Applying the IPA–Kano model to examine environmental correlates of residential satisfaction: A case study of Xi'an

Abstract: Many studies have examined the impacts of neighborhood characteristics on residential satisfaction. However, because their performance is not connected with their importance in residential choice, community planners have yet to know which characteristics need to be prioritized for neighborhood improvements. Using the 2014 data from Xi'an, China, to examine environmental correlates of residential satisfaction, this study pioneers the application of importance-performance analysis and three-factor theory for a joint evaluation of importance and performance. It classifies neighborhood characteristics into basic factors, performance factors, and excitement factors for urban, suburban, and exurban neighborhoods. By considering their performance, it further identifies development priorities for neighborhood self-improvement and the priorities for competition among different neighborhoods. These priorities allow local governments to deploy scarce resources to improve residential satisfaction of existing residents and attract more residents.

Keywords: three-factor theory, importance-performance analysis, land use, quality of life, customer satisfaction

Introduction

Residential satisfaction has become a significant research theme. Satisfaction with residential neighborhood is a major domain of life satisfaction (Campbell, Converse, & Rodgers, 1976). Planners are striving for developing communities to satisfy their residents. The prevalence of suburban sprawl in developed countries seems to suggest that suburban neighborhoods are what residents want. On the other hand, alternative development patterns (such as Smart Growth and Compact Cities) have been proposed to enhance quality of life. Not surprisingly, this dispute has become a focus in the field of residential satisfaction (Chapman & Lombard, 2006; Lovejoy, Handy, & Mokhtarian, 2010). Identifying influential factors of residential satisfaction is an important aspect in this dispute (Galster & Hesser, 1981; Lu, 1999; Mohit, Ibrahim, & Rashid, 2010; Salleh, 2008), because the factors are essential components of the theory of residential satisfaction and have important implications for planning practice.

Many researchers have examined the impacts of neighborhood characteristics on residential satisfaction (Chapman & Lombard, 2006; Lee, You, & Huang, 2013; Lovejoy et al., 2010; Yang, 2008). Some also identified the relative importance of various neighborhood characteristics by comparing the coefficients of these variables. This helps planners to understand key influential factors to residential satisfaction. However, because the performance of (or satisfaction with) neighborhood characteristics is not connected with their importance in the studies, community planners have yet to know which neighborhood characteristics need to be prioritized for the sake of neighborhood improvements. This calls for a joint evaluation of importance and performance.

Using the 2014 data from Xi'an, China, this study innovatively employs the IPA–Kano model, a popular technique for service evaluation in the field of customer satisfaction, to examine environmental correlates of residential satisfaction. It classifies neighborhood characteristics into basic factors, performance factors, and excitement factors. By considering the performance of neighborhood attributes, this study further identifies development priorities for neighborhood self-improvement and the priorities for competition among urban, suburban, and exurban neighborhoods.

The paper is organized as follows. The second section reviews the literature. Section 3 presents the data and variables. Section 4 implements the IPA-Kano model and discusses the results. The final section summarizes key findings and discusses the limitations of the approach.

Literature review

Examining important neighborhood characteristics in residential choice

Previous studies have adopted different approaches to explore the importance of neighborhood characteristics in residential choice. One method is to ask directly respondents how important various neighborhood characteristics are when they are looking for a place to live. For example, Cao (2008) compared the importance of neighborhood characteristics between home owners and renters and found that for both groups of residents home price and safety are more important than neighborhood characteristics related to land use and transportation systems. Although this finding is consistent with previous studies, the method of employing explicitly-stated importance has a few limitations. First, because respondents evaluate the characteristics one by one, there are limited trade off among different characteristics. Accordingly, respondents tend to rate many characteristics near the top of the importance scale (de Oña & de Oña, 2014). Second, the approach assumes the independence between importance and satisfaction (Matzler, Bailom, Hinterhuber, Renzl, & Pichler, 2004). However, a characteristic may not be rated as important if it performs well.

Some researchers applied stated-choice experiments to examine residential preferences. In the experiments, respondents are asked to choose among two or more hypothetical options having different scales on one or more neighborhood attributes, and then multivariate models are developed to determine which attributes influence their residential choice (Cao, 2008; Train, 2003). Based on the data of apartment dwellers in Austin, Texas, Bina, Warburg, and Kockelman (2006) studied their choices between transportation and apartment or neighborhood improvements. They found that women, non-Caucasian and those without children tend to be more concerned with commute times and freeway access than others. Using a sample of 1,455 residents from Atlanta, Georgia, Levine and Frank (2007) found that compactness, walkability, and transit-friendly environment are important in influencing residential choice. Although useful, stated-choice experiments do not measure actual behavior and to reduce respondents' burden, the approach can only test several of many dimensions that influence residential choice (Cao, 2008).

Some studies examined the influence of neighborhood attributes by regressing satisfactions with neighborhood attributes against residential satisfaction. Using a 1,977 sample from Republic of Ireland, Davis and Fine-Davis (1981) found that satisfaction with neighborhood is largely explained by satisfaction with public transport, perceived problem of vandalism and traffic, and condition of properties in the neighborhood. Based on a survey of homeowners in Franklin County, Ohio in 2001, Hur and Morrow-Jones (2008) showed that satisfactions with housing density, traffic, and proximity to areas with social problems are important correlates of overall neighborhood satisfaction. They also concluded that different correlates are significant in different kinds of neighborhoods but the unsatisfied neighborhoods often emphasize on safety and social problems. Some researchers also figured out the relative importance of neighborhood characteristics based on the size of their standardized coefficients in a multivariate analysis (Lovejoy et al., 2010; Mohit et al., 2010). Using

survey data of suburban and traditional neighborhoods in northern California, Lovejoy et al. (2010) found that residents' perceptions of the attractive appearance and safety of their neighborhoods are more important than other features associated with suburban living, or proximity to destination per se in predicting the neighborhood satisfaction. These implicitly-derived importance relaxes the assumption that importance and satisfaction are independent (Matzler et al., 2004).

Overall, these approaches are able to identify neighborhood characteristics important to residential choice or residential satisfaction. However, it offers limited guidance to planners on which neighborhood characteristics should be prioritized to improve residential satisfaction of existing inhabitants, essential for resident retention. Identifying neighborhood improvement priorities requires an integration between the importance and performance of neighborhood characteristics.

Integrating importance and performance in residential satisfaction

Importance-performance analysis (IPA) is a popular technique for service evaluation in the field of customer satisfaction because it yields insights into which service attributes should be prioritized (Arbore & Busacca, 2011). In particular, the attributes of a product or service can be divided into four groups based on their performance and importance to customers (Matzler, Sauerwein, & Heischmidt, 2003). As shown in Figure 1, managers should “keep up the good work” on the attributes in Quadrant I as they are important to customers and have high performance. The attributes with low performance and high importance demand immediate attention. Managers should concentrate their resources on these attributes to improve customers' overall satisfaction. The attributes with both low performance and low importance are of “low priority”. Improving these attributes tends to have a limited impact on the satisfaction. The attributes with high performance and low importance indicate a “possible overkill”. Managers may want to reduce their effort on these attributes.

Figure 1 Importance–performance analysis (adapted from Martilla and Fames (1977))

However, the IPA has two questionable implicit assumptions: (1) attribute performance and importance are independent; (2) attribute performance has a linear and symmetric impact on overall performance (Matzler et al., 2004). First, there is a causal relationship between performance and importance of attributes (Matzler et al., 2004; Ryan & Huyton, 2002; Sampson & Showalter, 1999) since “changes in performance lead to changes in importance” (Sampson & Showalter, 1999)(p.2). For instance, if some attributes perform well, they may not be evaluated very important by customers. Second, the relationship between attribute performance and overall performance is nonlinear and asymmetrical (Johnston, 1995; Kano, Seraku, Takahashi, & Tsuji, 1984; Matzler et al., 2004; Tontini & Silveira, 2007): some attributes may have a greater effect on overall satisfaction than overall dissatisfaction, while others may show an opposite pattern (Mittal, Ross, & Baldasare, 1998; Ting & Chen, 2002).

To relax the first assumption, some studies revise the original IPA model by using implicitly-derived importance, rather than explicitly-stated importance (Deng, 2007; Matzler et al., 2003). The implicit importance is usually obtained through partial correlation analysis or regression analysis between attribute performance and overall performance (Chen & Chen, 2014; Pezeshki, Mousavi, & Grant, 2009). It was shown that there is no significant correlation between implicit importance and explicit importance (Matzler et al., 2003) and hence implicit importance and performance are independent.

The three-factor theory of customer satisfaction addresses the second assumption. It proposes that attributes can be classified into three categories with different levels of importance to overall satisfaction: basic factors, performance factors, and excitement factors.

The theory was developed by Kano et al. (1984) and refined in later studies (Brandt, 1988; Johnston, 1995; Matzler & Sauerwein, 2002). Both basic factors and excitement factors have asymmetric impacts on overall satisfaction (Matzler et al., 2004; Ting & Chen, 2002). In particular, basic factors do not increase overall satisfaction if expectations are exceeded, but cause dissatisfaction if they are not fulfilled. Excitement factors do not cause dissatisfaction if they are not delivered, but can increase satisfaction if delivered. Performance factors have a symmetric impact on both satisfaction and dissatisfaction in proportion to their extent of fulfillment. One way to identify the three factors in the IPA-Kano model is to conduct a quadrant analysis using implicit importance and explicit importance (Figure 2). In affecting customer satisfaction, the most important factors are basic factors, followed by key performance factors and then excitement factors (Matzler et al., 2003).

Figure 2 Importance grid (adapted from Vavra (1997: p. 385))

Generally, neighborhood environment can be considered as a service to its residents. Local governments and real-estate developers are neighborhood providers. Residents as customers decide to which neighborhood to reside according to their residential preference and neighborhood performance, and local governments and developers enhance the quality of neighborhoods to keep/attract residents. Although the IPA and three-factor theory have become an effective marketing instrument in the fields of tourism (Albayrak & Caber, 2013; Deng, 2007), banking (Arbore & Busacca, 2011; Matzler et al., 2003), information service industry (Pezeshki et al., 2009; Skok, Kophamel, & Richardson, 2001), no studies have applied the approaches in the area of urban planning and residential satisfaction.

This study aims to fill the gap. It employs the IPA–Kano model to examine basic factors, performance factors, and excitement factors of residential satisfaction, and identifies development priorities for neighborhood self-improvement and the priorities for competition among different neighborhoods.

Data and Variables

The data came from a self-administered survey to residents in urban, suburban, and exurban neighborhoods in Xi'an in April - October 2014. As the capital of Shaanxi Province, Xi'an is the largest mega-city in northwestern China and located in the center of Guanzhong Plain. Xi'an was the capital of 13 dynasties in ancient China and was the starting point of Silk Road. It is also famous in the world because of the Terracotta Warrior Army. Now Xi'an consists of nine districts and 103 sub-districts in its jurisdiction. In 2013, Xi'an had more than 8 million residents. The area within the Ming Dynasty City Wall (the inner square in Figure 3) is the inner city, which has the highest population and building density. With rapid urbanization, urban spaces have expanded quickly, especially to the south and north, these suburban and exurban areas accommodate new migrants and attract many residents from the inner city.

This survey was originally designed to explore the relationships between metro development and travel behavior. The sampling frame contains neighborhoods located along two metro corridors: Line 2 (in operation) and Line 4 (under construction). The two metro lines are mostly parallel routes running from north to south across Xi'an. For each of the two lines, we selected urban, suburban and exurban neighborhoods around existing and future stations (Figure 3). In total, we surveyed 93 residential complexes within 800 meters of these stations. However, this study discarded the data from 20 complexes around suburban station Yannan Road of Line 4 because they are high-grade neighborhoods, which differ substantially from the neighborhoods around suburban stations of Line 2. Table 1 illustrates some characteristics of the sub-districts where our sample neighborhoods are located. Urban sub-districts have the highest population density and smallest mean household size, followed by suburban sub-districts and then exurban sub-districts. Meanwhile, the proportion of seniors in urban sub-districts is higher than that in suburban and exurban sub-districts. This is consistent with residential patterns in Chinese cities.

Table 1 Characteristics of Sub-districts (2010 census)

	Urban	Suburban	Exurban
Population density (person/sq km)	24817	8619	6778
Percent of female	49.6	47.4	45.7
Mean household size	2.93	3.17	3.26
Percent of seniors (65+)	12.0	4.8	6.4

The three types of neighborhoods have obvious differences in built environment characteristics. Urban neighborhoods have the most intensive road network; road density in urban neighborhoods is 8.97 km per square km while the density in suburban and exurban

areas is 5.96 and 4.75 km per square km, respectively. Urban neighborhoods have more narrow and messy streets than suburban and exurban neighborhoods. As shown in Figure 4, most basic service facilities such as restaurants, grocery stores and banks are within walking distance in urban neighborhoods. However, there are fewer facilities around suburban and exurban neighborhoods, particularly newly-established neighborhoods. Further, urban neighborhoods have a much better accessibility to malls and supermarkets than other two types of neighborhoods.

Figure 3 Locations of sampled residential complexes

We recruited thirty residents living in those neighborhoods to pre-test the survey. We incorporated their feedback in the final survey instrument. The survey was conducted through face-to-face interviews. Specifically, we hired 25 undergraduate students from Shaanxi Normal University as interviewers and they received two-hour training. Interviewers recruited respondents by knocking at the door of residents and at open spaces and parks within the neighborhoods. A small gift (less than 5 Yuan) was provided to each respondent as an incentive for participation in the study. The number of respondents totals 993 (Table 2). The response rate is approximately 60-70% based on the feedback from interviewers.

Table 2 compares sample characteristics of the three types of neighborhoods. Bonferroni tests of ANOVA show that suburban residents have a higher level of education than urban and exurban residents; urban residents tend to be older than suburban and exurban residents; household income of suburban and exurban residents is approximately equal, and significantly higher than that of urban residents. Urban residents in this sample tend to live in traditional Danwei neighborhoods with suboptimal living conditions. By contrast, the neighborhoods near suburban Exhibition Center tend to be affluent and exurban residents tend to live in brand-new commercial housing communities. Therefore, it is reasonable that urban residents are less affluent than suburban and exurban residents.

Table 2 Sample demographic characteristics of three types of neighborhoods

	All	Urban	Suburban	Exurban
% female	51.1	52.3	52.6	49.0
Mean age	39.5	41.6	37.4	38.6
Mean education	4.08	3.98	4.45	3.97
Mean household size	3.82	3.70	3.93	3.87
Mean income	2.98	2.58	3.24	3.24
Number of residents	993	386	211	396

Note: for income, 1 means total annual household income under 30000 RMB; 2=30001-50000 RMB; 3=50001-100000 RMB; 4=100001-200000 RMB; 5=200001-300000 RMB; 6 means income more than 300000 RMB; for education, 1=illiteracy; 2=elementary school, 3=junior middle school, 4=senior middle school, 5=college, 6= education level of postgraduate and above.

(a) Urban streets

(b) Urban residential complexes

(c) Suburban streets

(d) Suburban residential complexes

(e) Exurban streets

(f) Exurban residential complexes

Figure 4 Comparison of three types of neighborhoods

The variables used in this study consist of three groups: residential satisfaction, residential preferences, and perceived neighborhood characteristics. To measure residential satisfaction, survey respondents were asked to indicate how well the characteristics of their neighborhood meet the current needs of their household on a seven-point scale ranging from “extremely poorly” (1) to “extremely well” (7). The question was adapted from Lovejoy et al. (2010). Table 3 illustrates the shares of different residential satisfaction scales for the three types of neighborhoods. About three quarters of the respondents are satisfied with their neighborhoods to some extent and about 10% are dissatisfied.

Table 3 Share of residential satisfaction

Residential Satisfaction	All	Urban	Suburban	Exurban
1: Extremely poorly	2.7	3.1	4.7	1.3
2	2.8	4.7	0.9	1.8
3	5.8	8.5	3.8	4.3
4: Neutral	15.2	16.8	14.7	13.9
5	32.7	33.4	28.4	34.3
6	28.4	22.0	37.4	29.8
7: Extremely well	12.4	11.4	10.0	14.6
Total number of observations	993	386	211	396

In terms of residential preferences, respondents were asked to indicate how important 27 characteristics were when they were looking for a place to live, on a four-point scale from “not at all important” (1) to “extremely important” (4). The 27 statements cover attributes associated with living units, land use and transportation systems, safety, social environment, and so on. For perceived neighborhood characteristics, respondents were asked to indicate how true the 27 characteristics are for their current neighborhoods, on a four-point scale from “not at all true” (1) to “entirely true” (4). These two sets of questions were adapted from

Cao, Mokhtarian, and Handy (2007). Residential preferences measure explicit importance of neighborhood characteristics while the perception of neighborhood characteristics reflects their performance.

Table 4 shows the explicit importance (or preference) of neighborhood characteristics to the residents living in the three types of neighborhoods. They share many important characteristics: safe environment, public transit, quality and affordability of living unit were consistently rated as very important by respondents in the three types of neighborhoods, while appearances and styles of housing, investment potential, and relationship among neighbors were rated as unimportant.

Table 4 Explicit importance of neighborhood attributes of three types of neighborhoods

	urban		suburban		exurban	
	point	rank	point	rank	point	rank
Low crime rate within neighborhood	3.47	1	3.64	1	3.52	2
High quality living unit	3.43	2	3.38	5	3.63	1
Easy access to major arterials	3.37	3	3.36	6	3.34	5
Easy access to transit stop/station	3.35	4	3.54	2	3.34	6
Affordable living unit	3.34	5	3.31	9	3.46	3
Safe neighborhood for walking	3.32	6	3.36	7	3.28	9
Good public transit service (bus or rail)	3.26	7	3.54	3	3.36	4
Shopping areas within walking distance	3.22	8	3.51	4	3.30	8
Parks and open spaces nearby	3.20	9	3.25	11	3.22	12
Close to where I work	3.19	10	3.17	18	3.25	10
Good street lighting	3.18	11	3.22	13	3.04	16
Quiet neighborhood	3.17	12	3.26	10	3.33	7
Low level of car traffic on neighborhood streets	3.16	13	3.21	15	3.04	15
Easy access to a regional shopping mall	3.15	14	3.35	8	2.96	18
Safe neighborhood for kids to play outdoors	3.13	15	3.16	19	3.19	13
Sidewalks throughout the neighborhood	3.08	16	3.21	14	3.06	14
Easy access to downtown	3.02	17	3.22	12	2.85	19
High level of upkeep in neighborhood	2.92	18	3.19	17	3.23	11
High quality k-12 schools	2.81	19	3.20	16	2.97	17
Lots of off-street parking	2.81	20	3.14	20	2.74	20
Lots of interaction among neighbors	2.72	21	2.58	24	2.65	21
Good bicycle routes beyond the neighborhood	2.70	22	2.73	22	2.63	22
Religious or civic buildings nearby	2.64	23	2.73	21	2.55	24
Attractive appearance of neighborhood	2.54	24	2.63	23	2.62	23
Variety in housing styles	2.44	25	2.56	25	2.45	25
Good investment potential	2.37	26	2.28	26	2.28	26
Economic level of neighbors similar to my level	2.37	27	2.17	27	2.23	27

Table 5 shows the actual performance of neighborhood characteristics in the three types of neighborhoods. Urban and suburban respondents share many characteristics. Housing

affordability, accessibility to shopping (local shopping and mall), and transit tend to perform well. However, for residents living in exurban neighborhood, safe environment (safe neighborhood for kids to play outdoors, and walking, low crime rate within neighborhood), and quality and affordability of living unit outperform other characteristics. By contrast, accessibility to shopping mall and downtown perform poorly.

Table 5 Neighborhood performance of three types of neighborhoods

	Urban		Suburban		Exurban	
	point	Rank	point	rank	point	rank
Easy access to a regional shopping mall	3.26	1	3.32	5	2.62	20
Shopping areas within walking distance	3.24	2	3.43	4	2.80	16
Easy access to transit stop/station	3.23	3	3.50	2	3.03	10
Easy access to downtown	3.23	4	3.17	11	2.55	24
Affordable living unit	3.18	5	3.47	3	3.35	1
Easy access to major arterials	3.15	6	3.31	6	2.90	12
Parks and open spaces nearby	3.14	7	3.30	7	3.02	11
Good public transit service(bus or rail)	3.13	8	3.51	1	3.06	7
Close to where I work	3.00	9	3.04	13	2.84	14
Low crime rate within neighborhood	2.93	10	3.14	12	3.15	5
Safe neighborhood for walking	2.91	11	3.26	9	3.19	2
Good street lighting	2.90	12	3.02	15	3.04	9
High quality living unit	2.81	13	3.20	10	3.18	3
Safe neighborhood for kids to play outdoors	2.75	14	3.26	8	3.17	4
High quality k-12 schools	2.72	15	3.03	14	2.56	21
Religious or civic buildings nearby	2.65	16	2.98	17	2.47	27
Sidewalks throughout the neighborhood	2.63	17	2.88	20	2.85	13
Quiet neighborhood	2.62	18	2.90	19	3.06	6
Low level of car traffic on neighborhood streets	2.60	19	3.00	16	3.04	8
Lots of interaction among neighbors	2.54	20	2.28	27	2.56	23
Good bicycle routes beyond the neighborhood	2.52	21	2.57	25	2.68	19
High level of upkeep in neighborhood	2.50	22	2.74	22	2.80	15
Economic level of neighbors similar to my level	2.48	23	2.45	26	2.53	25
Good investment potential	2.45	24	2.64	24	2.51	26
Lots of off-street parking	2.42	25	2.91	18	2.73	17
Attractive appearance of neighborhood	2.39	26	2.78	21	2.73	18
Variety in housing styles	2.30	27	2.67	23	2.56	22

Results

This study adopts the importance grid to identify basic factors, performance factors, and excitement factors of residential satisfaction. The approach integrate explicit importance of neighborhood characteristics (Table 4) and implicit importance of these attributes to residential satisfaction (Table 6). When deriving implicit importance, previous studies often used partial correlation analysis or multivariate regression. This study has attempted to

apply these methods. However, the coefficients for some perceived neighborhood characteristics are significantly negative although their bivariate correlations with residential satisfaction are positive. This suggests high correlations among independent variables. In fact, multicollinearity is a concern for deriving implicit importance (Deng, 2007; Matzler et al., 2004). Following Chen and Chen (2014), we used bivariate correlation analysis to obtain the implicit importance of the 27 neighborhood characteristics. As shown in Table 6, for respondents in urban neighborhoods, the top three attributes are upkeep services, sidewalks in neighborhoods, and street lighting; in suburban neighborhoods, safety, upkeep in neighborhood, and proximity to workplace are most important, while for exurban neighborhoods, interaction among neighbors, quality of living unit, and safety prevail.

Table 6 Implicit importance of neighborhood attributes of three types of neighborhoods

	urban		suburban		exurban	
	point	rank	point	rank	point	rank
High level of upkeep in neighborhood	0.224	1	0.214	2	0.173	6
Sidewalks throughout the neighborhood	0.199	2	0.076	10	0.005	27
Good street lighting	0.195	3	0.022	19	0.093	18
Quiet neighborhood	0.182	4	0.001	27	0.131	12
Attractive appearance of neighborhood	0.179	5	0.029	17	0.081	19
Good bicycle routes beyond the neighborhood	0.176	6	0.149	4	0.050	22
Safe neighborhood for kids to play outdoors	0.176	7	0.130	7	0.192	4
Variety in housing styles	0.159	8	0.015	22	0.044	23
Lots of off-street parking	0.154	9	0.018	21	0.108	16
High quality living unit	0.115	10	0.123	8	0.231	2
Religious or civic buildings nearby	0.115	11	0.056	12	0.067	21
Low level of car traffic on neighborhood streets	0.114	12	0.094	9	0.151	9
Close to where I work	0.112	13	0.169	3	0.016	26
Easy access to major arterials	0.108	14	0.048	13	0.163	7
Easy access to a regional shopping mall	0.107	15	0.015	23	0.077	20
Safe neighborhood for walking	0.106	16	0.040	14	0.123	15
Good investment potential	0.101	17	0.021	20	0.039	25
Low crime rate within neighborhood	0.098	18	0.221	1	0.222	3
Easy access to downtown	0.084	19	0.005	24	0.039	24
Economic level of neighbors similar to my level	0.079	20	0.147	5	0.126	14
Good public transit service (bus or rail)	0.063	21	0.034	15	0.126	13
Shopping areas within walking distance	0.062	22	0.004	26	0.145	10
Affordable living unit	0.059	23	0.139	6	0.185	5
High quality k-12 schools	0.050	24	0.004	25	0.138	11
Easy access to transit stop/station	0.040	25	0.031	16	0.152	8
Parks and open spaces nearby	0.003	26	0.068	11	0.097	17
Lots of interaction among neighbors	0.003	27	0.029	18	0.245	1

Three-factor analysis of neighborhood self-improvement

This study chose the means of the implicit importance and explicit importance of the 27 neighborhood characteristics as the thresholds to conduct a quadrant analysis for each of the

three types of neighborhoods (See Appendix 1 for quadrants). Again, basic factors will not contribute to residential satisfaction if they are fulfilled, but they will undermine residential satisfaction if they are not delivered. Excitement factors increase residential satisfaction if delivered but do not cause dissatisfaction if not delivered. Performance factors influence residential satisfaction linearly: they lead to satisfaction if fulfilled and cause dissatisfaction if not fulfilled. Key performance factors are our interest because of their substantial impacts on residential satisfaction but secondary performance factors are not important. Therefore, our discussion will focus on basic factors, key performance factors, and excitement factors.

Table 7 compares the three factors for urban, suburban and exurban neighborhoods. There are more differences than similarities: six out of the 27 neighborhood characteristics are common for the three types of neighborhoods. Suburban and urban neighborhoods have more basic factors than exurban neighborhoods. Parks and open spaces nearby is the only common basic factor shared by the three types of neighborhoods. Urban and suburban neighborhoods share seven basic factors: easy access to transit stop/station, good public transit service, safe neighborhood for walking, shopping areas within walking distance, easy access to major arterial, a regional mall, and downtown. Therefore, alternative transportation systems are essential for urban and suburban dwellers. Proximity to workplace is a common basic factor shared by urban and exurban neighborhoods; and good street lighting is shared by suburban and exurban neighborhoods.

The three types of neighborhoods share three key performance factors: low level of car traffic on neighborhood streets, safe neighborhood for kids to play outdoors, and high quality living unit. Sidewalks throughout the neighborhood is a common key performance factor for urban and suburban neighborhoods. Quiet neighborhood is shared by urban and exurban neighborhoods. Suburban and exurban neighborhoods share three attributes: low crime rate within neighborhood, affordable living unit, and high level of upkeep in neighborhood. Exurban neighborhoods have more key performance factors than urban and suburban neighborhoods. Five key performance factors in exurban neighborhoods are basic factors in urban and suburban neighborhoods.

Within the three-factor framework, basic factors are the most important characteristics, followed by key performance factors. If we do not differentiate the two types of factors, urban, suburban, and exurban neighborhoods have 17, 20, and 16 such characteristics, respectively. The three types of neighborhoods share 15 characteristics; urban and suburban neighborhoods have 17 common characteristics, and suburban and exurban neighborhoods share 16 characteristics. Therefore, although the built environment of the three types of neighborhoods differs substantially, these neighborhoods have quite similar influential factors for residential satisfaction. This highlights the importance of these factors in residential location choice.

Table 7 Three factors of three types of neighborhoods

	Urban	Suburban	Exurban
Basic factors	Parks and open spaces nearby (Open spaces) Easy access to transit stop/station(Transit stop) Safe neighborhood for walking(Safe) Good public transit service(Transit) Shopping areas within walking distance(Shopping) Easy access to major arterials(Arterial) Easy access to a regional shopping mall(Mall) Easy access to downtown(Downtown) Close to where I work(Close to work) Affordable living unit(Afford) Low crime rate within neighborhood(Crime low)	Open spaces Transit stop Safe Transit Shopping Arterial Mall Downtown Lighting Quiet School Parking	Open spaces Lighting Close to work Sidewalk
Key performance factors	Low level of car traffic on neighborhood streets(Traffic low) Safe neighborhood for kids to play outdoors(Kids safe) High quality living unit(Quality) Sidewalks throughout the neighborhood(Sidewalk) Quiet neighborhood(Quiet) Good street lighting(Lighting)	Traffic low Kids safe Quality Sidewalk Crime low Afford Upkeep Close to work	Traffic low Kids safe Quality Crime low Afford Upkeep Quiet Arterial

			Transit stop Shopping Transit Safe
Secondary performance factors	Good investment potential(Investment) Lots of interaction among neighbors(Interaction) High quality schools(School) Economic level of neighbors similar to my level(Similar)	Investment Interaction Style Library Appearance	Investment Style Library Appearance Bicycle Parking Downtown Mall
Excitement factors	Good bicycle routes beyond the neighborhood(Bicycle) Variety in housing styles(Style) Attractive appearance of neighborhood(Appearance) Civic buildings (ex., library) nearby(Library) Lots of parking spaces(Parking) High level of upkeep in neighborhood(Upkeep)	Bicycle Similar	Similar Interaction School

Note: The bold entries are common basic/key performance factors among the three types of neighborhoods. The entries in color are common factors among/between neighborhoods.

Urban neighborhoods have much more excitement factors than suburban and exurban neighborhoods. Urban and suburban neighborhoods share good bicycle route beyond the neighborhood and there are no common characteristics between any other types of neighborhoods. Further, most of the excitement factors in urban neighborhoods are secondary performance factors for exurban neighborhoods. It is worth noting that if the excitement factors do not perform well, they are indifferent to secondary performance factors. As shown later, none of the excitement factors in the three types of neighborhoods perform well.

Although Table 7 illustrates the three factors of residential satisfaction, identifying the factors is not enough to provide concrete suggestions for neighborhood development. Since the contribution of a factor to residential satisfaction depends on its performance, we should combine the three-factor analysis with the actual performance of all neighborhood characteristics to identify the attributes that neighborhoods need to improve.

In this study, we grouped the actual performance into three categories to reflect different levels of performance. The top nine are the best performed attributes; the last nine are the worst performed attributes; and other attributes have mediocre performance. Based on the classification, we constructed four levels of priority as shown in Table 8.

Table 8 The definition of improvement priority

Improvement priority	Factors	Performance ranking
1	Basic factors	19-27
2	Key performance factors	19-27
3	Basic factors	10-18
4	Key performance factors	10-18

Based on the three factors in Table 7 and their actual performance, we identified improvement priority for the three types of neighborhoods (Table 9). Improving sidewalks appears to be desirable for all three types of neighborhoods although their priority levels differ. This makes sense. First, walking is an important means of transport for most Chinese. Second, auto-oriented transportation policies and the proliferation of personal vehicles have a detrimental effect on pedestrian facilities. For example, more and more personal vehicles park on sidewalks because of the scarcity of parking spaces, and the vehicles become barriers for complete and integrated sidewalks throughout residential neighborhoods. Besides, super blocks have increased in suburban and exurban areas. These blocks are designed for vehicles, not for pedestrians (Xu & Yang, 2010).

Low traffic on neighborhood streets, quite neighborhood, low crime rate within neighborhoods, good street lighting, and high quality living unit are common factors in the priority list for urban and suburban neighborhoods. In China, residential neighborhoods are often vertically mixed-use, particularly for the buildings facing major and minor arterials (See Figure 4). For example, the bottom two stories are occupied by grocery stores, convenience stores, banks, restaurants, and other services while the upper stories are apartments. The extensive presence of retail land uses in urban and suburban neighborhoods also brings business traffic and noises to the neighborhoods (Bi, Yang, Chen, & Liu, 2010; Liu & Liu, 1995). Attributes such as low crime rate within neighborhoods, and good street lighting suggest the importance of crime-related safety. However, safety in Xi'an seems to be not as important as that in the U.S. (Bina et al., 2006; Cao, 2008). Like other cities in China, Xi'an is undergoing a rapid expansion. Greenfield housing development erupts in exurban and some suburban neighborhoods. Therefore, it is not surprising that the housing stock is often outdated (in terms of style and size) in well-established neighborhoods.

Table 9 Improvement priority of three types of neighborhoods

	Urban	Suburban	Exurban
Priority 1		Quiet	
Priority 2	Traffic low	Sidewalk Upkeep	
Priority 3	Crime low Safe	Parking Lighting School Downtown	Close to work Sidewalk Open spaces
Priority 4	Quiet Sidewalk Kids safe Quality Lighting	Traffic low Close to work Crime low Quality	Shopping Upkeep Arterial Transit stop

Notes: If we use the median values of the 27 attributes as the thresholds, we can identify attributes with two levels of priority. Attributes in Priority 1 are basic factors with poor performance (ranking from the 15th to 27th among the attributes) and those in Priority 2 are key performance factors with poor performance. The attributes are bolded in the table.

Upkeep is a key performance factor with poor performance in suburban neighborhoods and mediocre performance in exurban neighborhoods. Actually, inadequate neighborhood upkeep in Chinese cities is a common problem, including maintenance delay, imperfect management system, and arbitrary charges of upkeep company, no matter where neighborhoods are located (Wen, 2013; Zeng, 2014). In urban neighborhoods, upkeep is an excitement factor. Its poor performance does not contribute to residential satisfaction.

Suburban residents seem to have conflicting demand for neighborhood attributes. They want quite neighborhoods and low traffic, but they also prefer more parking spaces, which induce traffic and noises. This conflicting demand is not uncommon in the literature: In a study in Portland, Oregon, Walker and Li (2007) found that residents who preferred compact development also wanted single-family homes and off-street parking.

The role of quality schools is interesting. In suburban neighborhoods, the quality of schools is in the third priority, but it's not a priority in urban and exurban neighborhoods. These findings are reasonable because residents' expectations are different in the three types of neighborhoods. In China, educational resources are concentrated in urban districts (Gao, Zhou, Wang, & Jiang, 2011; Xie, Feng, & Yang, 2014), so urban residents are not that worried about the quality of schools and hence it has limited contribution to residential satisfaction. However, suburban residents with school-age children are in great needs for education, so they have a high expectation for quality schools. In exurban neighborhoods, because many essential services are inadequate, residents have little expectation for quality schools. Many exurban residents with school-age children move back to urban and suburban areas just for schools, either by renting an apartment or buy a small apartment in quality school districts (Wu, Zhang, Zhu, & Xu, 2002; Zhang, 2013). Note that access to downtown shows a similar pattern to quality schools, which also makes sense.

For exurban neighborhoods, none of the attributes fall into the first and second priorities. Besides sidewalks, proximity to workplace and parks and open spaces are factors in the third priority. Priority 4 includes shopping areas within walking distance, high level of upkeep in neighborhood, easy access to transit stop/station, and easy access to major arterials. Except for upkeep, all factors in Priority 3 and 4 are related to fundamental land use and transportation system. In fast-growing China, large residential complexes in exurban neighborhoods often come way before employment, service, and amenities. Not surprisingly, job-housing imbalance and limited access to service and amenities are key issues that adversely affect residential satisfaction. Suburban residents also prefer close to workplace although it is in the fourth priority.

Three-factor analysis of neighborhood competition

Enhancing neighborhood characteristics identified in the previous section has the potential to improve residential satisfaction of existing residents. Neighborhood planners must also consider the performance of neighborhood attributes relative to competitors for the sake of attracting residents from other neighborhoods (equivalent to customer acquisition) or keeping existing residents (equivalent to customer retention). In this section, we compare the performance of the three types of neighborhoods based on the three-factor for the whole sample, and figure out competitive advantages and disadvantages of these neighborhoods, and then identify the attributes for improvement.

Using the same method as above, we obtained the three factors for the whole sample (See Appendix 2 for details). When identifying the competitiveness of different types of neighborhoods, we choose urban neighborhoods as the reference. In Table 10, we are interested in the attributes which have good (or poor) performance in urban neighborhoods while their competing neighborhoods have poor (or good) performance. These attributes have competitive advantages or disadvantages between neighborhoods. The performance of an attribute is good if its mean in a neighborhood is larger than that for the whole sample, and vice versa.

Regarding excitement factors, there are no competitive advantages among three types of neighborhoods. For basic factors, urban neighborhoods have no attributes that perform better or worse than suburban neighborhoods, so these two types of neighborhoods have no head-to-head competition in basic factors. Compared with exurban neighborhoods, urban and suburban neighborhoods have better performance in proximity to workplace, easy access to a regional shopping mall, and shopping areas within walking distance.

For key performance factors, urban neighborhoods have better street lighting compared with suburban neighborhoods, but have no competitive advantages compared with exurban neighborhoods. However, they have one competitive disadvantage compared with suburban neighborhoods: safe neighborhood for kids to play outdoors, and have three competitive disadvantage compared with exurban neighborhoods: safe neighborhood for kids to play outdoors, low level of car traffic on neighborhood streets, and quiet neighborhood.

Table 10 Competitions among different types of neighborhoods

Factors	Urban neighborhood's performance	Suburban neighborhoods' performance	Attributes	Exurban neighborhoods' performance	Attributes
Basic factors	Good	Good	Arterial/mall/shopping/transit stop/open spaces/ close to work/transit	Good	Open spaces/ transit stop/ Arterial/ Transit
		Poor		Poor	Close to work/mall/shopping
	Poor	Good		Good	
		Poor	Sidewalk	Poor	Sidewalk
Key performance factors	Good	Good	Crime low//quality/afford/safe	Good	Crime low/ quality/ lighting/ Afford/ safe
		Poor	Lighting	Poor	
	Poor	Good	Kids safe	Good	Traffic low/ quiet/ /kids safe
		Poor	Upkeep /traffic low/quiet	Poor	Upkeep
Excitement factors	Good	Good		Good	
		Poor		Poor	
	Poor	Good		Good	
		Poor	Appearance/style/parking	Poor	Appearance/style/parking

Conclusion

This study pioneers the application of importance-performance analysis and three-factor theory to examine environmental correlates of residential satisfaction. Previous studies have applied regression analysis to identify environmental correlates and evaluate their importance in affecting residential satisfaction (Lovejoy et al., 2010; Yang, 2008). The importance is actually implicit importance. Some studies have explored influential factors of residential location choice by comparing stated importance of different neighborhood characteristics (Cao, 2008). The stated importance is explicit importance. The IPA-Kano model considers both implicit importance and explicit importance to differentiate three categories of factors that have different effects on the formation of residential satisfaction. By integrating basic factors, key performance factors, excitement factors, and their actual performance, we have identified development priorities for neighborhood self-improvement and the priorities for competition among different neighborhoods. These priorities allow local governments to deploy scarce resources to effectively improve residential satisfaction of existing residents and attract more residents from other neighborhoods.

This approach has a few limitations, however. Similar to traditional IPA, the category (or quadrant) that an attribute falls in depends on the positioning of the horizontal and vertical axes. Thus, the choice of threshold values influences the classification of the three factors (Azzopardi & Nash, 2013). Furthermore, if an attribute is very close to an axis, its three-factor classification is less convincing than an attribute away from either axis. Thus, a borderline attribute may not be interpreted as other attributes in the same category (Azzopardi & Nash, 2013). Moreover, because of multicollinearity among neighborhood characteristics, this study follows previous studies and employs bivariate correlational analysis to derive the implicit importance of neighborhood characteristics, rather than the commonly-adopted partial correlational analysis or regression analysis. Thus, multicollinearity is a potential concern for the IPA-Kano model. Nevertheless, the approach offers a fresh view on environmental correlates of residential satisfaction.

Although urban, suburban, and exurban neighborhoods have different environments, they share many influential factors of residential satisfaction if we do not distinguish basic factors and key performance factors (or we just examine explicit importance). This suggests relatively homogenous residential preferences (or explicit importance) among individuals in different neighborhoods. Urban planners should pay attention to all of these common factors.

Development priorities for neighborhood self-improvement vary among different types of neighborhoods. First, low level of car traffic on neighborhood streets undermines residential satisfaction of urban neighborhoods, while neighborhood quietness, sidewalks throughout neighborhoods, and neighborhood upkeep have detrimental effects on residential satisfaction of suburbanites. In contrast, none of the major

factors (including both basic factors and key performance factors) in exurban neighborhoods fall into the category of worst performance. Second, sidewalk is the only characteristic that appears in all three types of neighborhoods although its level of priority differs. Therefore, it is important to maintain or create a pedestrian-friendly environment in urban China, particularly when automobiles have proliferated. Further, suburban neighborhoods have more major factors with poor or mediocre performance than urban and exurban neighborhoods. These findings reflect residents' heterogeneous needs and different levels of performance in different neighborhoods. Thus, the "one size fits all" approach is not appropriate for neighborhood self-improvement. Table 9 summarizes specific neighborhood characteristics that should be improved when resources are available.

To compete with suburban and exurban neighborhoods, urban neighborhoods should lower noises, reduce car traffic, and provide safe spaces for children to play. As emerging bedroom communities, exurban neighborhoods need to improve job-housing balance, and access to regional mall and neighborhood shopping facilities. Overall, suburban neighborhoods seem to have more comparative advantages than urban and exurban neighborhoods.

Acknowledgement

The paper was developed from a project sponsored by the Natural Science Foundation of China (#41401180), and partially supported by the National Science Foundation of USA (#1243535)

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Appendix 1 Three factors of residential satisfaction

1(a) urban neighborhoods

1(b) suburban neighborhoods

1(c) exurban neighborhoods

Appendix 2 Three factors of residential satisfaction for whole sample