# Improve Neighborhood Map Design by Using Kano's Model

Bo Yuan[2], Chuan-yu Zou[1(✉)], and Yongquan Chen[1]

[1] Research Group of Way Guidance, China National Institute of Standardization, Beijing 100191, China
zouchy@cnis.gov.cn
[2] Department of Visual Communication Academy of Arts and Design, Tsinghua Universiy, Beijing 100084, China

**Abstract.** Objective: Based on the result of users' satisfaction survey of the neighborhood map, the classification of neighborhood information was studied.

The 15 information carried by neighborhood maps were extracted from relative stansards. And then Kano questionnaire were made to analysis the attribute of 15 neighborhood information. Methods: 317 volunteers participated in the user satisfaction survey and the Kano questionnaire survey. Results: There were 4 must-be information, 7 one-dimensional information, 1 attractive information and 3 indifferent information. Conclusion: Based on the above discussion, a new national standard (GB/T 20501.4) on neighborhood map design has been developed, and is be issued.

**Keywords:** Neighborhood map · Sign · Map · Kano model

## 1 Introduction

Wayfinding refers to the activities and processes of individuals navigating and finding their ways in an environment (Golledge [1]). A neighborhood map is a special kind of maps that navigates individuals in unfamiliar and/or complex outdoor spaces. Many neighborhood maps in use are designed as same as the standard handheld maps, where all places are treated with the same priority and the maps' orientation are always north upward. But the cognitive style of neighborhood maps is different in many ways.

Previous researches on maps mainly focused on the theory of cognitive science, geography, cartography, and graphic/information design (Allen [2]; Casakin et al. [3]; Zipf 2006). However, findings about the usability of information in maps are still little.

This paper studies the information usability of neighborhood maps by using Kano's model to improve the design of neighborhood maps in China and support the relevant national standard development.

## 2 Background: Neighborhood Maps in Beijing

Neighborhood maps in China, take Beijing as an example, are used to help users finding their locations in the city. In 2015, to collect basic information for the revision of


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GB/T 20501.4—2006 "Guidance system for public information——Design principles and requirements of elements——Part 4: Street guidance map", a field research on neighborhood maps was conducted at Olympic Forest Park (see Fig. 1) and Xueyuan Lu block, Haidian District, Beijing, China.

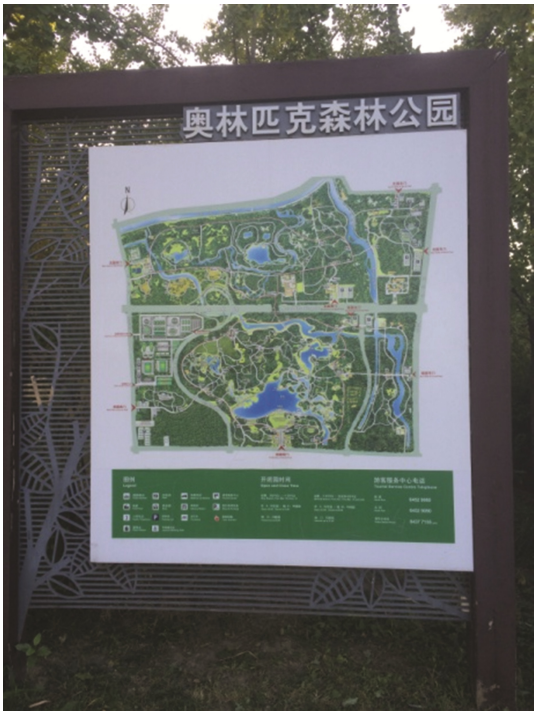


**Fig. 1.** Neighborhood map in Olympic Forest Park

Most neighborhood maps are alike, they cover a wide area, present various information and are designed in a colorful way. The advantages of those neighborhood maps are easy to find different kind of information. While the disadvantages are also clear. First, it's difficult to find information of public facilities among colorful surroundings. Second, compared with the covering area, the setting density is too low. In actual environment, users can not catch sight of neighborhood maps when needed (Fig. 2).

Many researchers studied the theory of wayfinding and maps. Casakin et al. [3] studied on spatial aspects of the physical environment, and use prototypical branching points and connecting road types to evaluate the cognitive effects in the schematization of maps. The study of Meilinger et al. [4] is concerned with the empirical investigation of different types of schematised maps. They conclude that providing unambiguous turning information (route knowledge) rather than survey knowledge is most crucial for wayfinding in unknown environments. Meilinger [5] investigated human wayfinding and knowledge acquisition in urban environments. The authors argue that both verbal directions and maps are memorized in a language-based format, which is mainly used

**Fig. 2.** Setting density of neighborhood maps in Olympic Forest Park

for wayfinding. Kueh [6] tried to apply a systemic approach to study human-map-space interactions that will benefit the design of a wayfinding map. He suggested that external systems such as maps and the actual environment affect an individual's latent and patent actions, while their behaviour affects the way they perceive the external systems. Li [7] combined route- and survey-based strategies in wayfinding and switched from the most familiar knowledge to a less familiar strategy. Previous researches on maps mainly focused on the theory of cognitive science, geography, cartography, and graphic/information design. However, findings about the usability of information in maps are still little.

## 3 Research Methods: Kano Model and Neighborhood Maps

This paper use the Kano model to find out what kind of information neighborhood maps present. In his model, Kano et al. [8] distinguish five types of product or service quality attributes according to their objective performance and the feeling of users. The five quality attributes are must-be, one-dimensional, attractive, indifferent and reverse attributes.

Since 1984, Kano model is widely used in the management of various fields, e.g. customer need analysis (Xu et al. [9]), commercial bank (Chen and Kuo [10]), stationery industry (Chen, Chang and Huang [11]), the Internet Protocol Television industry (Jan, Lu and Chou [12]), people management (Martensen and Gronholdt [13]), product development (Matzler and Hinterhuber [14]), and international airlines (Shahin and Zairi [15]). But, seldom studies use Kano model in the design of neighborhood maps.

In order to provide qualitative and quantitative suggestions for design neighborhood maps, this paper analyses the common neighborhood map information using Kano model, categories them into different information attributes, and then comes up with improvement design suggestions. It would help to improve the information communication effect of neighborhood maps, raise the efficiency of wayfinding, and create a convenient and comfortable urban environment by using standardized design techniques.

This paper aimed to improve the design of neighborhood maps in Beijing. Firstly, The user satisfaction was surveyed and analyzed by using questionnaires. Secondly, those information that scored highly unsatisfied were picked out. The neighborhood information carried by those neighborhood maps were analyzed and categorized by using Kano's model. Finally, based on the possible improve aspects analyzed and good practices around the world, a new design of neighborhood map was provided. The findings are also included in the standard revision.

### 3.1 User Satisfaction Survey

Based on the field investigation, this paper conducts user satisfaction survey on neighborhood maps. The primary objective of the survey was to provide national standard(GB/T 20501.4) revision with a means to identify users' concerns on neighborhood maps.

**Respondents.** This survey conducted from June to September 2015. A total of 319 questionnaires are collected, among which there are 317 valid questionnaires. The ratio of men to women was 59.9:40.1. Regarding the age distribution of the participants, those under the age of 18 was 1.58%, those between 19 and 44 accounted for 67.19%, those between 45 and 59 accounted for 23.66%, while those over the age of 60 accounted for 7.57%. Regarding the education level distribution, those under the education level of senior high school or technical secondary school was 34.07%, those with undergraduate education level was 51.1%, while those over the education level of Master degree was 14.83%.

**Questionnaire preparation and analysis.** The questionnaire included two parts, respondent self-report part, and Kano test part. In the respondent's self-report part, the following personal data was collected: age, sex, education level and annual income. 1 open question was also included in the test part. The open question collected respondents' ideas about existing problems and improvement suggestions.

The result of the survey was: extremely unsatisfied 9%, unsatisfied 19%, average 54%, satisfied 17%, extremely satisfied 1.0% (Fig. 3).

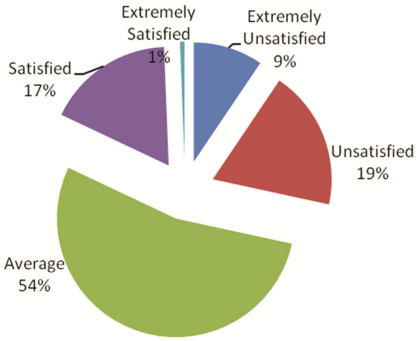


**Fig. 3.** Result of the survey on neighborhood maps

Above volunteers also participated in the Kano questionnaire survey. According to ISO standard ISO 28564-1:2010 and Chinese national standard GB/T 20501.4—2006, 15 neighborhood information were included in the questionnaire, they were: traffic transportation facilities (subway, overground, railway stations, bus stops), educational institution (primary school, middle school, university), hotels and shops, tourist attractions, public toilets, parking, scale, north indicator, orientation of map, 'You are here' identifier, walking circle, 2D or 3D buildings, legend, index, location in the city. Those information were mainly selected from on-site survey.

The questionnaire was formulated by questions in pair to which volunteers can answer in one of five different ways. By combining the two answers in the Kano evaluation table, the 15 information can be classified. The functional form of the question was to collect volunteers' attitude when one specific information provided in neighborhood maps; while the dysfunctional form of the question was to collect volunteers' attitude when one specific information not provided in neighborhood maps. A sample paired question for 'traffic transportation facilities' was given in Table 1. For the functional form and dysfunctional form of each information, there were 5 × 5 possible answers. And the combination of the questions in the evaluation table produces six different category A, O, M, I, R, Q (see Table 2) (Matzler and Hinterhuber [14]).

**Table 1.** Functional and dysfunctional questions for 'traffic transportation facilities'

| | |
|---|---|
| If you can find the information of traffic transportation facilities in a neighborhood map, how do you feel? | • I like it that way<br>• It must be that way<br>• I am neutral<br>• I can live with it that way<br>• I dislike it that way |
| If you can not find the information of traffic transportation facilities in a neighborhood map, how do you feel? | • I like it that way<br>• It must be that way<br>• I am neutral<br>• I can live with it that way<br>• I dislike it that way |

**Table 2.** Kano evaluation table

| Riding information | | Dysfunctional form of the question | | | | |
|---|---|---|---|---|---|---|
| | | 1. I like it that way | 2. It must be that way | 3. I am neutral | 4. I can live with it that way | 5. I dislike it that way |
| Functional form of the question | 1. I like it that way | Q | A | A | A | O |
| | 2. It must be that way | R | I | I | I | M |
| | 3. I am neutral | R | I | I | I | M |
| | 4. I can live with it that way | R | I | I | I | M |
| | 5. I dislike it that way | R | R | R | R | Q |

## 4 Result Analysis

The questionnaire is evaluated using the Kano evaluation table in Table 2. Combine two paired answers to the functional and dysfunctional questions in the Table 2. And the attributes of 15 neighborhood information can be gained according to the frequency of answers (see Table 3). Thus, from Table 3, there were 4 must-be information, 7 one-dimensional information, 1 attractive information and 3 indifferent information. Furthermore, SI/DSI were calculated using the formula of Matzler and Hinterhuner (1998). A SI/DSI sensitivity matrix was drawn (see Fig. 4).

**Table 3.** of results

| Information (frequency) | A | O | M | I | R | Q | Category | SI | DSI |
|---|---|---|---|---|---|---|---|---|---|
| 1. Traffic transportation facilities | 13.6 | 34.7 | 30.9 | 19.9 | 0.3 | 0.6 | O | 0.49 | −0.66 |
| 2. Educational institution | 13.2 | 23.0 | 17.7 | 44.2 | 1.3 | 0.6 | O | 0.37 | −0.41 |
| 3. Hotels and shops | 16.4 | 25.9 | 16.1 | 39.1 | 1.3 | 1.3 | O | 0.43 | −0.43 |
| 4. Tourist attractions | 14.8 | 27.1 | 18.0 | 37.9 | 0.6 | 1.6 | O | 0.43 | −0.46 |
| 5. Public toilets | 7.9 | 45.1 | 32.8 | 12.9 | 0.6 | 0.6 | O | 0.54 | −0.79 |
| 6. Parking | 9.1 | 27.4 | 27.8 | 34.4 | 0.6 | 0.6 | M | 0.37 | −0.56 |
| 7. Scale | 8.8 | 12.6 | 13.9 | 64.7 | 0.0 | 0.0 | I | 0.21 | −0.26 |
| 8. North indicator | 15.5 | 26.2 | 23.0 | 35.3 | 0.0 | 0.0 | O | 0.42 | −0.49 |
| 9. Orientation of map | 17.7 | 22.1 | 27.4 | 27.4 | 4.1 | 1.3 | M | 0.42 | −0.52 |
| 10. 'You are here' identifier | 15.1 | 30.9 | 24.9 | 28.1 | 0.6 | 0.3 | O | 0.46 | −0.56 |
| 11. Walking circle | 0.0 | 0.0 | 0.0 | 58.7 | 0.0 | 41.3 | I | 0.00 | 0.00 |
| 12. 2D or 3D buildings | 24.0 | 14.5 | 11.7 | 48.9 | 0.6 | 0.3 | A | 0.39 | −0.26 |
| 13. Index | 16.4 | 20.8 | 21.1 | 40.7 | 0.0 | 0.9 | M | 0.38 | −0.42 |
| 14. Legend | 12.6 | 19.6 | 24.0 | 41.6 | 1.3 | 0.9 | M | 0.33 | −0.45 |
| 15. Location in the city | 15.5 | 19.6 | 18.9 | 44.5 | 0.9 | 0.6 | I | 0.36 | −0.39 |

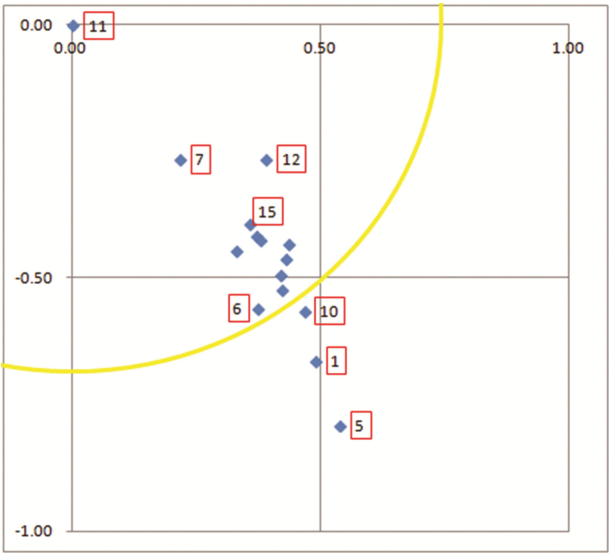


**Fig. 4.** SI/DSI sensitivity matrix

## 5 Discussion

The new neighborhood map design (see Fig. 5) provide all information according to its category: '2D or 3D buildings' (A) were used to present landmark buildings.


**Fig. 5.** Neighborhood map design in national standard

All O category information were provided in outstanding way. M category information were provided according its relevance with wayfinding.

## 6 Conclusion

If one has investigated and studied comprehensively into the need of wayfinding and the characteristics of neighborhood map, the Kano model can give an accurate judgment on map design: guarantee providing all Must-be information (e.g. Index, Legend, Orientation of map), improve actively the one-dimension information (e.g. North indicator, 'You are here' identifier), outstand those attractive information and SI > 0.5 information, that is, provide those information in outstanding way.

Based on the above discussion, a new national standard (GB/T 20501.4) on neighborhood map design has been developed, and is be issued.

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