang district, Fengtai district, Shijingshan district and Haidian  
408 district) and 10 outer suburb districts (Fangshan district, Tongzhou district, Shunyi district,  
409 Changping district, Daxing district, Mentougou district, Huairou district, Pinggu district, Miyun  
410 district and Yanqing district), in which age, gender and residential distribution is consistent with  
411 the whole population in Beijing generally.

412 The questionnaire was designed based on the life-oriented approach of Zhang (2014b). In  
413 order to obtain the respondent's subjective initiative decisions, the respondent was requested to  
414 recall his/her life experience from the year when he/she was 18 years old to 2016. Moreover, if the  
415 respondent arrived at Beijing after 18 years old, he/she had to recall from the time of arrival.  
416 Therefore, people with different ages have different observed periods in the survey, and the panel  
417 data is unbalanced in this study.

418 Different from the major life domains of Zhang (2015), IMTI usage was added as a separate  
419 life domain into the research framework. Therefore, six biographies containing a series of  
420 mobilities, over the life course, were included in this survey. For the mobilities of residential  
421 biography, household structure biography, employment /education biography and car ownership  
422 biography, the number of mobilities and exact time points for every mobility (the year when the  
423 mobility occurred) were asked first, then the information related to different types of biographies  
424 were investigated in each episode. Considering the complexity and cumbersome items of the  
425 questionnaire, the respondent only needed to fill in the last four mobilities at most.

426 For the holiday travel biography and the IMTI usage biography, there is no definite time  
427 points for the changes of holiday travel behaviour or IMTI usage, so the observed period for each  
428 respondent was divided into four episodes, and people with different ages had different episode  
429 durations. For each episode, respondents were asked to recall one holiday travel experience from  
430 the four statutory holidays (the Spring Festival, the Tomb-Sweeping Day, the Labor Day or the  
431 National Day). Information related to the spatiotemporal characteristics, travel conditions, and  
432 IMTI usage, were then investigated for each holiday travel. Moreover, our questions were not very  
433 detailed in order to guarantee the accuracy of the memory. Whenever the questions for each type  
434 of biography had been finished, there was a question that "what percentage can you recall from  
435 the above content?" If the answers for all life biographies were below 50%, that questionnaire was

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436 unqualified.

437 Detailed information about the six biographies is as follows:

438 (1) Residential biography: a series of mobilities for residence and surrounding environmental  
439 conditions over the life course, including the residence location, residential satisfaction,  
440 house-ownership, accessibility (distance to bus stop, railway station and surrounding  
441 facilities) and the relationship with the neighbourhood.

442 (2) Household structure biography: household members were defined as the persons who are  
443 living together in Beijing and have economic connections. Household structure biography  
444 recorded a series of mobilities for household members and family status over the life  
445 course, including the family size, household composition, the number of children, the  
446 number of elders, and family happiness. Moreover, the relationships with the head and the  
447 other members of the household were also investigated, to verify the accuracy of the  
448 questionnaire, as well as the reliability of the retrospective survey.

449 (3) Employment/education biography: a series of mobilities for working or learning  
450 conditions of office staff or students in Beijing. The changes in work/school location and  
451 job/school satisfaction were investigated from the year when the respondent was 18 years  
452 old to 2016.

453 (4) Car ownership biography: a series of mobilities for car ownership over the life course.  
454 The number of cars and car use frequency were investigated. Moreover, the family car  
455 possession quantity at present was asked first, and then the quantity changes of family  
456 cars over the life course were recorded one by one. It is also a method to verify the  
457 validity of the questionnaire by checking the consistency of the data.

458 (5) Holiday travel biography: a series of mobilities for holiday travel behaviour over the life  
459 course. Respondents were asked to recall one holiday travel experience in each episode.  
460 For each recalled holiday travel, the travel distance (intra-city, inter-city, travel to Hong  
461 Kong, Macao or Taiwan, or travel abroad), number of companions, activity duration (the  
462 time staying at the destination), travel modes used in Beijing, travel time spending in  
463 Beijing, traffic condition within Beijing and travel satisfaction were investigated in the  
464 survey.

465 (6) IMTI usage biography: a series of mobilities for IMTI usage over the life course. For each  
466 recalled holiday travel, the frequency of querying IMTI, the main query method (asking  
467 someone else, by experience, map, traffic radio, or navigation), and the influence degree  
468 of IMTI were also investigated in each episode.

## 470 4.2 Sample description

471 The age, gender and residential distribution of the life history survey sample is summarised  
472 in Table 2, comparing with the calculated data of the population sampling survey of Beijing in  
473 2014 (Beijing Statistical Yearbook, 2015).

474 Because the Internet penetration in outer suburb districts is lower than the urban districts or  
475 suburban districts in China, the sample proportion of outer suburb districts is slightly lower than  
476 its population proportion. Moreover, according to the age structure of Chinese netizens, the  
477 number of older netizens is less than the younger netizens (China Internet Network Development  
478 Statistical Report, 2016), thus the sample of respondents older than 50 years old are fewer than the

479 number it should be. However, comparing with the existing statistical data of the whole population  
 480 in Beijing, the life history survey data reasonably conform to the representative sample and can be  
 481 used for further analysis.

482

483 **Table 2**

484 Sample distribution.

Factor	Level	The census of Beijing		The sample	
		N (ten thousand people)	%	N (person)	%
Gender	Male	1106.5	51.43%	172	52.76%
	Female	1045.1	48.57%	154	47.24%
	sum	2151.6	100.00%	326	100.00%
Residential distribution	Central urban district	221.3	10.29%	24	7.36%
	Suburban districts	1055.0	49.03%	190	58.28%
	Outer suburb district	875.3	40.68%	112	34.36%
	sum	2151.6	100.00%	326	100.00%
Age	19			15	
	20-24	223.7	13.06%	45	14.56%
	25-29	243.6	14.22%	57	18.45%
	30-39	397.9	23.23%	102	33.01%
	40-49	354.4	20.69%	64	20.71%
	50-59	312.8	18.26%	32	10.36%
	60-69	180.8	10.55%	9	2.91%
	72			2	
	sum	1713.2	100.00%	309+17	100.00%

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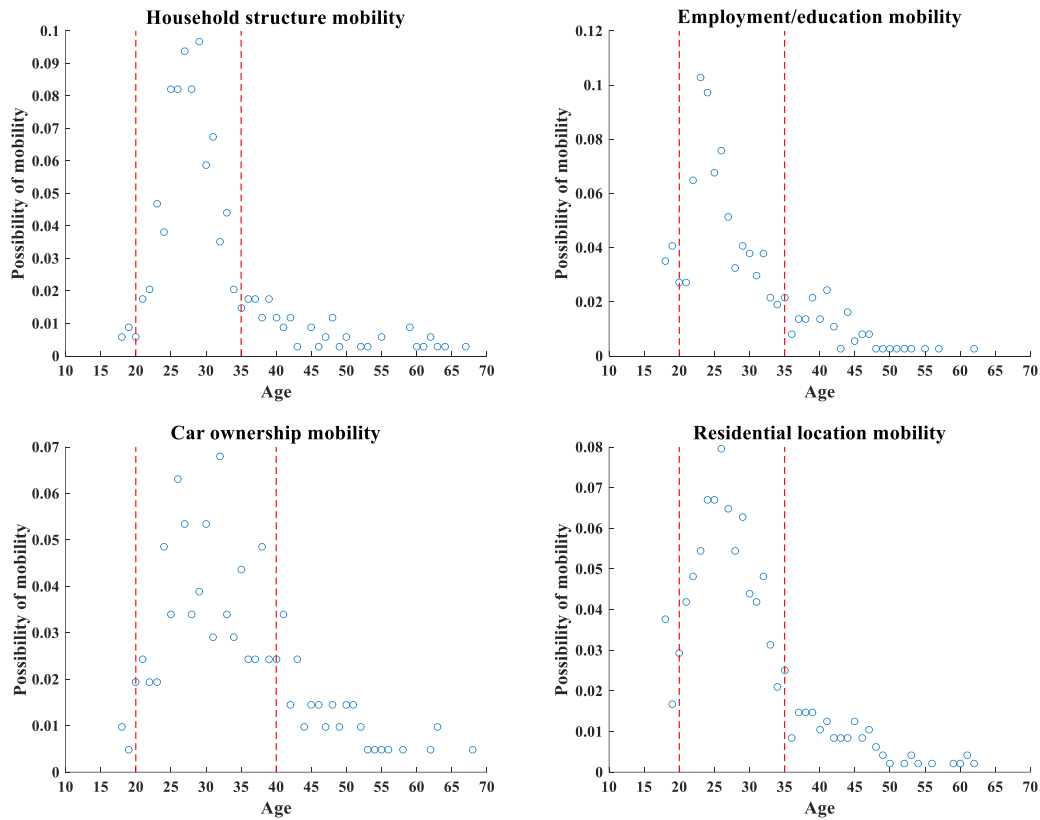
## 486 5 Statistical analysis

### 487 5.1 Mobility analysis at different ages

488 The occurrence timings of mobilities in residential, household structure,  
 489 employment/education, and car ownership biographies are shown in Fig. 2. There is a peak period  
 490 of mobilities lying between 20 and 30 years old for all these 4 biographies, which is similar like  
 491 the curve of Zhang et al. (2014). Considering the possibility of mobilities in different domains for  
 492 a person aged between 20 and 30 years old, they are more likely to change in residential location  
 493 instead of the other biographies, and the possibility of change in car ownership is the lowest.  
 494 Moreover, it can be seen that most mobilities fall in the range of 20 and 35 years old for  
 495 residential, household structure and employment/education biographies, except for the car  
 496 ownership biography which is in the range of 20 and 40 years old.

497 Generally, the four curves have the same variation trend, which indicates the co-occurrence  
 498 of the four life domain biographies over the life course.

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**Fig. 2.** Possibility of mobility in residential, household structure, employment/education, and car ownership biographies at different ages.

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## 5.2 Mobility analysis for different aged cohorts

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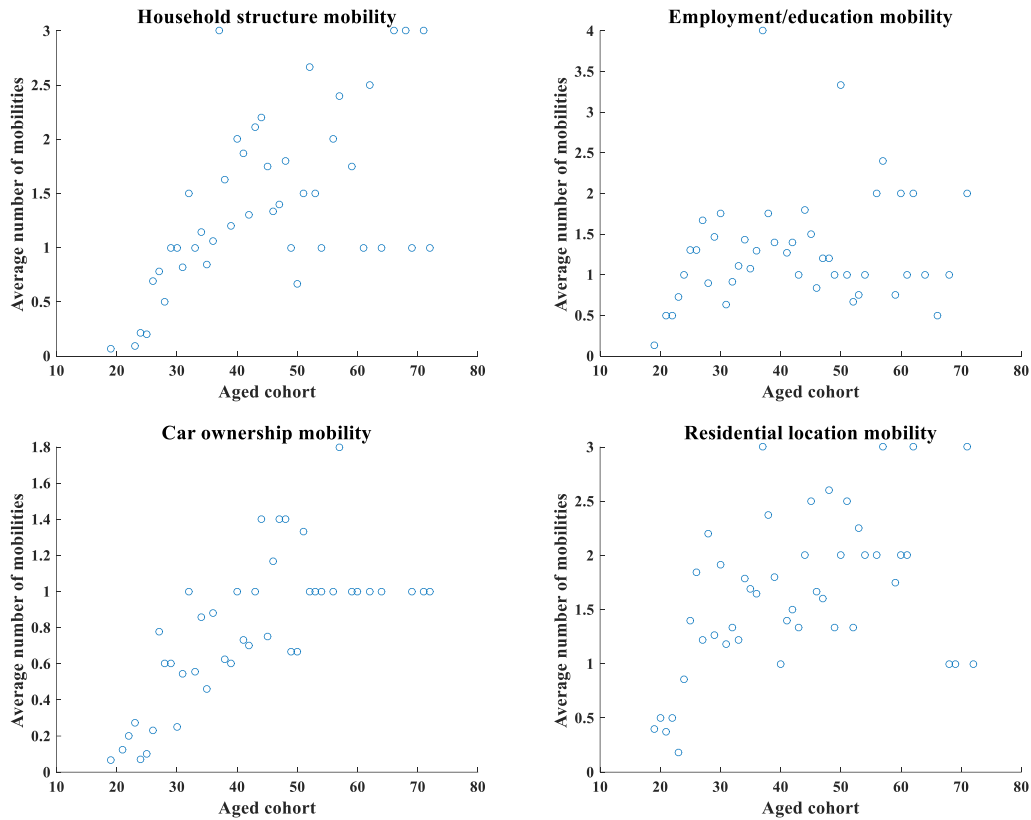
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Next, the average number of mobilities for each aged cohort in the four types of biographies is analysed in Fig. 3. Generally, the average number of mobilities increases with the growth of age. However, the mobility frequency of the people aged above 50 years old is lower than the young aged cohort, especially in the employment/education biography and car ownership biography; that is relevant with their education and social background at that time. In China in the 1970s and 1980s, the economic level was relatively backward and every student could get a stable job after graduation, thus the generation aged above 50 years old are more steady and don't love adventure. Therefore, Fig. 3 shows that the study of holiday travel behaviour dynamics should consider not only the influence of personal life cycle or life course, but also the influence of external background of the times.



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**Fig. 3.** Average number of mobilities for each aged cohort in residential, household structure, employment/education, and car ownership biographies.

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### 5.3 Cross-aggregation analysis between occurrence year and life course

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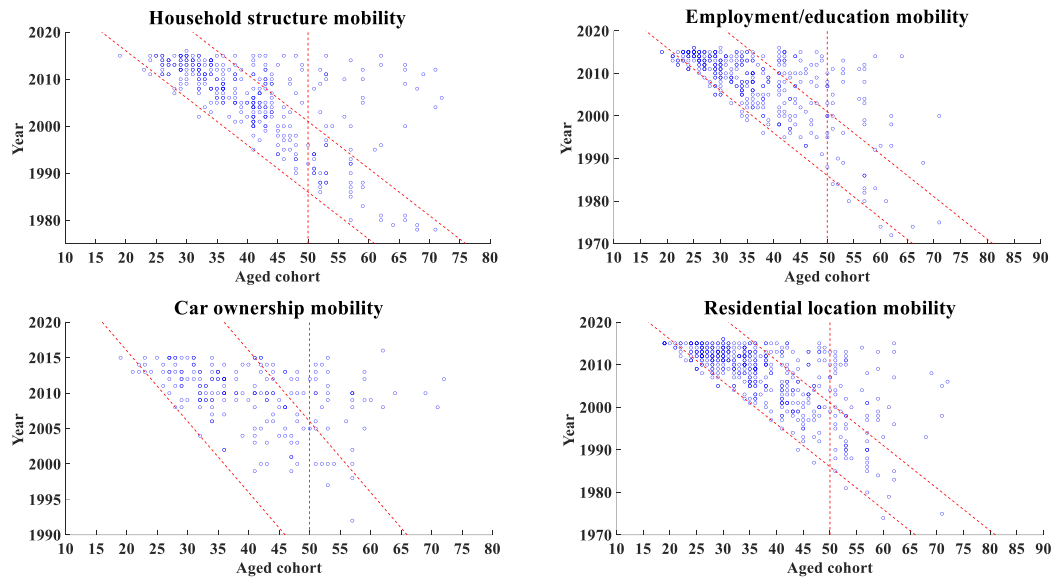
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The cross-aggregation between the occurrence year of mobilities and life course is analysed in Fig. 4. The mobility frequency can be identified through the density of these mobility points. If people's life choices are only affected by the life course, the distribution of these mobility points should be the same for different people at the same life stage. Fig. 2 shows the distribution ranges of high frequency points in the four life biographies, which provides a good observation interval to analyse the mobility frequency. Moreover, the samples aged above 50 years old are too small that they can be excluded from the analysis to avoid misunderstanding. Therefore, the area obtained from the intersection of three lines is shown in Fig. 4. It can be seen that the mobility points of household structure biography are distributed uniformly, which means the number of household members is mainly influenced by the life course. However, the mobility frequency increases year by year in the other three biographies, suggesting that life biography is affected by the external background of the times, as well as personal life course. Therefore, the holiday travel biography and IMTI biography should consider the interaction of inner individual factors and outer environment factors.



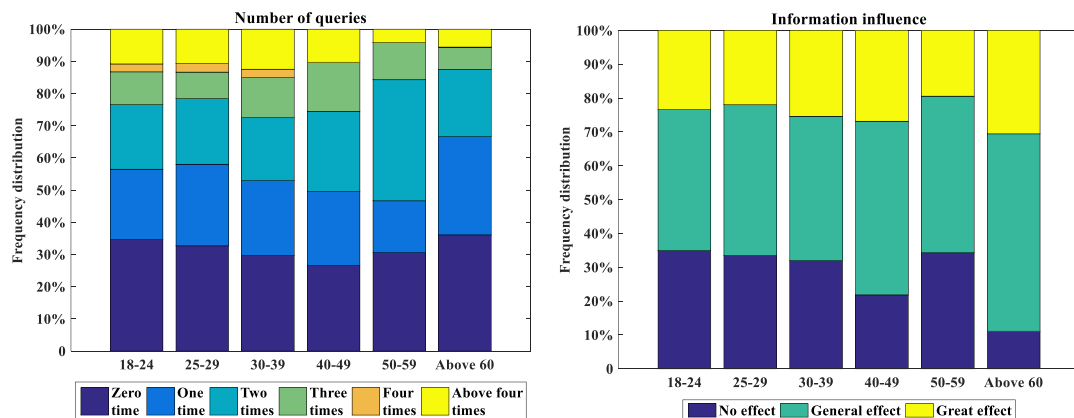


**Fig. 4.** Occurrence year of mobilities for each aged cohort in residential, household structure, employment/education, and car ownership biographies.

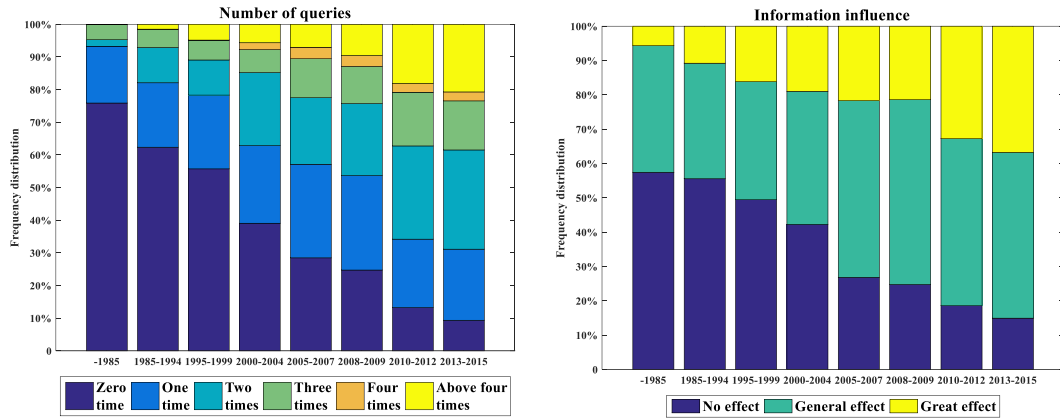
#### 5.4 Mobility analysis of IMTI usage biography

The frequency distributions of IMTI query times, and its influence over the life course, are shown in Fig. 5. Along with the increase of age, people are less likely to query IMTI with high frequency in holidays, and the proportion of no IMTI usage decreases first and then increases. For the influence degree of IMTI, people were less affected by IMTI when they were young, but the influence became bigger when they got older. This may be related to the development of ITS or their own growth.

The frequency distributions of IMTI usage mobilities over the years are presented in Fig. 6. With the development of the times, there are a more number of IMTI queries with a greater IMTI influence.



**Fig. 5.** Frequency distribution of IMTI usage mobilities over the life course.



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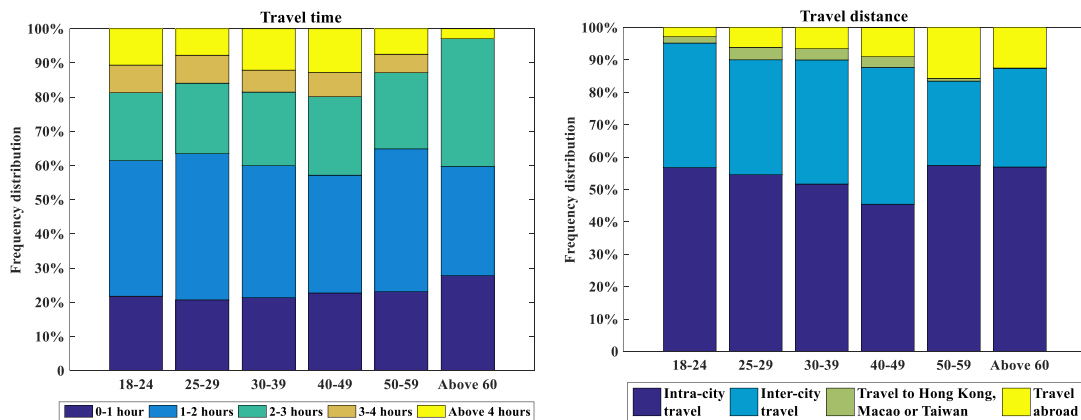
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**Fig. 6.** Frequency distribution of IMTI usage mobilities over the years.

### 559 5.5 Mobility analysis of holiday travel biography

560 The frequency distributions of holiday travel time and travel distance over the life course are  
 561 shown in Fig. 7. The proportion of holiday travel time within Beijing in 0-1 hour, increases as  
 562 people get older, and the proportions of travel time in more than 3 hours decrease at the same time.  
 563 Moreover, elderly people aged above 60 years old mainly have 2-3 hours travel time within  
 564 Beijing in holidays, which is of relevance with their lower movement speed. For the travel  
 565 distance, people prefer to travel in the city in holidays when they are young, and their travel  
 566 distance increases when they get into middle-age; that is related to the accumulation of personal  
 567 wealth and social economic growth. The frequency distributions of holiday travel mobilities over  
 568 the years are presented in Fig. 8. With the development of the times, the short-term travel reduces  
 569 and long-term travel increases gradually. At the same time, the intra-city travel reduces and  
 570 long-distance travel increases over the years.



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**Fig. 7.** Frequency distribution of holiday travel mobilities over the life course.

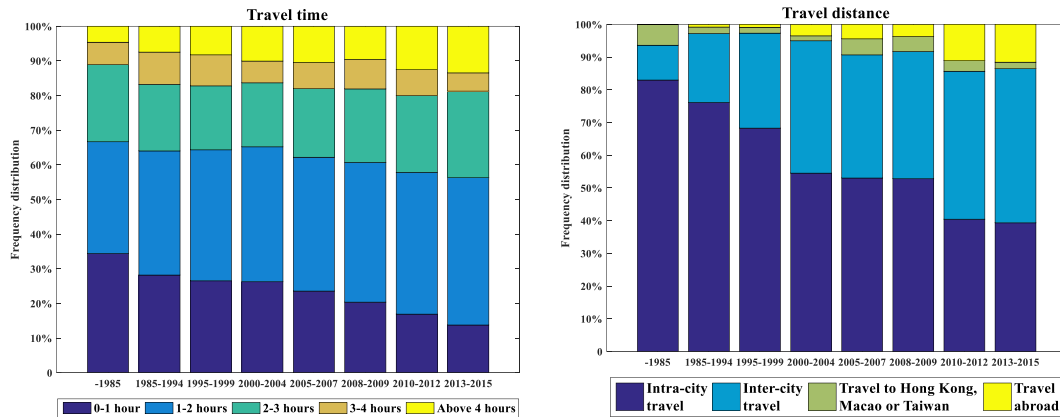


Fig. 8. Frequency distribution of holiday travel mobilities over the years.

## 6. Model analysis

### 6.1 Model estimation analysis

In order to analyse the two-way relationship between the holiday travel biography and IMTI usage biography, different models were established to investigate the influence mechanism between them. Moreover, the effects of residential, household structure, employment/education, and car ownership biographies were also considered in the models. Finally, 24 selected variables were taken into the models, and the parameters were estimated by the software Stata. The model results are shown as follows.

#### 6.1.1 The influence mechanism of the IMTI usage biography on the holiday travel biography

The holiday travel time and travel distance were taken as dependent variables, respectively, to describe the holiday travel biography. Therefore, the other observed variables, for the holiday travel biography, belong to intra-domain independent variables. The observed variables for residential, household structure, employment/education, car ownership and IMTI usage biographies belong to inter-domain independent variables. Moreover, the variable “year” is the outer-domain independent variable to describe the influence of outer environment on holiday travel biography. Two random-effects ordered logistic models for the holiday travel biography were established, based on the research framework, and the results are shown in Table 3.

The significance of independent variables can be determined by the p-value, and the higher significance means the higher dependency. The biographical interdependencies for holiday travel biography are analysed from the following four aspects:

(1) Intra-domain interdependency: The activity duration, travel modes used in Beijing, number of companions, traffic condition and travel satisfaction all have significant effects on holiday travel time and travel distance.

The activity duration has positive correlations with the travel time and travel distance, which means people with longer activity duration usually have a longer travel time and travel distance in holidays. This reveals the fact that the place people want to stay for a long time in holidays is

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606 usually far from their home. However, the number of companions has a negative correlation with  
607 holiday travel time and travel distance, and this is related to the inconvenience of the travel with a  
608 lot of people. Moreover, traffic congestion also has significant effects on people's travel time and  
609 travel distance in their holidays. Compared with public transport or slow traffic, the car or taxi  
610 travellers have a shorter travel time and longer travel distance, but P&R travellers have a longer  
611 travel time and longer travel distance in holidays. For the lag variables, the past activity duration  
612 and traffic conditions impressed on people's hearts, and it has a significant impact on their present  
613 travel time and travel distance; beside, different travel modes used in the past have similar effects  
614 on travel time and travel distance in holidays.

615 (2) Interdependency between holiday travel biography and IMTI usage biography: As shown  
616 in Table 3, the IMTI usage biography has a significant influence on the holiday travel biography,  
617 which confirms the conclusion of Wang et al. (2015b) that IMTI has a significant effect on  
618 people's holiday travel behaviour.

619 The coefficients of IMTI influence, for travel time and travel distance, are all positive, which  
620 means the influence degree of IMTI has a positive correlation with holiday travel time and travel  
621 distance. This is relevant with the popularity of the Internet. Rich and detailed travel information  
622 on the Internet affects people's holiday travel plans significantly, and makes them travel longer  
623 and further. Meanwhile, the coefficients of the past IMTI influence on travel time and travel  
624 distance are all negative; this means the past IMTI provides precious travel experience for people,  
625 and help them to save a lot of travel time and travel distance in holidays. Moreover, the number of  
626 queries also has a significant impact on holiday travel time and travel distance. A longer travel  
627 time or travel distance usually needs more IMTI queries. For the way of querying IMTI, the query  
628 method has significant effects on holiday travel time, but its influence on holiday travel distance is  
629 not so significant. Compared with asking someone else, the experience and traffic radio are  
630 usually used for longer time and shorter distance travel in holidays, while the map and navigation  
631 (vehicle/mobile) are usually used for longer time and longer distance travel in holidays.

632 (3) Interdependencies between holiday travel biography and other biographies: the residential,  
633 employment/education and car ownership biographies are found to be more influential on holiday  
634 travel biography than household structure biography. Compared with the other two influential  
635 biographies, the influence of residential biography on the holiday travel biography seems much  
636 more obvious, because the coefficients of its explanatory variables are larger than the other  
637 variables. Specially, lag variables of different life domains over the life course have significant  
638 effects on holiday travel biography. The past job/school satisfaction have a negative effect on  
639 holiday travel time and travel distance, which means people tend to longer travel time and travel  
640 distance in holidays when they are not satisfied with their past job or school. This also suggests  
641 that longer journey in holidays is another method for people to comfort their discontent on work or  
642 study. Meanwhile, people who worked in suburban districts or outer suburban districts before do  
643 not prefer longer time or longer distance travel in holidays. This is related to their travel habit of  
644 the past. Moreover, people lived in company/school dormitories now, or in the past, have longer  
645 travel distance in holidays, which may be due to having less pressure on life and economy. The  
646 family owning many cars usually has a shorter travel time and longer travel distance in holidays,  
647 and this is consistent with the intra-domain interdependency analysis for the car travelers.

648 (4) Outer-domain interdependency: the outer-domain independent variable year has  
649 significant effects on holiday travel time and travel distance. With the development of the times,

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650 people spend less travel time in the city, and more and more people travel to Hong Kong, Macao,  
651 Taiwan or foreign countries in holidays. This reveals the gradual improvement of people's living  
652 standards, and proves the outer environment biography has a great influence on the holiday travel  
653 biography.

654 The p-values for the two models all equal to 0, indicating that the two models are overall  
655 significant.  $\sigma_v^2$  is the panel-level variance component  $\sigma_v^2$ , which reveals the individual  
656 variation. The reported likelihood-ratio test shows that there is enough variability between the  
657 random-effects ordered logistic regression over the standard ordered logistic regression.

658

### 659 *6.1.2 The influence mechanism of the holiday travel biography on the IMTI usage* 660 *biography*

661 In order to analyse the two-way relationship between the holiday travel biography and the  
662 IMTI usage biography, the IMTI usage biography was taken as latent variable. Its observed  
663 variables, number of queries and query method, are taken as dependent variables, respectively.  
664 Similarly, the other observed variables for the IMTI usage biography belong to intra-domain  
665 independent variables. The observed variables for residential, household structure,  
666 employment/education, car ownership and holiday travel biographies belong to inter-domain  
667 independent variables. Moreover, the variable “year” is the outer-domain independent variable  
668 describing the outer environment influence on IMTI usage biography. Two random-effects ordered  
669 logistic models for IMTI usage biography were established, based on the research framework, and  
670 the results are shown in Table 4.

671 The significance of independent variables can be determined by the p-value, and the higher  
672 significance means the higher dependency. The biographical interdependencies for the IMTI usage  
673 biography are analysed from the following four aspects:

674 (1) Intra-domain interdependency: the IMTI influence, number of queries and query method  
675 are all significant variables for the IMTI usage biography. IMTI influence has positive correlations  
676 with the number of queries and query method, which means people affected by IMTI usually have  
677 a higher frequency of IMTI queries with a more advanced query method. Similarly, people  
678 influenced by historical IMTI also tend to query information in holidays, but they prefer to use  
679 traditional methods, such as asking someone else, by experience or map. The number of queries  
680 has a positive relationship with the query method, which is related to the convenience and  
681 accuracy of the advanced query method. Compared with asking someone else, the use of map,  
682 traffic radio or navigation increases the number of IMTI queries in holidays.

683 (2) Interdependency between the IMTI usage biography and the holiday travel biography: As  
684 shown in Table 4, holiday travel biography also has significant influence on the IMTI usage  
685 biography, but this relationship has seldom been investigated. Therefore, this study proves that  
686 there is a two-way relationship between the holiday travel biography and the IMTI usage  
687 biography.

688 Considering the significance of the predictor variables in the holiday travel biography, the  
689 longer activity duration usually needs a higher frequency of IMTI queries. This is relevant with  
690 the analysis result of section 6.1.1, i.e. the place where people want to stay for a long time in  
691 holidays is usually far from their home. So IMTI plays an important role in the holiday travel  
692 when people stay in a strange place. Moreover, the car, taxi and P&R travellers tend to query

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693 IMTI and use an advanced query method in holidays, compared with people who travelled by  
694 public transport or slow traffic tools. A congested traffic condition induces people to query more  
695 IMTI with advanced query methods. However, travel companions can provide all kinds of  
696 information, without need to query IMTI from the other ways. Besides, activity duration and  
697 traffic conditions in the past also have significant effects on the number of queries and query  
698 method for IMTI, which indicates that holiday travel biography has significant state dependence  
699 on IMTI usage biography.

700 (3) Interdependencies between the IMTI usage biography and other biographies: the  
701 residential, household structure, employment/education and car ownership biographies are found  
702 to have significant influence on IMTI usage biography. Compared with the other two life  
703 biographies, the influence of residential and employment/education biographies on the number of  
704 queries are much more significant. Meanwhile, the four life biographies all have significant effects  
705 on the query method for IMTI in holidays, and the influence of residential biography are much  
706 more obvious than the other life biographies.

707 Compared with people working in urban districts, people working in suburban districts or  
708 outer suburban districts prefer to use traffic radio or navigation in holidays; this is relevant with  
709 their travel habit on workdays. The present residence type has negative effects on the IMTI query  
710 method, while the past residence type has positive effects on the IMTI query method. Moreover,  
711 family owning many cars usually uses more advanced IMTI query methods, such as traffic radio  
712 or navigation on vehicles. Besides, the present or past family size all have negative effects on  
713 query method, which means the query method for a big family is usually based on their own travel  
714 experience. That is consistent with the analysis for travel companions.

715 (4) Outer-domain interdependency: the outer-domain independent variable has significant  
716 effects on the number of queries and query method for IMTI. With the development of the times,  
717 people have more queries for IMTI during the journey in holidays, and their query methods  
718 become more accurate and more advanced; that is down to the development of science and  
719 technology and the improvement of ITS. At the same time, the rapidly growing IMTI demand  
720 encourages government policy makers to strengthen the construction of ITS. Therefore, there is a  
721 two-way relationship between external environment and life domains, which can be analysed in  
722 the further study.

723 The p-values for the two models all equal to 0, indicating that the two models are overall  
724 significant. The reported likelihood-ratio test shows that there is enough variability between the  
725 random-effects ordered logistic regression over the standard ordered logistic regression.  
726

## 727 6.2 Model sensitivity analysis

728 The analysis above mainly focuses on the significance of explanatory variables and their  
729 positive or negative effects on dependent variables. The average marginal effects for these  
730 predictors will be analysed in detail in this section, to further explore the biographical  
731 interdependencies of the holiday travel biography and the IMTI usage biography. Marginal effects  
732 show the average change in probability when the predictor or independent variable increases by  
733 one unit (Green, 2011). For continuous variables, marginal effects represent the instantaneous  
734 change given that the ‘unit’ may be very small, i.e. derivative. For classified variables, the  
735 marginal effect calculates the discrete first-difference from the base category. The average

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736 marginal effects of these 24 selected variables for holiday travel biography and IMTI usage  
737 biography were estimated by the software Stata, and only the variables having significant marginal  
738 effects are shown in Table 5 - Table 8.

739

#### 740 *6.2.1 Marginal effects for holiday travel biography*

741 Holiday travel biography was described from two aspects of time and space. The marginal  
742 effects for different alternatives of holiday travel time within Beijing are shown in Table 5, and the  
743 marginal effects for different alternatives of holiday travel distance are shown in Table 6. The  
744 results are analysed as follows:

745 (1) Marginal effects for holiday travel time within Beijing: As shown in Table 5, the marginal  
746 effect's changing point for different alternatives of holiday travel time within Beijing lies in the  
747 "two hours".

748 For the outer-domain independent variable "year", its marginal effects for the choice of  
749 holiday travel time in 0-1 hour, 1-2 hours, 2-3 hours, 3-4 hours and above 4 hours are 0.0015,  
750 0.0008, -0.0015, -0.0005 and -0.0003, which means for one instant increase of year, the  
751 probability increases 0.15 percentage points for choosing 0-1 hour, increases 0.08 percentage  
752 points for choosing 1-2 hours, decreases 0.15 percentage points for choosing 2-3 hours, decreases  
753 0.05 percentage points for choosing 3-4 hours, and decreases 0.03 percentage points for choosing  
754 more than 4 hours. This confirms the conclusion that people spend shorter travel time in the city  
755 with the development of the times.

756 For the interdependency with the IMTI usage biography, people affected by IMTI usually  
757 prefer 2-3 hours travel time in holidays. When the query method shifts from "asking someone  
758 else" to "experience", "map", "traffic radio" or "navigation", the probability of holiday travel for  
759 0-1 hour decreases by 9.84, 18.48, 10.15 and 16.62 percentage points, respectively.

760 For the interdependency with the other life domain biographies, people who worked in  
761 suburban districts or outer suburban districts in the past, give priority to travel less than two hours  
762 in holidays.

763 For the intra-domain interdependency, when the travel modes used in Beijing shifts from  
764 "combined modes of public transport/slow traffic" to "car" or "taxi", the probability increases for  
765 the travel in less than 2 hours, and decreases for the travel in more than two hours. Moreover, the  
766 marginal effects of traffic conditions for holiday travel in 0-1 hour, 1-2 hours, 2-3 hours, 3-4 hours  
767 and above 4 hours are -0.0864, -0.0479, 0.0870, 0.0267 and 0.0206.

768 (2) Marginal effects for holiday travel distance: As shown in Table 6, the marginal effect's  
769 changing point for different alternatives of holiday travel distance lies between the "Intra-city  
770 travel" and "Inter-city travel".

771 For the outer-domain independent variable year, its marginal effects for choosing intra-city  
772 travel, inter-city travel, travel to Hong Kong, Macao or Taiwan, and travel abroad are -0.0014,  
773 0.0002, 0.0002 and 0.001, which also confirms the conclusion that more and more people travel to  
774 Hong Kong, Macao, Taiwan or foreign countries in holidays with the development of the times.

775 For the interdependency with the IMTI usage biography, for one instant increase of the  
776 number of IMTI queries, the probability decreases 1.07 percentage points for choosing intra-city  
777 travel, increases 0.14 percentage points for choosing inter-city travel, increases 0.19 percentage  
778 points for choosing travel to Hong Kong, Macao or Taiwan, and increases 0.74 percentage points  
779 for choosing travel abroad. This confirms the conclusion that a longer travel distance usually need

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780 more IMTI queries.

781 For the interdependency with the other life domain biographies, when the residence type  
782 shifts from “other” to “company/school dormitory”, “renting”, or “self-purchased house”, the  
783 probability of having an intra-city travel decreases by 10.47, 6.45 and 7.21 percentage points,  
784 respectively. Moreover, people will have longer travel distance in holidays, when they are not  
785 satisfied with their job or school.

786 For the intra-domain interdependency, when the travel modes used in Beijing shifts from  
787 “combined modes of public transport/slow traffic” to “car”, “taxi” or “P&R”, the probability  
788 decreases for intra-city travel in holidays, but the probability increases for inter-city travel or  
789 travel to Hong Kong, Macao, Taiwan or foreign countries in holidays. Moreover, bad traffic  
790 conditions make people reduce their intra-city travels in Beijing and stimulate them to travel to  
791 Hong Kong, Macao, Taiwan or foreign countries in holidays.

792

### 793 *6.2.2 Marginal effects for the IMTI usage biography*

794 IMTI usage biography was described from two aspects: the number of IMTI queries and  
795 query method for IMTI during the holiday journey. Marginal effects for different alternatives of  
796 the number of IMTI queries are shown in Table 7, and marginal effects for different alternatives of  
797 the query method for IMTI are shown in Table 8. The results are analysed as follows:

798 (1) Marginal effects for the number of IMTI queries: As shown in Table 7, the marginal  
799 effect’s changing point for different alternatives of the number of IMTI queries occurs in the “two  
800 times”.

801 For the outer-domain independent variable “year”, more and more people would query IMTI  
802 more than two times during their holiday journeys, with the development of the times.

803 For the interdependency with the holiday travel biography, for one instant increase of the  
804 number of companions, the probability will decrease 0.65 percentage points for querying IMTI  
805 two or more times, and this confirms the conclusion that more travel companions need less IMTI  
806 queries from others. Similarly, for one instant of bad traffic conditions, the probability for zero  
807 time query and one time query will decrease 1.29 and 0.12 percentage points, respectively.

808 For the interdependency with the other life domain biographies, the present job/school  
809 satisfaction and past job/school satisfaction have different marginal effects for the number of IMTI  
810 queries. The marginal effects of present job/school satisfaction for zero time query and one time  
811 query are 0.0187 and 0.0017, while the marginal effects of past job/school satisfaction for zero  
812 time query and one time query are -0.0207 and -0.0019.

813 For the intra-domain interdependency, people affected by IMTI usually query IMTI more  
814 than two times during their holiday journeys.

815 (2) Marginal effects for the query method for IMTI: As shown in Table 8, the marginal  
816 effect’s changing point for different alternatives of the query method for IMTI lies between the  
817 “map” and “traffic radio”.

818 For the outer-domain independent variable “year”, with one instant increase of year, the  
819 probability for “asking someone else”, “experience” and “map” decrease 0.39, 0.36, 0.06  
820 percentage points, while the probability for “traffic radio” and “navigation” will increase 0.02 and  
821 0.79 percentage points; this confirms the conclusion that people’s query methods for IMTI become  
822 more and more advanced with the development of the times.

823 For the interdependency with the holiday travel biography, when the travel modes used in



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824 Beijing shifts from “combined modes of public transport/slow traffic” to “car”, “taxi” or “P&R”,  
825 the probability for “asking someone else”, “experience” and “map” decrease to some extent, and  
826 the probability for “navigation” will increase 10.09, 14.00 and 10.82 percentage points,  
827 respectively. Moreover, travel with more companions is usually based on the traditional query  
828 method, such as asking someone else, by experience or map. Bad traffic conditions in Beijing  
829 stimulate the use of navigation in holidays.

830 For the interdependency with the other life domain biographies, when the work/school  
831 location changes from urban districts to suburban districts or outer suburban districts, the  
832 probability decreases for choosing “asking someone else”, “experience” or “map”, but increases  
833 for choosing “traffic radio” or “navigation”. This proves the conclusion that people who work in  
834 suburban districts or outer suburban districts prefer to use traffic radio or navigation in holidays.  
835 Moreover, one instant increase of the number of cars, the probability decreases 2.14 percentage  
836 points for choosing “asking someone else”, decreases 1.97 percentage points for choosing  
837 “experience”, decreases 0.30 percentage points for choosing “map”, increases 0.10 percentage  
838 points for choosing “traffic radio”, and increases 4.32 percentage points for choosing “navigation”.  
839 This confirms the conclusion that a family owning many cars usually use more advanced IMTI  
840 query methods.

841 For the intra-domain interdependency, people affected by IMTI usually use more advanced  
842 query methods in holidays.

843

## 844 **7. Conclusions**

845 In the current life-oriented approach, Internet usage has only been regarded as an explanatory  
846 variable for the leisure and recreation domain, and the two-way relationship between holiday  
847 travel behaviour and IMTI usage is seldom investigated. To fill this gap, this study took IMTI  
848 usage as a separate life domain, and investigated holiday travel behaviour dynamics with IMTI  
849 usage, based on the life-oriented approach. The two-way relationship between holiday travel  
850 behaviour biography and IMTI usage biography was examined after controlling for the effects of  
851 residential, household structure, employment/education, and car ownership biographies.

852 In order to support the analysis, a web-based life choice survey, considering the variation of  
853 different life domains over the life course, was carried out in February 2016 in Beijing, and 326  
854 completely valid questionnaires with 5425 scenarios were obtained from the respondents aged  
855 from 19 to 72 years old. Based on the panel data, statistical characteristics of mobilities in each  
856 biography over the life course were first analysed. Then, the random-effects ordered logistic  
857 model was applied to investigate biographical interdependencies among different life domains  
858 from three aspects: intra-domain interdependency, inter-domain interdependency and  
859 outer-domain interdependency. The findings are summarised below.

860 In a person's life, most of the life mobilities fall within the range of 20 and 35 years old for  
861 residential, household structure and employment/education biographies, except for the car  
862 ownership biography having a longer range of 20 and 40 years old. Considering the peak period of  
863 mobilities for these four biographies, the possibility of changing residential location is the highest,  
864 while the possibility of changing car ownership is the lowest. Moreover, there is a synergic  
865 relationship between these four biographies, which means a mobility occurring in one biography  
866 may drive mobilities in other biographies. Therefore, the policy making related to housing,

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867 employment and education should focus on the needs of 20-35 aged cohorts, and the automobile  
868 industry policy makers should consider the buying demand for 20-40 aged cohorts.

869 However, the above conclusion is not unchanging with the development of the times. The  
870 analysis results show that life biographies are not only affected by a personal life course, but also  
871 affected by the external background of the times. People are not as conservative as the past, and  
872 their mobilities are more frequent and complex. Now the generation aged above 50 years old are  
873 more stable than the young, but when the young live to 50 years old, their activities and energy  
874 may not be weaker than the young at that time; therefore, the formulation of long-term policy  
875 making should keep pace with the times.

876 Similarly, holiday travel biography and IMTI usage biography should consider the influence  
877 of personal life course and external background of the times at the same time. For holiday travel  
878 biography, as people get older, their travel time in the city become shorter, but their holiday travel  
879 distance become longer. When people get into the middle-aged, the proportion of inter-city travel  
880 and travel to Hong Kong, Macao, Taiwan or foreign countries increase greatly. With the  
881 development of the times, intra-city and short-term travels decrease and long-distance and  
882 long-term travels increase over the years. Therefore, the inter-city travel and travel abroad will  
883 become a mainstream in holidays, and the middle-aged people are the main consuming group for  
884 holiday tourism consumption.

885 For IMTI usage biography, the number of IMTI queries decreases when people get older, but  
886 the IMTI influence on them becomes bigger and bigger. IMTI is the product of the times, the  
887 number of queries and its influence increase greatly with the construction of ITS, and that is a  
888 positive feedback for the investment of ITS, which also brings much profit for the society.

889 There is a two-way relationship between the holiday travel biography and the IMTI usage  
890 biography, therefore, the hypothesis that the IMTI usage is a separate life domain and should not  
891 be treated as an explanatory variable for other life biographies only, is confirmed. The influence  
892 degree of IMTI has positive correlations with holiday travel time and travel distance. At the same  
893 time, the past IMTI provides precious travel experience for people and saves a lot of travel time  
894 and travel distance for them. This indicates that IMTI usage biography has significant influence on  
895 people's holiday travel behaviour, which helps people to have a convenient and comfortable travel  
896 in holidays.

897 On the other hand, holiday travel biography also has significant effects on IMTI usage  
898 biography. Congested traffic conditions induce people to query IMTI more frequently, and more  
899 rely on the advanced query method. Moreover, the car, taxi and P&R travellers prefer to query  
900 IMTI and use traffic radio or navigation in holidays, compared with people who travelled by  
901 public transport or slow traffic tools. Therefore, the radio station and navigation platform for  
902 traffic information should continue to provide good service for the car, taxi and P&R travellers.  
903 Moreover, they should consider providing a characteristic service for the public transport or slow  
904 traffic travellers.

905 Residential, household structure, employment/education and car ownership biographies have  
906 significant effects on holiday travel biography and IMTI usage biography. Though the residential  
907 biography was found to be more influential on these two biographies, mobilities in the other three  
908 biographies also play important roles in explaining the decisions for the holiday travel biography  
909 and the IMTI usage biography. Therefore, analysis of holiday travel biography and the IMTI usage  
910 biography should consider biographical interdependences between various life domains over the

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911 life course (e.g., residential, employment/education and car ownership biographies), and the  
912 life-oriented approach can provide a comprehensive analysis and a valid forecasting method.

913 Moreover, the influence of state dependence for different life domains over the life course is  
914 much more obvious when explaining holiday travel behaviour dynamics and IMTI usage  
915 mobilities. The results confirm the necessity for incorporating the state dependence into the  
916 dynamic models, and the research framework of this study can be applied to different life  
917 domains.

918 Intra-domain interdependency could describe the dynamic relationships between multiple  
919 facets or portfolio choices of a life domain. For the holiday travel biography, activity duration,  
920 travel mode, number of companions, traffic conditions and travel satisfaction, all have significant  
921 influence on travel time and travel distance in holidays. Moreover, activity duration and traffic  
922 conditions in the past have left a deep impression on people's hearts, and have significant impacts  
923 on their travel time and travel distance. For the IMTI usage biography, the influence degree of  
924 IMTI has significant effects on the number of queries and the query method. People affected by  
925 IMTI usually have a higher frequency of IMTI queries with more advanced query method.  
926 Moreover, people influenced by the past IMTI deeply will query IMTI more frequently, but they  
927 prefer to use a traditional query method. Therefore, the results can be applied into the study of  
928 portfolio decision-making processes for holiday travel behaviour.

929 The outer-domain independent variable has significant effects on the holiday travel biography  
930 and the IMTI usage biography. With the development of the times, people spend less travel time in  
931 the city, and more and more people travel to Hong Kong, Macao, Taiwan or foreign countries in  
932 holidays. At the same time, people have more queries for IMTI during the journey, with more  
933 advanced query methods. The model results are consistent with the statistical analysis results,  
934 which proves that the random-effects ordered logistic model is appropriate for the dynamic  
935 analysis of holiday travel behaviour with IMTI usage.

936 Besides, there is a two-way relationship between external environment and life domains.  
937 Under the stimulation of the external environment, people's life self-selection issues will change at  
938 the same time. If the change makes more profit for the society and economy, government policy  
939 makers will strengthen this stimulation, and then a positive feedback loop is formed. This study  
940 only proves the influence of the external environment on life domain biographies, but the reverse  
941 relationship has not been investigated; this can be analysed in the further study.

942 Overall, this study is an initial attempt to apply the life-oriented approach to analyse holiday  
943 travel behaviour dynamics in the long-term. By extending the current major life domains, this  
944 study enriches the life-oriented approach and provides a research framework for analysing holiday  
945 travel behaviour dynamics. Beijing is working on the construction of a smart city, and travel  
946 behaviour mechanism research under the technology of ITS is a key scientific problem for this  
947 innovative governance systems. In order to improve the urban traffic system efficiency, and  
948 achieve the balance of traffic supply and travel demand, dynamic analysis of holiday travel  
949 behaviour with IMTI usage cannot be ignored. Moreover, policy makers are required to take the  
950 whole situation into account over a longer period of time, to predict whether policies could  
951 achieve the expected result or not. Thus, the results of this study can provide useful information  
952 for policy makers understanding the evolution mechanism of holiday travel behaviour in the  
953 long-term, and supporting the policy making for holiday traffic demand management.

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1172 Table 3

1173 Random-effects ordered logistic model results for holiday travel biography

Variables	Travel time			Travel distance		
	Coef.	Std. Err.	P> z	Coef.	Std. Err.	P> z
year	-0.017**	0.008	0.027	0.042***	0.015	0.005
worksatisf	0.066	0.052	0.203	-0.279***	0.091	0.002
L5.worksatisf	-0.204***	0.051	0.000	-0.279***	0.089	0.002
2.workplace	-0.179	0.193	0.355	-1.400***	0.314	0.000
3.workplace	0.120	0.293	0.682	0.386	0.478	0.419
2L5.workplace	-0.666***	0.198	0.001	-0.379	0.311	0.223
3L5.workplace	-0.786**	0.306	0.010	-2.120***	0.519	0.000
2.residencetype	-0.047	0.322	0.883	3.122***	0.597	0.000
3.residencetype	0.614**	0.291	0.035	1.772***	0.527	0.001
4.residencetype	0.144	0.267	0.589	1.535***	0.481	0.001
2L5.residencetype	-1.517***	0.317	0.000	1.447***	0.504	0.004
3L5.residencetype	-1.678***	0.300	0.000	1.157**	0.495	0.019
4L5.residencetype	-1.443***	0.280	0.000	1.259***	0.452	0.005
carnumb	-0.392***	0.105	0.000	0.528***	0.181	0.003
householdnumb	0.027	0.063	0.662	0.217*	0.112	0.052
L5.householdnumb	0.282***	0.064	0.000	0.075	0.120	0.531
activityduration	0.013***	0.002	0.000	0.081***	0.003	0.000
L5.activityduration	0.002*	0.001	0.074	0.008***	0.002	0.000
2.travelmode	-0.625***	0.135	0.000	0.420*	0.250	0.093
3.travelmode	-1.798***	0.242	0.000	3.094***	0.384	0.000
4.travelmode	0.886***	0.259	0.001	1.254***	0.426	0.003
2L5.travelmode	-0.532***	0.140	0.000	0.988***	0.230	0.000
3L5.travelmode	-0.032	0.230	0.889	-0.087	0.367	0.812
4L5.travelmode	0.812**	0.330	0.014	2.038***	0.456	0.000
travelnumb	-0.079***	0.022	0.000	-0.117***	0.037	0.002
trafficconди	1.020***	0.073	0.000	0.245*	0.132	0.063
L5.trafficconди	0.554***	0.073	0.000	0.645***	0.124	0.000
travelsatisf	-0.191***	0.056	0.001	0.726***	0.111	0.000
informationinflu	0.350***	0.103	0.001	0.279*	0.170	0.100
L5.informationinflu	-0.348***	0.096	0.000	-0.619***	0.169	0.000
2.traveldis	-0.439**	0.177	0.013			
3.traveldis	-0.953***	0.316	0.003			
4.traveldis	-0.858***	0.281	0.002			
querytimes	0.075**	0.035	0.033	0.328***	0.057	0.000
2.querymethod	0.862***	0.180	0.000	-0.596*	0.344	0.084
3.querymethod	2.018***	0.215	0.000	0.520	0.378	0.169
4.querymethod	0.895***	0.233	0.000	-0.251	0.504	0.619
5.querymethod	1.701***	0.185	0.000	0.083	0.320	0.796
traveltime				-0.217***	0.080	0.006
cut1	-36.289**	15.497	0.019	96.991***	30.249	0.001
cut2	-32.165**	15.494	0.038	106.078***	30.262	0.000
cut3	-29.356*	15.493	0.058	107.346***	30.268	0.000
cut4	-28.000*	15.493	0.071			
sigma2_u	10.859***	1.196		16.218***	2.260	
N	3858			3858		
Wald chi2	777.277			748.241		
Prob > chi2	0.0000			0.0000		
LR test vs. ologit regression						
Prob>=chibar2	0.0000			0.0000		

1174 Standard errors in parentheses

1175 For categorical variable, the number in front of variable symbol refers to the options

1176 \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

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1178 Table 4

1179 Random-effects ordered logistic model results for IMTI usage biography

Variables	Query times			Query method		
	Coef.	Std. Err.	P> z	Coef.	Std. Err.	P> z
year	0.053***	0.010	0.000	0.080***	0.008	0.000
worksatisf	-0.270***	0.061	0.000	0.008	0.058	0.890
L5.worksatisf	0.299***	0.062	0.000	-0.041	0.056	0.470
2.workplace	0.169	0.215	0.431	1.184***	0.211	0.000
3.workplace	0.378	0.318	0.234	1.127***	0.344	0.001
2L5.workplace	0.205	0.224	0.360	0.510**	0.209	0.015
3L5.workplace	-0.290	0.353	0.412	0.530	0.339	0.118
2.residencetype	-0.516	0.343	0.133	-0.787**	0.318	0.013
3.residencetype	-0.057	0.305	0.851	-1.010***	0.301	0.001
4.residencetype	-0.753***	0.279	0.007	-1.278***	0.275	0.000
2L5.residencetype	0.344	0.328	0.294	1.474***	0.332	0.000
3L5.residencetype	0.301	0.320	0.347	1.989***	0.318	0.000
4L5.residencetype	0.438	0.295	0.138	2.490***	0.309	0.000
carnumb	0.036	0.120	0.763	0.439***	0.124	0.000
householdnumb	0.101	0.071	0.157	-0.130*	0.071	0.066
L5.householdnumb	-0.008	0.072	0.915	-0.349***	0.077	0.000
activityduration	0.007***	0.002	0.000	-0.004**	0.002	0.046
L5.activityduration	-0.002**	0.001	0.027	-0.003**	0.001	0.018
2.travelmode	0.140	0.155	0.365	0.688***	0.141	0.000
3.travelmode	1.297***	0.261	0.000	1.290***	0.312	0.000
4.travelmode	0.547**	0.268	0.041	1.042***	0.335	0.002
2L5.travelmode	0.096	0.150	0.523	0.960***	0.162	0.000
3L5.travelmode	0.235	0.249	0.345	0.270	0.269	0.316
4L5.travelmode	1.590***	0.304	0.000	-0.660*	0.391	0.091
travelnumb	-0.086***	0.024	0.000	-0.074***	0.026	0.004
trafficconди	0.186**	0.081	0.021	0.738***	0.090	0.000
L5.trafficconди	-0.228***	0.078	0.004	0.153*	0.089	0.085
travelsatisf	0.252***	0.064	0.000	0.015	0.063	0.808
informationinflu	2.324***	0.121	0.000	1.415***	0.118	0.000
L5.informationinflu	0.247**	0.104	0.017	-0.413***	0.126	0.001
2.traveldis	0.755***	0.192	0.000	-0.455**	0.214	0.033
3.traveldis	0.411	0.326	0.208	1.773***	0.398	0.000
4.traveldis	1.597***	0.289	0.000	-1.005***	0.341	0.003
querytimes				0.632***	0.051	0.000
2.querymethod	-1.678***	0.211	0.000			
3.querymethod	0.951***	0.232	0.000			
4.querymethod	1.379***	0.260	0.000			
5.querymethod	2.785***	0.205	0.000			
traveltime	0.250***	0.049	0.000	0.363***	0.054	0.000
cut1	113.159***	20.785	0.000	162.037***	15.062	0.000
cut2	117.005***	20.797	0.000	165.144***	15.075	0.000
cut3	120.570***	20.800	0.000	166.597***	15.080	0.000
cut4	123.072***	20.799	0.000	167.508***	15.083	0.000
cut5	123.649***	20.800	0.000			
sigma2_u	16.123***	1.840		18.071***	2.365	
N	3858			3858		
Wald chi2	1565.977			1215.825		
Prob > chi2	0.0000			0.0000		
LR test vs. ologit regression						
Prob>=chibar2	0.0000			0.0000		

1180 Standard errors in parentheses

1181 For categorical variable, the number in front of variable symbol refers to the options

1182 \* p<0.1, \*\* p<0.05, \*\*\* p<0.01

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Table 5

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Marginal effects for holiday travel time in Beijing

Variables	Travel time				
	1	2	3	4	5
year	0.0015** (0.0007)	0.0008* (0.0005)	-0.0015** (0.0007)	-0.0005** (0.0002)	-0.0003** (0.0002)
L5.worksatisf	0.0172*** (0.0046)	0.0096*** (0.0034)	-0.0174*** (0.0043)	-0.0053*** (0.0014)	-0.0041*** (0.0012)
2.workplace	0.0410*** (0.0139)	0.0319** (0.0150)	-0.0441*** (0.0156)	-0.0154** (0.0061)	-0.0135** (0.0057)
3.workplace	0.0028 (0.0183)	0.0009 (0.0218)	-0.0030 (0.0227)	-0.0007 (0.0092)	-0.0000 (0.0083)
2L5.workplace	0.0527*** (0.0156)	0.0374** (0.0150)	-0.0564*** (0.0165)	-0.0186*** (0.0062)	-0.0152*** (0.0055)
3L5.workplace	0.0638** (0.0267)	0.0414** (0.0175)	-0.0666*** (0.0255)	-0.0214** (0.0083)	-0.0173** (0.0071)
2.residencetype	0.0168 (0.0155)	0.0143 (0.0306)	-0.0189 (0.0215)	-0.0063 (0.0123)	-0.0059 (0.0119)
3.residencetype	-0.0079 (0.0119)	-0.0218 (0.0287)	0.0104 (0.0178)	0.0088 (0.0113)	0.0104 (0.0118)
4.residencetype	0.0487*** (0.0127)	0.0381 (0.0243)	-0.0555*** (0.0168)	-0.0175* (0.0094)	-0.0137 (0.0093)
2L5.residencetype	0.0982*** (0.0218)	0.1186*** (0.0326)	-0.1206*** (0.0244)	-0.0509*** (0.0127)	-0.0453*** (0.0136)
3L5.residencetype	0.1131*** (0.0203)	0.1242*** (0.0331)	-0.1347*** (0.0218)	-0.0546*** (0.0127)	-0.0480*** (0.0137)
4L5.residencetype	0.0917*** (0.0171)	0.1155*** (0.0315)	-0.1141*** (0.0201)	-0.0491*** (0.0122)	-0.0439*** (0.0133)
carnumb	0.0332*** (0.0094)	0.0184*** (0.0070)	-0.0335*** (0.0089)	-0.0103*** (0.0030)	-0.0079*** (0.0025)
L5.householdnumb	-0.0239*** (0.0058)	-0.0132*** (0.0048)	0.0240*** (0.0056)	0.0074*** (0.0019)	0.0057*** (0.0016)
activityduration	-0.0011*** (0.0002)	-0.0006*** (0.0002)	0.0011*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)
L5.activityduration	-0.0001* (0.0001)	-0.0001 (0.0001)	0.0001* (0.0001)	0.0000* (0.0000)	0.0000* (0.0000)
2.travelmode	0.0641*** (0.0133)	0.0419*** (0.0119)	-0.0702*** (0.0122)	-0.0207*** (0.0043)	-0.0152*** (0.0037)
3.travelmode	0.1813*** (0.0320)	0.0375 (0.0259)	-0.1560*** (0.0188)	-0.0377*** (0.0061)	-0.0250*** (0.0051)
4.travelmode	-0.0492*** (0.0129)	-0.0875*** (0.0294)	0.0699*** (0.0188)	0.0352*** (0.0117)	0.0317*** (0.0117)
2L5.travelmode	0.0479*** (0.0139)	0.0211** (0.0082)	-0.0465*** (0.0120)	-0.0129*** (0.0035)	-0.0095*** (0.0028)
3L5.travelmode	0.0026 (0.0187)	0.0017 (0.0124)	-0.0028 (0.0200)	-0.0009 (0.0063)	-0.0007 (0.0048)
4L5.travelmode	-0.0540*** (0.0189)	-0.0618* (0.0319)	0.0663*** (0.0250)	0.0267** (0.0127)	0.0227* (0.0120)
travelnumb	0.0067*** (0.0019)	0.0037** (0.0014)	-0.0067*** (0.0019)	-0.0021*** (0.0006)	-0.0016*** (0.0005)
trafficcondi	-0.0864*** (0.0100)	-0.0479*** (0.0133)	0.0870*** (0.0067)	0.0267*** (0.0034)	0.0206*** (0.0036)
L5.trafficcondi	-0.0469*** (0.0075)	-0.0260*** (0.0078)	0.0473*** (0.0063)	0.0145*** (0.0025)	0.0112*** (0.0024)
travelsatisf	0.0162*** (0.0050)	0.0090*** (0.0035)	-0.0163*** (0.0046)	-0.0050*** (0.0016)	-0.0039*** (0.0013)
informationinflu	-0.0297*** (0.0091)	-0.0165** (0.0066)	0.0299*** (0.0088)	0.0092*** (0.0029)	0.0071*** (0.0024)
L5.informationinflu	0.0295***	0.0163**	-0.0297***	-0.0091***	-0.0070***

	(0.0085)	(0.0064)	(0.0084)	(0.0027)	(0.0022)
2.traveldis	0.0375**	0.0191**	-0.0349***	-0.0120**	-0.0097**
	(0.0157)	(0.0084)	(0.0132)	(0.0050)	(0.0044)
3.traveldis	0.0892***	0.0280**	-0.0759***	-0.0232***	-0.0181***
	(0.0335)	(0.0119)	(0.0239)	(0.0072)	(0.0060)
4.traveldis	0.0790***	0.0274**	-0.0684***	-0.0213***	-0.0167***
	(0.0288)	(0.0111)	(0.0210)	(0.0068)	(0.0059)
querytimes	-0.0064**	-0.0035*	0.0064**	0.0020**	0.0015**
	(0.0031)	(0.0019)	(0.0030)	(0.0009)	(0.0008)
2.querymethod	-0.0984***	0.0035	0.0710***	0.0143***	0.0096***
	(0.0215)	(0.0147)	(0.0151)	(0.0036)	(0.0028)
3.querymethod	-0.1848***	-0.0747**	0.1785***	0.0456***	0.0355***
	(0.0250)	(0.0342)	(0.0198)	(0.0078)	(0.0077)
4.querymethod	-0.1015***	0.0025	0.0740***	0.0150***	0.0101***
	(0.0260)	(0.0157)	(0.0203)	(0.0047)	(0.0036)
5.querymethod	-0.1662***	-0.0451*	0.1495***	0.0354***	0.0264***
	(0.0238)	(0.0269)	(0.0169)	(0.0055)	(0.0050)
Observations	3,858	3,858	3,858	3,858	3,858

1186 Standard errors in parentheses

1187 For categorical variable, the number in front of variable symbol refers to the options

1188 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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1194 Table 6

1195 Marginal effects for holiday travel distance

Variables	Travel distance			
	1	2	3	4
year	-0.0014***	0.0002	0.0002***	0.0010***
	(0.0005)	(0.0001)	(0.0001)	(0.0004)
worksatisf	0.0091***	-0.0012	-0.0016***	-0.0063***
	(0.0030)	(0.0008)	(0.0006)	(0.0021)
L5.worksatisf	0.0092***	-0.0012	-0.0016***	-0.0063***
	(0.0030)	(0.0008)	(0.0006)	(0.0020)
2.workplace	0.0536***	-0.0046	-0.0084***	-0.0406***
	(0.0122)	(0.0036)	(0.0020)	(0.0093)
3.workplace	0.0001	-0.0035**	-0.0013	0.0047
	(0.0165)	(0.0017)	(0.0024)	(0.0130)
2L5.workplace	0.0136	-0.0017	-0.0023	-0.0096
	(0.0113)	(0.0016)	(0.0019)	(0.0080)
3L5.workplace	0.0723***	-0.0143**	-0.0133***	-0.0447***
	(0.0189)	(0.0072)	(0.0037)	(0.0107)
2.residencetype	-0.1047***	0.0283**	0.0182***	0.0583***
	(0.0200)	(0.0116)	(0.0038)	(0.0122)
3.residencetype	-0.0645***	0.0222**	0.0102***	0.0322***
	(0.0172)	(0.0100)	(0.0028)	(0.0075)
4.residencetype	-0.0721***	0.0267***	0.0100***	0.0354***
	(0.0160)	(0.0100)	(0.0026)	(0.0058)
2L5.residencetype	-0.0453***	0.0071	0.0081***	0.0300***
	(0.0158)	(0.0046)	(0.0030)	(0.0101)
3L5.residencetype	-0.0361**	0.0064	0.0064**	0.0233**
	(0.0155)	(0.0044)	(0.0029)	(0.0094)
4L5.residencetype	-0.0393***	0.0067	0.0070***	0.0256***
	(0.0141)	(0.0044)	(0.0027)	(0.0085)

carnumb	-0.0173*** (0.0060)	0.0023 (0.0015)	0.0030*** (0.0012)	0.0120*** (0.0041)
householdnumb	-0.0071* (0.0037)	0.0009 (0.0007)	0.0012* (0.0007)	0.0049* (0.0026)
activityduration	-0.0027*** (0.0001)	0.0004* (0.0002)	0.0005*** (0.0001)	0.0018*** (0.0001)
L5.activityduration	-0.0003*** (0.0001)	0.0000* (0.0000)	0.0000*** (0.0000)	0.0002*** (0.0000)
2.travelmode	-0.0245*** (0.0084)	0.0029 (0.0018)	0.0053** (0.0021)	0.0163*** (0.0056)
3.travelmode	-0.1164*** (0.0184)	0.0093 (0.0064)	0.0198*** (0.0033)	0.0874*** (0.0139)
4.travelmode	-0.0454*** (0.0146)	0.0044 (0.0032)	0.0094*** (0.0035)	0.0316*** (0.0110)
2L5.travelmode	-0.0330*** (0.0079)	0.0031 (0.0022)	0.0061*** (0.0016)	0.0238*** (0.0060)
3L5.travelmode	0.0028 (0.0118)	-0.0004 (0.0017)	-0.0006 (0.0023)	-0.0019 (0.0078)
4L5.travelmode	-0.0726*** (0.0186)	0.0063 (0.0045)	0.0118*** (0.0028)	0.0545*** (0.0144)
travelnumb	0.0039*** (0.0012)	-0.0005 (0.0003)	-0.0007*** (0.0002)	-0.0027*** (0.0009)
trafficondi	-0.0080* (0.0044)	0.0011 (0.0009)	0.0014* (0.0008)	0.0056* (0.0030)
L5.trafficondi	-0.0211*** (0.0041)	0.0028* (0.0017)	0.0037*** (0.0008)	0.0147*** (0.0029)
travelsatisf	-0.0238*** (0.0042)	0.0031 (0.0020)	0.0042*** (0.0007)	0.0165*** (0.0027)
L5.informationinflu	0.0203*** (0.0053)	-0.0027* (0.0015)	-0.0035*** (0.0010)	-0.0141*** (0.0040)
traveltime	0.0071*** (0.0026)	-0.0009 (0.0006)	-0.0012*** (0.0005)	-0.0049*** (0.0019)
querytimes	-0.0107*** (0.0020)	0.0014 (0.0009)	0.0019*** (0.0004)	0.0074*** (0.0013)
2.querymethod	0.0192* (0.0111)	-0.0029 (0.0022)	-0.0035* (0.0021)	-0.0129* (0.0075)
3.querymethod	-0.0171 (0.0125)	0.0015 (0.0017)	0.0031 (0.0022)	0.0125 (0.0092)
4.querymethod	0.0081 (0.0163)	-0.0010 (0.0023)	-0.0015 (0.0030)	-0.0056 (0.0111)
5.querymethod	-0.0027 (0.0104)	0.0003 (0.0011)	0.0005 (0.0019)	0.0019 (0.0074)
Observations	3,858	3,858	3,858	3,858

1196 Standard errors in parentheses

1197 For categorical variable, the number in front of variable symbol refers to the options

1198 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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1202 Table 7

1203 Marginal effects for the number of IMTI queries

Variables	Number of queries					
	1	2	3	4	5	6
year	-0.0037*** (0.0007)	-0.0003** (0.0001)	0.0002 (0.0002)	0.0020*** (0.0004)	0.0004*** (0.0001)	0.0014*** (0.0003)
worksatisf	0.0187*** (0.0042)	0.0017** (0.0007)	-0.0012 (0.0012)	-0.0102*** (0.0024)	-0.0021*** (0.0005)	-0.0070*** (0.0018)

L5.worksatisf	-0.0207*** (0.0043)	-0.0019*** (0.0007)	0.0013 (0.0013)	0.0113*** (0.0023)	0.0023*** (0.0006)	0.0077*** (0.0019)
2.residencetype	0.0331 (0.0231)	0.0030 (0.0024)	-0.0021 (0.0035)	-0.0180 (0.0124)	-0.0037 (0.0025)	-0.0123 (0.0084)
3.residencetype	-0.0006 (0.0199)	-0.0011 (0.0017)	-0.0006 (0.0011)	0.0017 (0.0101)	0.0003 (0.0023)	0.0003 (0.0081)
4.residencetype	0.0371** (0.0173)	0.0038** (0.0018)	-0.0068 (0.0044)	-0.0189** (0.0089)	-0.0036* (0.0021)	-0.0116 (0.0076)
activityduration	-0.0005*** (0.0001)	-0.0000** (0.0000)	0.0000 (0.0000)	0.0003*** (0.0001)	0.0001*** (0.0000)	0.0002*** (0.0000)
L5.activityduration	0.0002** (0.0001)	0.0000* (0.0000)	-0.0000 (0.0000)	-0.0001** (0.0000)	-0.0000** (0.0000)	-0.0001** (0.0000)
2.travelmode	-0.0110 (0.0109)	-0.0023 (0.0023)	0.0008 (0.0016)	0.0072 (0.0066)	0.0014 (0.0013)	0.0039 (0.0036)
3.travelmode	-0.0888*** (0.0173)	-0.0118*** (0.0039)	0.0014 (0.0047)	0.0467*** (0.0096)	0.0120*** (0.0029)	0.0405*** (0.0110)
4.travelmode	-0.0408** (0.0184)	-0.0071*** (0.0026)	0.0043 (0.0027)	0.0223** (0.0103)	0.0048** (0.0025)	0.0164** (0.0078)
2L5.travelmode	-0.0066 (0.0104)	-0.0007 (0.0012)	0.0006 (0.0010)	0.0036 (0.0056)	0.0007 (0.0012)	0.0024 (0.0038)
3L5.travelmode	-0.0162 (0.0172)	-0.0018 (0.0019)	0.0012 (0.0013)	0.0087 (0.0092)	0.0019 (0.0020)	0.0062 (0.0069)
4L5.travelmode	-0.1066*** (0.0193)	-0.0122*** (0.0045)	-0.0028 (0.0053)	0.0502*** (0.0092)	0.0140*** (0.0033)	0.0573*** (0.0154)
travelnumb	0.0060*** (0.0017)	0.0005** (0.0002)	-0.0004 (0.0004)	-0.0032*** (0.0010)	-0.0007*** (0.0002)	-0.0022*** (0.0007)
trafficcondi	-0.0129** (0.0056)	-0.0012** (0.0006)	0.0008 (0.0009)	0.0070** (0.0031)	0.0014** (0.0007)	0.0048** (0.0022)
L5.trafficcondi	0.0158*** (0.0054)	0.0014** (0.0007)	-0.0010 (0.0010)	-0.0086*** (0.0030)	-0.0018*** (0.0006)	-0.0059*** (0.0022)
travelsatisf	-0.0175*** (0.0045)	-0.0016*** (0.0006)	0.0011 (0.0011)	0.0095*** (0.0024)	0.0019*** (0.0006)	0.0065*** (0.0019)
informationinflu	-0.1614*** (0.0081)	-0.0147*** (0.0047)	0.0103 (0.0101)	0.0879*** (0.0060)	0.0180*** (0.0025)	0.0599*** (0.0087)
L5.informationinflu	-0.0171** (0.0071)	-0.0016* (0.0009)	0.0011 (0.0012)	0.0093** (0.0038)	0.0019** (0.0008)	0.0064** (0.0029)
traveltime	-0.0174*** (0.0035)	-0.0016*** (0.0005)	0.0011 (0.0011)	0.0095*** (0.0019)	0.0019*** (0.0004)	0.0064*** (0.0015)
2.traveldis	-0.0550*** (0.0144)	-0.0050** (0.0020)	0.0064* (0.0039)	0.0296*** (0.0079)	0.0065*** (0.0019)	0.0174*** (0.0051)
3.traveldis	-0.0302 (0.0240)	-0.0027 (0.0023)	0.0045 (0.0037)	0.0165 (0.0130)	0.0034 (0.0029)	0.0085 (0.0074)
4.traveldis	-0.1131*** (0.0202)	-0.0119** (0.0047)	0.0054 (0.0062)	0.0574*** (0.0108)	0.0149*** (0.0035)	0.0472*** (0.0121)
2.querymethod	0.1794*** (0.0239)	-0.0154 (0.0138)	-0.1218*** (0.0160)	-0.0348*** (0.0069)	-0.0029*** (0.0008)	-0.0045*** (0.0014)
3.querymethod	-0.0835*** (0.0207)	-0.0233** (0.0096)	0.0605*** (0.0161)	0.0353*** (0.0096)	0.0038*** (0.0012)	0.0072*** (0.0025)
4.querymethod	-0.1150*** (0.0217)	-0.0410*** (0.0136)	0.0820*** (0.0169)	0.0552*** (0.0125)	0.0063*** (0.0018)	0.0125*** (0.0042)
5.querymethod	-0.1884*** (0.0218)	-0.1275*** (0.0229)	0.1212*** (0.0223)	0.1317*** (0.0120)	0.0185*** (0.0031)	0.0445*** (0.0080)
Observations	3,858	3,858	3,858	3,858	3,858	3,858

1204 Standard errors in parentheses

1205 For categorical variable, the number in front of variable symbol refers to the options

1206 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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Variables	Query method				
	1	2	3	4	5
year	-0.0039*** (0.0006)	-0.0036*** (0.0004)	-0.0006** (0.0002)	0.0002 (0.0001)	0.0079*** (0.0007)
2.workplace	-0.0813*** (0.0156)	-0.0648*** (0.0109)	-0.0026 (0.0038)	0.0060*** (0.0022)	0.1428*** (0.0197)
3.workplace	-0.0699*** (0.0194)	-0.0547*** (0.0164)	-0.0014 (0.0036)	0.0062*** (0.0023)	0.1199*** (0.0324)
2L5.workplace	-0.0256** (0.0111)	-0.0236** (0.0099)	-0.0027 (0.0018)	0.0014 (0.0010)	0.0505** (0.0207)
3L5.workplace	-0.0265 (0.0166)	-0.0246 (0.0164)	-0.0028 (0.0025)	0.0015 (0.0011)	0.0524 (0.0337)
2.residencetype	0.0429* (0.0222)	0.0182* (0.0097)	-0.0005 (0.0024)	-0.0041 (0.0027)	-0.0564** (0.0280)
3.residencetype	0.0450** (0.0201)	0.0136 (0.0096)	-0.0063* (0.0033)	-0.0075*** (0.0025)	-0.0448* (0.0259)
4.residencetype	0.0183 (0.0164)	-0.0192* (0.0104)	-0.0100*** (0.0026)	-0.0055*** (0.0020)	0.0164 (0.0248)
2L5.residencetype	-0.1058*** (0.0262)	-0.0457*** (0.0117)	0.0045 (0.0049)	0.0120*** (0.0037)	0.1351*** (0.0297)
3L5.residencetype	-0.1332*** (0.0260)	-0.0688*** (0.0132)	0.0016 (0.0059)	0.0135*** (0.0043)	0.1870*** (0.0285)
4L5.residencetype	-0.1548*** (0.0264)	-0.0942*** (0.0155)	-0.0032 (0.0069)	0.0135*** (0.0049)	0.2386*** (0.0280)
carnumb	-0.0214*** (0.0064)	-0.0197*** (0.0061)	-0.0030** (0.0015)	0.0010 (0.0008)	0.0432*** (0.0123)
householdnumb	0.0064* (0.0035)	0.0059* (0.0033)	0.0009 (0.0006)	-0.0003 (0.0003)	-0.0129* (0.0070)
L5.householdnumb	0.0170*** (0.0043)	0.0157*** (0.0035)	0.0024** (0.0012)	-0.0008 (0.0006)	-0.0344*** (0.0076)
activityduration	0.0002* (0.0001)	0.0002** (0.0001)	0.0000 (0.0000)	-0.0000 (0.0000)	-0.0003** (0.0002)
L5.activityduration	0.0001** (0.0001)	0.0001** (0.0001)	0.0000 (0.0000)	-0.0000 (0.0000)	-0.0003** (0.0001)
2.travelmode	-0.0401*** (0.0080)	-0.0484*** (0.0090)	-0.0118*** (0.0030)	-0.0007 (0.0020)	0.1009*** (0.0156)
3.travelmode	-0.0570*** (0.0129)	-0.0729*** (0.0194)	-0.0128** (0.0063)	0.0027 (0.0030)	0.1400*** (0.0342)
4.travelmode	-0.0476*** (0.0141)	-0.0557*** (0.0205)	-0.0082 (0.0054)	0.0034 (0.0023)	0.1082*** (0.0369)
2L5.travelmode	-0.0405*** (0.0079)	-0.0496*** (0.0100)	-0.0102*** (0.0035)	0.0007 (0.0019)	0.0996*** (0.0175)
3L5.travelmode	-0.0131 (0.0126)	-0.0132 (0.0136)	-0.0020 (0.0025)	0.0008 (0.0008)	0.0276 (0.0278)
4L5.travelmode	0.0379 (0.0251)	0.0290* (0.0158)	0.0018 (0.0021)	-0.0037 (0.0029)	-0.0652* (0.0375)
travelnumb	0.0036*** (0.0013)	0.0034*** (0.0012)	0.0005* (0.0003)	-0.0002 (0.0001)	-0.0073*** (0.0026)
trafficcondi	-0.0360*** (0.0061)	-0.0332*** (0.0047)	-0.0051** (0.0022)	0.0017 (0.0012)	0.0727*** (0.0086)
L5.trafficcondi	-0.0075* (0.0044)	-0.0069* (0.0040)	-0.0011 (0.0008)	0.0003 (0.0003)	0.0151* (0.0087)
informationinflu	-0.0690*** (0.0099)	-0.0637*** (0.0072)	-0.0098** (0.0041)	0.0032 (0.0023)	0.1394*** (0.0112)
L5.informationinflu	0.0201*** (0.0064)	0.0186*** (0.0062)	0.0029* (0.0015)	-0.0009 (0.0007)	-0.0407*** (0.0126)
traveltime	-0.0177***	-0.0163***	-0.0025**	0.0008	0.0358***

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	(0.0033)	(0.0028)	(0.0011)	(0.0006)	(0.0052)
2.traveldis	0.0233**	0.0186**	0.0023*	-0.0007	-0.0435**
	(0.0114)	(0.0085)	(0.0013)	(0.0006)	(0.0200)
3.traveldis	-0.0566***	-0.0876***	-0.0219***	-0.0052	0.1712***
	(0.0125)	(0.0212)	(0.0078)	(0.0036)	(0.0387)
4.traveldis	0.0563***	0.0378***	0.0033	-0.0025*	-0.0949***
	(0.0216)	(0.0118)	(0.0022)	(0.0015)	(0.0310)
querytimes	-0.0308***	-0.0284***	-0.0044**	0.0014	0.0622***
	(0.0045)	(0.0033)	(0.0017)	(0.0010)	(0.0046)
Observations	3,858	3,858	3,858	3,858	3,858

1211 Standard errors in parentheses

1212 For categorical variable, the number in front of variable symbol refers to the options

1213 \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

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