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The subjective well-being of older adults in Shanghai: The role of residential environment and individual resources

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Abstract
As a rapidly ageing population becomes an increasingly serious social challenge for Chinese megacities, issues affecting older adults' subjective well-being (SWB) attract greater concern. However, it is difficult to gain a comprehensive understanding of older adults' SWB, since most SWB theories focus only on specific factors. Moreover, residential environmental factors are hardly considered in studies of older adults' SWB. In this paper we therefore investigate the effects of residential environment and individual resources on the SWB of older adults in Shanghai, using the integrative theoretical framework proposed by Lindenberg. We investigate the relationships between resources (residential environment and individual resources), needs satisfaction and SWB using multiple regression analysis. Our results show that the residential environment exerts a stronger impact on SWB than individual resources. Good quality residential building, good accessibility to medical and financial facilities, higher economic status of a neighbourhood, and a lower proportion of older adults in a neighbourhood are important environmental correlates of SWB. Health appears to be the most significant individual resource; other important individual resources include household income, a high-skilled occupation, a job in the public sector and living with grandchildren. Comfort is the most important basic need for older adults.

Keywords
individual resources, older adults, residential environment, Shanghai, subjective well-being

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Introduction

Chinese cities have experienced tremendous economic growth and dramatic urban expansion over the last three decades. While the cities continue to grow economically and physically, however, their population is rapidly ageing (Chen and Liu, 2009; Chen and Powell, 2012). Dramatic fertility decline, largely as a result of the 'one child policy' implemented in the 1970s, and increased longevity are causing China's population to age at a very fast pace. The United Nations estimates that approximately 35% of the Chinese population will be aged 60 years or older in 2050 (Banister et al., 2012). Some megacities, such as Shanghai and Beijing, are already facing serious social challenges of rapid population ageing. As their health status, mobility and financial resources decline, older adults may become more disadvantaged and face more difficulties than younger adults in pursuing a 'good life' (Steverink et al., 1998). Because of these changes, attention to older adults' quality of life and subjective well-being (SWB) is warranted.

Subjective well-being refers to the highest good and the ultimate motivation for human action, and it is based upon a person's self-appraisal of his/her overall life situation (Diener, 2009a; Ormel et al., 1999). A substantial body of scientific research has been published on theories, measurements and causal factors of SWB (Diener and Ryan, 2009). These studies show that an individual's SWB is linked to a wide range of factors, including subjective satisfaction with how needs and life goals are being met, socio-demographics (e.g. age, education, employment, income and religion), health, biological factors, personality, social relationships, behaviours and culture. Older adults' SWB, in particular, is closely related to physical and mental health, functional capacity, socio-economic status (Pinquart and Sörensen, 2000; Smith et al., 2002) and physical activity (Baker et al., 2005; McAuley et al., 2000), as well as social networks, family relations and living arrangements (Cheng et al., 2009; Litwin and Shiovitz-Ezra, 2011). So far, little effort has been made to integrate these multi-disciplinary and diverse factors of SWB in a comprehensive evidence-based theoretical framework. As a consequence, progress in SWB theory remains limited (Diener, 2009b).

The work of Lindenberg and his colleagues, who integrated SWB, goals, needs, activities and resources hierarchically in a theory of social production function (SPF), is an exception to this limitation (Lindenberg, 1996; Nieboer et al., 2005; Ormel et al., 1999; Steverink and Lindenberg, 2006; Steverink et al., 1998, 2005; van Bruggen, 2001). SPF theory states that SWB is 'produced' by the satisfaction of needs or goals, which is in turn 'produced' by activities and resources. Within this theory, subjective and objective factors of SWB are logically and systematically linked. According to SPF theory, well-being resources are primarily operationalised as individual resources, such as financial means, educational and occupational status, health and social supports. However, apart from housing and social networks, the resources of the residential environment, from a geographical perspective, are seldom addressed in SPF theory. Other SWB studies, in both Western and Chinese literature, reveal this same deficiency. There is limited and fragmented empirical evidence on the residential environmental factors influencing the SWB of individuals, especially older adults (Clarke and Nieuwenhuijsen, 2009; Day, 2008; Wahl et al., 2007), such as neighbourhood quality, accessibility to local amenities and the socio-economic composition of the neighbourhood population. As 'ageing in place', defined as 'keeping older people with low dependency in their own homes

and neighbourhoods and only resorting to institutional care when it becomes absolutely necessary', has become a focal concept in current ageing policy and research (Costa-Font et al., 2009; Vasunilashorn et al., 2012; Wiles et al., 2012), more evidence and understanding of the effects of the residential environment on older adults' SWB is required.

This paper aims to investigate the effects of the residential environment and individual resources on the subjective well-being of older adults in Shanghai, taking Lindenberg's integrative theoretical framework as a starting point. Shanghai was selected as our study area because it has the highest proportion of ageing population among the Chinese megacities; nearly a third (28.8%, 4.1 million) of its registered population were aged 60 or older at the end of 2014 (SHRCA, 2015). In the next section, Lindenberg's theoretical framework for analysing SWB is introduced and extended to include links to needs satisfaction, and well-being resources such as residential environment and individual resources. In the section on research design, the dataset related to well-being from the World Health Organization's Global Ageing and Adult Health Survey of 2010 is then introduced, followed by the estimation methods for SWB and needs satisfaction, and the statistics for the relevant variables. Following this, the effects of residential environment and individual resources on SWB are interpreted using multiple regression analysis. Conclusions and discussion are presented in the final section.

Theoretical framework for analysing subjective well-being

Subjective well-being is a multi-disciplinary concept which includes diverse components. These components vary widely, from subjective concepts (e.g. life and needs satisfaction) to objective conditions (e.g. health and functional status), from social (e.g. social relationships) to physical dimensions (e.g. residential environment), and from goals (e.g. happiness and success) to instrumental behaviours and means (e.g. entertainment and socio-economic resources). There are a variety of theories of SWB, the most prominent of which are telic, activity, top-down and bottom-up theories (Diener, 2009b; Diener and Ryan, 2009).

Telic theories state that SWB is gained when some state or endpoint, such as a goal or need, is attained (Diener and Ryan, 2009; Ormel et al., 1999). Exponents of telic theories, such as needs theory and goals theory, emphasise the importance of needs satisfaction and goals achievement in SWB. Activity theories, in contrast, state that SWB is a by-product of human activities and arises from behaviour, such as carrying out hobbies and interacting with good friends, rather than from achieving specific endpoints (Diener, 2009b). Bottom-up theories claim that SWB is the accumulation of many happy and positive moments in a person's daily life, whereas top-down theories state that SWB depends on personality, which influences a person's interactions with the outside world (Diener and Ryan, 2009). Top-down and bottom-up theories also suggest a hierarchical structure of SWB components, ranging from more universal and static factors to more specific and dynamic factors.

Since the focus of different SWB theories varies according to their disciplinary perspectives and domain-specific components, it is difficult to obtain an overall picture of SWB. However, these theories are not necessarily incompatible, and attempts have been made to integrate them. One prominent attempt is Lindenberg's SPF theory, which integrates concepts such as SWB, goals, needs, activities and resources hierarchically (Lindenberg, 1996; Nieboer et al., 2005; Ormel et al., 1999; van Bruggen, 2001). According to this theory, people strive to improve their SWB by optimising two

Table 1. Lindenberg's theory of social production function (SPF).

Top level universal goals	Subjective well-being				
	Physical well-being		Social well-being		
First-order Instrumental goals / Basic needs	**Comfort** (physiological needs; pleasant and safe environment)	**Stimulation** (optimal level of arousal)	**Status** (control over scarce resources)	**Behavioural confirmation** (approval for 'doing the right things')	**Affection** (positive inputs from caring others)
Activities	Eating; drinking; resting; using appliances; securing housing and clothing; self-care	Physically and mentally arousing activities; sports; study; creative activities; active recreation	Paid work; consumption; excelling in a valued dimension	Behaving according to external and internal norms (compliance)	Exchanging emotional support; spending time together
Resources and endowments	Financial means; food; housing; physical health	Physical and mental health; financial means	Education; social origin; scarce capabilities	Social skills; social network; normative environment	Attractiveness; empathy; intimate ties; partner; children

Source: Adapted from Ormel et al. (1999) and van Bruggen (2001).

universal goals: physical well-being and social well-being (see Table 1). These two universal goals can be attained by five instrumental goals or basic needs: comfort and stimulation for physical well-being; and status, behavioural confirmation and affection for social well-being (Nieboer et al., 2005). These five basic needs can be met in turn by lower level activities and resources.

Comfort needs correspond to the inner drive to reduce the tension of somatic and psychological states such as hunger, thirst, fatigue, pain and fear (Ormel et al., 1999). They are fulfilled and 'produced' by activities such as eating, drinking, sleeping and seeking personal safety and property security. Comfort needs and relevant activities can be fulfilled by well-being resources at the lowest level, such as financial means, food, housing and physical health.

In contrast to the tension reduction sought by comfort needs, stimulation needs refer to the drives towards arousal, including mental and sensory stimulation (Ormel et al., 1999). Stimulation needs can be fulfilled by physically and mentally invigorating activities such as sports, study, creative activities and active recreation. These activities require well-being resources such as physical and mental health and financial means.

Status needs refer to a person's relative ranking in society, which is mainly based on control over scarce resources such as political power and social and economic capital (Lindenberg, 2001). Status needs can be fulfilled through activities such as paid work, consumption and excellent performance in a valued field such as arts or sports. This entails lower level resources such as education, social origin and scarce capabilities.

Behavioural confirmation needs, similar to social approval, refer to confirmation from doing the right thing, having the right thoughts and conforming to the right norms in the eyes of relevant others (Lindenberg, 2001). They can be fulfilled by behaviours that comply with external and internal norms, and by resources such as social skills, social networks and a normative environment.

Finally, affection needs refer to the need for feelings of love and caring between people in close relationships. Activities such as exchanging emotional support and spending

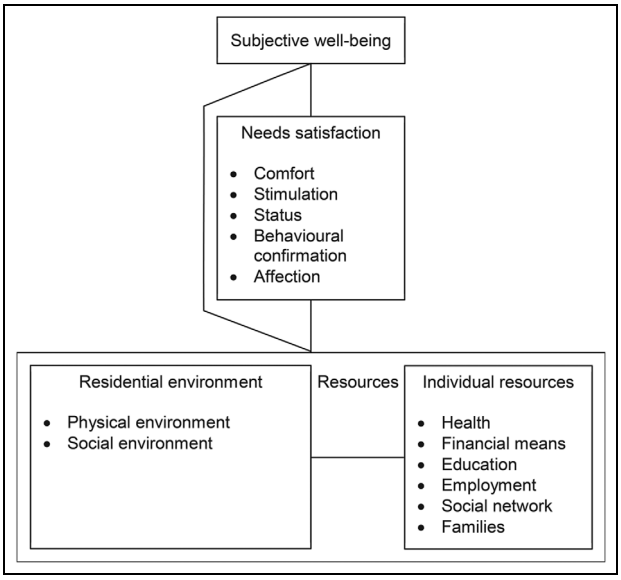


Figure 1. Relationships between subjective well-being, needs satisfaction, residential environment and individual resources.

time together can satisfy affection needs. The resources for affection needs include attractiveness, empathy and intimate ties, with a partner and children for instance.

Lindenberg's SPF theory has been applied in various contexts, including in research on older adults addressing successful ageing (SA) (Steverink and Lindenberg, 2006; Steverink et al., 1998, 2005). The SPF-SA theory, as an extension of SPF theory, explains age-related changes in the availability of resources and the possibilities of needs satisfaction and well-being realisation (Steverink and Lindenberg, 2006). In this view, the process of ageing can be seen as a changing balance between gains and losses in resources, in which losses will increasingly outweigh gains. To delay and mitigate this changing balance, the substitution of resources and basic needs is seen as the central mechanism of successful adaptive behaviour (Steverink et al., 1998). For instance, status, mostly reached through occupational prestige, becomes difficult to maintain after retirement. At that point it is usually easier to put more effort towards other social needs, such as behavioural confirmation and affection, for instance, by conforming more closely to behavioural norms and by intensifying social contacts with family and friends. Comfort and affection are also likely to decline with increasing age, but they are relatively easy to maintain over the life course. SPF-SA theory suggests that older adults might place different emphasis on different types of basic needs in response to the challenge of an age-related decline in individual resources.

Lindenberg's SPF theory describes the relationships between resources, needs satisfaction and SWB (Figure 1). According to this theory, the SWB of older adults correlates to the satisfaction level of the five basic needs as well as to the availability and quality of individual and residential environmental resources. Individual resources relate to a person's physical and mental health, financial means, educational and occupational

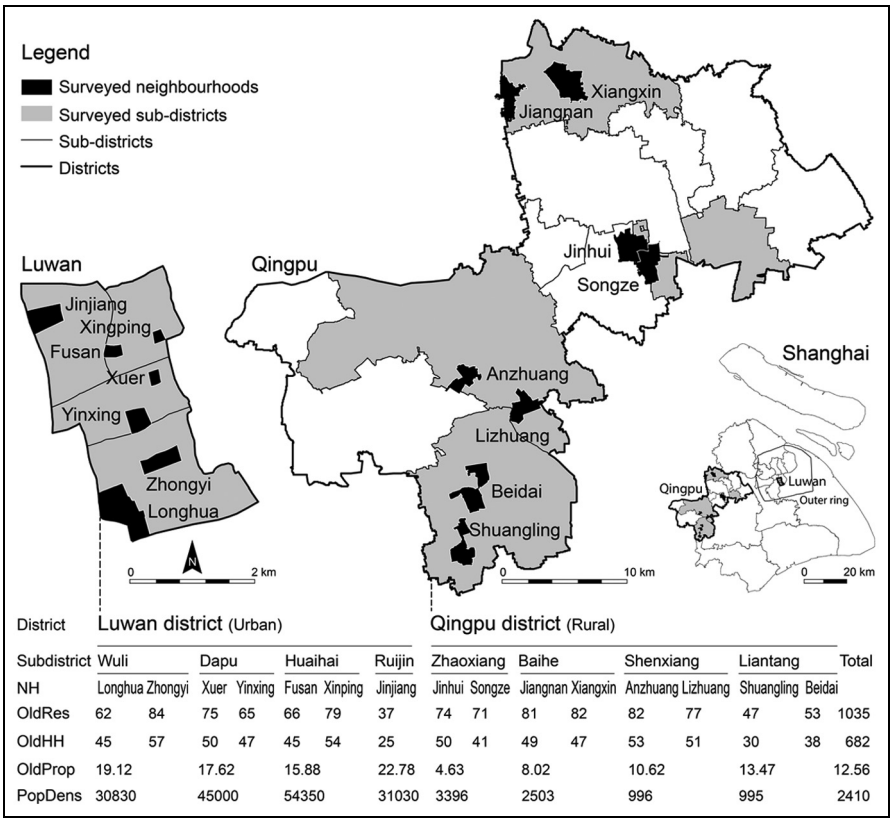
status, social networks and intimate relationships (Dai et al., 2013; Diener, 2009b; Diener and Ryan, 2009; Pinquart and Sörensen, 2000).

Unlike individual resources, little attention has been paid in SPF theory and SWB studies to the resources associated with the residential environment. This is remarkable, because residential environments can have a substantial impact on older adults' SWB, as they become less mobile and tend to spend a large proportion of their time close to home (Day, 2008). Moreover, due to escalating care costs and evidence that the majority of older adults prefer to remain living in their own homes and neighbourhoods, 'ageing in place' has become a widely recognised concept in ageing policy and research (Burton et al., 2011; Costa-Font et al., 2009). 'Ageing in place' indicates the significant role of the residential environment in influencing older adults' SWB. Consideration needs to be given not only to the home environment but also to the broader residential environment such as transportation, recreational opportunities, amenities etc. (Wiles et al., 2012).

Several studies show that the physical (Costa-Font, 2013; Phillips et al., 2005) and social (Rojo-Pérez et al., 2007; Schwanen and Wang, 2014; Seeman and Crimmins, 2001) aspects of the residential environment are correlated with older adults' SWB. The physical aspects of the residential environment are widely acknowledged, consisting of housing conditions and neighbourhood quality (e.g. physical qualities of residential buildings, spaces, exercise and leisure facilities, cleanliness and peacefulness), and accessibility to local amenities (e.g. hospitals, supermarkets and parks) (Peace et al., 2006). The physical environment is the spatial carrier of most material facilities and activities related to the production of well-being in older adults. For instance, food as a necessary resource for comfort needs is normally obtained from such facilities as supermarkets and restaurants, while entertainment activities for stimulation needs are usually performed in leisure facilities and urban spaces. Superior living circumstances as resources for status needs are normally linked to a good spatial location with good neighbourhood quality. The quality as well as distance and accessibility to these spatially allocated well-being resources influence older adults' SWB (Nordbakke and Schwanen, 2015; Ziegler and Schwanen, 2011). Poor accessibility means that more physical strength and energy, financial resources and time are needed to overcome the spatial separation, which will especially undermine the SWB of older adults who normally experience declining physical strength and mobility. Research on the impact of physical distances on the social interaction patterns of older adults shows that long distances can undermine social relationships (Wahl et al., 2007). The social aspects of the residential environment refer to the characteristics of neighbourhood residents (e.g. age, racial and socio-economic composition and population density), social cohesion and social norms (Chaudhury et al., 2012; Yen et al., 2009). Neighbourhoods dominated by older people might facilitate older adults' social interactions and behavioural confirmation, whereas neighbourhoods dominated by high-status residents might better satisfy older adults' status needs. We expect that both residential environment and individual resources will be significant for the subjective well-being of older adults in Shanghai.

Research design

In this section we first introduce the relevant datasets for older adults in Shanghai and select appropriate variables for the operationalisation of SWB and basic needs based on Lindenberg's SPF theory. We then estimate the values of SWB and some basic needs



District	Luwan district (Urban)							Qingpu district (Rural)								
Subdistrict	Wuli		Dapu		Huaihai		Ruijin	Zhaoxiang		Baihe		Shenxiang		Liantang		Total
NH	Longhua	Zhongyi	Xuer	Yinxing	Fusan	Xinping	Jinjiang	Jinhui	Songze	Jiangnan	Xiangxin	Anzhuang	Lizhuang	Shuangling	Beidai	
OldRes	62	84	75	65	66	79	37	74	71	81	82	82	77	47	53	1035
OldHH	45	57	50	47	45	54	25	50	41	49	47	53	51	30	38	682
OldProp	19.12		17.62		15.88		22.78	4.63		8.02		10.62		13.47		12.56
PopDens	30830		45000		54350		31030	3396		2503		996		995		2410

Figure 2. Study areas in Shanghai.
Note: NH = Neighbourhood, OldRes = Older respondents aged above 60, OldHH = Number of surveyed households of older adults, OldProp = Proportion (%) of older adults in total population at sub-district level, PopuDen = Population density (N/km^2) at sub-district level. Urban areas include towns, cities and metropolitan areas, while rural areas include commercial farms, small settlements, rural villages and other areas which are further away from towns and cities.

using confirmatory factor analysis. Finally, we present some statistics for the variables representing SWB, needs satisfaction, residential environment and individual resources.

Data selection

The 2010 Shanghai Population Census and the 2008 Shanghai Economic Census provide information on social and physical aspects of the residential environment. The population census contains basic socio-demographic and housing information for the local population, while the economic census comprises basic information on local workplace and economic activities, including various facilities relevant to older adults such as hospitals, markets and parks. The 'China – Study on Global Ageing and Adult Health (SAGE) – 2007/10, WAVE 1' dataset is a survey designed by the World Health Organization (SAGE team, 2013). It provides detailed individual information on Chinese older adults' SWB and quality of life, socio-demographics, work history, health state, health care utilisation and social cohesion. It also covers household

Table 2. Connections between SAGE datatset and Lindenberg's SPF theory.

SWB & needs	Theoretical operationalisation	Relevant questions in SAGE survey
SWB	Self-evaluation of life conditions and feelings	Q7008 How satisfied are you with your life as a whole these days? Q7010 How happy do you feel these days? Q7009 How would you rate your overall quality of life?
Comfort	Physiological needs, pleasant and safe environment (financial means; food; housing; security; physical health; vitality; absence of pain, fatigue, thirst and hunger)	Q7001 Do you have enough energy for everyday life? Q7002 Do you have enough money to meet your needs? Q7003 How satisfied are you with your health? Q7005 How satisfied are you with your ability to perform your daily living activities? Q7007 How satisfied are you with the conditions of your living place? Q6017 In general, how safe from crime and violence do you feel when you are alone at home? Q6018 How safe do you feel when walking down your street alone after dark?
Stimulation	Physical and mental arousal (sports; study; creative activities; active recreation)	Q7507 Were you enjoying what you were doing for much of the day yesterday?
Status	The feeling of superiority in the eyes of relevant others and oneself (excellence in a valued dimension; control over socially valued resources)	Q7004 How satisfied are you with yourself?
Behavioural confirmation	The feeling of behaving according to external and internal norms (pursuing social approval)	Q6001 How often in the last 12 months have you attended any public meeting in which there was discussion of local or school affairs? Q6002 How often in the last 12 months have you met personally with someone you consider to be a community leader? Q6003 How often in the last 12 months have you attended any group, club, society, union or organisational meeting? Q6004 How often in the last 12 months have you worked with other people in your neighbourhood to fix or improve something? Q6007 How often in the last 12 months have you socialised with coworkers outside of work?
Affection	The feeling of being loved and cared for (exchanging emotional support; spending time with family and friends)	Q7006 How satisfied are you with your personal relationships?

information, such as household composition, housing, assets and income. For Shanghai this dataset covers one randomly selected district in the urban areas (Luwan) and one county in the rural areas (Qingpu). Each district/county includes four randomly selected sub-districts/townships, each of which further contains two neighbourhoods (Figure 2). In each neighbourhood 84 households were randomly selected, including 70 households of those aged 50 + and 14 households of those aged 18–49. In total, 1035 older adults aged above 60 years were surveyed in Shanghai in 2010. In this study, these randomly selected elderly respondents from both urban areas and rural areas serve as a representative of older adults in Shanghai.

From these datasets we selected appropriate variables for the operationalisation of SWB and basic needs, based on Lindenberg's SPF theory (Table 2). These indices were mostly subjective expressions, directly reflecting older adults' satisfaction with and perception of particular issues. In some instances, related activities were used as proxies, since activities are closely related to needs satisfaction and SWB in SPF theory. SWB, comprising both cognitive and affective aspects, is widely measured by life satisfaction and happiness (Diener, 2009a; Nieboer et al., 2005). At the same time, SWB is considered virtually synonymous with subjective quality of life (Camfield and Skevington, 2008). Three questions from the SAGE dataset were therefore used to measure SWB (Table 2), each question containing a five-scale self-evaluation. Comfort needs were measured by the level of satisfaction with financial means and basic physiological needs, such as physical energy, health, physical ability, living/housing conditions and the feeling of safety inside and outside the home, which corresponded to seven questions from the SAGE dataset. Stimulation needs were assessed by respondents' self-evaluation of their enjoyment of mental and physical activity. Status needs were measured by respondents' subjective satisfaction with their self-worth, self-realisation, influence and reputation in society (Nieboer et al., 2005). Behavioural confirmation needs were evaluated by older adults' involvement in approval-seeking activities in their communities. The questions concerned the frequency of attendance at public meetings and social organisations, and socialising with community leaders, neighbours and co-workers. Affection needs were measured by respondents' subjective evaluation of personal relationships with families and friends.

Estimation of SWB and needs satisfaction

In order to serve as the dependent variables in further multivariate regression analysis, each of the identified variables (e.g. SWB and basic needs) was expressed as one single score. Stimulation, status and affection were represented directly by single score, while composite scores were created from data pertaining to the variables operationalised by multiple but related questions, such as SWB, comfort and behavioural confirmation. Since these multiple questions may not contribute equally to the composite score, their relative weights had to be calculated before they were combined to make up a composite score. The SPSS AMOS software package provided functions to generate the composite score. First, following a normal procedure (Joint Research Centre, 2008), the ordinal scores of the selected questions were recoded as numeric scores, and missing data was imputed. Next, AMOS was used to construct, test and modify a measurement model (or confirmatory factor analysis model), which included both unobserved composite variables and observed individual variables (Garson, 2012). After a good model fit was reached, the relative weights of individual

variables/questions on the unobserved composite variables were estimated in AMOS. Lastly, a suitable imputation method in AMOS – in this case ordinal data must use the Markov Chain Monte Carlo (MCMC) method of Bayesian estimation (Garson, 2012) – was selected to generate the values of composite variables.

Descriptive statistics of variables

SWB, comfort needs and behavioural confirmation needs are composite variables constructed by multiple questions, and their values are calculated as standardised scores. The values of other basic needs measured by a single ordinal question have also been transferred into standardised scores in order to create a unified data format of SWB and needs satisfaction for further regression analysis, excepting stimulation needs represented by a binary variable, 1 (yes) and 0 (no) (Table 3). The standardised score indicates the relative SWB and needs satisfaction of each older adult compared to the average level of all respondents. For instance, 1 and –1 indicate one standard deviation higher and lower respectively than the mean score 0. Approximately half of the respondents had above average SWB: <–1 (10.9%), –1~0 (39.9%), 0~1 (40.0%), >1 (9.2%). More than half of the respondents were satisfied with their comfort needs (–1~0 (43.3%), 0~1 (56.7%)), status needs (<–1 (21.1%), –1~0 (12.7%), 0~1 (53.5%), >1 (12.7%)) and affection needs (<–1 (24.1%), –1~0 (9.9%), 0~1 (52.9%), >1 (13.1%)), but unsatisfied with their behavioural confirmation needs (<–1 (1.1%), –1~0 (57.0%), 0~1 (34.6%), >1 (7.3%)). Most respondents were satisfied with their stimulation needs (0 (24.3%), 1 (75.7%)).

The individual resource variables are grouped into three categories of resources: physical, economic and social. Age, health and physical losses indicate older adults' physical resources and functional capabilities for achieving SWB. The average and the oldest age of the respondents were 71.1 and 94 years respectively. Household income, working status, economic sector (previous or current), occupation (previous or current), education, housing ownership and housing size combine to describe older adults' economic resources for the production of well-being. Most respondents (82.1%) were no longer working, and about 70 percent of those not working were retired. Approximately half of the respondents (48.3%) had worked or were working in the public sector. Within this group, skilled manual labour was the main occupation type (56.6%). Half of the respondents had not completed primary education, and only 7.9 percent had received higher education. Household size, living arrangement and marital status indicate older adults' social and emotional resources and social capital. The average household size was 2.67. About half of the older adults (48.4%) lived with their spouse only, and the rest mostly lived with their children and grandchildren (14.4%) or alone (12.0%). Older adults who lived in a multigenerational household (with children and grandchildren) tend to have more social and emotional resources available for their needs satisfaction and SWB production. The majority of older adults were married (76.6%), and most of the remainder were widowed (19.8%). Gender was not considered, not only because it doesn't belong to any types of individual well-being resources according to Lindenberg's SPF theory, but also because existing SWB literature shows there is no evident gender difference (Diener and Ryan, 2009).

The variables concerning residential environment were derived from the economic and population censuses, and were grouped into two categories: physical environment and social environment. Physical

Table 3. Variables and descriptive statistics.

Type		Variable	N	%	Mean	Min	Max
SWB		Subjective well-being	1035		–0.01	–3.11	2.52
Needs satisfaction		Comfort	1035		0.00	–0.34	0.28
		Stimulation	1035		0.76	0	1
		Status	1035		0.00	–3.06	2.03
		Behavioural confirmation	1035		0.00	–1.28	1.88
		Affection	1035		0.00	–3.44	2.16
Individual resource	Physical	Age	1035		71.12	60	94
		Health	1035		0.00	–2.71	2.23
		Physical losses	1035		0.01	–1.28	3.15
	Economic	Household income	1035		38,828	600	1,000,000
		Working status	1035	100			
		Working	185	17.9			
		Not working *	850	82.1			
		Economic sector	1035	100			
		Public sector *	500	48.3			
		Private sector	194	18.7			
		Self-employed	314	30.3			
		Informal sector	27	2.7			
		Occupation	1035	100			
		High skilled	166	16.0			
		Skilled non-manual	258	24.9			
		Skilled manual *	586	56.6			
		Elementary	25	2.5			
		Education	1035	100			
		Higher education	82	7.9			
		Secondary education	266	25.7			
		Primary education	163	15.7			
		Below primary education *	524	50.7			
		Homeownership	1035	100			
		Owned *	818	79.0			
		Rented	217	21.0			
		House size	1035		3.43	1	23
	Social	Household size	1035		2.67	1	7

(continued)

Table 3. (Continued)

Type		Variable	N	%	Mean	Min	Max
		Living arrangements	1035	100			
		Lives alone	124	12.0			
		Lives with spouse only *	501	48.4			
		Lives with child (no spouse)	58	5.6			
		Lives with grandchild (no spouse)	7	0.7			
		Lives with child and grandchild (no spouse)	69	6.7			
		Lives with spouse and child	74	7.1			
		Lives with spouse and grandchild	9	0.9			
		Lives with spouse, child and grandchild	149	14.4			
		Lives with parent	26	2.5			
		Lives with relatives and others	18	1.7			
		Marital status	1035	100			
		Married *	794	76.7			
		Divorced	25	2.4			
		Widowed	205	19.8			
		Never married	11	1.1			
Residential environment	Physical	Residence	1035	100			
		Urban	468	45.2			
		Rural *	567	54.8			
		Previous residence	1035	100			
		Same locality *	850	82.1			
		Different city, same region	41	4.0			
		Different rural area, same region	40	3.9			
		Different city, other region	43	4.2			
		Different rural area, other region	61	5.8			
		Residential building	1035	100			
		Mid-rise or high-rise apartment building	356	34.4			
		Low-rise lilong house	257	24.8			
		Low-rise rural house *	422	40.8			
		Access to financial facilities	1035		0.00	−1.21	1.52
		Access to health care facilities	1035		0.00	−0.28	0.72
		Access to food-related facilities	1035		0.00	−0.59	0.80

(continued)

Table 3. (Continued)

Type	Variable	N	%	Mean	Min	Max
	Access to culture and education facilities	1035		0.00	−0.66	1.91
	Access to entertainment facilities	1035		0.00	−1.17	0.65
	Access to non-daily consumption facilities	1035		0.00	−0.80	1.21
Social	Economic status of neighbourhood (NH)	1035		−0.18	−0.92	1.74
	Educational and occupational status of NH	1035		−0.06	−0.82	1.37
	Density of older adults	1035		−0.08	−0.93	1.23
	Proportion of older adults	1035		−0.17	−1.55	1.45

Note: * represents the majority of respondents, and indicates the group selected as the reference or control group for the categorical variables.

environment includes residence (urban or rural residential environment), previous residence, type of residential building and access to various well-being facilities. Results pertaining to previous residence showed that the majority (82.1%) of the older adults still lived in the same locality. Compared to these local people, older adults coming from other cities or rural areas tend to have lower SWB due to the relative lack of close social relationships (Oishi, 2010) and the institutional constraints of the Hukou system (Liu et al., 2015). Residential buildings comprised three types: mid-rise and high-rise buildings (34.4%), low-rise *lilong* (alley) houses (24.8%) and low-rise rural houses (40.8%). The accessibility variables were measured by access to financial facilities (e.g. saving banks and post offices), health care and long-term care facilities (e.g. hospitals, clinics, sanatoriums and nursing homes) and food-related facilities (e.g. markets and food stores) – the most fundamental, urgent and frequently used facilities for older adults in Shanghai – and also by access to cultural, leisure and non-daily consumption facilities, such as libraries, senior universities, senior activity centres, parks, retail stores and restaurants (Gui, 2004; Wu et al., 2005; Zhao, 2009). The road network-based and location-based accessibility measure was employed (Geurs and van Wee, 2004), and multiple travel modes (e.g. walking, cycling, bus, metro and care) were taken into account to calculate a comprehensive accessibility value. More information on the facilities and accessibility measurements can be found in our previous studies (Liu et al., 2014, 2015). The social environment comprises the economic status of the neighbourhood (measured by neighbourhood housing price), educational and occupational status of neighbourhood residents (measured by adding up the aggregated values of educational and occupational levels), density of

Table 4. Multiple linear regression model on the effects of basic needs on subjective well-being.

	SWB
Comfort	0.476***
Stimulation	0.190***
Status	0.139***
Behavioural confirmation	0.041*
Affection	0.104**
R square	0.524

Notes: *p < 0.10, **p < 0.05, ***p < 0.01.

older adult population and proportion of older adults in the neighbourhood.

Results

This section investigates the relationship between residential environment, individual resources, needs satisfaction and SWB in our theoretical framework using multiple regression models. We began by examining the relative importance of each of the five basic needs to SWB (Table 4). Our model shows that the impacts of five basic needs on SWB are all significant and positive. Comfort is the most important basic need for the SWB of older adults in Shanghai, followed by stimulation, status, affection and behavioural confirmation, in that order. This also indicates that physical needs (i.e. comfort and stimulation) and physical well-being seem to contribute more to the SWB of older adults than social needs (i.e. status, behavioural confirmation and affection) and social well-being. The models in Table 5 examine the effects of the residential environment and of individual resources on SWB and needs satisfaction.

Effects of individual resources on SWB and basic needs

As expected, older adults' SWB was affected by several variables representing physical (health and physical losses), economic (household income, economic sector and occupation) and social resources (living arrangement) (Table 4). This is largely consistent with existing empirical evidence (Cheng et al., 2009; Litwin and Shiovitz-Ezra, 2011; Pinquart and Sörensen, 2000; Smith et al., 2002). Of the individual resources, physical resources appear to have had by far the strongest impact on SWB. Better health condition and fewer physical losses were associated with higher SWB, and with higher needs satisfaction. Although economic resources had less influence on SWB than physical resources, they still exerted a slightly stronger effect than social resources. Having a higher income and occupational status, and working in the public sector implied a higher SWB. This probably derives from the socialist tradition of welfare provision in the public sector (work units), which continued after China's economic reform in 1978 and is evident in financial (subsidies for housing and endowment insurance), medical (medical insurance) and recreational welfare resources. Because public sector employment normally provides greater benefits and less uncertain and stressful working environments than the non-public sectors, the SWB, comfort and stimulation of older adults who previously worked in the public sector were higher. Regarding behavioural confirmation, there are negative signs for the self-employed and those working in the informal sector. For these people it is understandable that they are less in contact with others, compared to those working in the public sector which has long been the dominant type of employment. However, having a higher income was negatively associated with approval-seeking activities, which suggests that richer older adults had less need for contact with others. Working can generate more financial and medical means (e.g. income and medical insurance) to ensure comfort, but it can also reduce the time and energy available for

Table 5. Multiple linear regression models on the effects of residential environment and individual resources on subjective well-being and basic needs.

	Basic needs					
	SWB	Comfort	Stimulation	Status	Behavioural confirmation	Affection
Individual resources						
Physical resources						
Age					–0.078***	
Health	0.254***	0.312***		0.289***	0.084***	0.204***
Physical losses	–0.177***	–0.234***	–0.266**	–0.169***		–0.131***
Economic resources						
Household income	0.090***				–0.104***	
Working status (ref. = Not working)						
Working		0.054*	–1.064***			
Economic sector (ref. = Public sector)						
Private sector	–0.076***	–0.086***				
Self-employed		–0.136***			–0.125***	
Informal sector		–0.048*	–1.997***		–0.056**	
Occupation (ref. = Skilled manual)						
High skilled	0.090***	0.074***		0.085***	0.122***	
Skilled non-manual		0.049*			0.076***	
Elementary job					0.058**	
Education (ref. = Below primary education)						
Higher education				–0.054*	0.122***	
Secondary education					0.165***	0.069**
Homeownership (ref. = Owned)						
Rented						0.060*
Social resources						
Household size		0.069*				
Living arrangement (ref. = Lives with spouse only)						
Lives alone	0.046*					
Lives with spouse and child			1.496***			
Lives with spouse and grandchild	0.054**					
Lives with spouse, child and grandchild		–0.075**	0.689***	–0.052*		–0.057**
Lives with relatives and others	–0.051**				0.068**	
Marital status (ref. = Married)						

(continued)

Table 5. (Continued)

	Basic needs					
	SWB	Comfort	Stimulation	Status	Behavioural confirmation	Affection
Never married					–0.064**	
Residential environment						
Physical environment						
Residence (ref. = Rural)						
Urban			2.967***			
Previous residence (ref. = Same locality)						
Different city, same region			–0.946**			0.056**
Different rural area, same region			–0.956**			
Different city, other region	–0.045*					
Different rural area, other region						0.057**
Residential building (ref. = Low-rise rural house)						
Mid-rise or high-rise apartment building	0.519***	0.384***	–0.854**	0.494***		0.591***
Low-rise lilong house	0.411***	0.421***		0.438***	–0.122*	0.602***
Access to financial facilities	0.173***	0.138***		0.175***	0.231***	0.173***
Access to health care facilities	0.275***	0.404***		0.379***	0.143**	0.500***
Access to entertainment facilities	–0.291***	–0.251***	–1.047***	–0.203***	0.165***	–0.257***
Access to non-daily consumption facilities	–0.620***	–0.770***		–0.792***	–1.147***	–0.826***
Social environment						
Economic status of neighbourhood	0.426***	0.386***		0.543***	1.070***	0.374***
Proportion of older adults	–0.527***	–0.784***		–0.766***	–0.636***	–0.863***
R square	0.437	0.439	0.351	0.349	0.277	0.305

Notes: Backward stepwise selection method is employed in all the models. Stimulation (binary variable) uses logistic regression analysis, and reports Nagelkerke R square. Robustness checks suggest that the effects of different types of variables on SWB and basic needs are quite stable and the models are robust and reliable.
*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$.

participating in activities which offer stimulation. Status needs appeared to be fulfilled by high occupational status but not by higher education. The negative effect of higher education might be related to the contempt for intellectuals and higher education during the period of the Cultural Revolution (1966–1976), when most of these older adults were in their 20s and 30s. Teachers and former graduates then were seen as capitalist intellectuals, and were disparaged and humiliated (Wang, 2002).

Regarding social resources, living with a spouse and grandchild, and living with a spouse, child and grandchild (or spouse and child) had a positive impact on SWB and stimulation. This is consistent with the traditional Chinese idea of a household, which highly values multigenerational living arrangements. To older adults, happiness comes from their children and grandchildren who please them by living with them, and from having three generations living together harmoniously under one roof (Chyi and Mao, 2012). However, living with a spouse, child and grandchild may not only bring joy and stimulation to older adults, but also more responsibilities, such as housework and childcare, which could reduce comfort (Feng et al., 2013). It could also mean less time and ability for older adults to participate in social activities outside their home through which they could establish status, and more potential conflicts and tensions within the family (arising from different lifestyles and opinions) that could undermine affection. Living with relatives and other less closely related family members had negative effects on SWB. Living alone appeared to affect SWB positively, probably because two-thirds of those living alone were widowed women who, compared to the reference group of older couples, were more accustomed to taking care of the whole family and were more capable of dealing with life after their spouse had passed away (Carr, 2004).

Effects of residential environment on SWB and basic needs

The residential environment variables exerted a stronger effect on older adults' SWB and needs satisfaction than the variables representing individual resources. SWB was influenced by both the physical environment, such as type of residential building, access to facilities and previous residence, and the social environment, such as economic status of the neighbourhood and proportion of older adults. Different types of residential buildings had different impacts on SWB. Mid-rise and high-rise apartment buildings and low-rise *lilong* houses have better quality and better facilities than low-rise rural houses, and therefore exerted a greater positive impact on SWB. Access to financial facilities (saving banks and post offices where older adults receive their pensions) and health care facilities were the only two accessibility variables that had significant positive effects on SWB. This indicates the significance of health care and financial facilities to older adults. Surprisingly, accessibility to entertainment facilities (e.g. senior activity centres, cinemas and theatres) and non-daily consumption facilities (e.g. big retail stores, computer stores and restaurants) had a negative impact on SWB. This might be due to negative side-effects of these facilities, such as noise and overcrowding. The economic status of a neighbourhood had a significant positive impact on SWB, indicating that older adults experience greater well-being when they live with neighbours who have higher economic status. Contrary to our expectations, however, the proportion of older adults in a neighbourhood had a negative effect on their SWB.

This might suggest that older adults prefer to live in a more vibrant and lively social environment, in which multiple age groups live together. A higher proportion of older adults could also mean a greater probability of experiencing negative events such as illness and death, which could exert a negative influence on SWB. Older adults who previously lived in another city appeared to have slightly lower SWB scores than local older adults.

Comfort needs were similarly influenced by the same residential environmental variables as SWB, with the exception of previous residence. Comfort was positively linked to higher quality residential buildings, accessibility to health and financial facilities, and the high economic status of a neighbourhood, but negatively associated with accessibility to entertainment and to non-daily consumption facilities, and with the proportion of older adult residents. Urban residence exerted a strong positive effect on stimulation needs, suggesting that older adults living in urban areas generally had a higher level of stimulation than those in rural areas. Older adults from other cities and rural areas of the Yangtze River Delta region had a lower level of stimulation than locals. These older migrants might have had less extended social networks in which to carry out stimulating activities and less knowledge about relevant facilities. After controlling for residence, mid-rise and high-rise apartment buildings had less impact on stimulation than low-rise rural houses. This suggests that lower-rise buildings make it more convenient for older adults to meet people and to perform physically and mentally arousing activities. As with SWB and comfort, stimulation was negatively associated with accessibility to entertainment facilities.

Status needs were similarly affected by the same environmental variables as comfort. Good quality residential buildings, good access to health and financial facilities and high economic status of a neighbourhood represented a superior residential environment to older adults, fulfilling their status needs. Since status, mostly obtained through occupational prestige, becomes difficult to maintain after retirement (Steverink and Lindenberg, 2006), older adults might generally be expected to have a lower status compared to younger adults. Neighbourhoods with a higher proportion of older people could therefore negatively affect older adults' perception of superiority and status. Concerning behavioural confirmation, better accessibility to entertainment, health and financial facilities, a higher economic status of a neighbourhood and a lower proportion of older adults living in the neighbourhood seemed to facilitate older adults' approval-seeking behaviour. *Lilong* houses had a weaker effect on behavioural confirmation compared to rural houses, which is possibly attributed to the nature of rural communities which are more traditional and homogeneous, with rural villagers sharing similar backgrounds, values, norms and behaviours. Regarding affection needs, good residential buildings, good accessibility to health and financial facilities and high economic status of a neighbourhood seemed to positively influence older adults' perception of personal relationships and affection. A high proportion of older adult residents exerted a negative impact on affection, possibly due to a depressive and less lively social environment. Older migrants from other cities of the Yangtze River Delta region and from rural areas of other regions had a slightly higher level of affection compared to natives. Due to the substitution mechanism (Ormel et al., 1999), these older migrants, who have more limited local social networks for behavioural confirmation as compared with locals, perhaps pay more attention to their personal relations and affection in order to maintain their overall social well-being.

Conclusions and discussion

In facing the serious challenges of a rapidly ageing population, it is imperative that Chinese megacities such as Shanghai pay particular attention to older adults and their subjective well-being. However, it has so far been difficult to obtain a comprehensive understanding of the subjective well-being of older adults, since most SWB theories focus on specific components only. An exception to this is Lindenberg's social production function theory which integrates SWB, goals, needs, activities and resources logically and hierarchically. However, even in this theory the meaning of the geographical dimension in the sense of the influence of the residential environment for SWB is hardly discussed. In this study, we therefore investigated the impact of the residential environment in addition to that of individual resources on older adults' SWB in Shanghai.

This paper has shown that residential environmental variables exert an even stronger effect on older adults' SWB and needs satisfaction than the variables representing individual resources. This indicates the vital significance of geographical resources for the SWB of Chinese older adults. The main residential environmental variables impacting older adults' SWB were good quality residential housing, good accessibility to health and financial facilities, high neighbourhood economic status and a small proportion of older adults living in the vicinity. Of the various individual resources, health and physical losses, corresponding to physical and functional resources, had the strongest effect on SWB, which is consistent with the existing literature (Cho et al., 2011; Smith et al., 2002). Other important economic and social resources included household income, high-skilled occupation, public sector job and living with grandchildren. The last two are influenced by the Chinese institutional system (work-unit) and Confucian ideals (filial piety and the centrality of the family). Regarding the impact of basic needs on SWB, comfort seemed to be much more important than all other needs, and physical needs (comfort and stimulation) were more important than social needs.

SWB theories have so far been relevant primarily to the social, psychological and medical sciences, but have hardly been applied in geography and urban planning. This paper has shown that Lindenberg's SWB theory could in fact be a very appropriate framework for geographers, urban planners and urban designers to study the relationships between SWB and urban geographical resources. This potential could be increased by incorporating a more sophisticated interpretation of geographical resources. This paper has made a major theoretical contribution to existing literature by exploring and extending the geographical dimension of well-being resources within Lindenberg's integrative SWB theory and illustrating some important physical attributes (e.g. accessibility to health and financial facilities) and social attributes (e.g. economic status of neighbourhood and proportion of older adult residents) for older adults' SWB. In addition, this paper has provided a more comprehensive and accurate understanding of the effects of residential environments on older adults' SWB, by taking into account the crucial individual factors and the subcategories of SWB (i.e. basic needs) based on Lindenberg's integrative SWB theoretical framework. This is the first time that Lindenberg's SWB theoretical framework has been applied in geographical and planning fields. Further research is needed to elaborate more on this geographical dimension of well-being resources, in which other social groups could also be taken into account. Moreover, this research could be extended to incorporate subjects' perception of geographical resources instead

of using only objective measurements of these resources (Parra et al., 2010; Phillips et al., 2005). A person's perception of his/her environment might to some extent mediate the SWB effects of their objective environment.

Culture and context may also be an important factor in SWB studies. Some studies show that people in individualistic societies pay more attention to personal emotions and individual identity when making life satisfaction judgments, whereas people in collectivistic cultures emphasise social relationships and the opinions of others more (Diener, 2012). Chinese society has long been regarded as a collectivistic culture. To a certain extent, our study has also demonstrated the importance of social relationships and social resources, by showing that multigenerational living arrangements are positively and significantly associated with older adults' SWB and stimulation needs in Shanghai. This may be affected by traditional Chinese ideals such as the Confucian virtues of filial piety (to love, respect and support one's parents and ancestors) and family harmony. Most SWB studies to date have focused on Western and Chinese societies separately. Comparative studies investigating the impact of contextual differences on older adults' pursuits of SWB, needs and well-being resources (e.g. individual, residential environmental and even natural/ecological environmental resources) could be very interesting.

The findings of this study have a number of important implications for future practice. The significant role of the residential environment in SWB offers planners, urban designers and local governments important insights for shaping elderly-friendly environments. Such environments should especially include good quality housing, good accessibility to medical and financial facilities and convenient pedestrian and public transport systems. In addition, a smaller proportion of older adults living in the vicinity and a socially mixed neighbourhood with a range of age groups seem to provide a more vibrant and lively social environment for improving older adults' SWB. Regarding individual resources, the significant effect of health and functional capability on older adults' SWB indicates the importance of providing health-related facilities, infrastructures, urban spaces and environmental qualities (e.g. hospitals, clinics, pedestrian and cycling lanes, parks, green spaces, serenity and clean air and water) in cities. The rapidly ageing population is a huge challenge and also responsibility for the Chinese megacities in the near future. Much effort is still required to promote good residential environments and to provide essential individual resources for the improvement of older adults' SWB.

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