<fresh page><CN>16.<EN><CT>Impact of individuals' commuting trips on satisfaction and subjective well-being: evidence from Xi'an, China

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<A>1 INTRODUCTION

Transportation as an important component for urban sustainability has been well recognized. Although the lay understanding of sustainability generally focuses on environmental stewardship, more broadly sustainability is comprised of three aspects: environmental, economic and social sustainability. Individual and societal well-being are critical indicators of social sustainability, however, little attention from research and policy has been paid to the impacts of transportation on well-being. The relationship between well-being, and in particular subjective well-being (SWB), and transportation has only recently attracted attention from both scholars and policy makers. Well-being is defined as "the state of being happy, healthy, or successful" (Merriam-Webster, n.d.) and SWB is broadly defined as a person's perception of their wellness, including their moods and emotions in reaction to the events happening to them (affective component), as well as their broad judgments about their life as a whole (cognitive component) (Diener, 1984). Even though the relationship between SWB and transportation is largely indirect and often goes unnoticed by travelers, several studies (Ettema et al., 2010; Stutzer and Frey, 2008; Bergstad et al., 2011; Smith, 2013; Cao, 2013) have shown that the relationship is significant; as a result some policy makers (Stiglitz et al., 2009) have proposed that transportation-related strategies could be an effective and far-reaching solution to well-being related problems. Several recent studies have called for an investigation as to whether, how, and to what extent SWB can be influenced by changes of travel context, such as changes of travel mode and changes of level-of-service of public transit (Bergstad et al., 2011; Ettema et al., 2010). Better understanding of the key travel-related determinants on SWB will help to design transport and urban planning policies and interventions that improve social well-being. Further, SWB would be a powerful tool for transportation policy evaluation if a relationship

between transportation and SWB can be found (Ettema et al., 2010, 2011). For example, the changes of travel well-being following the implementation of a transport policy could be an important outcome indicator to assess the success of the policy. Finally, SWB has been intensively studied in economics, psychology and social sciences, while the discipline of transportation has only recently started to investigate the link between transportation and SWB. We have little knowledge about how and to what extent transport contributes to SWB, and this limits our ability to make effective transport policies that aim to improve SWB.

Travel and the characteristics of the journey can influence well-being positively and negatively, directly and indirectly. Long-duration commuting, for example, can reduce the amount of time an individual has for other activities which contribute to (subjective) well-being, such as physical exercise, time with family, social activities, and so on (Ettema et al., 2010). Travel also potentially increases exposure to nuisances and hazards, such as traffic noise, crowds, congestion, pollution and poor thermal conditions (Stutzer and Frey, 2008). These can cause physical or emotional distress and can have a direct influence on one's physical and mental health (De Nazelle et al., 2009; McNabola et al., 2008; Wener et al., 2003). Furthermore, change from active travel (for example, walking and bicycling) to vehicle-dependent travel reduces the possible walking- and bicycling-related physical activities, which are important to prevent obesity and other related chronic diseases (Wareham et al., 2005). Travel for the purposes of commuting is of particular interest with regards to well-being. Commuting is often associated with particularly poor travel conditions created by serious congestion; it may make up the greatest proportion of travel time in a daily travel, and has been a major target of travel management policies (Redmond and Mokhtarian, 2001; Shiftan and Barlach, 2002). Therefore, commuting has not only a monetary cost, but also can be a physical and mental burden for individuals, significantly influencing their well-being.

Although there is growing interest in the area of transport and well-being, there is little empirical work that has directly studied the impact transportation may have on subjective well-being. Further, little research has been conducted on this topic with regard to the Chinese context. Unhappiness is currently a growing social problem in China as a consequence of the dramatic social transformation in recent decades (Easterlin et al., 2012), and despite China's high rate of economic growth and rising levels of prosperity. China has been undergoing a period of rapid urbanization and its cities have been changed radically (Ma, 2002; Ding, 2007). Alongside increasing urban expansion, China has seen worsening transportation conditions and increasing travel distances, particularly for the daily commute (Guan and Cui, 2003). These may in part be contributing to the growing levels of unhappiness.

As an economic hub in western China, Xi'an has, like many Chinese cites, undergone massive urban development in the past 30 years. The population increased from five million in 1980 to about 8.5 million in 2010 (Xi'an Bureau of Statistics, 2011). Over the same period the urban built up area has increased threefold, from approximately 120 square kilometers in 1980 to 370 square kilometers in 2010 (Xi'an Bureau of Statistics, 2011). This large expansion of the urban space has had two significant consequences on travel activities, especially commuting. First, commuting distance and time have increased significantly due in part to the increasing spatial separation of jobs and housing. Based on our survey, the average commuting distance and time in Xi'an is 10 kilometers and 38 minutes (one-way) respectively, and this number is likely to increase due to continuing urban expansion and rising congestion. Second, the traditional travel modes, bicycling and walking, are gradually becoming impossible due to these longer-trip distances. Instead, more and more people are relying on either the private car or public transit for their daily commuting. Relying on a case study of Xi'an, China, this chapter aims to contribute to the growing literature on the relationship between transportation and well-being in three aspects. First, this study focuses on commuting trips, which ~~is~~ are a large part of everyday life and should ideally be ~~a~~ pleasant experiences that contribute~~s~~ positively to the quality of life. Second, this study is one of the first studies to quantify the relationship between commuting trips and SWB in the Chinese context, a booming economy and transforming society, providing a unique context to study the relationships between travel and subjective well-being. Third, this study improves on previous ~~studying~~ studies by exploring the structural relationships among travel characteristics, travel satisfaction and SWB, while controlling for satisfaction with other important domains of life.

This chapter begins by reviewing recent studies that investigate the relationship between transportation and well-being, goes on to describe our data, variables and modeling approach, summarizes the key findings, and finally proposes policy implications, and concludes with a discussion of the study limitations and areas for future research.

<A>2 LITERATURE REVIEW

By reviewing the previous literature on subjective well-being, two main schools are identified

– the hedonic and eudaimonic approach. The hedonic approach (Kahneman et al., 1999) deems that well-being consists of pleasure and happiness. Diener (1984, 2000; Diener et al., 1999, 2003) defined SWB as people's moods and emotions to the events happening to them, and their broad judgments about their life as a whole, as well as about important domains such as work and marriage. They argue that SWB is composed of a number of separable components: life satisfaction (global judgments of one's life), satisfaction with important domains (for example, work satisfaction), positive affect (experiencing many pleasant emotions and moods), and low levels of negative affect (experiencing few unpleasant emotions and moods). Cognitive well-being refers to an individual's cognitive assessment of his or her life in general, while the affective well-being refers to an individual's emotions and moods (Diener et al., 1985). The eudaimonic approach (Waterman, 1993), on the other hand, contends that well-being consists of more than just pleasure and happiness, emphasizing the realization of self-worth and achievement of goals.

Empirically, the eudaimonic well-being could be strongly correlated with hedonic well-being, but nonetheless they represent two types of philosophical thinking. The hedonic approach developed based on the thoughts from early philosopher like Aristippus, who stated that the goal of life is to experience the maximum of pleasure (Ryan and Deci, 2001). The utilitarianism by Bentham (1789), who argues that a good society is built through individuals' desire to maximize pleasure and self-interest, was based on Aristippus's philosophical thought on hedonism. On the other hand, the philosopher, Aristotle, criticized happiness per se as a principal criterion of well-being, and argued that true happiness derives from the expression of virtue and excellence, and self-realization. Ryff and Singer (1998: 2), drawing from Aristotle, argued that well-being is not just gaining pleasure and happiness, but is "the striving for perfection that represents the realization of one's true potential". Ryff and Keyes (1995: 720) proposed a multidimensional construct for subjective well-being that include six aspects of human actualization: "autonomy, personal growth, self-acceptance, life purpose, mastery, and positive relatedness".

This study adopts a hedonic approach, concentrating on subjective well-being based on moods, emotions and life satisfaction as per Diener et al. (1985), since the hedonic approach is the mainstream in previous and current well-being and transportation research.

<B>2.1 Transport and Subjective Well-being

Several recent studies have constructed frameworks linking subjective well-being with travel in general (Abou-Zeid, 2009; Ettema et al., 2010) and commuting in particular (Novaco and Gonzalez, 2009). Ettema et al. (2011) deem that the utility of travel could influence overall well-being for two reasons. First, overall well-being has been shown to be related to well-being in specific domains (for example, family, work, health). Therefore, it is plausible to assume that well-being (or satisfaction) in the travel domain has implications for overall well-being. Second, improvement in travel conditions may increase options to participate in meaningful or enjoyable activities and may reduce stress associated with these activities, with both increasing well-being (Pychyl and Little, 1998).

Transport can affect subjective well-being directly. Travel itself may invoke positive and negative moods and emotions (affective well-being) as well as cognitive assessments of quality of travel (Ettema et al., 2010). The link between commuting and mental stress has been well established in the literature (Abou-Zeid, 2009). Studies have found that commuting-related stress results from various commuting attributes including long commute distances, traffic congestion, long travel or waiting times, the unpredictability of travel time and conditions, over-crowding, and other travel conditions (Evans et al., 2002; Novaco et al., 1990; Wener et al., 2003). Gatersleben and Uzzell (2007) found that active commuting by walking and bicycling is perceived as more "relaxing and exciting" than commuting by car and public transit, which are perceived as being more "stressful and boring". They also found that the affective appraisals of the daily commute are not only related to instrumental aspects, such as journey time, but also to general attitudes toward various travel modes. In addition to the traffic condition per se, there are other factors which can worsen or alleviate commuting stress. Lucas and Heady (2002) found that commuters with flextime employment contracts reported less driver stress and fewer feelings of time urgency than those without flextime, but there was no significant difference in terms of commute satisfaction. Lyons and Urry (2005) hypothesized that undertaking activities, such as working, during the journey, might help individuals to cope with travel stress.

Travel is traditionally considered as a derived demand, and travel itself is often judged as wasted time, only yielding negative utility. However, a number of studies have recognized that an individual can also gain positive value during the travel (Mokhtarian et al., 2001; Mokhtarian and Salomon, 2001; Steg, 2005), for example from working, playing, socializing, sleeping, and so on (Lyons and Urry, 2005). Furthermore, people may enjoy traveling for a number of other reasons including the sensation of speed, feelings of freedom, exposure to the environment and movement through the environment, the ability to control movement,

enjoyment of scenic beauty or the attractions of a route (Mokhtarian and Salomon, 2001). In particular, Steg (2005) found that commuter car use was most strongly related to symbolic and affective motives, and not to instrumental motives, such as speed, flexibility, and convenience. Based on data from a web-based survey of university students in Hamilton, Canada, Paez and Whalen (2010) found that active travelers tend to feel more satisfied with their commute than those traveling by other modes, followed by those who travel in personal vehicles and transit users. They also found that there are a number of attitudinal responses that may impact the desire to travel more or less, including the social environment, availability of local activities, quality of facilities, productive use of the commute, and the intrinsic value of commute travel.

In addition to the direct effects on SWB, the transport system also affects SWB indirectly by influencing important domains of SWB, such as health. Exposure to the traffic environment can affect our physical and mental health (De Nazelle et al., 2009; McNabola et al., 2008; Wener et al., 2003). Commuting stress can further spillover into domains such as work performance and family relationships (Novaco et al., 1990; Wener et al., 2005). Transportation can also affect our work–life balance and our ability to access activities, goods and services, essential for our well-being (Ettema et al., 2010; Delbosc, 2012).

The significant role of transportation with respect to health has been widely recognized. There is a mushrooming literature on the topic, with most finding that characteristics of transportation can have direct and indirect influences on human health. The link between transportation and health can be broadly summarized into the following five aspects. First, travel behavior is associated with level of physical activities (Handy et al., 2002), which in turn influence one's physical health. Second, commuting time (Stutzer and Frey, 2008) and mode choice (Wener et al., 2003), which are in part determined by built environment, are correlated with people's mental health (for example stress). Transport also enables "contact with nature", which can provide an effective strategy in prevention of mental illness (Maller et al., 2006). Third, the risk of injury from road traffic and pedestrian collisions is influenced by not only traffic management factors, such as traffic speed, signage and volume, but also by the design of built environment, factors such as the street network design, road layout, road width, and land use patterns (Ewing and Dumbaugh, 2009). Further, fear of being injured may also affect mental health. Fourth, traffic-related emissions affect ambient air quality on a wide range of spatial scales, from local roadsides and urban scales to broadly regional background scales. Exposure to traffic pollutants is associated with a variety of respiratory and cardiovascular symptoms and illnesses (Buckeridge et al., 2002; Riediker et al., 2004). Finally, transportation planning influences the accessibility of food shopping destinations (Clifton, 2004). Lack of

access to affordable, healthy food is potentially associated with obesity and other health problems (Walker et al., 2010).

As already highlighted, travel can influence SWB by facilitating participation in activities that are important for life, such as working, education, leisure, social and family activities (Ettema et al., 2010). For example, many studies have found car accessibility is important for employment, particularly for the low income population (Cervero et al., 2002; Grengs, 2010; Clark and Wang, 2010; Ong and Miller, 2005). Poor transportation contributes to social exclusion by restricting access to activities that enhance people's life chances, such as work, learning, health care, and other key activities. It can also contribute to social isolation and loneliness; fear of injury from traffic, fear of falling on poorly maintained footways, pollution and difficulty crossing busy traffic can deter some from leaving their homes and thus reduce levels of social interaction (Social Exclusion Unit, 2003). Finally, family life can also be influenced by daily commuting. Using data from existing household surveys in the London and Paris regions, Jones et al. (2008) examined the differences in the overall numbers and kinds of trips and activities carried out on weekdays and at weekends by "short" duration (30 minutes or less one way) and "long" duration (60 minutes and over one way) commuters. They found that short duration commuters spend more time at home than long duration commuters.

Based on the literature summarized above, Figure 16.1 shows how commuting affects subjective well-being both directly and indirectly. It can exert direct and immediate effects on the affective components of well-being, such as moods, stress, and emotions, which may in turn have spillover effects on other important domains of SWB, such as work performance and family relationships. It also indirectly influences the SWB by positively and negatively affecting important domains of life, such as physical and mental health, social and family activities.

[Figure 16.1 roughly here]

<B>2.2 Empirical Studies on Transport and Subjective Well-being

Although there is growing interest in the relationship between transportation and subjective well-being, there is relatively little empirical work that has directly studied the impact of transport on subjective well-being. Further, existing studies have reported mixed results.

Several recent studies have found a significant association between transportation and

subjective well-being. Based on data from the German Socio-economic Panel Study (GSOEP), Stutzer and Frey (2008) found that people with a longer commuting time report systematically lower subjective well-being than those with a shorter commute. A similar finding was reported by Choi et al. (2013), who found that commute time was statistically significant and negatively associated with SWB. Bergstad et al. (2011) investigated the correlation between satisfaction with daily travel and subjective well-being (SWB). Based on a survey of 1,330 Swedish citizens, they found that the effect of satisfaction with daily travel on affective and cognitive SWB is both direct and indirect via satisfaction with performance of activities. They also found that weekly car use has a small but significant positive effect on travel satisfaction and affective SWB. Using data from a web-based survey of workers (n=828) in Portland, Oregon, USA, Smith (2013) found those who bike and walk to work have significantly higher satisfaction with their commuting than transit and car commuters. He also found that, along with travel mode, traffic congestion, travel time, income, health, travel attitudes, job and residential satisfaction also play important roles in shaping commute satisfaction, which in turn may affect SWB. Cao (2013) found that the Hiawatha LRT (in Minneapolis, MN, USA) positively influenced satisfaction with life through enhanced access to different activities, and through improved transit service, enhanced accessibility, and their impacts on satisfaction with travel, but the size of the impacts were small. Olsson et al. (2013) found that commute satisfaction has a substantial influence on overall happiness based on the survey data on commuters living in the three largest urban areas of Sweden.

However, not all studies show a significant relationship between transportation and subjective well-being. Abou-Zeid (2009) proposed a framework that uses happiness measures as indicators of utility to model both activity and travel choices using data from a cross-sectional web-based survey. Through structural equation modeling, she found that commute satisfaction is significantly associated with commute enjoyment and commute stress, which can be further caused by longer travel time, higher variability, encountering congestion frequently, and walking or bicycling beside traffic. However, she found that the association between commute satisfaction and overall well-being is not statistically significant. Morris and Guerra (2014) explored the relationship between mood (affective component of SWB) and mode using ~~the~~ data from the American Time Use Survey, and found that bicycling had the most positive affect on mood, followed by driving a car, with bus and train riders showing the most negative emotions. However, most of these relationships were weak and not statistically significant in their models. They also concluded that travel has only a small total impact on affective SWB.

The mixed results in the literature may be due to characteristics of the environmental features studied, inconsistent measurement of well-being, and different statistical methods. They also imply that more empirical studies are needed to make sound conclusions and draw policy implications. Further, only one of these empirical studies ~~have~~ has focused on commuting trips, which is important for everyday life and a major target of travel management policies. Transportation planning and policies typically only probe the economic aspects of commuting; yet travel being a ubiquitous activity, it should be more than "functionally and economically" sound, it should also add to the quality of life. Thus the specific contribution of this chapter is to add a qualitative dimension to the utility theory, which is commonly used in transportation planning.

<A>3 METHODOLOGY

The data used in this study was gathered through a specially designed survey. The study is limited to residents of Xi'an aged over 18 who are in employment within Xi'an and do not work from home. In-depth interviews with several small groups of local residents with different socio-demographic characteristics were conducted to capture the basic characteristics and residents' immediate perception of their daily commute and well-being. These interviews helped to design the questionnaire used for the main data collection. Before distributing the final survey, a pilot study with 168 participants was conducted between early August and late September in 2012, aiming to test the validity of the survey questions.

Participants for the questionnaire survey were recruited through their employers and the survey was conducted at their employers' sites. Employers were sampled by industry type from the current industry listings (catalogues); a quota-based approach was taken to ensure that each industry type was represented in the survey. Once companies were selected, they were contacted to ask their permission to distribute the questionnaire to their employees. For those who accepted, a letter to explain the purpose of the survey, a consent form and a link to the web version of the survey were sent to the person in charge, and then distributed to the employees through their internal mailbox or instant messaging software. For those employees where it was difficult to obtain internet access, such as those working in factories or banks, the survey and consent form were distributed in paper and/or e-form format. All participants were

given a small gift to thank them for their participation.

The survey gathered data on individuals' (1) socio-demographic information, such as age, income, employment status, education, and so on; (2) details of their most recent commuting journey, including travel time and mode choice; (3) current home and job locations; (4) travel satisfaction; and (5) satisfaction with life.

Subjective well-being was measured using the Satisfaction with Life Scale (SWLS) developed by Diener et al. (1985). Satisfaction with life is a cognitive and judgmental process, where individuals assess the quality of life based on their unique set of criteria (Shin and Johnson, 1978). SWLS has been widely used (Pavot and Diener, 1993) and is a global assessment of one's life rather than only one's satisfaction with specific domains. The SWLS has shown strong internal reliability and moderate temporal stability (Pavot and Diener, 1993). Also, the SWLS has shown sufficient sensitivity to detect the change in life satisfaction during the course of clinical intervention (Pavot and Diener, 1993). The five items for measuring the SWLS are: (1) In most ways my life is close to my ideal; (2) The conditions of my life are excellent; (3) I am satisfied with my life; (4) So far I have gotten the important things I want in life; (5) If I could live my life over, I would change almost nothing. Satisfactions with other important domains of life were measured by asking the respondents to indicate the extent they agree with items adapted from Personal Well-being Index (International Well-being Group, 2013). The items include information about respondent's health, personal relationships, community involvement, future security, and spirituality. Each question is measured on a zero to ten scale, where zero is not at all satisfied and ten is completely satisfied.

Commuting satisfaction was measured using The Satisfaction with Travel (STS) Scale developed by Ettema et al. (2011). This measure includes both affective and cognitive components related to daily travel, and consists of nine items scoring from minus four to four to assess each aspect of travel experiences. In this study only seven of the nine items were used because after the pilot study, we found the two items "Fed up engaged "and "Travel was low-high standard" showed insufficient differences with items "bored-enthusiastic" and "worst-best" respectively after translating into Chinese. The seven items for measuring commuting satisfaction are: (1) I felt time was pressed – I felt time was relaxed during the commute; (2) I was worried I would not be in time – I was confident I would be in time; (3) I was stressed – I was calm; (4) I was tired – I was alert; (5) I was bored – I was enthusiastic; (6) I think this commute is the worst – I think this commute is the best I can think of; (7) I think this commute worked well – I think this commute worked poorly. Commuting satisfaction measured in this

study is based on the respondents' evaluation of the whole commuting journey or the main travel leg of the commute, depending on their interpretation of the question. Individual stages of the trip were not evaluated separately.

Other travel characteristics, such as travel mode choice and level of service of transit, were measured by asking the respondents to recall the characteristics of their most recent commuting trip. For example, I asked "for your most recent commute to work, what is your primary mode of transportation to work? By 'primary' I mean the mode you use for the longest duration of your trip" as the measure of travel mode choice, and I asked "for your most recent commute to work, how crowded was the bus?" as a measure of level of service of transit.

<B>3.1 Survey Data

The survey was conducted between May 15 and June 30, 2013. A total of 1,364 valid surveys were collected, including 794 web-based surveys and 570 paper-based surveys. After excluding cases with a lot of missing data, 1,215 cases were used for the data analysis. Table 16.1 presents the sample characteristics. In general, the survey captures a variety of population of the Xi'an city. Even with the large sample, the sample is not perfectly representative of the working population. The respondents were more likely to be female (52 percent versus 49 percent in the region), have larger household size (3.5 persons versus 2.8 persons in the region) and have higher annual income (¥42,000 versus ¥33,100 in the region). However, this limitation is not expected to materially affect the analysis and results; this is because our focus is on investigating the associations between the commuting and SWB, rather than on describing the patterns and characteristics of commuting and SWB of the city.

Table 16.1 Sample characteristics

Socio-demographics	**Statistics**
Average number of persons in household	3.5
Average number of children in the household	0.6
Average number of full-time workers	2.0
% Having a driver's license	56%
% Female	52%
% Working in government or education institutions	16%
Average age	34
# Cars in household	

0	49%
1	41%
2	8%
3 and more	2%
# Bikes/E-bikes in household	
0	45%
1	35%
2	16%
3 and more	4%
Marriage Status	
Single (never been married)	28%
Married	65%
Living with partner	4%
Separated or divorced	2%
Widowed	0.3%
Education Level	
Junior high school or less	4%
High school or technical secondary school	11%
Some college	36%
Bachelor's degree	40%
Master's degree	8%
Doctoral or professional degree	2%
Annual Income	
Less than ¥10,000	17%
¥10,000-¥19,999	14%
¥20,000-¥29,999	18%
¥30,000-¥49,999	20%
¥50,000-¥74,999	13%
¥75,000-¥99,999	8%
¥100,000-¥149,999	6%
¥150,000 and over	3%
Relative Income	
Higher than peers/friends	13%
Almost the same	35%
Lower than peers/friends	52%

Source: Authors.

<B>3.2 Travel Characteristics of the Sample

Table 16.2 provides the commuting mode choice, commuting distance and time. In terms of commuting mode choice, around 36 percent of the respondents choose bus for their most recent commuting, followed by car (26 percent, combined drive alone and carpool), walk (19 percent), bicycle (10 percent: combined bicycle and e-bicycle), rail (4 percent), taxi (3 percent), and works bus (2 percent). In addition, transit commuters have the longest commuting distance and time, while the walking commuters have the shortest commuting distance and time.

Table 16.2 Average commuting distance and time by travel modes

	Mode Share	**Commuting Distance (GIS calculated airline distance, meters)**	**Self-reported Commuting Time (minutes)**
Bus	36%	6,610	51
Car	26%	6,340	35
Walk	19%	1,924	25
Bicycle	4%	2,942	28
E-bicycle	5%	4,082	29
Rail (i.e. subway)	4%	8,262	45
Taxi	3%	5,313	39
Works bus	2%	2,848	44

Source: Authors.

Table 16.3 provides the characteristics of the car commuters, either as the sole occupant or as part of a carpool. Amongst these respondents, around 84 percent rely on their private car, whereas 16 percent use a car provided by their employers; 57 percent reported the road was somewhat congested and 33 percent reported the road was very congested, whereas only 10 percent reported the road was not congested at all.

Table 16.3 Characteristics of the car commute

	%
Car type	
Private car	84.1
Company car	15.9
Parking charge	
Pay to park	56.8
Free parking	43.2
Traffic congestion levels	
Not at all congested (1)	10.2
Somewhat congested (2)	57.2
Very congested (3)	32.6

Source: Authors.

Among those respondents who choose transit to commute, around 43 percent need to transfer during the trip, and 36 percent of those who did transfer needed to transfer more than once. Almost all of the transit riders reported that the bus or the rail they used was crowded during the commute (Table 16.4).

Table 16.4 Characteristics of the transit commute

	%
Need transfers?	
Yes (1)	42.6
No, get there directly (0)	57.4
Number of transfers?	
1	64.0
2	30.6
3+	5.4
How crowded was the bus or rail?	
Not at all crowded (1)	2.6
Somewhat crowded (2)	45.6
Very crowded (3)	51.9

Source: Authors.

<B>3.3 Methods of Analysis

Descriptive analysis was conducted initially to explore the sample characteristics and to extract

general information related to the commute and subjective well-being of the respondents. Structural Equation Modeling (SEM) was then used to test the conceptual model (Figure 16.2), examining the relationships among socio-demographics, travel time, travel mode choice, commuting satisfaction, and subjective well-being. In Figure 16.2, rectangles indicate the variables are observed, while the ovals refer to unobserved or latent variables. SEM was chosen because of its ability to solve simultaneous equations enabling the causal relationships between the independent, dependent and intermediate variables to be disentangled (Maruyama, 1997). Commuting satisfaction and subjective well-being were incorporated as latent variables. The latent constructs for commuting satisfaction and SWB are illustrated in Figure 16.3, where λ is the regression coefficient, δ is the residual (uniqueness) for the observed measures, cs1–cs7 are the seven observed indicators for commuting satisfaction, and sw1–sw5 are the five observed indicators for SWB. ~~This~~ These latent constructs help to remove the measurement and specification error from these variables (Maruyama, 1997). The models were estimated using AMOS 21.0, and the full information maximum likelihood (FIML) procedure was used to estimate the models. FIML outperforms the common methods of handling missing data, such as listwise and pairwise data deletion (Enders and Bandalos, 2001). Because of this, the variables that are only relevant to transit commuters, such as crowd and transfer, were kept in the model, and including them did not reduce sample size in estimation. In addition, for a large sample size, which is the case ~~of~~ for this study, the maximum likelihood approach is fairly robust against violations of multivariate normal distribution assumptions of SEM, as shown by many simulation studies (Golob, 2003; Scheiner and Holz-Rau, 2007).

The analysis includes five types of variables: socio-demographics, commuting characteristics, commuting satisfaction, subjective well-being, and satisfactions with important domains of life. Socio-demographic variables including age, gender, education, income, employment, and marriage status, were assumed to be associated with both commuting satisfaction and subjective well-being. Commuting characteristics, including mode choice, times of transfer needed for riding transit, congestion level, level of crowding in transit, and commuting time, were assumed to affect commuting satisfaction, which in turn influences subjective well-being. In addition to the indirect link via commuting satisfaction, commuting characteristics were also assumed to influence subjective well-being directly. Further, satisfaction with important domains of life, such as health condition, personal relationship, community involvement, spirituality, and future security, may also affect subjective well-being and therefore were also incorporated in the model. In model estimation, the commuting characteristics, socio-demographics and satisfaction with other domains of life were exogenous

variables and the covariances between them were specified. The summary of the variables used in this chapter is in Table 16.5.

Table 16.5 Summary statistics of the variables in this chapter

Variable	Mean	Std. Dev.	Min	Max
Socio-demographics				
Age	33.78	9.83	18	75
Female (1=yes; 0=otherwise)	0.51	0.50	0	1
Work in Govt. (1=yes; 0=otherwise)				
Income	3.61	1.98	1	10
Relative income (1=higher than peers/friends; 0=otherwise)	2.21	0.65	1	3
Married (1=yes; 0=otherwise)	0.65	0.48	0	1
Commuting characteristics				
Car (including drive alone, carpool, and taxi)	0.29	0.45	0	1
Rail Transit	0.04	0.20	0	1
Active Travel (including walking and bicycling)	0.19	0.39	0	1
Congestion (self-reported; see Table 16.3 for coding)	2.22	0.62	1	3
Commuting time (minutes; self-reported)	38.83	30.53	0	300
Crowding in bus/rail (self-reported; see Table 16.4 for coding)	2.49	0.55	1	3
Transfer (self-reported; see Table 16.4 for coding)	0.43	0.50	0	1
Commuting satisfaction				
Tense-relax (cs1)	0.32	1.80	-3	3
Worried-confident (cs2)	0.45	1.93	-3	3
Stressed-calm (cs3)	-0.14	1.65	-3	3
Tired-alert (cs4)	-0.11	1.57	-3	3
Bored-enthusiastic (cs5)	0.18	1.66	-3	3
Worst-best (cs6)	0.38	1.67	-3	3
Well-poor (cs7)	0.38	1.66	-3	3
Subjective well-being				
My life is close to my ideal (sw1)	3.57	1.49	1	7
The conditions of my life are excellent (sw2)	3.74	1.42	1	7
I am satisfied with my life (sw3)	3.81	1.44	1	7
have gotten the important things (sw4)	3.82	1.61	1	7
I would change almost nothing (sw5)	3.31	1.66	1	7
Satisfactions with important domains of life				
Satisfaction with Health	5.68	2.36	0	10
Satisfaction with Personal relationship	5.71	2.23	0	10
Satisfaction with Community involvement	4.50	2.38	0	10
Satisfaction with Spirituality	5.20	2.41	0	10
Satisfaction with Future security	4.64	2.47	0	10

Source: Authors.

[Figure 16.2 roughly here]

[Figure 16.3 roughly here]

<A>4 MODEL RESULTS

First, a model specified as the conceptual model (Figure 16.2) was estimated. However, the model results indicated that none of the commuting characteristics variables were significantly associated with SWB. We, therefore, deleted the direct link from commuting characteristics to the SWB in the final model estimation to acquire a better model fit. The standardized loadings (Figure 16.4) for the seven indicators assessing commuting satisfaction and the five indicators measuring SWB are of sufficient magnitude (0.588 to 0.870). This indicates that the two instruments measuring the commuting satisfaction and SWB are well applied in the Chinese context. The model results, including model fits, standardized coefficients and significance, are provided in Figure 16.4. The fit indices suggest a good fit (CFI = 0.935, RMSEA = 0.043) based on Hu and Bentler (1999), who suggest a cutoff value close to 0.95 for CFI and a cutoff value close to 0.06 for RMSEA are needed to conclude there is a relatively good fit between the hypothesized model and the observed data.

Overall, the model explains about 27 percent of the variation in commuting satisfaction and about 47 percent of the variation in SWB (Figure 16.4). Most of socio-demographic characteristics are significantly associated with SWB. For example, women, those working in government and educational institutions, those who perceived they had higher income than their peers, and those who were married, were more likely to have higher level of SWB. Interestingly, absolute income was not significantly associated with SWB. However, none of the socio-demographic variables were significantly associated with commuting satisfaction except age.

Both commuting mode choice and level of service are associated with commuting satisfaction. Active travel (that is, walking and bicycling) commuters had the highest levels of commuting satisfaction. Car commuters were more satisfied with their most recent commuting than those relying on other motorized modes. However, the association between rail use and commuting satisfaction was not statistically significant, even though it is positive. For transit commuters, having to transfer and over-crowding were associated with lower levels of commuting satisfaction. For car commuters, congestion on the road could significantly reduce their commuting satisfaction. As expected, commuting time was significantly and negatively associated with commuting satisfaction. In terms of the importance, congestion is the biggest

deterrent to the commuting satisfaction, while active travel contributes most to improve commuting satisfaction.

Even though the direct effects were not significant, the commuting characteristics indirectly influence SWB via commuting satisfaction. For example, the congestion could reduce the SWB by 0.0355 (-0.218*0.163) standard deviations, while active travel could increase the SWB by 0.0344 (0.211*0.163) standard deviations. In addition, though the individual effect of each commuting characteristic on SWB is marginal, the combined effects of all commuting factors could be large.

Furthermore, the five dimensions of life, including health condition, personal relationships, community involvement, spiritual life, and future security, were all significantly associated with SWB. After controlling for social demographics and these important dimensions of life, commuting satisfaction remained a significant relationship with SWB. Comparing with other domains of life, commuting satisfaction is the second most important factor that affects SWB. This indicates the strong associations between commuting and SWB in Xi'an, China.

This study has some limitations. First, the survey revealed a number of factors influencing mode choice, and which may hence influence commuting satisfaction, which were not included in the Satisfaction with Travel Scale (STS). Data on trip time reliability and wait-time for public transportation on commuting satisfaction were not available for inclusion in the model; these have been found to be significant factors influencing commute satisfaction (Cantwell et al., 2009). Second, the measure of SWLS in this study only considers the cognitive component, not the affective component of well-being. Travel characteristics may have different impacts on cognitive and affective well-being. More research is needed to further investigate their relationship. Third, even though we assumed a causal relationship between transportation well-being and subjective well-being, we only provided ~~the~~ evidence for ~~the~~ a significant association between them. Studies relying on longitudinal data that explore the impact of changes of travel characteristics on changes of well-being would be enlightening. Finally, all the variables on commute characteristics are self-reported measures, which are subject to recall and may introduce bias.

[Figure 16.4 roughly here]

<A>5 CONCLUSIONS AND POLICY IMPLICATIONS

Based on ~~the~~ data from a megacity of China, Xi'an, this study finds that commute characteristics, including travel mode choice and level of service, significantly influence commuting satisfaction, which in turn significantly affects overall satisfaction with life (SWB). These findings have important policy implications. They illustrate that travel model choice and the efficiency and quality of the transportation network not only affects economic activities, but also has significant impact on individuals' well-being. Commuting satisfaction is determined by ~~the~~ travel mode choice and level of service, and has little relationship with the socio-demographic characteristics of commuters. In contrast, most of the socio-demographic variables are significantly associated with subjective well-being.

In particular, people who choose the active modes of walking and bicycling are most satisfied with their commute. Given this, policies that aim to promote active travel should be encouraged. The role of the built environment on active travel behavior has been well established. Many studies have found that a built environment featuring high density (Kitamura et al., 1997, Ewing and Cervero, 2010), mixed land uses (Frank and Engelke, 2005; Ewing and Cervero, 2010), well-connected streets (Handy et al., 2002; Ewing and Cervero, 2010), sidewalks (Forsyth et al., 2008) and bicycle infrastructure (Pucher et al., 2010) is associated with more walking and bicycling behavior. Chinese cities are currently experiencing fast development and thus considerable transformation. It is critical that urban planners intervene in this process to help shape an environment friendly for walking and bicycling. It is also worth noting that car is also positively associated commuting satisfaction, but the magnitude of association is much smaller than that of active travel. Unexpectedly, rail commuters are not significantly more satisfied with their commuting comparing with other mode users (for example bus, taxi, motorbike).

As expected, the attributes of the commuting trip significantly influence travel satisfaction, and in turn affect overall satisfaction of life. Congestion in particular severely affects commuting satisfaction, despite the positive association between car uses and commuting satisfaction. A series of congestion management strategies may help to ease the serious congestion in big Chinese cities. Possible pricing strategies include charging congestion fee in the inner city and high-occupancy toll (HOT) lanes. These strategies have been successfully implemented in some Asian and western cities. Other regulation and planning strategies that may help to reduce motorized travel and curb congestion include restricting car purchase and

use, introducing parking restrictions, maintaining a jobs-housing balance in new developments (Cervero and Duncan, 2006), promoting alternative work hours, and introducing employer-based rideshare programs.

For public transit commuters, having to transfer between services and crowding on services significantly affect their travel experience. These findings are consistent with previous studies, as discussed in literature review. Crowding in public transit is significantly associated with a negative psychological-outcome, including anxiety, stress and feeling of exhaustion (Cheng, 2010; Lundberg, 1976; Mahudin et al., 2012). Transfer between services also increases stress level (Wener et al., 2005). Increasing network coverage, making interchange easier, less stressful and increasing the frequency of public transit during peak hours may help to improve the level of service, commuting satisfaction and thus well-being.

<A>REFERENCES

Abou-zeid, M. (2009). Measuring and modeling activity and travel well-being. Doctor of Philosophy, Massachusetts Institute of Technology.

Bentham, J. (1789). *An Introduction to the Principles of Morals and Legislation*. London: T. Payne, published online, https://www.earlymoderntexts.com/assets/pdfs/bentham1780.pdf, accessed October 25, 2019.

Bergstad, C.J., Gamble, A., Gärling, T., Hagman, O., Polk, M., Ettema, D., Friman, M. and Olsson, L.E. (2011). Subjective well-being related to satisfaction with daily travel. *Transportation*, 38, 1–15.

Buckeridge, D.L., Glazier, R., Harvey, B.J., Escobar, M., Amrhein, C. and Frank, J. (2002). Effect of motor vehicle emissions on respiratory health in an urban area. *Environmental Health Perspectives*, 110, 293–300.

Cantwell, M., Caulfield, B. and O'Mahony, M. (2009). Examining the factors that impact public transport commuting satisfaction. *Journal of Public Transportation*, 12, 1–22.

Cao, X. (2013). The association between light rail transit and satisfactions with travel and life: evidence from Twin Cities. *Transportation*, 40, 921–933.

Cervero, R. and Duncan, M. (2006). Which reduces vehicle travel more: jobs-housing balance or retail-housing mixing? *Journal of the American Planning Association*, 72, 475–490.

Cervero, R., Sandoval, O.S. and Landis, J. (2002). Transportation as a stimulus of welfare-to-work: private versus public mobility. *Journal of Planning Education and Research*, 22, 50–63.

Cheng, Y.H. (2010). Exploring passenger anxiety associated with train travel. *Transportation*, 37, 875–896.

Choi, J., Coughlin, J.F. and D'ambrosio, L. (2013). Travel time and subjective well-being. *Transportation Research Record: Journal of the Transportation Research Board*, 2357, 100–108.

Clark, W.A.V. and Wang, W.W. (2010). The automobile, immigrants, and poverty: implications for immigrant earnings and job access. *Urban Geography*, 31, 523–540.

Clifton, K.J. (2004). Mobility strategies and food shopping for low-income families: a case study. *Journal of Planning Education and Research*, 23, 402–413.

De Nazelle, A., Rodríguez, D.A. and Crawford-brown, D. (2009). The built environment and health: impacts of pedestrian-friendly designs on air pollution exposure. *Science of The*

Total Environment, 407, 2525–2535.

Delbosc, A. (2012). The role of well-being in transport policy. *Transport Policy*, 23, 25–33.

Diener, E. (1984). Subjective well-being. *Psychological Bulletin*, 95, 542–575.

Diener, E. (2000). Subjective well-being: the science of happiness and a proposal for a national index. *American Psychologist*, 55, 34–43.

Diener, E., Emmons, R.A., Larsen, R.J. and Griffin, S. (1985). The satisfaction with life scale. *Journal of Personality Assessment*, 49, 71–75.

Diener, E., Oishi, S. and Lucas, R.E. (2003). Personality processes: personality, culture, and subjective well-being: emotional and cognitive evaluations of life. *Annual Review of Psychology*, 54, 403.

Diener, E., Suh, E.M., Lucas, R.E. and Smith, H.L. (1999). Subjective well-being: three decades of progress. *Psychological Bulletin*, 125, 276–302.

Ding, C. (2007). Policy and praxis of land acquisition in China. *Land Use Policy*, 24, 1–13.

Easterlin, R.A., Morgan, R., Switek, M. and Wang, F. (2012). China's life satisfaction, 1990–2010. *Proceedings of the National Academy of Sciences of the United States of America*, 109, 9775–9780.

Enders, C.K. and Bandalos, D.L. (2001). The relative performance of full information maximum likelihood estimation for missing data in structural equation models. *Structural Equation Modeling*, 8, 430–457.

Ettema, D., Ettema, D., Gärling, T., Eriksson, L., Friman, M., Olsson, L.E. and Fujii, Satoshi (2011). Satisfaction with travel and subjective well-being: development and test of a measurement tool. *Transportation Research Part F: Psychology and Behaviour*, 14, 167–175.

Ettema, D., Gärling, T., Olsson, L.E. and Friman, M. (2010). Out-of-home activities, daily travel, and subjective well-being. *Transportation Research Part A: Policy and Practice Transportation Research Part A: Policy and Practice*, 44, 723–732.

Evans, G.W., Wener, R.E. and Phillips, D. (2002). The morning rush hour: predictability and commuter stress. *Environment and Behavior*, 34, 521–530.

Ewing, R. and Cervero, R. (2010). Travel and the built environment. *Journal of the American Planning Association*, 76, 265–294.

Ewing, R. and Dumbaugh, E. (2009). The built environment and traffic safety: a review of empirical evidence. *Journal of Planning Literature*, 23, 347–367.

Forsyth, A., Hearst, M., Oakes, J.M. and Schmitz, K.H. (2008). Design and destinations: factors influencing walking and total physical activity. *Urban Studies*, 45, 1973–1996.

Frank, L. and Engelke, P. (2005). Multiple impacts of the built environment on public health: walkable places and the exposure to air pollution. *International Regional Science Review*, 28, 193–216.

Gatersleben, B. and Uzzell, D. (2007). Affective appraisals of the daily commute: comparing perceptions of drivers, cyclists, walkers, and users of public transport. *Environment and Behavior*, 39, 416–431.

Golob, T.F. (2003). Structural equation modeling for travel behavior research. *Transportation Research Part B: Methodological*, 37, 1–25.

Grengs, J. (2010). Job accessibility and the modal mismatch in Detroit. *Journal of Transport Geography*, 18, 42–54.

Guan, C. and Cui, G. (2003). A probe into transit oriented spatial structure pattern of metropolis in China. *City Planning Review*, 27, 39–43.

Handy, S., Boarnet, M.G., Ewing, R. and Killingsworth, R.E. (2002). How the built environment affects physical activity: views from urban planning. *American Journal of Preventive Medicine*, 23, 64–73.

Hu, L.-T. and Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling*, 6, 1–55.

International Well-being Group (2013). *Personal Well-being Index* (5th edition). Melbourne: Australian Centre on Quality of Life: Deakin University.

Jones, P., Thoreau, R., Massot, M.-H. Orfeuil, J.-P. and Proulhac, L. (2008). *The impact of commuting duration on family lifestyles: A comparison of the London and Paris regions*. European Transport Conference, June 10, 2008. Noordwijkerhout, the Netherlands.

Kahneman, D., Diener, E. and Schwarz, N. (1999). *Well-being: The Foundations of Hedonic Psychology*, New York: Russell Sage Foundation.

Kitamura, R., Mokhtarian, P.L. and Laidet, L. (1997). A micro-analysis of land use and travel in five neighborhoods in the San Francisco Bay area. *Transportation*, 24, 125–158.

Lucas, J.L. and Heady, R.B. (2002). Flextime commuters and their driver stress, feelings of time urgency, and commute satisfaction. *Journal of Business and Psychology*, 16, 565–571.

Lundberg, U. (1976). Urban commuting: crowdedness and catecholamine excretion. *Journal of Human Stress*, 2, 26–32.

Lyons, G. and Urry, J. (2005). Travel time use in the information age. *Transportation Research Part A: Policy and Practice*, 39, 257–276.

Ma, L.J. (2002). Urban transformation in China, 1949–2000: a review and research agenda. *Environment and Planning A*, 34, 1545–1570.

Mahudin, N.D.M., Cox, T. and Griffiths, A. (2012). Measuring rail passenger crowding: scale development and psychometric properties. *Transportation Research Part F-Traffic Psychology and Behaviour*, 15, 38–51.

Maller, C.J., Townsend, M., Pryor, A. and Brown, P. (2006). Healthy nature healthy people: 'contact with nature' as an upstream health promotion intervention for populations. *Health Promotion International*, 21, 45–54.

Maruyama, G. (1997). *Basics of Structural Equation Modeling*. Thousand Oaks, CA: Sage Publications.

McNabola, A., Broderick, B.M. and Gill, L.W. (2008). Relative exposure to fine particulate matter and VOCs between transport microenvironments in Dublin: personal exposure and uptake. *Atmospheric Environment*, 42, 6496–6512.

Merriam-webster. (n.d.). http://www.merriam-webster.com/dictionary/well-being, accessed October 25, 2019.

Mokhtarian, P. and Salomon, I. (2001). How derived is the demand for travel? Some conceptual and measurement considerations. *Transportation Research Part A: Policy and Practice*, 35, 695–719.

Mokhtarian, P., Salomon, I. and Redmond, L. (2001). Understanding the demand for travel: it's not purely 'derived'. *Innovation: The European Journal of Social Sciences*, 14, 355–380.

Morris, E.A. and Guerra, E. (2014). Mood and mode: does how we travel affect how we feel? *Transportation*, 42, 25–43.

Novaco, R.W. and Gonzalez, O.I. (2009). Commuting and well-being. In Amichai-Hamburger, Y. (ed.), *Technology and Psychological Well-Being*. Cambridge, UK: Cambridge University Press, pp, 174–205.

Novaco, R.W., Stokols, D. and Milanesi, L. (1990). Objective and subjective dimensions of travel impedance as determinants of commuting stress. American *Journal of Community Psychology*, 18, 231–257.

Olsson, L.E., Gärling, T., Ettema, D., Friman, M. and Fujii, S. (2013). Happiness and satisfaction with work commute. *Social Indicators Research*, 111, 255–263.

Ong, P.M. and Miller, D. (2005). Spatial and transportation mismatch in Los Angeles. *Journal of Planning Education and Research*, 25, 43–56.

Paez, A. and Whalen, K. (2010). Enjoyment of commute: a comparison of different

transportation modes. *Transportation Research Part A: Policy and Practice*, 44, 537–549.

Pavot, W. and Diener, E. (1993). Review of the Satisfaction With Life Scale. *Psychological Assessment*, 5, 164–172.

Pucher, J., Dill, J. and Handy, S. (2010). Infrastructure, programs, and policies to increase bicycling: an international review. *Preventive Medicine*, 50, Supplement, S106–S125.

Pychyl, T.A. and Little, B.R. (1998). Dimensional specificity in the prediction of subjective well-being: personal projects in pursuit of the PhD. *Social Indicators Research*, 45, 423–473.

Redmond, L.S. and Mokhtarian, P.L. (2001). The positive utility of the commute: modeling ideal commute time and relative desired commute amount. *Transportation*, 28, 179–205.

Riediker, M., Cascio, W.E., Griggs, T.R., Herbst, M.C., Bromberg, P.A., Neas, L., Williams, R.W. and Devlin, R.B. (2004). Particulate matter exposure in cars is associated with cardiovascular effects in healthy young men. *American Journal of Respiratory and Critical Care Medicine*, 169, 934–940.

Ryan, R.M. and Deci, E.L. (2001). On happiness and human potentials: a review of research on hedonic and eudaimonic well-being. *Annual Review of Psychology*, 52, 141–166.

Ryff, C.D. and Keyes, C.L.M. (1995). The structure of psychological well-being revisited. *Journal of Personality and Social Psychology*, 69, 719–727.

Ryff, C.D. and Singer, B. (1998). The contours of positive human health. *Psychological Inquiry*, 9, 1-28.

Scheiner, J. and Holz-rau, C. (2007). Travel mode choice: affected by objective or subjective determinants? *Transportation*, 34, 487–511.

Shiftan, Y. and Barlach, Y. (2002). Effect of employment site characteristics on commute mode choice. *Transportation Research Record: Journal of the Transportation Research Board*, 1781, 19–25.

Shin, D.C. and Johnson, D.M. (1978). Avowed happiness as an overall assessment of the quality of life. *Social Indicators Research Social Indicators Research*, 5, 475–492.

Smith, O.B. (2013). Peak of the day or the daily grind: commuting and subjective well-being. Doctor of Philosophy, Portland State University.

Social Exclusion Unit (2003). Making the connections: final report on transport and social exclusion. London: Office of the Deputy Prime Minister.

Steg, L. (2005). Car use: lust and must. Instrumental, symbolic and affective motives for car

use. *Transportation Research Part A: Policy and Practice*, 39, 147–162.

Stiglitz, J., Sen, A. and Fitoussi, J.P. (2009). The measurement of economic performance and social progress revisited. Reflections and overview. Commission on the Measurement of Economic Performance and Social Progress, Paris.

Stutzer, A. and Frey, B.S. (2008). Stress that doesn't pay: the commuting paradox. *The Scandinavian Journal of Economics*, 110, 339–366.

Walker, R.E., Keane, C.R. and Burke, J.G. (2010). Disparities and access to healthy food in the United States: a review of food deserts literature. *Health & Place*, 16, 876–884.

Wareham, N.J., Van sluijs, E.M.F. and Ekelund, U. (2005). Symposium on 'Prevention of obesity': physical activity and obesity prevention: a review of the current evidence. *Proceedings of the Nutrition Society*, 64, 229–247.

Waterman, A.S. (1993). Two conceptions of happiness: Contrasts of personal expressiveness (eudaimonia) and hedonic enjoyment. *Journal of Personality and Social Psychology*, 64, 678.

Wener, R., Evans, G. and Boately, P. (2005). Commuting stress : psychophysiological effects of a trip and spillover into the workplace. *Transportation Research Record: Journal of the Transportation Research Board*, 112–117.

Wener, R., Evans, G., Phillips, D. and Nadler, N. (2003). Running for the 7:45: the effects of public transit improvements on commuter stress. *Transportation*, 30, 203–220.

Xi'an Bureau of Statistics (2011). *Xi'an Statistical Yearbook*, United States: China Statistics Press.