


Factors associated with home-based e-working and e-shopping in Nanjing, China

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Abstract The widespread adoption of information and communication technology has facilitated frequent e-activities in people’s daily life. From the perspective of individual’s time use on e-working and e-shopping at home, this paper aims to enhance our understanding of the function of home beyond a living space for family life. Using a household survey of 608 full-time paid employees who conducted e-activities at home in Nanjing, China, we investigated the characteristics and patterns of home-based e-working and e-shopping. Only 7.9% of the respondents neither e-shopped nor e-worked at home. We find that the socio-demographic context, Internet use habits, attitudes towards e-working/e-shopping, and geographical accessibility have influenced the patterns of home-based e-working and e-shopping. The results indicate that the rich e-activities taking place at home have changed the time use at home and reinforced the function of home as a multifunctional hub.

Keywords Home · Time use · E-working · E-shopping · Geographical accessibility · China

Introduction

In the e-society, the widespread adoption of information and communication technology (ICT) in people’s daily life has changed how we work, shop, travel, communicate, and live (Loo 2012). A resultant trend is the “fragmentation” of activities in both time and space because of the prevalence of e-activities (generally defined as activities which are conducted with the aid of ICT) (Lenz and Nobis 2007). With ICT being more accessible and affordable, many activities are no longer imperatively bound to specific place and time as

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before (Kwan 2007); and this enables a partial decoupling of activity and physical activity space (Schwanen et al. 2008). The accompanying changes challenge our traditional understanding of a person's activity space based on static and fixed locations (Kwan 2013), such as home which has long been regarded mainly as a living space in geographical research (Blunt 2005; Domosh 1998; Tuan 2004) and modern urban planning practice (Corbusier 1973). From the perspective of time use on e-working and e-shopping at home, this current study aims to examine the conditions for full-time paid employees¹ to choose to e-work and e-shop at home. We define home-based e-work as when people use ICT to work at home during or outside of regular work hours, instead of commuting to a conventional workplace²; home-based e-shopping is defined as when people use ICT to search for and/or purchase consumer goods at home, instead of going to a retail store.

In recent decades, e-working and e-shopping, together with their impacts on travel behaviour, have received much attention in the academia (for example, Aguilera et al. 2016; Calderwood and Freathy 2014; Farag et al. 2006a, b; Kim et al. 2015; Mokhtarian and Salomon 1994, 1996; Nilles 1976; Ren and Kwan 2009; Singh et al. 2013; Zhen et al. 2016). These studies largely focused on the adoption and frequency of e-working and e-shopping separately; however, there may also be relevant factors influencing both activities (Sener and Reeder 2012). Up to date, only a few research studies have dealt with e-working and e-shopping together (Hjorthol and Gripsrud 2009; Sener and Reeder 2012). Meanwhile, although it is widely acknowledged that the frequency of e-working and e-shopping has increased, their interrelationships with specific activity space are still unclear (Alexander et al. 2010; Lenz and Nobis 2007). Changes in people's activity space, in turn, will affect their travel behaviour and time use (Kwan et al. 2007; Pred 1984). In the current study, we analyze how in-home time is allocated to e-working and e-shopping. The concepts of part-day and whole-day homeworking (Haddad et al. 2009) are adopted.³

Moreover, very few studies have focused on China where very rapid informatization and urbanization have been taking place (Loo and Wang 2017; Wu 2015). On the one hand, e-working and e-shopping have proliferated in China during the last two decades. In 2014, according to the Survey Report on Internet Development in China, 47.9% of the Chinese population used the Internet and on an average, they spent 26.1 h per week on the Internet (CNNIC 2015). The number of e-shoppers reached 361 million (CNNIC 2015). Although detailed information on home-based e-working is unavailable in China, it is known that about 90 and 78.7% of enterprises used computers and the Internet in their business, respectively (CNNIC 2015). On the other hand, after more than 30 years of urban transition, China has reached an urbanization rate above 50% in 2010 (Wang et al. 2015). Many large cities in China are now facing serious traffic congestion and other transport problems as urbanization accelerates. A recent report estimated a total loss of about one billion yuan every day in terms of travel time wasted on roads among 15 large Chinese cities.⁴ Traffic congestion has become a major problem for urban and transport planners and policy makers alike. Meanwhile, another report also indicates that commuting and

¹ Self-employed and people running home-based business or having more than one job were not considered in this study.

² For e-working, many previous studies have focused on the impacts on job-related commuting and, hence, it is often referred as telecommuting and telework.

³ In this paper, we mainly focus on e-working at home. Therefore, part-day and whole-day home-based e-working are used.

⁴ More details can be obtained from: http://www.china.org.cn/top10/2012-11/02/content_26980425.htm.

shopping travel accounted for about three-fourths of urban residents' total trips.⁵ And commuting distance in many big cities has increased significantly during the socio-spatial transformation of urban China (Ta et al. 2017). Given the potential of e-working and e-shopping to replace physical working and shopping trips, particularly in large cities where the time cost spent on travel is high (Aguilera et al. 2016), an empirical study on the home-based e-working and e-shopping patterns will be helpful for evidence-based policy making and urban planning practice in China.

Using a household survey in Nanjing, China, this study examines the multifunctional role of home, geographical accessibility, attitudinal characteristics, Internet use and experience, and various socio-demographic factors influencing e-working and e-shopping. It aims to answer the following specific research questions: (1) For full-time paid employees who have e-activities at home, how has home become an alternative workplace and shopping site? (2) What are the main factors associated with the actual choice of (both part-day and whole-day) home-based e-working? (3) What are the key factors associated with the duration that full-time paid employees spent on e-shopping at home daily?

Literature review

In geographical research, home is always considered as a place of security, familiarity, and nurture (Blunt 2005; Domosh 1998; Tuan 2004). With this, home is filled with personal experience that is tied to the conceptual and substantive terms of domesticity, intimacy, privacy, and a sense of belonging or alienation (Blunt and Varley 2004). Nowadays, modern ICT allows different kinds of activities, many of which conducted outside home traditionally, to be conducted without leaving home. It is common for a typical family to have access to the Internet via a wide variety of ICT devices at home. The possibility of conducting e-activities at home may influence people's decisions on the choice of out-of-home activities on the one hand and change people's time use at home on the other.

In this paper, we examine the multifunctional role of home from the perspective of time use at home, that is, part-day and whole-day home-based e-working and the time spent on e-shopping at home daily. The time allocation of in-home and out-of-home activities has been studied using the activity-travel behaviour approach (Wang and Lin 2013). There exists a variety of ways of measuring the prevalence of e-working at home, such as preference, choice, and frequency. Due to various constraints (e.g., job nature, the lack of manager support and unavailable technical support), there are often disparities between a preference and the actual practice of e-working (Aguilera et al. 2016; Loo 2012; Mokhtarian and Salomon 1994). Binary and ordered data are used in measuring the preference, choice, and self-reported frequency of e-working (e.g., would/would not prefer to e-work; does/does not e-work; the extent to which a person wants to practice e-working) (Deng et al. 2015; Haddad et al. 2009; Hjorthol and Gripsrud 2009; Kim et al. 2015; Mokhtarian and Salomon 1996; Paleti 2016; Sener and Reeder 2012). The results, however, depend greatly on whether the sample is limited to those who have the choice or not (Mokhtarian and Salomon 1996). This current study examines the actual choice of e-working at home among respondents who are able to e-work at home. And e-working has been divided into two sub-groups of part-day and whole-day home-based e-working (Deng et al. 2015; Haddad et al. 2009). In contrast to the latter, the former shows an increasing incidence and has the potential for one or both of the commute trips to be shifted and thus,

⁵ More details can be obtained from: http://news.xinhuanet.com/mrdx/2009-11/02/content_12372481.htm.

contributes to the spreading of peak-hour traffic (Asgari et al. 2016; Haddad et al. 2009). Compared to e-working, e-shopping has been studied more widely. Generally, the e-shopping frequency and the amount of money spent on e-shopping have been used in analyzing e-shopping behaviour (Cao 2009, 2012; Farag et al. 2006a, b; Mokhtarian et al. 2009; Ren and Kwan 2009; Sener and Reeder 2012; Zhai et al. 2016). However, its connection with home or other place(s) where e-shopping activities (from information gathering, price comparisons, placing order, transactions to product delivery and even after-sales service) take place has still been unclear (Cao 2012; Zhen et al. 2016).

Based on the literature, the determinants of the preference, adoption, and frequency of e-working and e-shopping can roughly be classified into four types, including socio-demographic attributes, Internet use attributes, attitudes towards e-working/e-shopping, and geographical accessibility (Calderwood and Freathy 2014; Cao 2012; Farag et al. 2006a, b; Kim et al. 2015; Mokhtarian and Salomon 1996; Ren and Kwan 2009; Singh et al. 2013; Zhai et al. 2016; Zhen et al. 2016). Socio-demographic characteristics play an important role in explaining e-working and e-shopping behaviour. Various studies examine the impact of variables like gender, age, educational level, income, household car ownership, and household structure. However, so far, findings from the existing literature are rather mixed (Andreev et al. 2010), indicating that people's e-activities and physical activities may be historically and spatially contingent (Kwan 2001).

As some scholars claimed, in addition to these "objective" socio-demographic attributes, antecedent and "subjective" lifestyle factors such as culture, experience, personal attitudes and preference play a significant role in explaining people's behaviour. First, the traditional culture may influence people's choice between staying at home to conduct e-activities and participating in out-of-home physical activities (Cao and Chai 2007; Fong 2004; Kwan and Kotsev 2015). Home has long been the fundamental unit of the society; and family value is highly appreciated in the Chinese culture (Logan and Bian 1999). Under the heavy influence of Confucianism, Chinese people tend to show more collectivistic characteristics and less individualism compared with people in Western countries (Oyserman et al. 2002). In addition, Confucian traditions and norms also impact on gender role, with females being more in charge of domestic household tasks while men being more in charge of out-of-home social activities (Cao and Chai 2007; Zuo and Bian 2001). As a result, we expect that females and people with children are more likely to choose to e-work and e-shop at home.

Second, familiarity with the Internet and frequent use of the Internet have positive effects on both e-working and e-shopping (Farag et al. 2006a, b; Loo 2012; Mokhtarian and Salomon 1996; Ren and Kwan 2009; Singh et al. 2013; Zhai et al. 2016). In previous studies, the number of months/years since they used the Internet, home Internet access types (i.e., dial-up, wired, and wireless), and daily Internet use duration have frequently been used to measure Internet experience. However, the influence of Internet usage may differ at different time scales and areas due to the differences in popularity of Internet use (Cao 2009; Zhai et al. 2016).

Third, people's attitudes towards e-working and e-shopping at home are also related to their behaviour. An attitude refers to a subjective evaluation of a behaviour (Gärling et al. 1998). Over time, different attitudinal variables have been introduced to explain individual online behaviour (Dijst et al. 2008; Farag et al. 2006a; Mokhtarian et al. 2009; Mokhtarian and Salomon 1996; Wilton et al. 2011; Zhai et al. 2016; Zhen et al. 2016). Regarding e-working, as Mokhtarian and Salomon (1994) summarized, attitudes towards e-working at home could be work, family, leisure, travel, and environment related. For e-shopping, positive attitudes towards the perceived quality of e-vendors, the time/cost saving, and the

pleasure of browsing the Internet, also increase the intention to e-shop (Dijst et al. 2008; Farag et al. 2006a; Mokhtarian et al. 2009; Zhai et al. 2016; Zhen et al. 2016).

Lastly, geographical accessibility variables can also help to explain online behaviour (Calderwood and Freathy 2014; Cao 2009; Farag et al. 2006b; Kim et al. 2015; Ren and Kwan 2009; Sener and Reeder 2012; Wang and Lin 2013). Distance from workplace and commuting mode have been considered influential in affecting the choice and frequency of e-shopping, the spatial distribution of in-store shopping opportunities and the local residential context have proved to influence people's e-shopping behaviour significantly (Cao 2009; Cao et al. 2013; Farag et al. 2006b; Ren and Kwan 2009; Zhou and Wang 2014). In general, the results lend support to the "innovation-diffusion" hypothesis and/or the "efficiency hypothesis" proposed by Anderson et al. (2003). On the one hand, people in urban areas are more likely to be e-shoppers because of the availability of new technologies and flourishing creative thinking. On the other hand, people tend to e-shop more if they have to spend more efforts and time/money in going to local stores, such as, living in a suburban environment. In addition, previous studies suggest that the lack of opportunities for social and recreational interactions may limit people's choice of working at home (Henderson and Mokhtarian 1996; Wilton et al. 2011). In addition to buying consumer goods, shopping also fulfills some social and recreational functions and thus, in-store shopping may be mixed with other leisure activities (Dijst 2004). Therefore, it is reasonable to believe that the spatial distribution of in-store shopping opportunities may also influence people's home-based e-working behaviour. However, whether these findings can be generalized to China with a different socio-geographic context needs further investigation. As a country with rigorous government-led land use planning and rapid urban development (Wu 2015), knowledge of the relationship between built environment variables and home-based e-working and e-shopping behaviour helps to provide insights for new transport and land-use designs that shape (facilitate or hinder) people's online behaviour.

Based on the literature review, we investigate the characteristics and patterns of home-based e-working and e-shopping from the perspective of an individual's time allocation on e-working and e-shopping at home. To reiterate, four types of independent variables, socio-demographic attributes, Internet use attributes, attitudes towards e-working/e-shopping, and geographical accessibility characteristics were introduced to analyze factors associated with home-based e-working and e-shopping behaviour. Using a case study of Nanjing, China, this research aims to enrich the existing literature on the situation of e-working and e-shopping at home and widen our understanding of home as a multifunctional hub in people's daily life.

Methodology

Study area and the household survey

The data of this study came from a household survey in Nanjing in July–August, 2015. As the capital city of Jiangsu Province located in the Yangtze River Delta, Nanjing is a representative example of the rapidly growing and large coastal cities of China (Yuan et al. 2016). It covers an area of 6587 square kilometers with a total population of over 8 million in 2014 (Statistical Bureau of Nanjing 2015). The city built its first metro line in 2005 and has five metro lines in 2015. On average, each urban household has 2.7 family members

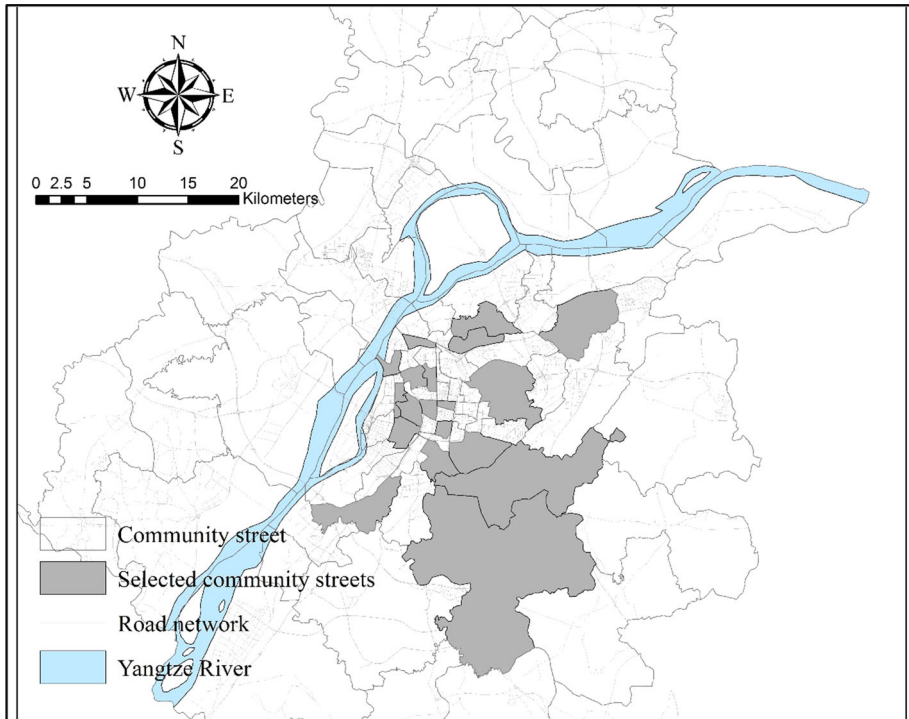


Fig. 1 The survey locations in Nanjing, China

and the per-capita living space is about 30 square meters (Statistical Bureau of Nanjing 2014). The tertiary industry has become the largest industrial sector since 2008 and its employees made up 57.1% of the total number of employment in 2013 (Statistical Bureau of Nanjing 2014).

Yangtze River runs through the city. Compared to the northern part with many heavy industrial sites, the southern part of the city has better accessibility and are primarily residential, commercial, and light industrial areas (Yuan et al. 2016). This study focuses on 9 districts in the south which cover the major urban areas of Nanjing. The sub-sample size of each district is proportional to its population. Within each district, two to three community streets (*jiedao* in Chinese, the lowest administrative unit in China) were randomly selected to represent different locations within the district. The number of community streets totaled 19. In each community street, one or two neighborhoods were chosen. To balance the diversity of neighborhoods, close to and away from metro stations were considered in the selection. Overall, 30 neighborhoods were sampled (Fig. 1).

The population of this study are full-time paid employees having e-activities at home. The data were collected through face-to-face interviews with a six-page structured questionnaire. Respondents were recruited through “knocking on doors”.⁶ In order to distinguish respondents who had experience of e-activities, the screening question runs as follows: “Have you used the Internet at home for purposes like shopping, communication,

⁶ Some respondents did not want to fill in the questionnaire at home. We invited them to fill in the questionnaire in public areas in the neighbourhoods.

working, and other entertainment in the last month?"; those who answered "yes" were invited to participate in the survey. The survey was conducted in the evening (18:30–22:00) on weekdays and throughout the day on weekends (08:00–22:00). An excise book (roughly worth 20 *yuan* or 3 US dollar) was provided as an incentive for participation in the study. With the support of officers of the "community street",⁷ we knocked on the doors of 1765 households; 935 households answered. 645 respondents passed the screening question test and finished the survey. After removing 37 questionnaires with many missing responses, the valid samples comprise 608 respondents.

Variables

For e-working, binary data of whether the respondents chose to part-day and whole-day home-based e-working in the last two weeks among those who had a choice to e-work at home were used in measuring the patterns of home-based e-working. People engaging in part-day home-based e-working were full-time paid employees who used ICT to conduct working tasks⁸ at least half an hour at home in any given day on workdays. Full-time paid employees who engaged in whole-day home-based e-working were those who used ICT to work at home during regular work hours instead of commuting to a conventional workplace at the conventional time in any given day on workdays.⁹ For e-shopping, we analyze the amount of time spent on e-shopping at home daily in the last two weeks among those who e-shopped at home. According to their responses, three groups were identified: low (0–0.5 h), middle (0.5–1.0 h), and high (more than 1.0 h).

The independent variables used in this study fall into four categories—socio-demographic attributes, Internet use attributes, attitudes towards e-working/e-shopping, and geographical accessibility characteristics. Socio-demographic variables include gender, age, education level, children under 16 in family, annual household income, and whether the respondents usually drive to workplace/shops. The Internet use variables include the use of smartphone in 2012 and daily Internet use time. Perhaps because of the widespread and long use of the Internet in China (Loo and Wang 2017), it becomes difficult for respondents in our survey to recall how long they have been using the Internet. Convenient access to mobile Internet, together with smartphones, has greatly facilitated Internet development in China (Loo and Ngan 2012). According to CNNIC (2013), the percentage of smartphone usage among Internet users has first surpassed 50% in 2012. In other words, the share of smartphone usage in 2012 was about one third when the whole population was considered. Therefore, the use of smartphone in 2012 can well reflect the respondents' Internet experience. Variables relating to geographical accessibility include the distance from the respondents' home location to workplace, to the nearest metro station, and to the nearest shopping center.¹⁰ Instead of simply having retail shops, shopping centers in China provide almost all kinds of non-daily goods and leisure services (e.g., catering and cinema) that satisfy people's in-store shopping and related leisure requirements. Table 1 summarizes the socio-demographic, Internet use, and geographical accessibility characteristics of

⁷ We found it difficult to enter some neighborhoods (in particular the gated neighbourhoods) without the aid of officers of the "community streets".

⁸ These working tasks at home are the continuation of their work at the usual workplace.

⁹ No respondents reported that they had full-day home-based e-working every day during last 2 weeks.

¹⁰ Here, we only include those shopping centers at the district level which usually cover a larger area and provide almost all kinds of shopping and leisure service for residents living and working in the district. The list of district shopping centers comes from the "Master Plan of Nanjing (2011–2020)".

Table 1 Sample characteristics of respondents who had a choice of e-working and who e-shopped at home

Variables	E-working		E-shopping		Full samples	
	Case	Percentage	Case	Percentage	Case	Percentage
Gender						
Male	175	48.7	246	46.1	314	51.6
Female	166	51.3	288	53.9	294	48.4
Age						
21–30	155	45.5	283	53.0	298	49.0
31–40	144	42.2	212	39.7	231	38.0
41–50	42	12.3	39	7.3	79	13.0
Educational level						
Low (High school or below)	32	9.4	82	15.4	110	18.1
Middle (College or university)	216	63.3	345	64.6	379	62.3
High (Graduate school)	93	27.3	107	20.0	119	19.6
Children under 16						
Non children under 16	131	38.4	228	42.7	261	42.9
One or more children under 16	210	61.6	306	57.3	347	57.1
Annual household income ^a	3.23 ^b	1.10 ^c	2.99 ^b	1.12 ^c	3.01 ^b	1.13 ^c
Usually drive to workplace						
No	247	72.4	–	–	567	76.8
Yes	94	27.6	–	–	141	23.2
Usually drive to shopping center						
No	–	–	393	42.7	430	70.7
Yes	–	–	141	26.4	178	29.3
Smartphone use in 2012						
Non smartphone use in 2012	79	23.2	149	27.9	179	29.4
Smartphone use in 2012	262	76.8	385	72.1	429	70.6
Daily Internet use time						
Low (Less than 2 h)	92	27.0	152	28.5	180	29.6
Middle (2–5 h)	194	56.9	296	55.4	332	54.6
High (More than 5 h)	55	16.1	86	16.1	96	15.8
Distance to workplace (km)	5.82 ^b	4.92 ^c	–	–	5.60 ^b	4.68 ^c
Distance to the nearest metro station (km)	0.85 ^b	0.88 ^c	0.88 ^b	0.91 ^c	0.86 ^b	0.88 ^c
Distance to the nearest shopping center (km)	0.93 ^b	0.92 ^c	0.94 ^b	0.92 ^c	0.93 ^b	0.90 ^c
Total	341	100.0	534	100.0	608	100.0

^a Annual household income is measured on an ordinal scale: 1 = Less than 50,000 Yuan, 2 = 50,000–100,000 Yuan, 3 = 100,001–150,000 Yuan, 4 = 150,001–200,000 Yuan, 5 = More than 200,000 Yuan

^b The mean value

^c The SD value

the samples who had a choice of e-working, who e-shopped at home, and the full sample. Most of the respondents were young (aged 21–40), highly-educated with high-income, and frequent Internet users.¹¹ The results are not surprising as we focus on full-time paid employees having e-activities at home.

Regarding attitudes towards home-based e-working, with reference to previous studies by Mannering and Mokhtarian (1995), Mokhtarian and Salomon (1994), de Graaff and Rietveld (2007) and Wilton et al. (2011), respondents were asked to indicate the extent of their agreement (on a 5-point Likert scale) with 10 statements about e-working at home, as listed in Table 2. Since the attitudinal statements are usually highly correlated, an exploratory factor analysis is used to identify the key groups of respondents according to their attitudes towards e-working: workaholic, enjoyment seeking at workplace, and freedom seeking (Table 2). Generally, the workaholic and freedom seeking groups hold a relatively more positive attitude towards e-working at home while the enjoyment seeking at workplace group holds a relatively negative attitude. Making reference to Mokhtarian et al. (2009), Zhai et al. (2016) and a survey report on e-shopping in China (CNNIC 2015), respondents were asked to indicate the extent of their agreement (also on a 5-point Likert scale) with 11 statements about e-shopping. These statements are shown in Table 3. Similarly, for e-shopping attitudes, an exploratory factor analysis is used to reduce these statements into four factors: novelty seeking, shopping enjoyment, time consciousness, and cost consciousness (Table 3). Generally, the novelty seeking, time consciousness, and cost consciousness groups hold a relatively more positive attitude towards e-shopping at home while the shopping enjoyment group holds a relatively more negative attitude (Zhen et al. 2016).

Results

Summary of home-based e-working and e-shopping behaviour

Among the 608 full-time paid employees who had e-activities¹² at home, only 48 respondents (7.9%) neither e-shopped nor e-worked at home. In other words, the majority did engage in home-based e-working and/or e-shopping, indicating that home was not solely a living space for most respondents. Specifically, 534 respondents (87.8%) e-shopped at home. Among them, 39.0, 42.7, and 18.4% of them spent less than 0.5, 0.5–1.0 h, and more than 1.0 h per day on e-shopping at home. About half (54.8%) of the respondents conducted e-shopping at home but did not engage in home-based e-working. In addition, 159 and 73 respondents (26.2 and 12.0%) had undertaken both e-shopping and part-day home-based e-working and both e-shopping and whole-day home-based e-working, respectively.

Compared to e-shopping at home, e-working at home is not as common. 341 respondents (56.1%) claimed that they were able to conduct working tasks remotely (that is, they had the choice to e-work at home) and have considered to work at home, instead of the traditional workplace. 185 and 82 respondents had actually engaged in part-day and whole-

¹¹ According to the Sixth National Census, the percentage of people with a college/university degree or above in Nanjing was about 26% in 2010. And the annual household disposable income of urban residents averaged 68,876 yuan in 2013 (Statistical Bureau of Nanjing 2014).

¹² The e-activities include e-shopping, e-working, e-education, e-networking, e-leisure (e.g., e-games, watching videos), website browsing and search, etc.

Table 2 Pattern matrix for attitudes towards e-working at home

Attitude statements	Workaholic	Enjoyment seeking at workplace	Freedom seeking
For me, I usually work overtime	0.795		
I think working is all my life	0.713		
I like to get more done in my job	0.549		
I like to use new technologies to conduct my work efficiently	0.378		
I think working with colleagues/leaders together bring me lots of fun		0.771	
I enjoy communicating with my colleagues/clients during my work		0.698	
I am happy when my workload are reasonable measured and recognized by my leaders		0.615	
I enjoy more freedom			0.832
I hate to waste my time in commuting almost every day			0.684
I hope to spend more time on household tasks and thus, make a better balance between family and work			0.568

The Kaiser–Meyer–Olkin Measure of Sampling Adequacy is 0.792

Extraction method: Principal component analysis with eigenvalue larger than one

Rotation method: Oblimin with Kaiser normalization. The highest correlation between factor scores is 0.266 (between workaholic and enjoyment seeking at workplace)

Score estimation method: Regression

Loadings smaller than 0.30 are suppressed

The three factors explain 57.1% of the variation in the items

day home-based e-working; 40 respondents had undertaken both part-day and whole-day home-based e-working. Among all respondents, the percentages of part-day and whole-day home-based e-working in this study (30.4 and 13.5%, respectively) are higher than the shares in the UK in 2007 (17.2 and 9.8%, respectively) (Haddad et al. 2009). However, the percentage of whole-day home-based e-working among 341 respondents who had the choice to e-work at home was less than half of the estimated share among Americans who had the option of working at home in 2009 (24.0 vs. 59.8%) (Sener and Reeder 2012), indicating that whole-day home-based e-working is just emerging and not common in China. The comparisons also suggest that we need to be cautious when comparing e-working practices among different countries due to the different definitions, forms (e.g., home-based and center-based telecommuting), sampling methods, and continuing evolution of patterns (Haddad et al. 2009; Mokhtarian et al. 2005).

Factors associated with home-based e-working and e-shopping

Since the dependent variables are measured as a binary variable (e-working) and an ordinal variable (e-shopping), binary logit regression and ordered logit regression models are adopted. In particular, as unobserved factors may jointly influence the engagement in part-day and whole-day home-based e-working, we allow their error terms to be correlated. Accordingly, by using the “cmp” module in Stata 12.0 (Roodman 2009), we developed a

Table 3 Pattern matrix for attitudes towards e-shopping at home

Attitude statements	Novelty seeking	Shopping enjoyment	Time consciousness	Cost consciousness
I enjoy buying personalizing things	0.841			
I like to buy rare things	0.711			
I prefer novelty things	0.589			
I like to search rich information and have enough choices when buying things	0.424			0.321
Shopping helps me relax and happy		0.812		
I think in-store shopping is an important part of my leisure activity chain		0.652		
I enjoy going to and strolling through shopping areas		0.542		
I am too busy to shop as often or as long as I'd like			0.778	
I like to stay indoors			0.634	
I like to buy imitated brand things online				0.862
It is important to me to get the lowest prices when I buy things				0.635

The Kaiser–Meyer–Olkin Measure of Sampling Adequacy is 0.675

Extraction method: Principal component analysis with eigenvalue larger than one

Rotation method: Oblimin with Kaiser normalization. The highest correlation between factor scores is 0.241 (between novelty seeking and time consciousness)

Score estimation method: Regression

Loadings smaller than 0.30 are suppressed

The three factors explain 66.2% of the variation in the items

joint binary logit regression model to gauge the effects of multidimensional variables on e-working among 341 respondents who had the choice to e-work at home. The significantly positive correlation between the error terms suggests that unobserved factors are influencing the engagement of part-day and whole-day home-based e-working in the same direction (Table 4). This also confirms that it is statistically more efficient to estimate the two equations jointly than to develop them separately. In addition, an ordered logit regression was developed to analyze the effects of multidimensional variables on the time spent daily on e-shopping among 534 respondents who e-shopped at home.

Prior to estimating the regression models, a Pearson correlation analysis was also used to check potential autocorrelation problems among independent variables before each regression model was applied. A correlation coefficient less than -0.7 or more than 0.7 is usually seen as strong correlation (Friedman et al. 2001) that may lead to serious multicollinearity (Loo 2007; Midi et al. 2010). All correlation coefficients among variables in the final model are less than 0.4 and/or statistically insignificant at 0.05 level.

Home as an alternative workplace

Table 4 indicates that the presence of children under 16 does have a significantly positive impact on both people's choice to part-day and whole-day home-based e-working. This

Table 4 Joint binary logit regression results on the choice of part-day and whole-day home-based e-working

Variable	Part-day home-based e-working			Whole-day home-based e-working		
	Coef.	SE	<i>P</i> value	Coef.	SE	<i>P</i> value
<i>Socio-demographics</i>						
Gender (female = ref.)	-0.009	0.041	0.820	-0.104	0.039	0.008
Age (21–30 = ref.)						
31–40	-0.004	0.046	0.927	-0.005	0.044	0.900
41–50	0.026	0.068	0.696	0.007	0.065	0.917
Education (high = ref.)						
Low	-0.273	0.078	0.000	-0.163	0.075	0.029
Middle	-0.078	0.046	0.089	-0.077	0.044	0.076
Children under 16 (non = ref.)	0.095	0.044	0.033	0.099	0.042	0.019
Annual household income	0.046	0.020	0.019	0.021	0.019	0.258
Usually drive car to workplace (non = ref.)	0.180	0.047	0.000	0.071	0.045	0.111
<i>Internet use</i>						
Smartphone use in 2012 (non = ref.)	0.036	0.048	0.458	0.017	0.046	0.705
Daily Internet use time (low = ref.)						
Middle	0.113	0.047	0.015	0.117	0.045	0.009
High	0.169	0.064	0.008	0.218	0.061	0.000
<i>Attitudes towards e-working at home</i>						
Workaholic	0.084	0.008	0.000	0.052	0.008	0.000
Enjoyment seeking at workplace	-0.039	0.020	0.054	-0.053	0.019	0.006
Freedom seeking	0.005	0.025	0.841	0.103	0.024	0.000
<i>Geographical accessibility</i>						
Distance to workplace	0.024	0.004	0.000	0.027	0.004	0.000
Distance to the nearest metro station	-0.042	0.023	0.065	-0.019	0.022	0.388
Distance to the nearest shopping center	-0.078	0.024	0.001	-0.127	0.022	0.000
Rho_12	0.251	0.054	0.000			

The dependent variable is equal to 1 if the respondent had experience of part-day/whole-day home-based e-working and 0 otherwise

N = 341

LR $\chi^2 = 317.04$

Log-likelihood at convergence = -228.755

corroborates with the observations in earlier studies of a higher home-based e-working adoption rate due to the need for flexibility in childcare (Haddad et al. 2009; Sener and Reeder 2012; Singh et al. 2013). Our results may also be related to China's one-child policy; and parents tend to spend as much time as possible with their children (Fong 2004). Though no statistically significant relationship is found between gender and the adoption of part-day home-based e-working, females tend to be more likely to engage in whole-day home-based e-working. Although previous studies show mixed evidence of gender differences in the adoption of home-based e-working (Haddad et al. 2009; Hjørthol and Gripsrud 2009; Sener and Reeder 2012; Singh et al. 2013), our findings suggest that

females are more likely to choose to whole-day home-based e-working. The findings also support that e-working at home can become an important strategy to strike a balance between family and work, especially for females and people with children. Given that females in China usually bear a disproportionate share of domestic responsibilities, a home-based e-working option could be used as a human resource strategy to raise female labour participation rate (Fan 2003; Wilton et al. 2011). Similar to previous findings in Western countries, people with higher education level are more likely to choose to home-based e-work, which presumably is related to their knowledge of and comfort with ICT or perhaps an increased leverage and bargaining ability with their employers. Compared to previous studies, no age-related effects have been found in this study. Yet, people with higher income are having more part-day home-based e-working. This may be related to the higher position of these individuals with more flexibility associated with their job.

For Internet use experience, there is no obvious difference between people with or without a smartphone three years ago in the adoption of part-day and whole-day home-based e-working. Some recent research also suggests that the history of Internet use may no longer be significant in influencing the engagement of e-activities such as e-working and e-shopping (Cao 2012; Sener and Reeder 2012). Due to the rapid informatization and high smartphone penetration in China, even people with a relatively short history of Internet use can readily use ICT to accomplish their work or leisure tasks (Foster Thompson and Aspinwall 2009; Loo and Ngan 2012). Besides, as our focus is on full-time paid employees having e-activities at home, it is reasonable to believe that there should be small differences among respondents' familiarity with smartphone or the Internet. Rather than whether people use smart ICT devices, the extent to which they use these devices may be more relevant in understanding people's e-activity behaviour. The results show that people who used the Internet more often are more likely to choose to part-day and whole-day home-based e-working.

Attitudes towards e-working at home play an important role in the adoption of both part-day and whole-day home-based e-working. In particular, workaholic has a positive association with e-working at home, while enjoyment seeking at workplace has a negative association. As Haddad et al. (2009) and Wilton et al. (2011) suggest, working longer hours and getting more done have been a major reason for people to work at home. It is noteworthy that freedom seeking has a strong and statistically significant relationship with the choice of whole-day home-based e-working, while having a statistically insignificant relationship with the choice of part-day home-based e-working. This finding further confirms the difference in attitudes towards the engagement of part-day and whole-day home-based e-working. It seems that the choice of whole-day home-based e-working is more related to people's preference for a free lifestyle. People engaged in whole-day home-based e-working are perhaps those having an increased level of social and domestic responsibilities towards the environment and family (Sener and Reeder 2012; Singh et al. 2013). In our survey, those people who chose to e-work at home spent roughly 0.7 more hours altogether on work, that is, they had longer total work time (P value = 0.000). This may also imply that there is no need for employers to worry too much about their e-working employees spending less time on work (Loo 2012; Wilton et al. 2011). Perhaps, the time saved from commuting between work and home could be used more efficiently in working for these e-workers at home. This point is particularly important in large cities as increasing time has been wasted in traffic congestion (Aguilera et al. 2016; Ta et al. 2017).

People who live farther away from workplace are also more likely to engage in part-day and whole-day home-based e-working, which is consistent with the previous literature (Deng et al. 2015; Haddad et al. 2009; Hjorthol and Gripsrud 2009; Sener and Reeder

2012; Singh et al. 2013). It is interesting to note the significantly positive relationship of car use and negative association of the distance from home to the nearest metro station on the adoption of part-day home-based e-working; yet, these factors are both statistically insignificant in accounting for whole-day home-based e-working. This may suggest at least two important points. Firstly, it is important to differentiate between part-day and whole-day home-based e-working. As people engaging in part-day home-based e-working want to have a more flexible time schedule, it is important for them to conveniently commute between workplace and home by car or metro. Secondly, the results suggest that a policy that facilitates part-day home-based e-working may efficiently alleviate traffic congestion during the peak period. In addition, a policy that encourages the choice and frequency of whole-day home-based e-working may help to control the number of long-distance commuting. Both policies may contribute to alleviating the severe traffic congestion problems in big cities in China.

In addition, the significantly negative association of the distance from home to the nearest shopping center on both choices of part-day and whole-day home-based e-working further demonstrates the importance of geographical accessibility or land use in understanding the multiple functions of home. Previous evidence suggests that high accessibility to non-work and leisure activity opportunities is more favourable to home-based e-working, compared to center-based telecommute (Singh et al. 2013). Proximity to shopping centers enables people to easily organize their non-work activities and satisfies their social and recreational requirements. Therefore, there is a tendency for people who live closer to a shopping center to choose both part-day and whole-day home-based e-working. Hence, it is important to provide adequate sites around the neighbourhood to meet people's demand of leisure activities in urban planning if the government aims to encourage more whole-day home-based e-working.

Home as an alternative shopping site

Table 5 indicates that females and younger people (21–30 years old) tend to spend more time on e-shopping at home. Compared to their older counterpart, adults aged 21–30 years old may have a better grasp of the use of smartphone and related technologies, which may indirectly increase their overall time spent on e-shopping at home. Although the influence of gender seems to differ across different cultures and countries (Farak et al. 2006a; Ren and Kwan 2009), our results are consistent with the findings of earlier studies in China that females tend to be more engaged in e-shopping (Zhen et al. 2016). One reason for the higher involvement of females in e-shopping compared to men may be related to their experience of more stringent space-time constraints and thus, having greater need to search or buy products online to save time (Schwanen et al. 2008). Another reason may be that females tend to undertake more shopping activities in China (CNNIC 2015; Cao and Chai 2007). However, compared to previous evidence in Western countries (Cao et al. 2013; Farak et al. 2006b; Ren and Kwan 2009; Zhou and Wang 2014), there is no significant difference among people with children under 16 years old and different education levels and income. It could be attributed to the fact that e-shopping has become very popular in China among people from almost all walks of life (CNNIC 2015).

Regarding the Internet use attributes, similar to the above findings, people who used the Internet more often are more likely to spend more time in e-shopping at home. As suggested by the previous literature, an individual's attitudes towards e-shopping appear to play important roles in determining the time spent on e-shopping in general (Cao et al. 2009; Dijst et al. 2008; Mokhtarian et al. 2009; Zhai et al. 2016; Zhen et al. 2016).

Table 5 Ordered logit regression results on e-shopping time spent at home

Variables	Coef.	SE	<i>P</i> value
<i>Socio-demographics</i>			
Gender (female = ref.)	−1.188	0.119	0.000
Age (21–30 = ref.)			
31–40	−0.271	0.129	0.036
41–50	−0.529	0.233	0.024
Education (high = ref.)			
Low	0.075	0.197	0.702
Middle	0.167	0.142	0.239
Children under 16 (non = ref.)	0.202	0.124	0.102
Annual household income	0.025	0.055	0.653
Usually drive car to shop (non = ref.)	−0.651	0.140	0.000
<i>Internet use</i>			
Smartphone use in 2012 (non = ref.)	0.063	0.130	0.631
Daily internet use time (low = ref.)			
Middle	0.278	0.131	0.034
High	0.483	0.173	0.005
<i>Attitudes towards e-shopping at home</i>			
Novelty seeking	0.235	0.036	0.000
Shopping enjoyment	−0.108	0.045	0.017
Time consciousness	0.283	0.067	0.000
Cost consciousness	0.122	0.067	0.068
<i>Geographical accessibility</i>			
Distance to the nearest metro station	0.306	0.061	0.000
Distance to the nearest shopping center	0.390	0.063	0.000
Threshold 1	1.779	0.061	0.000
Threshold 2	3.516	0.063	0.000
LR χ^2	305.12		
Log likelihood at convergence	−403.74		
Pseudo R ²	0.274		

N = 534

Specifically, this study finds that a positive attitude towards e-shopping (including novelty seeking, time consciousness, and cost conscious) significantly increases people's time spent on e-shopping at home, while shopping enjoyment has a significantly negative association with e-shopping behaviour at home.

Geographical accessibility variables also significantly account for the variability of the amount of time spent on e-shopping at home daily. People with poorer access to public transport and shopping centers tend to spend more time on e-shopping at home. Combined with the significantly negative relationship with car use, our results lend support to the “efficiency hypothesis” as people tend to spend more time on e-shopping at home when they have to spend more efforts and time/money in going to shopping centers physically (Ren and Kwan 2009). This means that people with low accessibility to non-daily shopping and leisure activity opportunities attach more value to e-shopping at home. The negative association with car use also implies that people may choose to e-shop more frequently if they need to drive long distances to buy goods.

Among the 341 respondents who also had the choice of e-working at home, it is interesting to note that people who chose to part-day home-based e-working spent less time on e-shopping at home compared to their counterparts engaged in whole-day home-based e-working. It may be that people who engaged in part-day home-based e-working actually conducted in-store shopping or e-shopping elsewhere other than home. Besides, they also need to attain a balance of time spent on e-working and e-shopping. For people who choose to engage in whole-day home-based e-working, they tend to spend more time not just on e-working but also e-shopping at home and thus, have the highest tendency to use their homes also as workplaces and shopping sites. The travel time saved from commuting between work and home enables them to conduct other activities such as e-shopping. Though this result is quite interesting, further investigation is needed for a better understanding of whole-day home-based e-workers' time allocation at home.

Conclusion and discussion

Our study sets out to explore the multifunctional role of home from the perspective of people's time use on e-working and e-shopping. The actual decision of whole-day home-based e-working is still relatively low (13.5%), indicating that few of our samples were practicing telecommuting. However, it should also be noted that the incidence of part-day home-based e-working in this study (30.4%) is already considerably higher than a study in the UK about 6 years ago (Haddad et al. 2009). Home has the potential to (or has already) become an alternative workplace for many Chinese families. Furthermore, a majority of the respondents e-shopped at home, reflecting the popularity of e-shopping in Nanjing. More than 60% of the respondents spent more than 0.5 h per day on e-shopping at home. The findings show that home, to some extent, has also become an alternative shopping site where people search for, browse, compare, and purchase consumer goods online. These changes are extending the meanings of home as a place mainly for domesticity, intimacy, and privacy. The rich e-activities taking place at home change the time use at home and gradually enrich the function of home in people's daily life.

In addition, the study further reveals the influence of socio-demographic attributes, Internet use attributes, attitudes towards e-working/e-shopping, and geographical accessibility characteristics on people's home-based e-working and e-shopping behaviour. Our results indicate that both part-day and whole-day home-based e-working have the potential to alleviate traffic congestion by transferring commuting traffic volume from peak hours and reducing long distance commuting. Furthermore, e-shopping behaviour has the potential to reduce long-distance shopping trips by car. According to The People's Daily (2016), the Chinese government is considering a flexitime policy to encourage people to e-work at home (including both part-day and whole-day home-based e-working) to alleviate traffic congestion and other transport problems during peak hours in big cities. This study suggests that a policy that encourages the choice and frequency of part-day home-based e-working may indeed be effective and efficient in shifting the commuting traffic volume from the peak hours, especially for those who live farther away from their workplaces but were having convenient transportation (e.g., by private car and metro). In addition, a policy that promotes whole-day home-based e-working may help to control the number of long-distance commuting. As evidence shows, the ever-increasing commuting distance has increased the travel time for commuters in many big cities in China (Ta et al. 2017).

Our results on the relationship between neighbourhood geographical accessibility characteristics and home-based e-working and e-shopping behaviour also suggest that it is important to consider the spatial distribution of shopping centers, the alignment of metro lines and the provision of public transport services in urban planning with reference to people's living space and their use of different places in cities. For instance, easy access to shopping centers can increase people's involvement in e-working but reduce e-shopping time at home. For urban or transport planners who hope to reduce people's commuting and shopping trips, there is a dilemma as to whether to provide more shopping sites around the neighbourhood or not. There is a need for more empirical studies in different contexts to enhance our understanding of the relationship between trip frequency for different purposes and the corresponding e-activities to fulfill people's desires at home. Moreover, previous evidence suggests that it is also important to know the extent to which e-shopping can replace in-store shopping trips for different types of products (Zhai et al. 2016; Zhen et al. 2016).

Further studies are needed. Through a diary on people's detailed time allocation on different e-activities and physical activities at different places, it would be possible to examine the differences and changes of time use in the e-society. To geographers, everyday life could be depicted as a sequence of various activity chains performed in different places in 24 h (Pred 1977). Such further analysis will contribute to a better understanding of people's time-space use of different places in cities and activity-travel behaviour. Taking e-shopping as an example, where does the time spent on home-based e-shopping come from? Is it from the time saved from physical shopping or commuting between work and home? Or is it from the sacrifice of interactions with family members at home? What about time spent on e-shopping during travelling (Jain and Lyons 2008; Lyons 2014)? All these studies will influence our perception of activity space based on static locations. In addition, further studies should probe more deeply into people's subjective feelings of different trade-offs about the time use at home and the implications on family life directly.

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Authors' contribution B. P. Y. Loo: identified the research gap, suggested the literature review and research design, critically review the data quality and methodology, edited the manuscript, and made final approval of the version submitted. B. Wang: collected data, performed the analysis, and drafted the manuscript.

References

- Aguilera, A., Lethiais, V., Rallet, A., Proulhac, L.: Home-based telework in France: characteristics, barriers and perspectives. *Transp. Res. Part A Policy Pract.* **92**, 1–11 (2016)
- Alexander, B., Ettema, D., Dijst, M.: Fragmentation of work activity as a multi-dimensional construct and its association with ICT, employment and sociodemographic characteristics. *J. Transp. Geogr.* **18**(1), 55–64 (2010)
- Anderson, W.P., Chatterjee, L., Lakshmanan, T.: E-commerce, transportation, and economic geography. *Growth Change* **34**(4), 415–432 (2003)

- Andreev, P., Salomon, I., Pliskin, N.: Review: state of teleactivities. *Transp. Res. Part C Emerg. Technol.* **18**(1), 3–20 (2010)
- Asgari, H., Jin, X., Du, Y.: Investigation of commute departure time to understand the impacts of part-day telecommuting on the temporal displacement of commute travel. In: *Transportation Research Board 95th Annual Meeting*. No. 16-1662 (2016)
- Blunt, A.: Cultural geography: cultural geographies of home. *Prog. Hum. Geogr.* **29**(4), 505–515 (2005)
- Blunt, A., Varley, A.: Geographies of home. *Cult. Geogr.* **11**(1), 3–6 (2004)
- Calderwood, E., Freathy, P.: Consumer mobility in the Scottish isles: the impact of internet adoption upon retail travel patterns. *Transp. Res. Part A Policy Pract.* **59**, 192–203 (2014)
- Cao, X.J.: E-shopping, spatial attributes, and personal travel: a review of empirical studies. *Transp. Res. Rec. J. Transp. Res. Board* **2135**, 160–169 (2009)
- Cao, X.J.: The relationships between e-shopping and store shopping in the shopping process of search goods. *Transp. Res. Part A Policy Pract.* **46**(7), 993–1002 (2012)
- Cao, X.J., Chai, Y.: Gender role-based differences in time allocation: case study of Shenzhen, China. *Transp. Res. Rec. J. Transp. Res. Board* **2014**, 58–66 (2007)
- Cao, X.J., Mokhtarian, P.L., Handy, S.L.: Examining the impacts of residential self-selection on travel behaviour: a focus on empirical findings. *Transport Rev.* **29**(3), 359–395 (2009)
- Cao, X.J., Chen, Q., Choo, S.: Geographic distribution of e-shopping: application of structural equation models in the Twin Cities of Minnesota. *Transp. Res. Rec. J. Transp. Res. Board* **2383**, 18–26 (2013)
- China Internet Network Information Center: The 31st Survey Report on Internet Development in China. CNNIC (2013). <http://www.cnnic.net.cn/hlwfyj/hlwzxbg/>
- China Internet Network Information Center: The 35th Survey Report on Internet Development in China. CNNIC (2015). <http://www.cnnic.net.cn/hlwfyj/hlwzxbg/>
- Corbusier, L.: *The Athens Charter*. Grossman Publishers, New York (1973)
- de Graaff, T., Rietveld, P.: Substitution between working at home and out-of-home: the role of ICT and commuting costs. *Transp. Res. Part A Policy Pract.* **41**(2), 142–160 (2007)
- Deng, H., Mokhtarian, P.L., Circella, G.: Factors influencing full-day, part-day, and overtime telecommuting: an investigation of Northern California Workers. In: *Transportation Research Board 94th Annual Meeting*. No. 15-1825 (2015)
- Dijst, M.: ICTs and accessibility: an action space perspective on the impact of new information and communication technologies. In: Beuthe, M. (ed.) *Transport developments and innovations in an evolving world*, pp. 27–46. Springer Science & Business Media, Berlin (2004)
- Dijst, M., Farag, S., Schwaben, T.: A comparative study of attitude theory and other theoretical models for understanding travel behaviour. *Environ. Plan. A* **40**(4), 831–847 (2008)
- Domosh, M.: Geography and gender: home, again? *Prog. Hum. Geogr.* **22**(2), 276–282 (1998)
- Fan, C.C.: Rural-urban migration and gender division of labor in transitional China. *Int. J. Urban Reg. Res.* **27**(1), 24–47 (2003)
- Farag, S., Krizek, K.J., Dijst, M.: E-Shopping and its relationship with in-store shopping: empirical evidence from the Netherlands and the USA. *Transport Rev.* **26**(1), 43–61 (2006a)
- Farag, S., Weltevreden, J., Van Rietbergen, T., Dijst, M., van Oort, F.: E-shopping in the Netherlands: does geography matter? *Environ. Plan.* **33**(1), 59–74 (2006b)
- Fong, V.L.: *Only Hope: Coming of Age Under China's One-Child Policy*. Stanford University Press, Stanford (2004)
- Foster Thompson, L., Aspinwall, K.R.: The recruitment value of work/life benefits. *Pers. Rev.* **38**(2), 195–210 (2009)
- Friedman, J., Hastie, T., Tibshirani, R.: *The Elements of Statistical Learning*. Springer Series in Statistics. Springer, Berlin (2001)
- Gärbling, T., Gillholm, R., Gärbling, A.: Reintroducing attitude theory in travel behavior research: the validity of an interactive interview procedure to predict car use. *Transportation* **25**(2), 129–146 (1998)
- Haddad, H., Lyons, G., Chatterjee, K.: An examination of determinants influencing the desire for and frequency of part-day and whole-day homeworking. *J. Transp. Geogr.* **17**(2), 124–133 (2009)
- Henderson, D.K., Mokhtarian, P.L.: Impacts of center-based telecommuting on travel and emissions: analysis of the Puget Sound Demonstration Project. *Transp. Res. Part D Transport Environ.* **1**(1), 29–45 (1996)
- Hjorthol, R., Gripsrud, M.: Home as a communication hub: the domestic use of ICT. *J. Transp. Geogr.* **17**(2), 115–123 (2009)
- Jain, J., Lyons, G.: The gift of travel time. *J. Transp. Geogr.* **16**(2), 81–89 (2008)
- Kim, S.-N., Choo, S., Mokhtarian, P.L.: Home-based telecommuting and intra-household interactions in work and non-work travel: a seemingly unrelated censored regression approach. *Transp. Res. Part A Policy Pract.* **80**, 197–214 (2015)

- Kwan, M.-P.: Cyberspatial cognition and individual access to information: the behavioral foundation of cybergeography. *Environ. Plan.* **28**(1), 21–37 (2001)
- Kwan, M.-P.: Mobile communications, social networks, and urban travel: hypertext as a new metaphor for conceptualizing spatial interaction*. *Prof. Geogr.* **59**(4), 434–446 (2007)
- Kwan, M.-P.: Beyond space (as we knew it): toward temporally integrated geographies of segregation, health, and accessibility: space–time integration in geography and GIScience. *Ann. Assoc. Am. Geogr.* **103**(5), 1078–1086 (2013)
- Kwan, M.-P., Kotsev, A.: Gender differences in commute time and accessibility in Sofia, Bulgaria: a study using 3D geovisualisation. *Geogr. J.* **181**(1), 83–96 (2015)
- Kwan, M.-P., Dijst, M.J., Schwanen, T.: The interaction between ICT and human activity-travel behavior. *Transp. Res. Part A Policy Pract.* **41**(2), 121–124 (2007)
- Lenz, B., Nobis, C.: The changing allocation of activities in space and time by the use of ICT-“Fragmentation” as a new concept and empirical results. *Transp. Res. Part A Policy Pract.* **41**(2), 190–204 (2007)
- Logan, J.R., Bian, F.: Family values and coresidence with married children in urban China. *Soc. Forces* **77**(4), 1253–1282 (1999)
- Loo, B.P.Y.: Strategies of internet development in the Asia-Pacific region. *J. Urban Technol.* **14**(1), 3–22 (2007)
- Loo, B.P.Y.: *The E-Society*. Nova Science Publishers, New York (2012)
- Loo, B.P.Y., Wang, B.: Progress of e-development in China since 1998. *Telecommun. Policy* (2017). doi:10.1016/j.telpol.2017.03.001
- Loo, B.P.Y., Ngan, Y.: Developing mobile telecommunications to narrow digital divide in developing countries? Some lessons from China. *Telecommun. Policy* **36**(10), 888–900 (2012)
- Lyons, G.: Viewpoint: transport’s digital age transition. *J. Transport Land Use* **8**(2), 1–19 (2014)
- Mannering, J.S., Mokhtarian, P.L.: Modeling the choice of telecommuting frequency in California: an exploratory analysis. *Technol. Forecast. Soc. Change* **49**(1), 49–73 (1995)
- Midi, H., Sarkar, S.K., Rana, S.: Collinearity diagnostics of binary logistic regression model. *J. Interdiscip. Math.* **13**(3), 253–267 (2010)
- Mokhtarian, P.L., Salomon, I.: Modeling the choice of telecommuting: setting the context. *Environ. Plan. A* **26**(5), 749–766 (1994)
- Mokhtarian, P.L., Salomon, I.: Modeling the choice of telecommuting: 3. Identifying the choice set and estimating binary choice models for technology-based alternatives. *Environ. Plan. A* **28**(10), 1877–1894 (1996)
- Mokhtarian, P.L., Salomon, I., Choo, S.: Measuring the measurable: why can’t we agree on the number of telecommuters in the US? *Qual. Quant.* **39**(4), 423–452 (2005)
- Mokhtarian, P.L., Ory, D.T., Cao, X.: Shopping-related attitudes: a factor and cluster analysis of Northern California shoppers. *Environ. Plan.* **36**(2), 204–228 (2009)
- Nilles, J.M.: *Telecommunications-Transportation Tradeoff: Options for Tomorrow*. Wiley, London (1976)
- Oyserman, D., Coon, H.M., Kimmelmeier, M.: Rethinking individualism and collectivism: evaluation of theoretical assumptions and meta-analyses. *Psychol. Bull.* **128**(1), 3 (2002)
- Paleti, R.: Generalized extreme value models for count data: application to worker telecommuting frequency choices. *Transp. Res. Part B Methodol.* **83**, 104–120 (2016)
- Pred, A.: The choreography of existence: comments on Hägerstrand’s time-geography and its usefulness. *Econ. Geogr.* **53**(2), 207–221 (1977)
- Pred, A.: Place as historically contingent process: structuration and the time-geography of becoming places. *Ann. Assoc. Am. Geogr.* **74**(2), 279–297 (1984)
- Ren, F., Kwan, M.-P.: The impact of geographic context on e-shopping behavior. *Environ. Plan.* **36**(2), 262–278 (2009)
- Roodman, D.: Estimating fully observed recursive mixed-process models with cmp (2009). Available at SSRN: <https://ssrn.com/abstract=1392466>
- Schwanen, T., Dijst, M., Kwan, M.P.: ICTs and the decoupling of everyday activities, space and time: introduction. *Tijdschr. Econ. Soc. Geogr.* **99**(5), 519–527 (2008)
- Sener, I.N., Reeder, P.R.: An examination of behavioral linkages across ICT choice dimensions: copula modeling of telecommuting and teleshopping choice behavior. *Environ. Plan. A* **44**(6), 1459–1478 (2012)
- Singh, P., Paleti, R., Jenkins, S., Bhat, C.R.: On modeling telecommuting behavior: option, choice, and frequency. *Transportation* **40**(2), 373–396 (2013)
- Statistical Bureau of Nanjing: *Statistical Yearbook of Nanjing 2013*. Phoenix Press of Phoenix Publishing and Media Group, Nanjing (2014)

- Statistical Bureau of Nanjing: Statistical Yearbook of Nanjing 2014. Phoenix Press of Phoenix Publishing and Media Group, Nanjing (2015)
- Ta, N., Chai, Y., Zhang, Y., Sun, D.: Understanding job-housing relationship and commuting pattern in Chinese cities: past, present and future. *Transp. Res. Part D Transport Environ* **52**, 562–573 (2017)
- The People's Daily.: Does telecommute work? (2016). <http://society.people.com.cn/n1/2016/0115/c1008-28055032.html>. Accessed 12 June 2016
- Tuan, Y.F.: Home. In: Harrison, S., Pile, S., Thrift, N. (eds.) *Patterned Ground: The Entanglements of Nature and Culture*, pp. 164–165. Reaktion Books, Islington (2004)
- Wang, D., Lin, T.: Built environments, social environments, and activity-travel behavior: a case study of Hong Kong. *J. Transp. Geogr.* **31**, 286–295 (2013)
- Wang, X.-R., Hui, E.C.-M., Choguill, C., Jia, S.-H.: The new urbanization policy in China: which way forward? *Habitat Int.* **47**, 279–284 (2015)
- Wilton, R.D., Páez, A., Scott, D.M.: Why do you care what other people think? A qualitative investigation of social influence and telecommuting. *Transp. Res. Part A Policy Pract.* **45**(4), 269–282 (2011)
- Wu, F.: *Planning for Growth: Urban and Regional Planning in China*. Routledge, London (2015)
- Yuan, F., Gao, J., Wu, J.: Nanjing—an ancient city rising in transitional China. *Cities* **50**, 82–92 (2016)
- Zhai, Q., Cao, X., Mokhtarian, P.L., Zhen, F.: The interactions between e-shopping and store shopping in the shopping process for search goods and experience goods. *Transportation*, 1–20 (2016). doi:[10.1007/s11116-016-9683-9](https://doi.org/10.1007/s11116-016-9683-9)
- Zhen, F., Cao, X., Mokhtarian, P.L., Xi, G.: Associations between online purchasing and store purchasing for four types of products in Nanjing, China. *Transp. Res. Rec. J. Transp. Res. Board* **2566**, 93–101 (2016)
- Zhou, Y., Wang, X.C.: Explore the relationship between online shopping and shopping trips: an analysis with the 2009 NHTS data. *Transp. Res. Part A Policy Pract.* **70**, 1–9 (2014)
- Zuo, J., Bian, Y.: Gendered resources, division of housework, and perceived fairness—a case in urban China. *J. Marriage Fam.* **63**(4), 1122–1133 (2001)

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