

Urban Space, Activity-Travel Behavior and ICTs: Constraint and Interaction

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1 Background

1.1 Spatial Restructure

Over the last three decades, China has undertaken a transition from a planned economy towards a market economy, which has resulted in profound changes in society (Ma, 2002). Housing reform in urban China is a crucial part of institutional transition, and it aims to introduce market mechanisms into a previously welfare-oriented system (Wang and Murie, 2000). China's starting point in terms of housing reform is very different from western countries. For example, the *Danwei* was the traditional form of residential space for decades, but it is not easy to dismantle *Danwei*'s influence immediately during housing transition (Wang and Chai, 2009; State Council, 1988; 1998). The promotion of housing reform in China expands tremendously urbanized areas in cities and further affects activity-travel behavior of urban residents. For example, the urbanized area in Beijing increased from 488.3 sq.km in 1998 to 1,310.9 sq.km in 2008 (National Bureau of Statistics of China, 1999, 2009). The individual ownership of automobiles is more than doubled during 2004-2009, reaching three million by 2009 (Beijing Statistical Bureau, 2010). Due to the historic downtown and *Danwei* zones occupies city centers, commodity and affordable housing are usually built beyond that (Wang and Murie, 2000), which changes the original landscape and produces a particular spatial pattern. On the other hand, new residential areas are built not following *Danwei*'s job-housing principle so that they are criticized for being long-travel-oriented and automobile-oriented and for worsening the traffic conditions (Pan et al. 2009).

1.2 Cultural Transition

In the contemporary era, people living in different societies are likely to have different experiences with environment. The studies to draw big distinction between West and East have a long history with the theoretical constructs, individualism versus collectivism, and they change diversified in the process of modernization (Bauman, 2005). Scholars conceptualize individualism as the opposite of collectivism when comparing American and European with East Asian cultural frames. Individualism is assumed more prevalent in industrialized Western societies with a Christian heritage. However, East Asian countries have more traditional societies with deep cultural heritages of Confucian, especially China, which is representative as collective society. Current studies portray American and European societies are higher in individualism and lower in collectivism than East Asian (Oyserman et al. 2002; Oyserman and Lee, 2008). Indeed, cultures in modern societies develop with changes of social environment and economic level. China's transition to open-oriented economy brings pervasive cultural, social and urban changes in recent decades (for example, Logan, 2001; Ma, 2002). Rapid economic development promotes the reform and perfection of welfare systems and ensures people to have enough income, good care if being old resulting in seldom help and support from others (Lu and Feng, 2008). Meanwhile, traditional Confucian moral understanding dominates in modern China because cultural change is path dependent (Inglehart and

Baker, 2000), and social network is basically characterized by strong family links (Leung, 2010; Fan, 2011). The existing studies present unclear impacts on how cultural change in varied contexts, needing further research.

Gender role is an important topic in cultural studies in many countries due to the traditional values, like men possess the attitude that “you live in order to work” but women value that “you work in order to live” (Hofstede, 1980). Women might value family-first belief as the sex role so that they endure household responsibility and do most of housework when facing the work-nonwork conflict (Carlson, 1996). China is one society which is similar in the sex role but different in many other ways. First, China has undergone the socialist development for decades. The government highlighted social justice and equal so that women were encouraged to enter into the labor market as the half-sky. *Danwei* provided necessary facilities close and free to employees, which ensured women to do full-time work in the plan-oriented period (Wang and Chai, 2009). In spite of the economic reform launched in 1978, these feathers still exist. The female labor participation rate is 69% in 2007, much higher than western countries (World bank, 2011). Dual-worker families are common, especially in cities. Second, as the persistence of traditional values, many healthy elders co-reside with adult children and they provide reciprocal help to each other (Logan, 1999), like elders take care of young grandchildren or adults take care of sick elders. However, most studies investigate the unique phenomenon of gender difference in household in China from the sociology perspective but pay limited attention to gender differences of activity-travel behavior in daily life.

1.3 Technological Transition

The widespread use of information and communication technologies (ICTs) has changed urban lifestyle in modern cities. The concept of space-time shrinking and decoupling has been formed (Schwanen, Dijst et al. 2008), which not only influences urban land use change causing social and economic inequality, but also complicates individual everyday activities. The high mobility within modern cities has brought new challenges for urban geography. The studies began to conceive of a person’s activities in urban space as the result of a complex and variable mix of incentives and constraints (Chapin, 1974). By analyzing space-time patterns of activity and travel behavior people participate, such as commuting, shopping, housework etc., researchers can study whether urban space is optimized or not (Ettema, 1996; Timmermans , Waerden, 2003). Further, the use of mobile communications, supported by ICTs, might have significant impacts on urban life. People could change their habits because of the new technology, that is, people who want to participate in joint activities are no longer required at a fixed location, fixed time and connection but they can achieve the same goal with more flexibility (Kwan, 2006; Schwanen, Dijst et al. 2008). In particular, activity and travel behavior, as the direct outcome of ICTs, might reflect interesting and various patterns.

2 Research Design and Framework

2.1 Research Framework

Activity-travel behavior is the daily performance we could grasp to investigate the interaction between urban form and travel, and reflect the constraints people perform in space and time. Residents need to make numerous decisions including what activities to participate, how long to allocate to each activity, when, where and with whom to conduct activities, which transport mode to travel activity location etc. The complexity and interaction exist between urban form and behavior decision, as well as between different activities and travels. Most previous studies paid attention to aggregate distributions of activities and travels in space and time, but the characteristics of individual behavior might demonstrate more detailed information on decision making process and coordination with specific situation in space and time.

Based on the background discussions above, Figure 1 illustrates the framework on interactions and constraints among urban space, activity-travel behavior and ICTs in China. First, as an important background, I focus on three transitions in urban China: urban transition, social transition and technological transition. In general, urban transition causes the restructure of urban form, from *Danwei* to commodity housing, which is actually a process of housing diversity. So that I plan to analyze patterns of space-time paths and daily travel time of residents living in different neighborhoods, and the comparisons is based at the aggregated level. For social transition, I pay attention to two points, family composition and family belief. Family composition focus on the changes of family size and member composition might influence the gender division of housework allocation and non-work activity participation at the individual level. Family belief is more associated with cultural elements, which can be discussed by the choice of companions in activity-travel behavior at the activity-travel level. I hypothesis that, although some changes have been done, people in China might have path dependence on valuing strong ties with given family members rather than self-chosen friends. The point of technological transition is related to the wide use of ICTs. I want to learn the general patterns caused by ICTs and discuss the possible effects on physical behavior in daily life. I also try to investigate how to analyze ICTs behavior in the suitable spatial scales. This part might be the primary study to stimulate further research.

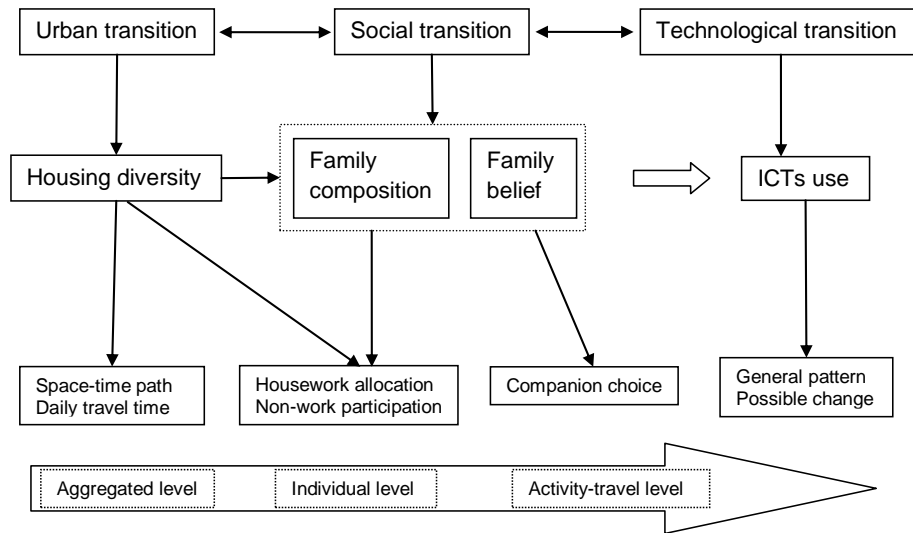


Figure 1 Research Framework

2.2 Research Question

This research is established in geographical perspective. The main research questions to be examined are: How are urban form factors influence individual space-time behavior? How is the relationship associated with cultural, social and technological contexts in China? The subsequent questions are: How is the neighborhood space related to behavior patterns? Whether do gender and family-obligation affect behavior decisions? Is with whom an important dimension of behavior? How is companionship associated with activity-travel behavior? How is the use of ICTs associated with physical activities and travels?

2.3 Case City and Data

This study uses an existing data coming from a two-day activity diary survey conducted in Beijing in October and November, 2007. Beijing, the capital city of China, has experienced plan-oriented developments from 1949 to 1978 and explosive growth after China's economic reform. It is worth noting that Beijing is the fast growing city in China and residents' behavior are influenced by traditional cultural persistence and modern values simultaneously.

The Beijing dataset was collected in 10 typical neighborhoods, shown in Fig 2. With supports from sub-districts (Ju Wei Hui), we randomly surveyed 60 households for each neighborhood. Both male household head and female household head were asked to complete the questionnaire. The sample contains 520 households including 1119 individuals. Respondents were required to report household attributes, individual attributes, and activity diary. Household attributes contain household information such as household structure, income, number of workers, presence of children and elders. Individual

attributes include age, education, occupation and monthly income of both household heads. Activity diary data came from 24-hour activity records of both household heads on Sunday and Monday.

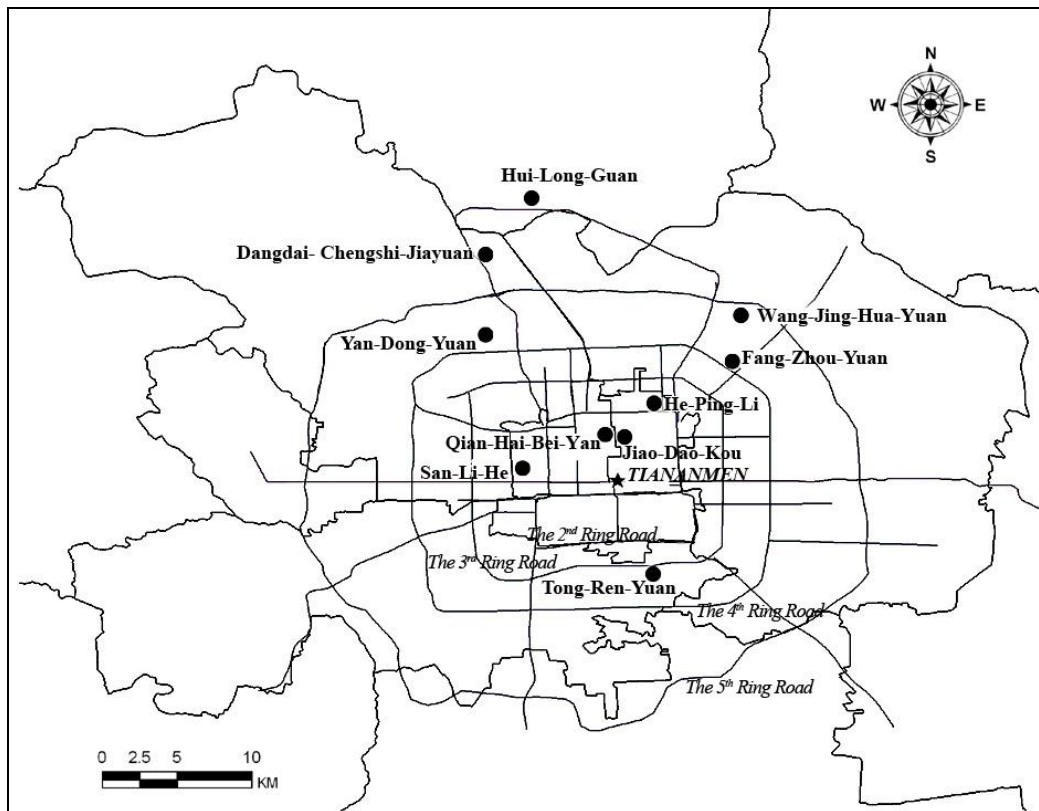


Figure 2 Research Area

3 Research Content and Main results

3.1 Behavior Patterns by Neighborhood Type

This part aims to investigate how residents' activity-travel behavioral changes in different neighborhoods by focusing on individual daily patterns. We hypothesize that residents' behavior in daily life is affected not only by individual socio-economic factors, but also by spatial and institutional factors unique to China represented by neighborhood type. It contributes twofold. First, it is based on Chinese context to make up the deficiency that limited research on the interaction between built environment and behavior are tested in the developing world. The fast-paced economic growth and socialist system in China provides a valuable and relatively unique case to be studied. Second, it tries to indicate individual behavior as an integrated pattern consisting of activity and travel, following the viewpoint that travel is derived from activity demand in activity-based approach. In particular, we apply three dimensions geo-visualization to observe general behavior, and test travel time as fixity constraint and leisure time as flexible counterpart to find individual behavior patterns.

From the evidence of space-time path analysis, residents from different neighborhoods show behavior variations in space and time. Danwei residents have shorter commuting time, which are indicated by the short slope travel segments connecting home to workplace. As they have less fixity travel time, they tend to perform plenty of short stops back home at lunch time or non-work activities after work. Their space-time paths appear to be more fragmented and contractive around home location. For people in commodity housing neighborhoods, the time-budget constraint, like work and commuting imposed on non-work activities, is evident. Long commuting and working time are revealed by long travel process between home and workplace and long activity duration at workplace, as indicated by length of the slope segments and the vertical episodes. In spite of relatively high constraints, people undertake several non-work activities, like some short stops near the workplace at lunch time, shopping or business stops after work etc. As for people in affordable housing neighborhoods, the space-time paths have many similarities with the paths of commodity housing, except that they tend to have more fixity constraints due to extremely long commuting time. The separation of home and workplace results in long time to spend on commuting, which imposes on fewer flexible activities or travels compared to other two groups. The shapes of space-time paths seem to be the most extensive mostly occupied by the long length of slope segments in the morning and evening rush hours.

From the evidence of multi-variable regression model, the causal relations between residential space and daily travel time are verified by model. The neighborhood type is an integrated indicator with meanings of space attributes and institutional effects. The result shows *Danwei* significantly reduces daily travel time, responded with existing studies on traditional-style neighborhood design (Handy, 1996; Cervero, 1996; Pan et al. 2009). Residents in commodity housing tend to travel longer than those in *Danwei*. Further, residents in affordable housing even endure more space-time constraints. These findings reflect two points: first, traditional neighborhoods with higher-density, smaller blocks and better job-housing balance encourage less travel time for residents; second, three types present different stages of housing reform in China, and the results investigate a trend to travel growth in the process of urban transition. As for socio-economic variables, Age, employment status and commuting mode have significant impacts on travel time.

3.2 Gender Difference and Non-work Activities

This part aims to investigate gender differences in Chinese society by activity-based approach. It tries to analyze the impacts of family-obligation and household responsibility on non-work activity and travel generation and distribution with the consideration of space-behavior interaction and fixity-flexible activity relationship. First, we pay attention to the effects of gender and household status, like the presence of children and retirees in the household, with the context of urban China. Second, we consider

mainly on the complication of non-work activity, like interaction of purpose, distance and duration elements.

We analyze the gender differences of activity generation and time allocation based on descriptive method. Women generally conduct more activities than men. Confirmed on this point, it is obvious that men perform more leisure activity, but women are involved more in household related activities. These findings are responded by the discussions on Confucian norms in traditional China that women are in a subordinate position to men and are responsible for most of domestic housework. For time allocation, men spend more time on work while women spend more time on non-work. As for distance of non-work activities, men perform activities far away from home, but women's activities are much closer to home, in line with the findings by Kwan (1999).

From SEM modeling results, the features of socio-demographic attributes and household responsibility have both direct and indirect effects on non-work generations. Gender has significant effects on residential space and activity purpose of household responsibility. Men tend to live in the neighborhoods with less retail density, where are low-urbanized. Also, men are unlikely to perform non-work activities for household purpose, which means that women have tendency to finish more activities with household-obligation. That might be associated with the traditional domestic division that women endure more unpaid housework. Men tend to conduct non-work activities far away from home and spend long time out of home, responded by the cultural influence of gender differences. The causal effects of age, work and salary have the similar patterns on activity-travel behavior. Older full time workers with the low income tend to live in the neighborhoods with high retail density. The possible reason is that these people have the high travel demand but low travel capacity, so that good urbanized areas, like urban center, may provide necessary facilities to them. As for the effects of household composition, the presences of kids or retirees in the household have different impacts on behavior patterns. If there are young kids in the household, people tend to spend less time on working, but generate more activities for household purpose with short distance and less duration. It presents that the presence of kids might add more household responsibility and space-time constraints on household headers, so that cause the change of activities patterns. However, the presence of retirees might cause a little increase of household related activities. The result is not as expected that retirees might help to reduce household burdens, but it also illustrates that the presence of retirees have two-fold effects: one might help to share housework mostly in-home, and the other might increase household burden due to decreased health situations. In addition, the endogenous variables present the hypothesis of complicated relationships between residential space, fixity activity and non-work activity-travel behavior.

3.3 Companionship: International Cultural Comparison

In answer to the questions what cultural difference reflects in urban daily life or how to observe from human external appearance, activity-travel behavior is the daily performance we could grasp. One form of differences in cultures from the perspective of activity-travel behavior is *companionship*. If narrowing into activity-travel behavioral study, it means people undertake both alone and joint activities and travels as part of activity-travel patterns (Wellman and Worley, 1990; Srinivasan and Bhat, 2008).

Companionship in activity-travel behavior might reflect individualistic or collectivistic tendency to some degree. However, it is perhaps surprising that there are only few direct empirical investigation of companionship with the background of China, for most are based on West contexts.

The general comparison of activity companions from descriptive statistics clearly shows that residents in Beijing finish activities alone less often than those in USA. If with accompanied, as percentages in italics shown, people in Beijing tend to choose family members, but people in USA or NL choose friends relatively more often. Further considering activities only with families, extended family take up a considerable part while the group is unimportant in Utrecht. Consequently, the percentage of core families accompanied activities is much higher in Utrecht and USA than Beijing. It provides evidence that the phenomena of social individualization are more obvious in western countries. Friends are the crucial group in individuals' social networks in USA and NL, because people interact with friends frequently in western surveys. Family obligation and physical proximity result in frequent interaction with core family members. However, strong family belief occupies Chinese society with the supports that families, besides extended members, play important roles as companions in daily life in Beijing. As for travel companion choice by descriptive statistics, the percentages show that travels happen alone much more often than activities. The circle of core families occupies the second highest percentages in both cities because they have the same departure location. Friends as travel companions are of importance in Beijing rather than in USA.

The mechanism of companion choice is also estimated by model analysis. The dependent variable in first model is with whom people conduct out-of-home activities. Multi-nominal logit model (MNL) is used to estimate effects in Beijing, and "alone" alternative is chosen as the reference category. Male and old age have the expected impact on the propensity of joint activities only in Beijing. Household structure and presence of young kids have crucial impacts on joint activities with families, especially with core families. The influence of income and car-ownership is relatively strong. Activity type is an important factor on joint activities. As for travel companions, we also apply MNL to estimate and draw transport modes into the model. The effects of gender, age and household structure to travel companions are similar with activity companions, but education, travel purpose and travel mode influence differently.

3.4 ICTs and its Effects on Physical Behavior

First, whether people could surf on the internet at home is the capacity of ICTs use. Nearly 80% households connect to the internet at home. According to the observation during the survey, most connections belong to fixed ADSL. It means the popularizing rate of ICTs is high. The considerable proportion of households could use internet freely at home. Second, we test time spent on internet weekly. We know that 30% residents never connect internet. 15% spend less than 7 hours per week on internet, and 18% spend 7 to 14 hours, which means one third of respondents spend around two hours per day on ICTs related activities. A surprising result is that nearly 15% residents spend really long time on internet surfing, over 35 hours per week. This group might be associated with retirees or no-job people who have plenty of spare time. Also, it reflects the immature use patterns of ICTs, too much time wasting on internet. Third, each respondent reported the main activities conducted via internet. The question is requested as Internet is applied on work or study purpose for nearly 50% people. The second top activity is e-mail about 30%, which is more or less related to working. The purposes of checking travel information and e-shopping are balanced, each 16%. The advantage of conducting these activities is abundant information via internet. The purposes of social and leisure take up relatively low percentages of internet activities, which might be only popular among young people.

We further analyze the time rhythm of ICT activities Monday and Sunday. Most activities on Monday concentrate in the evening, after 8 p.m. Only small amount of cases conduct ICTs activities in the morning or afternoon. The rhythm also reflects the relatively low during lunch and dinner time. The pattern illustrates the high density use of ICTs in the evening which might be associated to the period full-time employees have spare time. ICTs activities are mostly related to assisting work or leisure purposes. As for the time rhythm of ICTs activities on Sunday, the frequency is much higher than that on Monday. The evening is also the rush period of surfing on internet or chatting by telephone. Generally, people conduct more ICTs activities in the afternoon than that in the morning. The time around noon or nightfall, people reduce ICTs for one or two hours.

4 Summary and Discussion

This research investigates the relationships between urban form, activity-travel behavior and ICTs. Increasing evidence suggests that there are controversial relations among different elements. In this research, I analyze four main contents on housing diversity, gender difference, companionship and ICTs, which provide useful insights to urban planning and management in China. This chapter summarizes the four analyses, draws conclusion from the findings, and discusses the points of the future research.

China has undertaken a transition period from a planned economy toward a market economy resulting in many changes in urban structure and society, which provides an opportunity for quasi-longitudinal cases study on the relationship between built environment and activity-travel behavior. The study on behavior diversity by neighborhood type shows significant differences exist for residents' behavior living in *Danwei*, commodity and affordable housing neighborhoods. The analysis on 3D geo-visualization of space-time path and statistical multivariate regression models on daily travel and leisure time, shows that residential spatial factors and socio-demographics both influence residents' daily behavior. The findings present that *Danwei* residents have relative less daily travel time than those in commodity housing, but people living in affordable housing endure the longest travel time. Daily leisure time is more associated with individual attributes.

With respect to gender difference on activity-travel patterns, I argue that China is one society with traditional sex roles but also influenced by socialist and modern values. The study analyzes the impacts of family-obligation and household responsibility on non-work activity-travel generation and distribution with the consideration of space-behavior interaction and fixity-flexible activity relationship. The finding supports that gender difference exists because women dominate household related activities. The presence of children and retirees adds household burden. Individual preference, like age, working status and salary, should be taken into account for activity-travel pattern analysis. For the relations among urban form, fixity and flexible activities, neighborhood space with high density impacts short-distance travel for non-work activities, and space-time constraints exist between work and non-work activities.

Results from companionship show big distinction of cultures between West and East with the constructs of individualism and collectivism. This coincides with a growing awareness that society change diversified in the process of modernization from the perspective of activity-travel behavior. The companionship research shows people in Beijing perform more often with family members, yet those in USA and the Netherlands tend to perform more alone or with friends. The important differences in these characteristics are also observed based on socio-demographic, life cycle, activity type and transport mode. These findings are intended to provide evidence on collective behavior is popular in Eastern society but individualized behavior is prevalent in Western society.

With respect to the widespread use of ICTs, this research considers that ICTs provide people alternatives to face-to-face communication and decouple the space and time constraints in daily life, which might have the potentials to substitute physical activity and behavior. The study on ICTs in this research discusses the possible factors on physical activity-travel patterns. A considerable proportion of residents in Beijing could access to internet at home and most ICTs activities are related to work. Respect with time

rhythm, the use of ICTs concentrate in the evening both on Monday and Sunday. Men in young age with high income tend to use ICTs more than other groups.

This research also has several limitations. First, it examines the effects of urban form and ICTs on activity-travel behavior separately. The reason is that the complex relationships exist among these factors and multiple dimensions of space-time behavior. A possible extension is to develop integrated activity-travel measures. Second, the gender difference of behavior needs to link the deep cultural background in China. This research pays attention to traditional culture, plan-oriented development and open-door reform, but the measurements and discussions are primary, which need to further research. Third, the study on companionship only focuses on the frequency of with whom to conduct activities and travels. Yet, the factors of location, duration and time need to be considered in the following study. Fourth, ICTs research here does primary research on theoretical review and descriptive analysis. An attempt should be made to link ICTs to physical behavior, like e-shopping and in-store shopping, and discuss geographical effects on ICTs use, like ICTs use of urban and suburban residents etc.

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