Chapter 2
Point Space: Measurement of the Urban Memory of Historic Buildings

Rapid and large-scale urban construction results in the increasingly similar appearance of urban landscapes and the demolition of many historic buildings that once existed in people's memories but that now are making way for commercial development. At the same time, lifestyles, scenes, sounds and fragments with which people are familiar are everywhere disappearing and are being replaced by similar modern constructions, leading to urban amnesia. As a major material carrier of urban memory, historical buildings not only constitute urban styles and spatial patterns, but also embody the spiritual connotations and cultural characteristics of the city. In this chapter, historical buildings will be studied as the point space of urban memory.

2.1 Statistical Features

Beijing is a city with a history of more than 3000 years. It has been China's capital for 850 years. From a large number of historical buildings, this study selects 345 in the inner city walls of Beijing for a statistical analysis. According to the ancient capital's features and the historical function of its architecture, these selected buildings are divided into eight categories—the royal buildings, the feudal office buildings, the cultural buildings, the service buildings, the political buildings, the vernacular dwelling buildings, the religious buildings and the landmark buildings—which were further divided into 17 subcategories (Fig. 2.1). The royal buildings, constituting as many as 16 typical buildings, including three subcategories of the imperial palaces, the imperial festival buildings and the imperial living buildings, stand as the unique architecture heritage of the imperial city. The feudal office buildings category, including two subcategories of the imperial mansions and the

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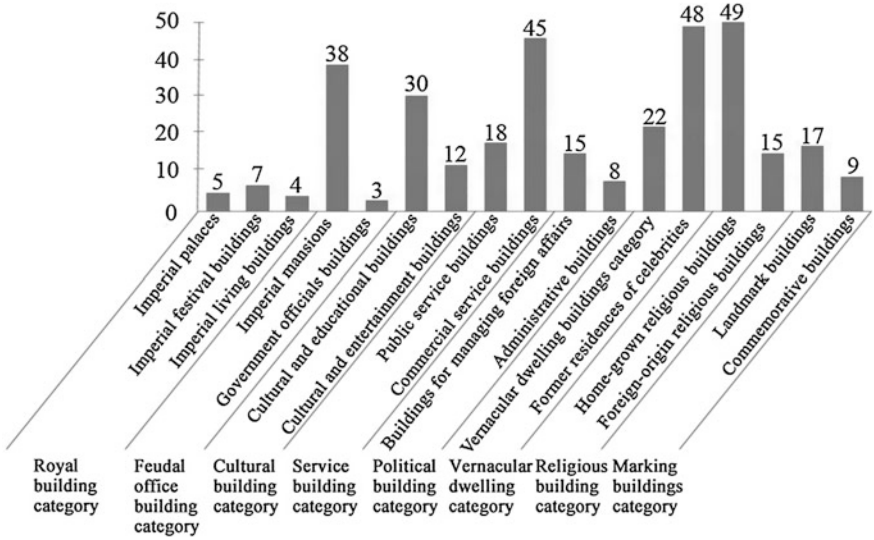

Fig. 2.1 Chart for statistical distributions of historic buildings in Beijing's inner city according to their historical functions (*Source* Drawing by Ming Jiang)

government office buildings with the total number of 41 buildings, refers to buildings erected for the Eight Banners, which were military-administrative organizations of the Manchu nationality in the Qing Dynasty. Because Beijing is the cultural center of China, the amount of cultural buildings here, including two subcategories of the cultural and educational buildings, as well as the cultural and entertainment buildings, numbers as many as 42. The service buildings, including two subcategories of the public service buildings and the commercial service buildings with a total number of 63, suggest the prosperity of Beijing's businesses. The number of the political buildings, including two subcategories of the buildings for managing foreign affairs and the administrative buildings, is 23, and that of the vernacular dwelling buildings, including two subcategories of the common residences and the former residences of celebrities, reaches 70 owing to a large number of celebrities in Beijing's history. The religious buildings, including two subcategories of the home-grown religious buildings and the foreign-origin religious buildings in Beijing, have undergone splendid growth and now number 64. The marking buildings, including two subcategories of the landmark buildings and the commemorative buildings, number 26.

Based on the classifications of buildings, the study carried out a statistical analysis toward spatial characteristics, construction age, historical relic grades and functional changes of historical buildings in Beijing's inner city. The results are as follows.

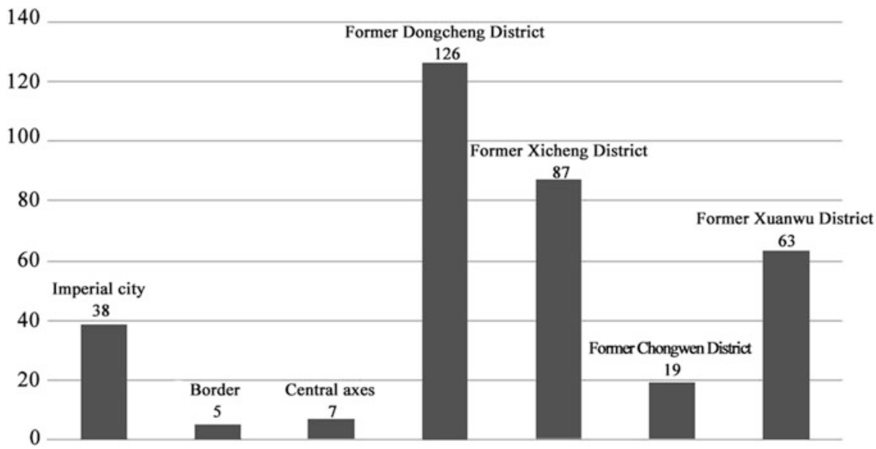

Fig. 2.2 Chart for statistical distributions of historic buildings in Beijing's inner city according to their geographical locations (*Source* Drawing by Ming Jiang)

2.1.1 Spatial Characteristics

The 345 selected historical buildings in the inner city are widely cited in the imperial city, central axes, border and the former Districts of Dongcheng, Xicheng, Chongwen and Xuanwu[1] (Fig. 2.2). In terms of geographical distribution, 126 are distributed in the former Dongcheng District, followed by the former Xicheng District, with 87, the former Xuanwu District with 63, the former Chongwen District with 19, the imperial city with 38, and the border and central axes with 5 and 7, respectively. In terms of distribution density, the largest concentrations of historical buildings are found in the imperial city and the former Dongcheng District.

Among the buildings distributed in the border and the central axes, 75 % are landmark buildings, including city walls, turrets and city gates, and the remainder are service buildings. In terms of the construction age, the ancient buildings, except for those special landmark buildings, are all far from the city walls and central axes, while the modern buildings, such as the cultural and entertainment buildings, as well as the commercial service buildings, are mostly located on the sides of the central axes and on Chang'an Avenue, forming new landmarks.

[1]The Dongcheng District of Beijing is currently merged with the original Chongwen District; Xicheng District is merged with the original Xicheng District, known as Xuanwu District. For the convenience of a clear statement of the investigative situation of this research, considering that the original Xuanwu District is a concentrated area of Beijing's ancient urban historical relics, the administrative division still uses the original names of Dongcheng, Xicheng, Chongwen and Xuanwu.

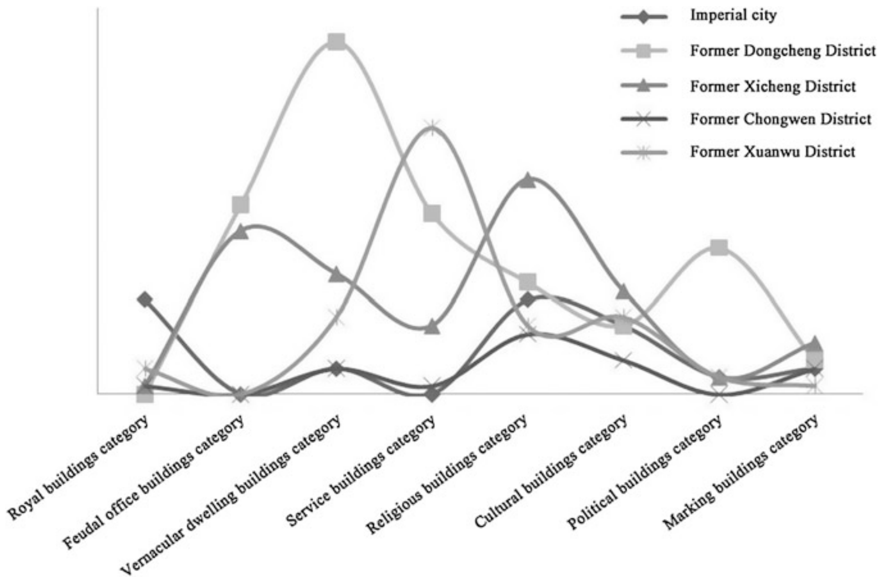

Fig. 2.3 Correlation between the statistical distributions of historic buildings in Beijing's inner city according to their historical functions and geographical locations (*Source* Drawing by Ming Jiang)

In terms of the functions of the historical buildings in the imperial city and the former Districts of Dongcheng, Xicheng, Chongwen and Xuanwu (Fig. 2.3), buildings in the former Dongcheng District mainly serve as the vernacular dwelling buildings; in the former Xicheng District, they serve as the official and religious buildings; in the former Xuanwu District, they are the service buildings; in the former Chongwen District, there are the residential and religious buildings; and in the imperial city, there are the royal and religious buildings. In Beijing, there is an old saying that the rich and the noble live in the east and the west while the poor and the common live in the north and south, which is also in agreement with the distribution rules of these historical buildings. The former Dongcheng District once had rich people living there, and the Xicheng District was for prominent officials and eminent personages, while the former Districts of Chongwen and Xuanwu in the south were the concentration Districts for common people's business and service sectors.

2.1.2 Construction Age

In terms of the construction age (Fig. 2.4), the historical buildings built in the Qing Dynasty account for approximately 47 %, the Republic Era for 28 % and the Ming

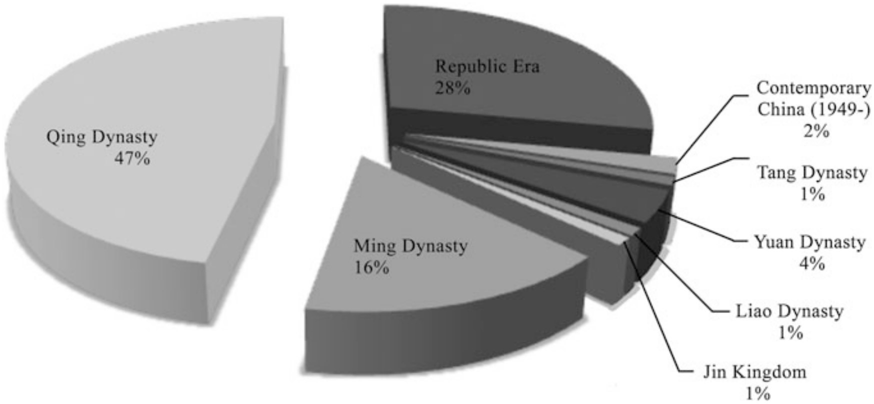

Fig. 2.4 Diagram of construction age statistics of historic buildings in Beijing's inner city (*Source* Drawing by Ming Jiang)

Dynasty for 16 %. These three dynasties, when most of the buildings were built, are the typical periods of Beijing urban memory.

These three periods (Fig. 2.5) show that the existing historical buildings built during the Ming Dynasty are mainly the royal buildings, the religious buildings and the marking buildings. The existing imperial city and the basic urban framework of Beijing were constructed during the Ming Dynasty, demonstrating that the Ming

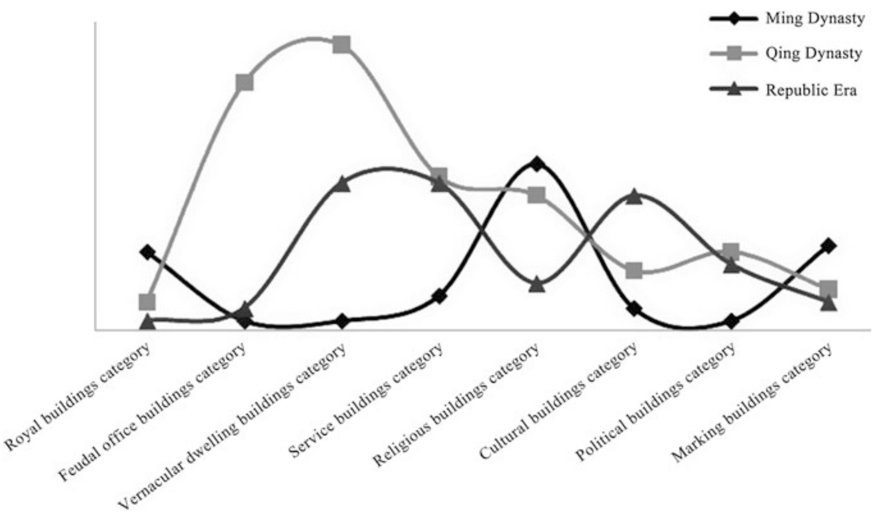

Fig. 2.5 Correlation between the statistical distributions of historic buildings in Beijing's inner city according to their historical functions and construction ages (*Source* Drawing by Ming Jiang)

Dynasty greatly influenced the urban planning and development of Beijing. The existing historical buildings built during the Qing Dynasty are mainly the vernacular dwelling buildings, the feudal office buildings, the service buildings, the cultural buildings and the political buildings. The Qing Dynasty witnessed the development of urban architecture flourishing in Beijing; from the Eight Banners' mansions and imperial mansions in the initial stage of the Qing, to the prosperity of business in the middle stage and further to the emergence of the political buildings for managing foreign affairs in the late Qing Dynasty, this dynasty set the tone for Beijing's urban architecture. Historical buildings from the Republic Era are mainly the vernacular dwelling buildings, the service buildings and the cultural buildings owing to the development of cultural industry triggered by the New Culture Movement in 1919 and the emergence of new ideas.

2.1.3 *Historic Relic Grade*

The selected historical buildings were rated according to six grades, including World Cultural Heritage, National Heritage Conservative Units, Municipal Heritage Conservative Units, District Heritage Conservative Units, Excellent Architecture in modern China (1840–1949), in accordance with the rating results published on the official Website of the Beijing Municipal Administration of Cultural Heritage (http://www.bjww.gov.cn/index.html). The statistical diagram (Fig. 2.6) shows that the Municipal Heritage Conservative Units account for the greatest proportion, approximately 38 %, followed by unlisted ones at approximately 24 %, the District Heritage Conservative Units at 19 %, the National Heritage Conservative Units at 8 % and the World Cultural Heritages at 1 %. In the inner city, historical buildings with the label of Municipal Heritage Conservative Unit comprise a large proportion so that it is a historical vocation to preserve these buildings and explore memories.

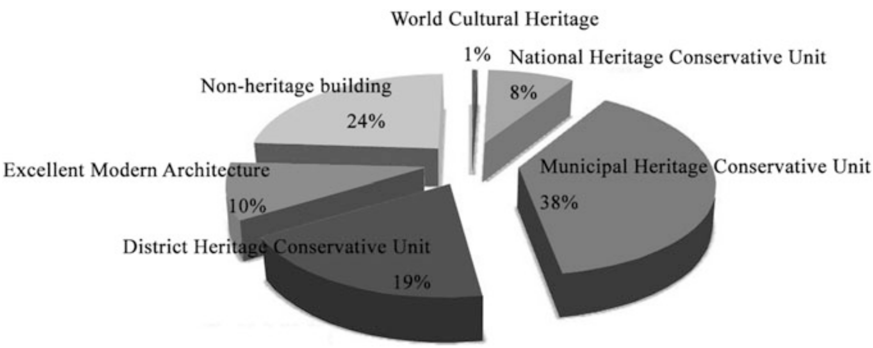

Fig. 2.6 Diagram of historical relic grade statistics of historic buildings in Beijing's inner city (*Source* Drawing by Ming Jiang)

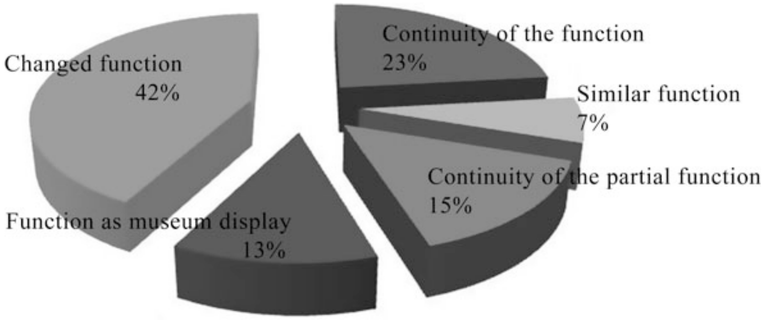

Fig. 2.7 Diagram of function statistics of historic buildings in Beijing's inner city (*Source* Drawing by Ming Jiang)

2.1.4 Functional Change

The functions have changed for most of the historic buildings surviving today in Beijing's inner city (Fig. 2.7). Forty-two percent of them now have totally different functions. Fifteen percent of them, although have abandoned their original functions, bear such characteristics of the past as name and usage; as can be seen in the case of the Gongjian Ice Cellar, once a facility exclusively for the royalty but now having evolved into the Royal Ice Cellar Restaurant. Some clear clues can be found despite the changes in purposes. Seven percent of them have similar functions to those of their past. A case in point is the Ancient Books branch of the National Library of China, which originally was the Beiping Library. There have been no changes for 23 % of the historic buildings in function. Another 13 % have become museums for demonstration and education to preserve their original memories better.

Based on the classification of their historic functions (Fig. 2.8), the memory circulation of religious buildings lasts longest because faith is passed on from generation to generation. Regarding service buildings for commercial and public interests, their fundamental functions will not change because many former and famous enterprises have endured the passing of time. The memory circulation for vernacular dwelling buildings is not very impressive, but some memory segments can always manage to survive by word of mouth for people to recall their past. It is common that memories fade with time, particularly in imperial and prestigious family mansions. Museums are perhaps the most common means of preserving memories. For such distinctive buildings as royal and marking buildings, the establishment of museums can preserve massive amounts of historical materials and, at the same time, provide education and promotion. Beijing's concentrated and dense historic buildings left to function as museums are limited. It is unnecessary

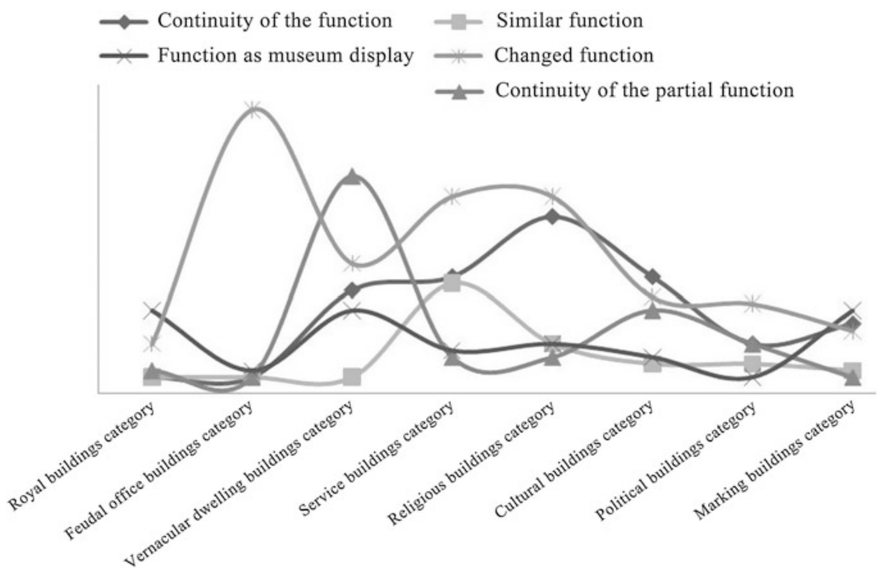

Fig. 2.8 Correlation between the statistical distributions of historic buildings in Beijing's inner city according to their historical functions and changes in function (*Source* Drawing by Ming Jiang)

and not worthwhile to build a museum for every single historical building because the establishment of museums cannot guarantee the preservation of memory. Finding a way for people to connect actively to the past and to promote the historic culture of the cities is an important task for us. Notes are as follows.

① The 345 historic buildings selected cannot represent all of the historic buildings in Beijing's inner city. Every brick can tell a part of history for as ancient a capital as Beijing. The selection of the historic buildings is mainly based on historic preservation lists of Beijing at all levels, books and reference materials on ancient buildings of Beijing and on-site surveys by our group. The selection standard is the existence of the building that bears the historic significance and historic function. Cultural and non-cultural protection buildings are both included.
② The classification method that this research employed might not have universal meaning in scientific and referential nature. However, classification study is not an either-or science: different people might adopt their own classification methods. The focus of this research is not the classification itself but a differential study and comparison of these historic buildings.

2.2 Design Research and Investigation Process

2.2.1 Research Object

The research objects consist of historic buildings in Beijing's inner city. The historic buildings were selected from the following:

① Ancient buildings map of Beijing
② National Heritage Conservative Units
③ Beijing Municipal Heritage Conservative Units
④ Beijing Excellent Architecture in modern China (1840–1949) Units (first batch).

This research selected historic buildings based on proportional sampling of the stratified sampling, combined with the expert screening method. Stratified sampling is an accurate counting method for sample investigation (Gao 2010). It is the process of dividing members of the population into homogeneous subgroups before sampling. The strata should be mutually exclusive: every element in the population must be assigned to only one stratum. Then, simple random sampling or systematic sampling is applied within each stratum (Lin and Wu 2010). The principles of the screening method employed by experts include that the buildings selected can cover every category in spatial characteristics, temporal characteristics and functional features, thus demonstrating typicalness and representativeness. Based on the basic information of the selected 345 historic buildings within the domain of Beijing City, three two-dimensional information tables were drawn as a reference for selection: temporal–spatial characteristics (Table 2.1), function–temporal characteristics (Table 2.2), and functional–spatial characteristics (Table 2.3).

Sample points and the size of every stratified sampling are selected based on proportional sampling of the stratified sampling.

According to the formula of the proportionate sampling, the proportion of the sample capacity (n_i) of every stratified sampling in all of the units (N_i) is equal, that is, equal to the sample capacity (n) in the total size (N) (Sun 1998).

$$\frac{n_1}{N_1} = \frac{n_2}{N_2} = \cdots \frac{n_k}{N_k} = \frac{n}{N}$$

Therefore, we can determine the sample capacity of every stratified sampling:

$$n_i = \frac{N_i}{N} \times n \tag{2.1}$$

Formula 2.1: Calculation of the sample capacity with proportions

We established 24 on-site investigation areas (Table 2.4), and in every area, 20 questionnaires were distributed in line with the formula of the proportionate sampling and the expert screening method, and we made appropriate adjustments according to the complexity of the research, ensuring that the number of the questionnaires covering each category reaches 35, and each subcategory numbers 5.

Table 2.1 Statistical table of the temporal–spatial characteristics of historic buildings in Beijing's inner city

Temporal characteristics	Imperial city/axes/boundary	Xicheng district			Dongcheng district		
		Former Xicheng district	Former Xuangwu district	Total	Former Dongcheng district	Former Chongwen district	Total
Yuan Dynasty and earlier	4	9	3	12	5	1	6
Ming and Qing Dynasties	30	53	39	92	70	14	84
Republic Era	11	15	16	31	40	2	42
Contemporary China (1949–)	5	10	5	15	11	2	13
Sub-total	50	87	63	150	126	19	145
Total	50	150			145		

Table 2.2 Statistical table of the functional–temporal characteristics of historic buildings in Beijing's inner city

Functional features		Temporal characteristics (construction age)					Sub-total	Total
Category	Subcategory	Yuan Dynasty and earlier	Ming Dynasty	Qing Dynasty	Republic Era	Modern		
Royal buildings	Imperial palaces	2	2	1	0	0	5	16
	Imperial festival buildings	0	7	0	0	0	7	
	Imperial living buildings	0	2	2	0	0	4	
	Sub-total	2	11	3	0	0	16	
Feudal office buildings	Imperial mansions	0	0	37	1	0	38	41
	Government office buildings	1	0	1	0	1	3	
	Sub-total	1	0	38	1	1	41	
Cultural buildings	Cultural and educational buildings	2	2	4	17	5	30	42
	Cultural and entertainment buildings	0	0	4	3	5	12	
	Sub-total	2	2	8	20	10	42	
Service buildings	Public service buildings	1	4	8	2	3	18	63
	Commercial service buildings	1	0	15	20	9	45	
	Sub-total	2	4	23	22	12	63	
Political buildings	Buildings for managing foreign affairs	0	0	11	4	0	15	
	Administrative buildings	0	0	0	5	3	8	23
	Sub-total	0	0	11	9	3	23	

(continued)

Table 2.2 (continued)

Functional features		Temporal characteristics (construction age)					Sub-total	Total
Category	Subcategory	Yuan Dynasty and earlier	Ming Dynasty	Qing Dynasty	Republic Era	Modern		
Vernacular dwelling buildings	Common residences	0	0	13	6	3	22	70
	Former residences of celebrities	0	0	31	16	1	48	
	Sub-total	0	0	44	22	4	70	
Religious buildings	Home-grown religious buildings	8	23	17	0	1	49	64
	Foreign-origin religious buildings	3	2	3	6	1	15	
	Sub-total	11	25	20	6	2	64	
Marking buildings	Landmark buildings	3	8	2	2	2	17	26
	Commemorative buildings	1	4	3	1	0	9	
	Subtotal	4	12	5	3	2	26	
Total	Historic buildings	22	54	152	84	33	345	345

Table 2.3 Statistical table of the functional–spatial characteristics of historic buildings within the domain of Beijing

Functional features		Temporal characteristics (construction age)					Sub-total	Total
Category	Subcategory	Imperial city/axes/boundary	Former Xicheng district	Former Xuanwu district	Former Dongcheng district	Former Chongwen district		
Royal buildings	Imperial palaces	4	0	1	0	0	5	16
	Imperial festival buildings	3	1	2	0	1	7	
	Imperial living buildings	4	0	0	0	0	4	
	Sub-total	11	1	3	0	1	16	
Feudal office buildings	Imperial mansions	0	18	0	20	0	38	41
	Government office buildings	0	1	0	2	0	3	
	Sub-total	0	19	0	22	0	41	
Cultural buildings	Cultural and educational buildings	7	9	5	7	2	30	42
	Cultural and entertainment buildings	2	3	4	1	2	12	
	Sub-total	9	12	9	8	4	42	
Service buildings	Public service buildings	0	5	6	6	1	18	63
	Commercial service buildings	2	3	25	15	0	45	
	Sub-total	2	8	31	21	1	63	

(continued)

Table 2.3 (continued)

Functional features		Temporal characteristics (construction age)					Sub-total	Total
Category	Subcategory	Imperial city/axes/boundary	Former Xicheng district	Former Xuanwu district	Former Dongcheng district	Former Chongwen district		
Political buildings	Buildings for managing foreign affairs	0	0	0	15	0	15	23
	Administrative buildings	2	2	2	2	0	8	
	Sub-total	2	2	2	17	0	23	
Vernacular dwelling buildings	Common residences	0	7	1	13	1	22	70
	Former residences of celebrities	3	7	8	28	2	48	
	Sub-total	3	14	9	41	3	70	
Religious buildings	Home-grown religious buildings	10	22	6	6	5	49	64
	Foreign-origin religious buildings	1	3	2	7	2	15	
	Sub-total	11	25	8	13	7	64	
Marking buildings	Landmark buildings	11	3	0	1	2	17	26
	Commemorative buildings	1	3	1	3	1	9	
	Subtotal	12	6	1	4	3	26	
Total	Historic buildings	50	87	63	126	19	345	345

Table 2.4 Classification table of historic buildings in Beijing's inner city

Category	Subcategory	Number of buildings	Number of investigation spots
Royal buildings	Imperial palaces	5	1
	Imperial festival buildings	7	1
	Imperial living buildings	4	0
Feudal office buildings	Imperial mansions	38	3
	Government office buildings	3	0
Cultural buildings	Cultural and educational buildings	30	2
	Cultural and entertainment buildings	12	1
Service buildings	Public service buildings	18	1
	Commercial service buildings	45	3
Political buildings	Buildings for managing foreign affairs	15	1
	Administrative buildings	8	1
Vernacular dwelling buildings	Common residences	22	1
	Former residences of celebrities	48	3
Religious buildings	Home-grown religious buildings	49	3
	Foreign-origin religious buildings	15	1
Marking buildings	Landmark buildings	17	1
	Commemorative buildings	9	1
Total	Historic buildings	345	24

This study has considered the following factors when selecting the buildings. (1) For temporal characteristics, that is, construction age we devised four periods: the Yuan Dynasty and earlier, the Ming Dynasty, the Qing Dynasty, the Republic Era, and contemporary China (1949–). (2) Spatial characteristics, that is, the spatial location: The historic buildings we selected are scattered within the domain of Beijing City. (3) The opinion of the experts was that the buildings we select should be typical and representative. (4) We also considered functional features. The number of imperial living buildings and government office buildings is small so they are not listed as the investigation areas. Finally, we decided on 28 sampling spots for historic buildings (and 10 online investigations), as shown in Table 2.5. In total, the buildings we selected covered almost all 8 categories and 15 of 17 subcategories. Research on the urban memory of historic buildings represented by these 28 buildings within the domain of Beijing City was subsequently undertaken.

Table 2.5 Sample table of historic buildings in Beijing's inner city

Category	Subcategory	Number of buildings	Number of investigation buildings	On-site research spots	Online research spots
Royal buildings	Imperial palaces	5	1	Forbidden City (Palace Museum), Jingshan Mountain	Forbidden City (Palace Museum)
	Imperial festival buildings	7	1	Temple of Heaven, Imperial Ancestral Temple	Temple of Heaven, the Imperial Ancestral Temple
	Imperial living buildings	4	0	0	0
Feudal office buildings	Imperial mansions	38	3	Princess Mansion, Mansion of Princess Hejing, Prince Kung Mansion	Prince Kung Mansion, Kuijun Mansion
	Government office buildings	3	0	0	0
Cultural buildings	Cultural and educational buildings	30	2	Imperial College, Confucian Temple, Shuntianfu School	Confucian Temple, the Imperial College, Beijing National History Museum
	Cultural and entertainment buildings	12	1	National Centre for the Performing Arts	National Centre for the Performing Arts, Daguanyuan Garden
Service buildings	Public service buildings	18	1	Huguang Guild Hall, Site of the French Post Office	Huguang Guild Hall
	Commercial service buildings	45	3	Dashilar Commercial Buildings, Beijing Hotel, Citibank Site	Dashilar Commercial Buildings, Beijing Hotel, Minzu Hotel
Political buildings	Buildings for managing foreign affairs	15	1	Embassy Group of Beijing Legation Street	Embassy Group of Beijing Legation Street
	Administrative buildings	8	1	Former Site of the Duan Qirui Government	Great Hall of the People

(continued)

Table 2.5 (continued)

Category	Subcategory	Number of buildings	Number of investigation buildings	On-site research spots	Online research spots
Vernacular dwelling buildings	Common residences	22	1	New courtyard house of Ju'er Hutong	New courtyard house of Ju'er Hutong
	Former residences of celebrities	48	3	Former Residence of Song Ching-ling, Former Residence of Mao Dun, Former Residence of Chen Duxiu	Former Residence of Song Ching-ling
Religious buildings	Home-grown religious buildings	49	3	Fayuan Temple, Lama Temple	Lama Temple, Fayuan Temple, Huguo Temple
	Foreign-origin religious buildings	15	1	Niujie Mosque	Niujie Mosque, Church of the Saviour
Landmark buildings	Landmark buildings	17	1	Zhengyang Gate, Desheng Gate	Towers of Bell and Drum, Zhengyang Gate, Tian'an Men
	Commemorative buildings	9	1	Wen Tianxiang Shrine	Wen Tianxiang Shrine, Yuan Chonghuan Shrine
Total	Historic buildings	345	24	28 on-site research spots	28 online research spots, 10 additional research spots

2.2.2 Model Construction

Based on the OST model of urban memory in Chap. 1, we performed a deep analysis of the model construction, combined with the research object, i.e., historic buildings.

(1) **Object–Time (O–T)**

About the elements of "Object–Time", outside-of-scene memory is involved. Time and object form a basic framework of site experience and can bring people pictorialized memory about a particular scene.

Memory usually appears in people's mind in scenarized images (Downing 2000). In the book *On Collective Memory*, Halbwachs (1992) reported that memory is scenarized and can surface suddenly by accident through the spatial arrangement of the city and site. Scenarized factors fully embody the impact on subjective memory of the objective materials in the external environment (Boyer 1996).

Based on the scenarized memory theory, we summarize the elements forming outside-of-scene memory into 17 observational variables. Those variables include one regarding external space and its combination of features reflecting historic buildings—geographical location, peripheral environment, style unification, etc.; the variable that reflects the characteristics of the historic buildings—construction age, architectural scales, architectural type, exterior appearance and color, structural and technical designs, construction applications, historical relic grades, historical relic value, historical function, preservation status, etc.; and also includes such aggregative indicators as the overall perception, functional changes, traveling impressions, geographical indications, etc. Object–Time memory reflects deep perception, scenes in sight and comprehensive connections of the people to the objective property of the historic buildings.

(2) **Time–Subject (T–S)**

About the elements of "Time–Subject", symbolic connotation memory is involved. The deepening of memory occurs with time and the processing of people's feelings. Signified memory can offer a process for revaluation and discovery.

Memory and a series of symbol signs are closely interconnected. The image and scene formed in the process of memory can not only recover and pass on information and generate emotion but can also rediscover the meaning of internalized things for people. Marcel Proust (2006) expounded clearly and at length on this idea in his book *Remembrance of Things Past*, that is, the significance of memory does not rely on unconscious recall (in search of the past) and experience alone, and more importantly, on the study of signs (identity).

The elements of Time–Subject place additional emphasis on the memory formed by the existing knowledge and experience about an object, which is the dynamic function of the memory generated by the subject's knowledge and experience with outside information. We summarize the elements of Time–Subject memory as 18 observational variables, which include the marking of symbolization such as building name replacements and the remaining place names, as well as the stories and clues derived from the historic buildings, such as the literal materials, audio-visual materials, dictated materials, stories and legends and literary works, and the people's feelings and recording modes, such as Travelling notes, photographic records, souvenirs, experience narrations, scenes in sight, knowledge learning, atmosphere feelings and sign interpretations. Iconic identification and cultural features of the historic buildings can help to promote the memory of subject cognition. Time–Subject emphasizes the stories and clues derived from names, identifications and signs, and it also emphasizes people's thinking, methods and the results of coding of the historic buildings.

(3) **Object–Subject (O–S)**

About the elements of "Object–Subject", feeling and experience memory is involved. People integrate a particular site, forming stable behavioral patterns and habits during the experiment after the customary and repeated conduction.

According to the theories of psychology, to allow information in the sensory memory into the short-term memory, the active participation of people is needed (Yang et al. 2012). During the experience, the subject of urban memory can have a more direct and real impact on the object of urban memory. Moreover, the experience can even help the subject to form a stable behavioral pattern and habits and transmit the object of urban memory. In his book *How Societies Remember*, Paul Connerton (1989) demonstrated in detail the two non-textual and non-cognitive styles: physical practices and commemorative ceremonies.

This study views the way that memory results in the experiencing of feelings as one of the factors in evaluating the subject's effect on memory processes toward historic buildings, placing additional emphasis on the importance of the physical actions of the subject. We divide the elements constituting the feeling and experience memory into 18 observational variables, including indictors such as visit and sightseeing, shopping, religious worship, cuisine tasting, leisure and sports, performance watching, activity participation, other activities and activity spaces, and the memory process of evaluating whether there have been colorful athletic events and sufficient activity space to be satisfied with the direct experience. The observational variables also include on-site findings, guider's interpretations, browsing through materials, image association, story association, guide signs and mental feelings, as well as whether the subject can successfully connect the memory object and the way and path of that connection. Memory can deepen by frequent and diversified experience.

The study summarizes the elements of urban memory with three memory composition models—Object–Time memory, Time–Subject memory and Object–Subject memory—and it elaborates the observational variables of every memory model (Table 2.6). These variables are the fundamental assumptions of the questionnaires. Further revision and deletion are needed to obtain more accurate variables forming urban memory through factor analysis.

Table 2.6 Statistical table of the model and observational variables of urban memory

Memory model	Observational variables
Object–Time (O–T)	(1) Geographical location; (2) peripheral environment; (3) style unification; (4) construction age; (5) architectural type; (6) architectural scale; (7) historical relic grade; (8) historical function; (9) preservation; (10) overall perception; (11) exterior appearance and color; (12) structural and technical design; (13) construction application; (14) historical relic value; (15) functional change; (16) impression formation; (17) geographical indication
Time–Subject (T–S)	(1) Name replacement; (2) remaining place name; (3) iconic identification; (4) cultural feature; (5) story and legend; (6) audiovisual materials; (7) literal material; (8) literary works; (9) dictated material; (10) traveling note; (11) photographic record; (12) souvenir; (13) experience narration; (14) scene insight; (15) sign interpretation; (16) knowledge learning; (17) atmosphere feeling
Object–Subject (O–S)	(1) Guide sign; (2) mental feeling; (3) on-site finding; (4) activity participation; (5) guider's interpretation; (6) browsing through materials; (7) visit and sightseeing; (8) shopping; (9) religious worship; (10) cuisine tasting; (11) performance watching; (12) image association; (13) story association; (14) leisure and sports; (15) other activities; (16) activity space

2.2.3 Questionnaire Design and Investigation Methods

(1) **Questionnaire design**

According to the established urban memory component model in the segment above, using the questionnaire on urban memory of historic buildings in Beijing's inner city, research and investigation were performed to collect metrical data. To reduce errors in the questionnaire investigation, the design of the questions was accommodated to popularization to the greatest extent, in an attempt not to cause semantic deviations in its meaning. The overwhelming majority of questions on this questionnaire used a Likert scale (ranging from 1 to 5), with 1 indicating the worst evaluation, 2 a negative evaluation, 3 a moderate evaluation, 4 a positive evaluation, and 5 the best evaluation for the convenience of conducting correlation analysis. The following section is a brief analysis to the questionnaire design.

The question part of this questionnaire mainly included the variable part of the three main bodies—Object–Time, Time–Subject, Object–Subject—as well as a question part to collect information.

(2) **Questionnaire execution**

When the questionnaire was created, ten experts were found to conduct an in-depth interview and meticulous filtration of the investigation cases, as well as the collection of suggestions for the questionnaire design on 22–25 March, 2010 on the basis of which the questionnaire was modified and was greatly approved by others. Thereafter, the questionnaire investigation proceeded in the places where cases were last chosen. The questionnaire was conducted by two means: field questionnaire and website questionnaire. The field questionnaire was proceeded by stratified sampling, while the website questionnaire used the Sojump Investigation Network (http://www.sojump.com/) as the investigation platform to supplement the investigation.

The questionnaire investigation procedure was divided into three stages: the preliminary investigation stage, formal investigation stage and supplementary investigation stage. The preliminary investigation was launched on 26–29 March 2010, for 3 days; the time of the formal investigation was from 30 March to 10 April. The temporal distribution considered weekends, weekdays and minor vacations, and the site distribution of the paper questionnaires was given priority. The supplementary questionnaire investigation was performed between 11 and 13 April 2010 by the conjunctive means of a website investigation and field research to solve the problem of an insufficient number of questionnaires in certain single case field.

The questionnaires were distributed in a total of 477, among which the paper questionnaires numbered 322, and electronic ones numbered 155. There were a total of 28 field research spots chosen and 10 investigation spots supplemented by e-questionnaires. A total of 454 valid questionnaires were returned in total, for a validity ratio of 95.2 % (Table 2.7).

(3) **Data processing**

The operational data processing softwares used were Excel 2007 and SPSS 13.0 for Windows. The data processing method mainly included: (1) utilizing Excel 2007 to perform descriptive statistics of the historic buildings' features and the population characteristics of the questionnaire samples; (2) conducting modeling construction and calculation, ensuring the quantitative relationships and quantitative classification by means of questionnaire grading; (3) utilizing SPSS software, version 13.0, to perform factor analysis, as well as Pearson's correlation analysis, analysis of variance, and curvilinear regression analysis; and (4) fuzzy evaluation, weighting and constructing matrices by experts and conducting variance operation to obtain fuzzy evaluation characteristic values.

2.3 Survey Results

2.3.1 Descriptive Statistics of the Investigation Data

(1) **The spatial characteristics distribution of questionnaires**

① *The quantitative distribution of questionnaires*: Sample points of 345 historic buildings in Beijing's inner city were selected to distribute questionnaires. Among the 454 valid questionnaires returned, the sample range covered eight representative

Table 2.7 Statistical table on the stratified sampling questionnaire of historic buildings in Beijing's inner city

Category	Subcategory	Number of buildings	Number of investigation buildings	Number of on-site questionnaires	On-site research spots	Number of online questionnaires	Online research spots	Total	Number of effective questionnaires
Royal buildings	Imperial palaces	5	1	6	Forbidden City (Palace Museum), Jingshan Hill	21	Forbidden City (Palace Museum)	27	26
	Imperial festival buildings	7	1	2	Temple of Heaven, Imperial Ancestral Temple	18	Temple of Heaven, Imperial Ancestral Temple	20	20
	Imperial living buildings	4	0	0	0	0	0	0	0
Feudal office buildings	Imperial mansions	38	3	29	Princess Mansion, Mansion of Princess Hejing, Prince Kung Mansion	21	Prince Kung Mansion, Kuijun Mansion	50	47
	Government office buildings	3	0	0	0	0	0	0	0

(continued)

Table 2.7 (continued)

Category	Subcategory	Number of buildings	Number of investigation buildings	Number of on-site questionnaires	On-site research spots	Number of online questionnaires	Online research spots	Total	Number of effective questionnaires
Cultural buildings	Cultural and educational buildings	30	2	39	Imperial College, Confucian Temple, Shuntianfu School	7	Confucian Temple, Imperial College, History Museum	46	45
	Cultural and entertainment buildings	12	1	3	National Centre for the Performing Arts	13	National Centre for the Performing Arts, Daguanyuan Garden	16	16
Service buildings	Public service buildings	18	1	16	Huguang Guild Hall, Site of France Post Office	2	Huguang Guild Hall	18	18
	Commercial service buildings	45	3	35	Dashilar Commercial Buildings, Beijing Hotel, Citibank Site	13	Dashilar Commercial Buildings, Beijing Hotel, Minzu Hotel	48	48
Political buildings	Buildings for managing foreign affairs	15	1	21	Embassy Group of Beijing Legation Street	2	Embassy Group of Beijing Legation Street	23	23
	Administrative buildings	8	1	10	Former Site of the Duan Qirui Government	3	Great Hall of the People	13	13

(continued)

Table 2.7 (continued)

Category	Subcategory	Number of buildings	Number of investigation buildings	Number of on-site questionnaires	On-site research spots	Number of online questionnaires	Online research spots	Total	Number of effective questionnaires
Vernacular dwelling buildings	Common residences	22	1	22	New courtyard house of Ju'er Hutong	1	New courtyard house of Ju'er Hutong	23	22
	Former residences of celebrities	48	3	66	Former Residences of Soong Ching-ling, Mao Dun, and Guo Moruo	5	Former Residence of Soong Ching-ling	71	65
Religious buildings	Home-grown religious buildings	49	3	27	Fayuan Temple, Lama Temple	20	Lama Temple, Fayuan Temple, Huguo Temple	47	44
	Foreign-origin religious buildings	15	1	22	Niujie Mosque	3	Niujie Mosque, Xishiku Church	25	22
Marking buildings	Landmark buildings	17	1	20	Zhegyang Gate, Desheng Gate	20	Towers of Bell and Drum, Zhengyang Gate, Tian'an Men	40	40
	Commemorative buildings	9	1	3	Wen Tianxiang Shrine	2	Wen Tianxiang Shrine, Yuan Chonghuan Shrine	5	5

(continued)

Table 2.7 (continued)

Category	Subcategory	Number of buildings	Number of investigation buildings	Number of on-site questionnaires	On-site research spots	Number of online questionnaires	Online research spots	Total	Number of effective questionnaires
Others	Other buildings	–	–	1	–	5	–	6	0
Total	Historic buildings	345	24	322	On-site research spots 28	155	Online research spots 28, supplementary spots 10	477	454

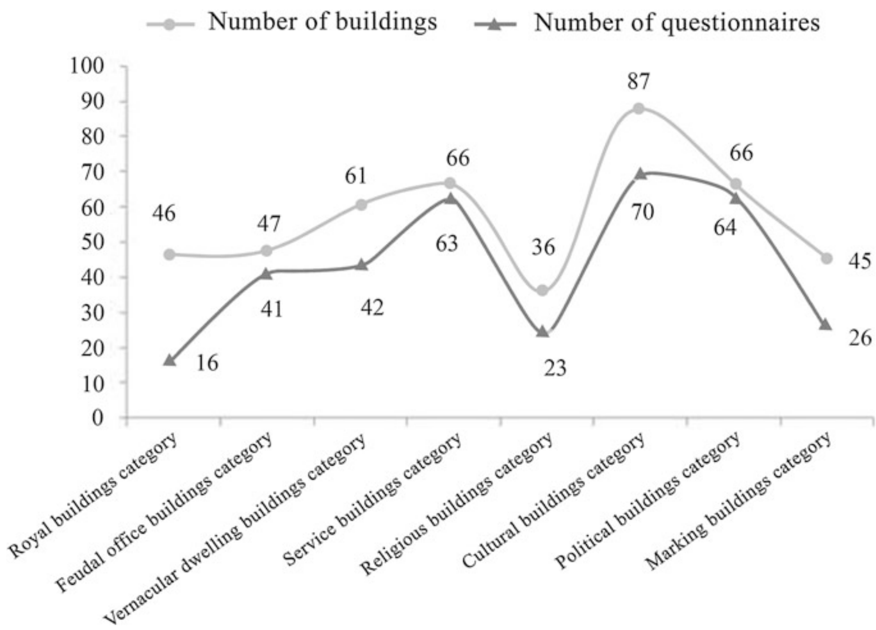

Fig. 2.9 Distribution diagram of the number of samples according to their historical functions (*Source* Drawing by Ming Jiang)

historic building categories of Beijing's inner city, ensuring that the number of buildings classified by function had the same proportional relationship as the number of questionnaires and a very high degree of curve fitting. The number of each type of questionnaires reached the fundamental statistical standard of being greater than 35 (Fig. 2.9).

② *The spatial distribution of samples*: Eight categories, including 28 representative historic buildings, were chosen to be investigated and were researched in the field investigation samples. These historic buildings were equally distributed in four regions: the imperial city, central axes, city walls and inner city. The setting of the investigated points, to the greatest extent, considered rationality, representativeness and accessibility, while ten investigated spots of historic buildings were added through online open-ended questionnaires (Fig. 2.10).

(2) **Population characteristics of questionnaires**

The statistics of the respondents' demographic characteristics were performed first, as well as a brief descriptive analysis to the variable structure of the scale (Table 2.8).

According to the 454 shares of valid sample data attained from the questionnaire survey, the demographic features could be summarized as follows.

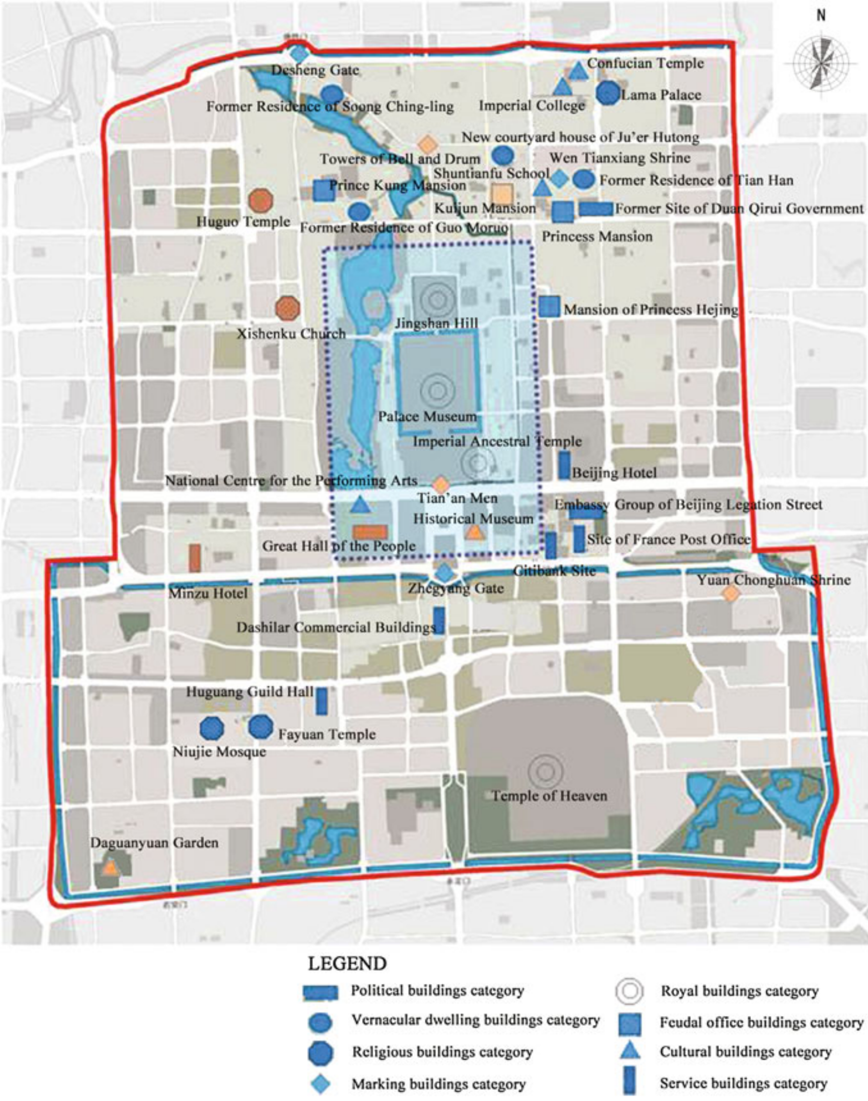

Fig. 2.10 Distribution diagram of the number of investigation spots. The *yellow marks* indicate the supplemented investigated sites online (*Source* Drawing by Ming Jiang)

① *Gender structure*: The gender structure of the samples was basically flat.
② *Age structure*: The age samples were of non-uniform distribution. On the one hand, the distribution of social demographic ages in Beijing was young- and middle-aged-oriented currently; on the other hand, a certain portion of website questionnaires were distributed in this investigation survey, so the young generation was in an absolutely dominant position due to its frequent contact with the internet,

Table 2.8 Analysis of fundamental structural features of the sample data

	Comparative items	Number	%
Gender	1. Male	210	46.3
	2. Female	244	53.7
Age	1. Younger than 20 years old	42	9
	2. 21–30 years old	264	58
	3. 31–40 years old	69	15
	4. 41–50 years old	41	9
	5. 51–60 years old	25	6
	6. 60 years old	13	3
Education status	1. Junior high school or less	25	5
	2. Senior high school or technical secondary school	48	11
	3. Junior college	57	13
	4. Bachelor	186	41
	5. Master	119	26
	6. Doctor or above	19	4
Income	1. Less than 1,000 yuan	159	35
	2. 1,001–3,000 yuan	131	29
	3. 3,001–5,000 yuan	95	21
	4. 5,001–8,000 yuan	46	10
	5. More than 8,000 yuan	23	5
Profession	1. Company employee	110	24
	2. Technician	57	13
	3. Teacher	29	6
	4. Civil servant	28	6
	5. Individual management	24	5
	6. Worker	12	3
	7. Solider	7	2
	8. Peasant	6	1
	9. Student	162	36
	10. Retiree	19	4
Duration of residence in Beijing	1. Less than 1 year	108	24
	2. 1–3 years	84	18
	3. 3–5 years	77	17
	4. 5–10 years	84	19
	5. More than 10 years	102	22

Note The gross sample is 454

which was one of the deficiencies of website investigations and surveys. Young and middle-aged people who played a very significant role in continuing and developing urban memory were the focus group in this urban memory research. Therefore, the age distribution of this sample could be accepted.

③ *Educational structure*: The sampling results showed that the educational background was slightly high, and the people who had bachelor's degree or more education were more than half, which was slightly higher than the actual educational status of today's society. However, considering the research project of historic buildings on which urban memory was borne, the research itself required a certain ability to be understood, so it was normal that the educational status was a slightly high.
④ *Income structure*: The income structure distribution of the samples basically conformed to the pyramid structure of income, showing that people with low and medium income accounted for the great majority, while people with medium and high incomes were fewer. Otherwise, some of the respondents refused to reveal their whole incomes, which might be why the high-income groups were comparatively smaller.
⑤ *Professional structure*: From the aspect of professional structure, students and company employees accounted for the dominant position, which conformed to the age structure as well, while it was relevant to the high degree of compatibility of students.
⑥ *Duration of residence in Beijing*: The samples came from newcomers who had resided in Beijing for less than a year to the old tenants who had resided in Beijing for more than 10 years, so the samples' proportions were uniformly distributed.

2.3.2 Analysis of the Constitutive Elements

To realize the comprehensiveness of the research as much as possible and to achieve the overall measurement of various influential factors of the urban memory of historic buildings, 50 observational variables were established in the stage of research and design, aimed at the constitutive elements of urban memory of historic buildings, but there might have been a strong relationship among individual variables, resulting in the inaccuracy of statistical analysis. Thus, we studied the dependence relationship between these 50 variables through factor analysis, deleted variances and extracted the data structure denoted by several factors to reflect accurately the important information denoted by numerous observational variables.

(1) **Test for the factor elements**

① **Test for factor analysis applicability**

Before starting factor analysis, KMO and Bartlett's test of sphericity were first conducted. Using SPSS, the KMO numerical value of fifty observational variables was calculated as 0.848 (Table 2.9). On the basis of KMO docimastic theory, when

Table 2.9 KMO and Bartlett's test

Kaiser–Meyer–Olkin measure of sampling Adequacy		0.848
Bartlett's test of sphericity	Approx. Chi-Square	7333.497
	Df	1225
	Sig.	0.000

the numerical value of KMO is less than 0.5, the PCA (principal component analysis) is unfit to be performed; when greater than 0.6, it indicates a "mediocre effect"; when greater than 0.7, it indicates "moderately suitable"; and when greater than 0.8, it indicates "sound effect".[2] Because the KMO numerical value of the current data was greater than 0.8, it was quite suitable for PCA (principal component analysis). According to Bartlett's test results[3] ($P \leq 0$), the test for the applicability of factor analysis was passed.

② The deletion and extraction of factors

Factor analysis was conducted on the basis of 454 pieces of sample data by means of PCA (principal component analysis). Transforming these 50 original variables into another group of irrelevant variables by active transformation, these variables were then ranked in successively diminishing sequences of variance, choosing the principal components with characteristic values equal to or greater than 1 as initial factors and omitting the principal elements with characteristic values less than 1 to guarantee that the retained common factor could at least explain the variance of one variable. From the aspect of characteristic root and accumulated variance contribution rates in Table 2.10, the contribution rate of the first 15 factors was 62.917 %. The Scree plot (Fig. 2.11) also showed that the variation of the first 5 factors' characteristic value was the most obvious, and the first 15 factors represented the basic constitutional tendency of the diagram, while the afterward tendency tended to be stable. It indicates that these 15 factors play significant roles in describing the original variable attributes.

Factor rotation to the original 50 variables was performed by adopting variance maximum methods. We analyzed the loading numerical value in the rotated factor loading matrix, as in Table 2.11, and we extracted the observational variables with factor loadings greater than 0.5. Because the factor loadings of these eight factors, including historical relic grades, the overall perception, audiovisual materials, on-site findings, visit and sightseeing, religious pilgrimage and other activities, were less than 0.5, they were deleted.

Deletion was performed in the same manner six times, after which all of the variables with factor loading absolute values less than 0.5 or with differences between two factors less than 0.02 were all deleted. The KMO numerical value in each time was greater than 0.8, and each observational variable was explained by one factor. From the characteristic root and accumulated variance contribution rates

[2]The value of KMO measurement used to compare the relative sizes of simple correlation coefficient and partial correlation coefficient among the observational variables ranges from 0 to 1. Generally, the nearer it is to 1, the more suitable it is for observational variables to be conducted the factor analysis.

[3]Bartlett's test is a type of statistical test performing by taking the correlation coefficient matrix of variables as the starting point. If the statistical magnitude is greater, and the corresponding concomitant probability value is less than the significant level set by users, it could be decided that the correlation coefficient matrix is possibly not a unit matrix, so it is suitable to conduct factor analysis; otherwise, it is not.

Table 2.10 The characteristic root and accumulated variance contribution rate of factor analysis

	Initial characteristic root			Disjunction of common factor variance			Rotating common factor variance		
Principal component	Characteristic root	Variance (%)	Accumulated variance value (%)	Characteristic root	Variance (%)	Accumulated variance value (%)	Characteristic roots	Variance (%)	Accumulated variances value (%)
1	8.87664	17.7533	17.7533	8.87664	17.7533	17.7533	3.71112	7.42224	7.42224
2	3.0305	6.06101	23.8143	3.0305	6.06101	23.8143	3.69919	7.39838	14.8206
3	2.46695	4.9339	28.7482	2.46695	4.9339	28.7482	3.22073	6.44147	21.2621
4	2.22072	4.44145	33.1896	2.22072	4.44145	33.1896	2.60194	5.20388	26.466
5	1.80431	3.60863	36.7983	1.80431	3.60863	36.7983	2.36401	4.72802	31.194
6	1.65577	3.31154	40.1098	1.65577	3.31154	40.1098	2.14046	4.28091	35.4749
7	1.50228	3.00455	43.1144	1.50228	3.00455	43.1144	2.10116	4.20232	39.6772
8	1.46682	2.93364	46.048	1.46682	2.93364	46.048	1.7317	3.46339	43.1406
9	1.39642	2.79283	48.8408	1.39642	2.79283	48.8408	1.66944	3.33887	46.4795
10	1.34687	2.69375	51.5346	1.34687	2.69375	51.5346	1.55881	3.11763	49.5971
11	1.22026	2.44053	53.9751	1.22026	2.44053	53.9751	1.44698	2.89396	52.4911
12	1.20919	2.41837	56.3935	1.20919	2.41837	56.3935	1.43058	2.86116	55.3522
13	1.15921	2.31842	58.7119	1.15921	2.31842	58.7119	1.34253	2.68505	58.0373
14	1.07237	2.14475	60.8566	1.07237	2.14475	60.8566	1.29003	2.58007	60.6173
15	1.0302	2.0604	62.917	1.0302	2.0604	62.917	1.14985	2.29971	62.917

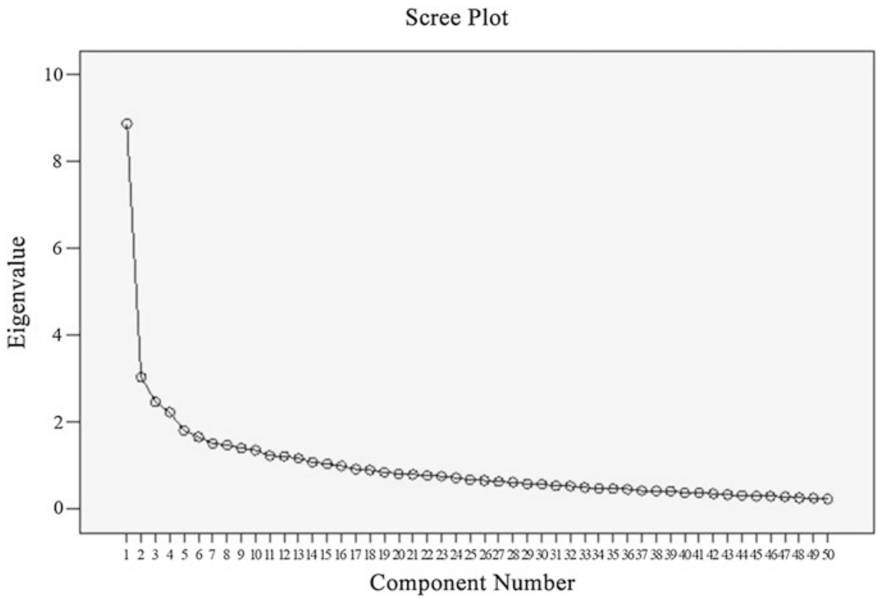

Fig. 2.11 Common factor scree plot of urban memory of historic buildings in Beijing's inner city (characteristic root is greater than 1) (*Source* Drawing by Ming Jiang)

in Table 2.12, the variance contribution rates of the first 9 factors of 29 observational variables remained in the end as high as 63.47 %. The reliability of the 29 variables was obviously enhanced (Table 2.13).

(2) **Model analysis based on factor analysis**

From the factor loading matrix of the 29 rotated observational variables, the meaning of the factors after rotation became clearer, and the unnecessary repeated variables were deleted. In addition, the real meanings of the majority of the variables were taken into account, and the variable models of urban memory were adjusted and amended. The level-two variables of nine principal components were nominated as well; thus, the level-three variables of urban memory models were at last produced (Table 2.14).

① Object–Time memory model

According to the results of factor analysis, Object–Time memory was composed of the first principal component, scene elements, including six observational variables (exterior appearance and color, structural and technical design, construction application, historical relic value, geographical indication, and impression formation), the second principal component, construction elements, including five observational variables (geographical location, construction age, architectural type, architectural scale, and historical function), and the eighth principal component, style elements, including two observational variables (preservation status and style

Table 2.11 Matrix of the factor loading after rotation (50 observational variables before deletion)

Observational variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Geographical location			0.6873												
Peripheral environment				0.5063											
Style unification								0.7695							
Construction age			0.631												
Architectural type			0.7002												
Architectural scale			0.7642												
~~Historic relic grade~~															
Historical function			0.5865												
Preservation status								0.6592							
~~Overall perception~~															
Exterior appearance and color	0.7139														
Structural and technical design	0.7573														
Construction application	0.6423														
Historical relic value	0.6864														
Story and legend	0.5296														
Functional change														0.5029	
Name replacement		0.6169													

(continued)

Table 2.11 (continued)

Observational variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Remaining place name						0.5886									
Iconic identification					0.529										
Cultural feature					0.5831										
Geographical indication						0.6904									
~~Audiovisual material~~															
Literal material		0.8058													
Literary works		0.7591													
Dictated material		0.7152													
Travelling note												0.6824			
~~Photographic record~~															
Souvenir									0.5921						
Experience narration											0.6776				
Scene in sight					0.7404										
Image association					0.6705										
Story association					0.5152										
Guide sign				0.5598											
Mental feeling				0.6365											
Travelling impression				0.6078											

(continued)

Table 2.11 (continued)

Observational variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
~~On site finding~~															
Activity participation										0.7847					
Guider's interpretation													0.5361		
Sign interpretation							0.5579								
Browsing through material												0.7974			
~~Visit and sightseeing~~															
Shopping									0.7079						
~~Religious worship~~															
Cuisine tasting									0.7621						
Performance watching										0.7752					
Knowledge learning							0.6178								
Atmosphere feeling							0.6345								
Leisure and sports															0.8758
~~Other activities~~															
Activity space				0.5158											

Table 2.12 The characteristic root and accumulated variance contribution rate of factor analysis after deletion

	Initial characteristic root			Extracting common factor variance			Rotating common factor variance		
Principal component	Characteristic root	Variance (%)	Accumulated variance value (%)	Characteristic root	Variance (%)	Accumulated variance value (%)	Characteristic root	Variance (%)	Accumulated variance value (%)
1	6.270429	21.62217	21.62217	6.270429	21.62217	21.62217	3.29941	11.37728	11.37728
2	2.46514	8.500483	30.12265	2.46514	8.500483	30.12265	2.897143	9.99015	21.36743
3	1.814812	6.257972	36.38062	1.814812	6.257972	36.38062	2.560947	8.830852	30.19828
4	1.534899	5.292757	41.67338	1.534899	5.292757	41.67338	1.919352	6.618455	36.81673
5	1.460862	5.037455	46.71084	1.460862	5.037455	46.71084	1.755791	6.054451	42.87118
6	1.362661	4.69883	51.40967	1.362661	4.69883	51.40967	1.737477	5.9913	48.86248
7	1.299071	4.479555	55.88922	1.299071	4.479555	55.88922	1.454765	5.01643	53.87891
8	1.134515	3.91212	59.80134	1.134515	3.91212	59.80134	1.399731	4.826659	58.70557
9	1.065735	3.674948	63.47629	1.065735	3.674948	63.47629	1.383507	4.770714	63.47629

Table 2.13 Matrix of the factor loading after rotation (29 observational variables before deletion)

Observational variables	1	2	3	4	5	6	7	8	9
Exterior appearance and color	0.7562								
Structural and technical design	0.7891								
Construction application	0.7017								
Historical relic value	0.7233								
Geographical indication	0.5528								
Travelling impression	0.5265								
Geographical location		0.7381							
Construction age		0.68							
Architectural type		0.733							
Architectural scale		0.7522							
Historical function		0.5857							
Name replacement			0.587						
Literal material			0.8212						
Literary works			0.8306						
Dictated material			0.6798						
Iconic identification				0.8399					
Cultural feature				0.771					
Travelling note					0.5913				
Sign interpretation					0.6123				
Knowledge learning					0.7155				
Atmosphere feeling					0.6081				
Image association						0.7898			
Story association						0.7548			

(continued)

Table 2.13 (continued)

Observational variables	1	2	3	4	5	6	7	8	9
Activity participation							0.8244		
Performance watching							0.806		
Preservation status								0.7263	
Style unification								0.7659	
Shopping									0.7246
Cuisine tasting									0.8249

Table 2.14 The level-three variables of urban memory models with historic buildings in Beijing's inner city as the object

Memory model	Principal components	Observational variables
Object–Time (O–T)	1. Scene elements	(1) Exterior appearance and color (2) structural and technical design (3) construction application (4) historical relic value (5) geographical sign (6) travelling impression
	2. Construction elements	(1) Geographical location (2) construction age (3) architectural type (4) architectural scale (5) historical function
	8. Style elements	(1) Preservation status (2) style unification
Time–Subject (T–S)	3. Symbol elements	(1) Name replacement (2) literal material (3) literary works (4) dictated material
	4. Distinctive elements	(1) Iconic identification (2) cultural feature
	5. Feeling elements	(1) Traveling note (2) sign interpretation (3) knowledge learning (4) atmosphere feeling
Object–Subject (O–S)	6. Associative elements	(1) Image association (2) story association
	7. Participation elements	(1) Activity participation (2) performance watching
	9. Experience elements	(1) Shopping (2) cuisine tasting

unification). The following paragraphs provide a statistical analysis of the three principal components (thirteen observational variables), and the memory model of construction O–T (Object–Time) is as follows.

$$\mathrm{I}_{\mathrm{P-T}} = \sum_{n=1}^{6} \frac{A_n}{N_\lambda} + \sum_{k=1}^{5} \frac{B_k}{N_\lambda} + \sum_{r=1}^{2} \frac{C_r}{N_\lambda} \quad (2.2)$$

Formula 2.2: The Object–Time memory model

In this memory model of Formula 2.2, $\mathrm{I}_{\mathrm{P-T}}$ represents the memory evaluation score; A_n represents the sum of memory scores; B_k represents the sum of memory scores for the construction elements; C_r represents the sum of memory scores for the style elements; n = 1, 2, 3, 4, 5, 6; k = 1, 2, 3, 4, 5; r = 1, 2; N_λ represents the number of questionnaires for certain types of architecture. The specific value of the sum of A_n, B_k, C_r and the number of questionnaires is named as weight. There are altogether 13 variables for $\mathrm{I}_{\mathrm{P-T}}$, the total score of which is 65.

Object–Time memory demonstrates people's memory situation for objective characteristics. The eight categories of historic buildings in Beijing's inner city, classified by function, were scored according to the O–T memory model (Fig. 2.12), with the average score being 47.66. As categories, the royal buildings, the feudal office buildings, the cultural buildings, the religious buildings as well as the political buildings exhibit greater-than-average scores, while the service buildings, the marking buildings as well as the vernacular dwelling buildings have scores that are far below the average. Furthermore, the observation can be made that

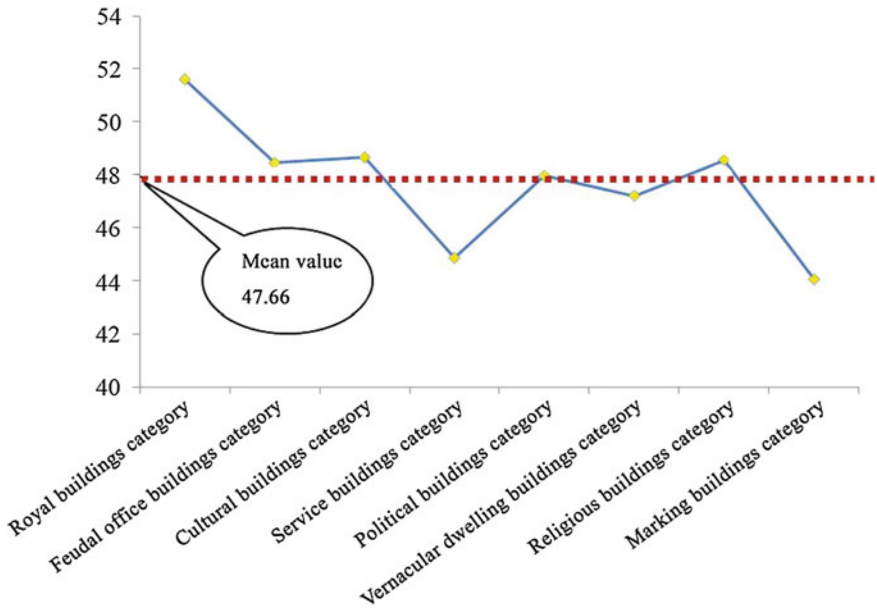

Fig. 2.12 Object–Time memory score (*Source* Drawing by Ming Jiang)

the historic buildings whose scores are above average are generally of great scale and obvious appearance, which leaves people a higher degree of distinctive and impressive scenarized memory. While the architectures of the vernacular dwelling buildings category and the service buildings category, etc. are usually hard to impress people only by its appearance characteristics.

According to Object–Time memory model, taking the memory model scores for different types of historic buildings as the sample data, the three component indexes of Object–Time memory—scene elements, construction elements, and style elements—can be applied as observational variables for a new round of factor analysis. In this factor analysis, the number of setting factors chosen is two, and the factor score coefficient matrix must be displayed by means of orthogonal rotation.

From the factor score coefficient matrix (Table 2.15) and the loading diagram obtained after orthogonal rotation (Fig. 2.13), it is evident that the scene elements and the construction elements consist of the first principal component, while the style elements consists of the second principal component. The factor molecular results are drawn in a coordinate graph (Fig. 2.14), in which the first quadrant contains the architectural types that have positive grades for the scene elements, the construction elements, as well as the style elements. This quadrant includes the subcategories of the imperial festival buildings, the feudal official buildings, the cultural and educational buildings as well as the home-grown religious buildings. However, none of the actual factor scores for these four categories of architecture is beyond 1, which indicates that their characteristics are not distinctive even though

Table 2.15 Factor score coefficient matrix after rotation of Object–Time memory

	Component	
	1	2
Scene elements	0.820	
Construction elements	0.838	
Style elements		0.954

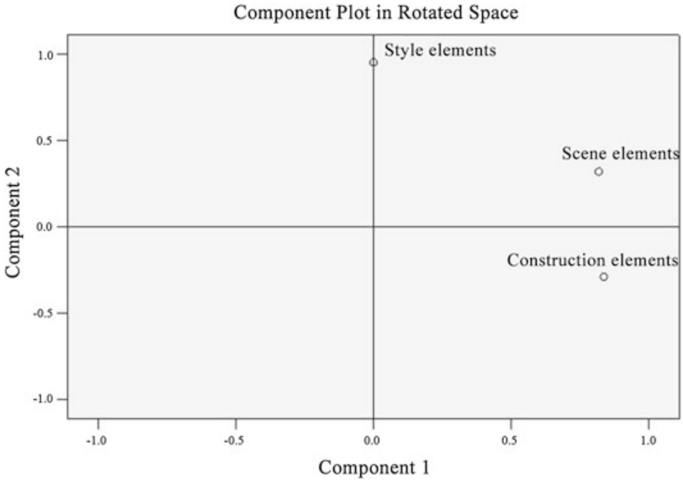

Fig. 2.13 The loading diagram after orthogonal rotation of Object–Time memory (*Source* Drawing by Ming Jiang)

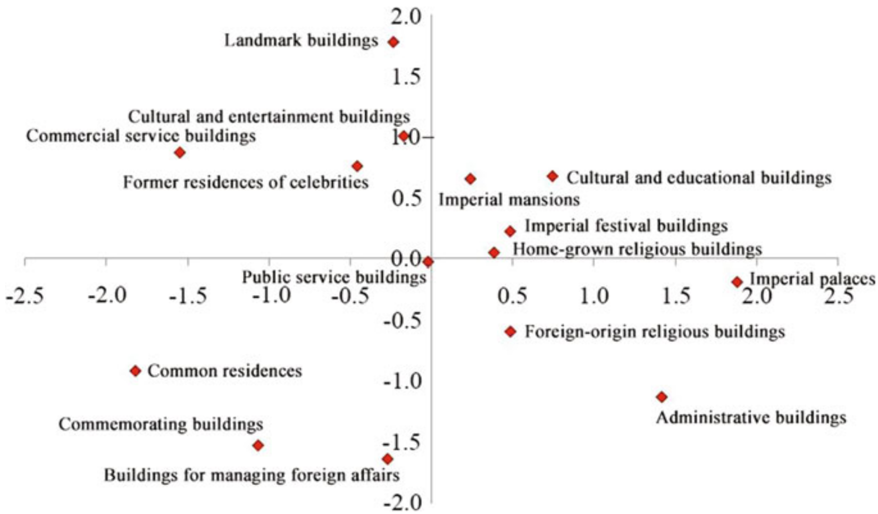

Fig. 2.14 Model factor score coordinate graph of Object–Time memory (*Source* Drawing by Ming Jiang)

they all have positive evaluations. The second quadrant contains the architectural types with negative evaluations for scene elements and construction elements, but positive evaluations for style elements. The style elements in this quadrant include the subcategories of the former residences of celebrities, the commercial service buildings, the landmark buildings, and the cultural and entertainment buildings, which indicate that the preservation status of these four subcategories is better and the styles are comparatively unified, but the overall architectural landscape is not very distinctive. The third quadrant contains the architectural types with negative evaluations for scene elements, construction elements and style elements, including the vernacular dwelling buildings, the commemorative buildings, the buildings for managing foreign affairs as well as the public service buildings. The scores for the commemorative buildings and the vernacular dwelling buildings are negative, indicating that the three characteristics are not very obvious in them. The fourth quadrant contains the architectural types with positive evaluations for the scene elements and construction elements, but negative evaluations for the style elements, which includes the imperial palaces, the foreign-origin religious buildings, the administrative buildings, indicating that their scene characteristics are strong. However, the discrepancies between them and the peripheral buildings are great, and the styles are not quite unified.

② **Time–Subject memory model**

According to the results of factor analysis, Time–Subject memory is composed of the third principal component, the symbol elements (including the four observational variables of name replacement, literal material, literary works, and dictated material), the fourth principal component, the distinctive elements (including the two observational variables of iconic identification and cultural feature), and the fifth principal component, the feeling elements (including the four observational variables of traveling note, sign interpretation, knowledge learning, and atmosphere feeling). The following paragraphs provide the statistical analysis of these three principal components and ten observational variables, and Time–Subject memory model is as follows.

$$\mathrm{I}_{\mathrm{T-P}} = \sum_{n=1}^{4} \frac{\mathrm{C_n}}{N_\lambda} + \sum_{k=1}^{2} \frac{\mathrm{D}_k}{N_\lambda} + \sum_{r=1}^{4} \frac{\mathrm{E_r}}{N_\lambda} \tag{2.3}$$

Formula 2.3: The Time–Subject memory model

In this memory model of Formula 2.3, $\mathrm{I}_{\mathrm{T-P}}$ represents the memory evaluation score; C_n represents the sum of memory scores; D_k represents the sum of memory scores for the distinctive elements; E_r represents the sum of memory scores for the feeling elements, among which, n = 1, 2, 3, 4; k = 1, 2, 3, 4; and N_λ represents the number of questionnaires of a certain type of buildings. The specific value between the sum of C_n, D_k, E_r and the number of questionnaires is used as weight. $\mathrm{I}_{\mathrm{T-P}}$ has a total of 10 variables, the total scores of which are 50.

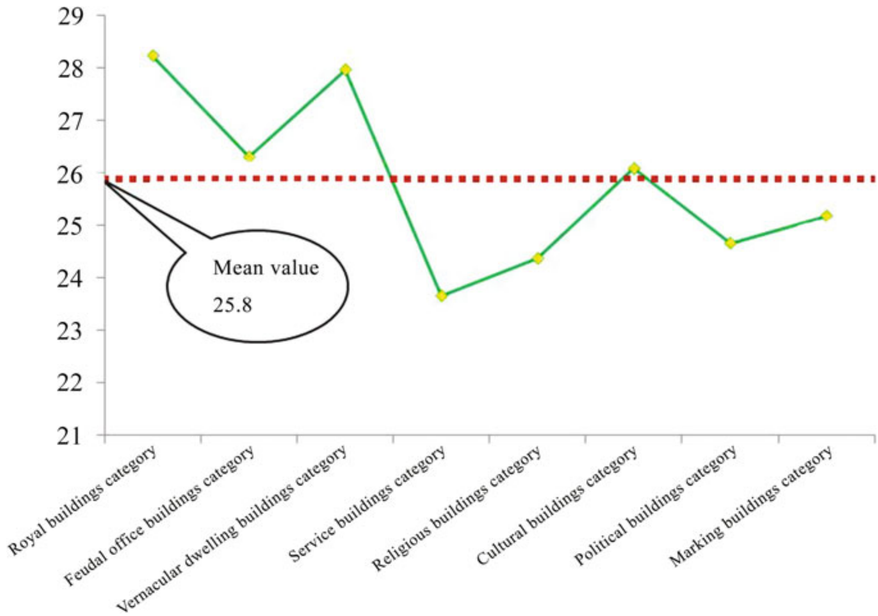

Fig. 2.15 Time–Subject memory score (*Source* Drawing by Ming Jiang)

Time–Subject memory is a summarizing and abstract memory method that people use for evaluating historic buildings and is a type of knowledge memory. The eight categories of historic buildings in Beijing's inner city, classified by functions, were scored according to the T–S memory model (Fig. 2.15). The average score was 25.8. As categories, the royal buildings, the feudal office buildings, the cultural buildings, as well as the vernacular dwelling buildings exhibit above-average scores, while the service buildings, the political buildings, the religious buildings, and the marking buildings are the opposite. These results indicate that people have more knowledge memories on the literary inscriptions of the historic buildings with rich cultural deposits, but people's knowledge memory for the daily life buildings (such as the service buildings and the political buildings) have not yet been aroused.

On the basis of Time–Subject memory model, taking the memory model scores of different types of historic buildings as the sample data, the three component indexes of Time–Subject memory—symbol elements, distinctive elements, and feeling elements—can be applied as observational variables for a new round of factor analysis. In this factor analysis, the number of setting factors chosen is 2, and the factor score coefficient matrix must be displayed by means of orthogonal rotation.

From the factor score coefficient matrix (Table 2.16) and the loading diagram obtained after orthogonal rotation (Fig. 2.16), it is evident that the symbol elements and the feeling elements consist of the first principal component, while the

Table 2.16 Factor score coefficient matrix after rotation of Time–Subject memory

	Component	
	1	2
Symbol elements	0.887	
Distinctive elements		0.988
Feeling elements	0.872	

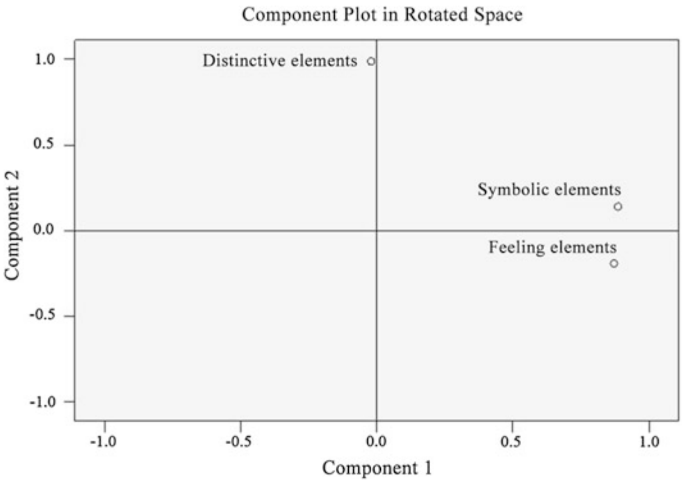

Fig. 2.16 The loading diagram after orthogonal rotation of Time–Subject memory (*Source* Drawing by Ming Jiang)

distinctive elements consists of the second principal component. The factor molecular results are drawn in a coordinate graph (Fig. 2.17), in which the first quadrant contains the architectural types that have positive evaluations for the symbol elements, the feeling elements, as well as the distinctive elements, including the imperial palaces, the cultural and educational buildings, and the administrative buildings. In particular, the results for the imperial palaces, whose actual scores for the two factors are above 1, indicate that people have many memories about the imperial palaces related to literal and symbolic materials. Additionally, they have good knowledge about the characteristics of their cultural images and have learned certain relevant historical knowledge. The second quadrant contains the architectural types with negative evaluations for the symbol elements and the feeling elements, but positive evaluations for the distinctive elements, including the commercial service buildings, the landmark buildings, the foreign-origin religious buildings, the home-grown religious buildings as well as the imperial festival buildings. The characteristics of the commercial service buildings and the landmark buildings are especially obvious, indicating that people have a clear understanding

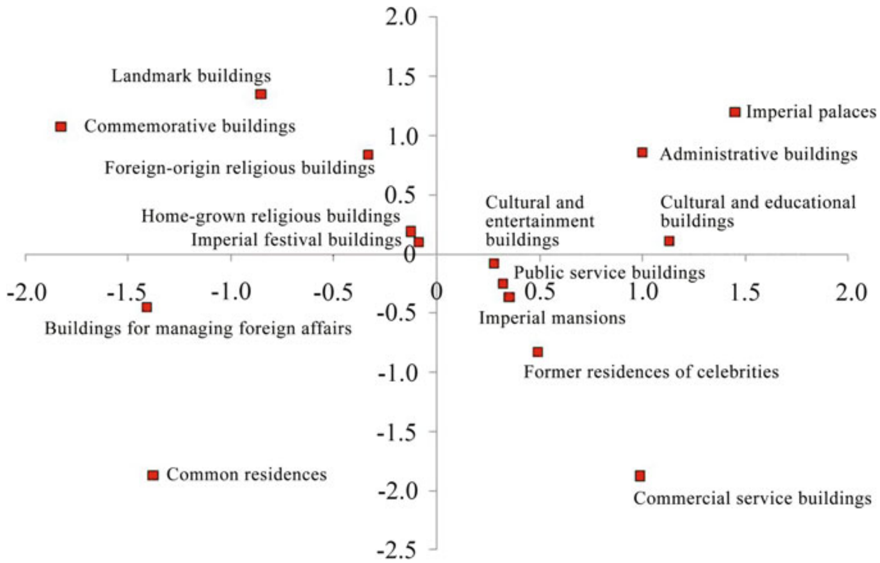

Fig. 2.17 Model factor score coordinate graph of Time–Subject memory (*Source* Drawing by Ming Jiang)

about their images and characteristics, but have less literal–materials and historical knowledge. The third quadrant contains the architectural types with negative evaluations for the symbol elements, the feeling elements and the distinctive elements, including the buildings for managing foreign affairs and the common residences, indicating that the historical records for these two categories of buildings are fewer, and the cultural features are not very distinctive. Additionally, the memory level for the symbol elements is worse. The fourth quadrant contains the architectural types with positive evaluations for the symbol elements and the feeling elements, but negative evaluations for the distinctive elements, including the former residences of celebrities, the commemorative buildings, the cultural and entertainment buildings, the public service buildings and the imperial mansions. The characteristics of the former residences of celebrities and the imperial mansions are comparatively obvious, with greater contrasts, indicating that people's knowledge records and learning activities about them are richer, but people can still not truly master their cultural features.

③ Object–Subject memory model

According to the results of factor analysis, Object–Subject memory is composed of the sixth principal component, the associative elements (including the two observational variables of image association and story association), the seventh principal component, the participation elements (including the two observational variables of activity participation and performance watching), and the ninth principal component, the experience elements (including the two observational variables of shopping and cuisine tasting). The following paragraphs present the statistical analysis of these three principal components, and Object–Subject memory model is as follows.

$$I_{P-P} = \sum_{i=1}^{4} \frac{F_i}{N_\lambda} + \sum_{i=1}^{4} \frac{M_i}{N_\lambda} + \sum_{i=1}^{4} \frac{G_i}{N_\lambda} \quad (2.4)$$

Formula 2.4: The Object–Subject memory model

In this memory model of Formula 2.4, I_{P-P} represents the memory evaluation score of Object–Subject; F_i represents the sum of memory scores for the associative elements; M_i represents the sum of memory scores for the participation elements; G_i represents the sum of memory scores for the experience elements, among which, n = 1, 2, 3, 4; and N_λ represents the number of questionnaires of a certain type of buildings. The specific value between the sum of F_i, M_i, N_i and the number of questionnaires is used as weight. I_{P-P} has a total of 10 variables, the total scores of which are 30.

Through people's direct and real experiences of the historic buildings, Object–Subject memory was deepened in terms of memory process and developed into stable impressions and habits. The eight categories of historic buildings in Beijing's inner city, classified by function, were scored according to the O–S memory model, with the average score being 9.73 (Fig. 2.18). The scores for the categories of service buildings and religious buildings are the best, indicating that the participatory activities and ceremonies in the service and religious categories are increasing, and the feelings they bring to the buildings are comparatively

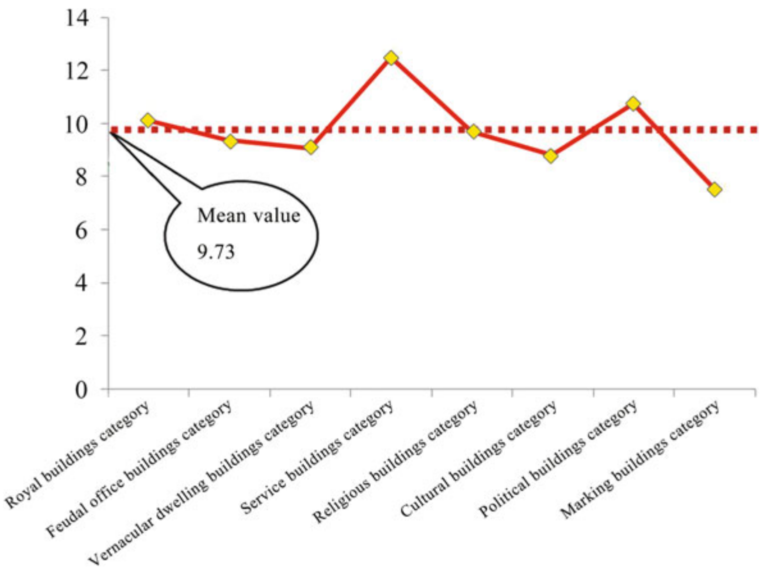

Fig. 2.18 Object–Subject memory score (*Source* Drawing by Ming Jiang)

audio-visual, so people can deepen their memories through the experience and participation process.

On the basis of Object–Subject memory model, taking the memory model scores of different types of historic buildings as the sample data, the three component indexes of Object–Subject memory—the associative elements, the participation elements and the experience elements—can be applied as observational variables for a new round of factor analysis. In this factor analysis, the number of setting factors chosen is 2, and the factor score coefficient matrix must be displayed by means of orthogonal rotation.

From the factor score coefficient matrix (Table 2.17) and the loading diagram obtained after orthogonal rotation (Fig. 2.19), it is evident that the associative elements and the participation elements consist of the first principal component, while the experience elements consists of the second principal component. The factor molecular results are drawn in a coordinate graph (Fig. 2.20), in which the first quadrant contains the architectural types with positive evaluations for the associative elements, the participation elements, as well as the experience elements, including the foreign-origin religious buildings and the public service buildings, indicating that the experiencing activities, the cultural performances and ceremonies of these two

Table 2.17 Factor score coefficient matrix after rotation of Object–Subject memory

	Component	
	1	2
Associative elements	0.864	
Participation elements	0.913	
Experience elements		0.986

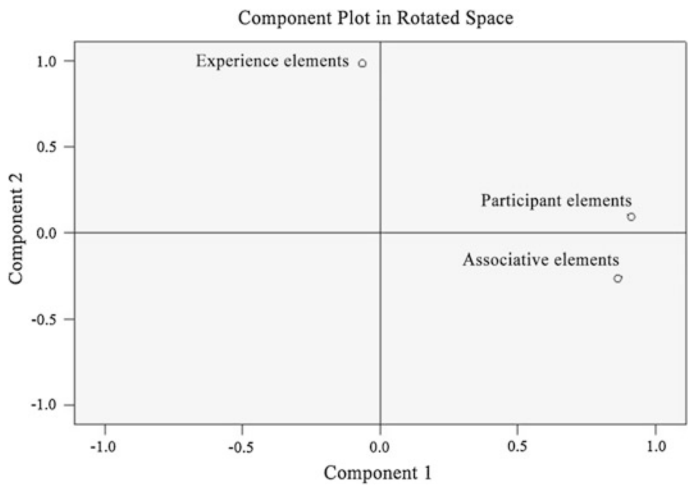

Fig. 2.19 The loading diagram after orthogonal rotation of Object–Subject memory (*Source* Drawing by Ming Jiang)

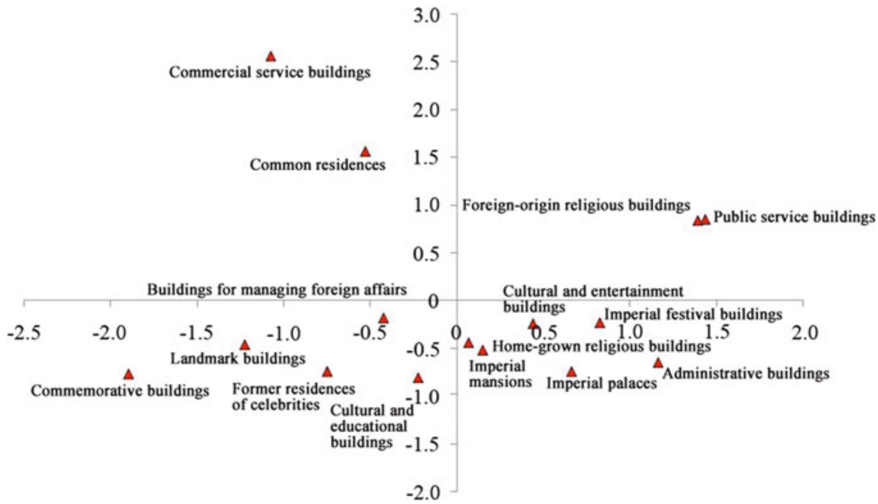

Fig. 2.20 Model factor score coordinate graph of Object–Subject memory (*Source* Drawing by Ming Jiang)

types of buildings, are more numerous, and the property of participation is comparatively better. Additionally, the memorability produced by people's participation in activities is much stronger. The second quadrant contains the architectural types with negative evaluations for the associative elements and the participation elements, but positive evaluations for the experience elements, including the commercial service buildings and the common residences. These results indicate that the activities and performances as well as other performing experiences related to these two types of buildings are fewer, but people's actual experiences from shopping and cuisine tasting are more numerous. The third quadrant contains the architectural types with negative evaluations for the associative elements, the participation elements, as well as the experience elements, including the commemorative buildings, the former residences of celebrities, the cultural and educational buildings, as well as the buildings for managing foreign affairs. These results indicate that the experience and participatory activities related to these types of buildings are fewer; thus, they cannot bring people the associative and experience memorial feelings. The fourth quadrant contains those architectural types with positive evaluations for the associative elements and the participation elements, but negative evaluations for the experience elements, including the imperial palaces, the imperial festival buildings, the administrative buildings, the feudal office buildings, the home-grown religious buildings, as well as the cultural and entertainment buildings. These results indicate that Object–Subject memory related to these buildings are generated from the performing activities and stories, and image association, and people's individual experiences are comparatively less influential.

By means of factor analysis, the principal components of the 50 observational variables that exert influence on the level of urban memory for historic buildings were analyzed using extraction and deletion. Thus, 29 observational variables from the results were reserved, and they were classified and explained on the basis of the 9 factors. Finally, the level-three variables was generated. According to the classification of urban memory indicator system, the Object–Time, the Time–Subject, and Object–Subject memory models were established, and after the second round factor analysis of each type, the factor score coordinate graphs for different functional types of historic buildings were produced. These graphs can be divided into 4 quadrants to illustrate the influence that the level-two observational variables have on the memory level for different types of historic buildings.

2.4 Cognitive Results

2.4.1 Influence of Population Characteristics

This section primarily addresses the correlation and changing rules between the population characteristics of evaluators (including gender, age, income, education, profession, and duration of residence in Beijing) and the variables of urban memory. The Pearson's correlation coefficient is first utilized to explore the existence of simple correlations between specific population characteristics and memory variables. For the variables exhibiting correlations, one-way analysis of variance (ANOVA) is used to examine whether the interaction effect is obvious. For factors with an obvious effect, the S–N–K method can be utilized to compare any two factors, identify the factors with obvious significance and determine the changing rules under different scales.

(1) **Correlation analysis among each element**

This section presents the data analysis conducted by means of Pearson's correlation analysis. Pearson's correlation analysis is not influenced by the variable characteristics, and the resulting values fall between −1 and 1. A negative value generally represents a negative correlation; an absolute value close to 1 usually represents a higher correlation. Generally speaking, if the correlation coefficient's absolute value falls between 0.70 and 0.99, it is considered to be a high correlation; if it falls between 0.40 and 0.69, it is called a moderate correlation; and if it falls between 0.10 and 0.39, it is called a low correlation.

① **Correlation analysis of Object–Time memory**

Based on the Pearson's correlation analysis, people's duration of residence in Beijing has a significant influence on the construction elements. The correlation coefficient is above 0.01, and the significance level is 0.289, which is regarded as a low correlation. No obvious correlation exists among the scene elements, the style elements and tourists' gender, age, education, profession, the duration of residence in Beijing, etc. (Table 2.18). The inner variables of population characteristics and

Table 2.18 Correlation analysis of Object–Time memory

	Index	Scene elements	Construction elements	Style elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Scene elements	Pearson's correlation									
	Sig. (2-tailed)									
	N									
Construction elements	Pearson's correlation	0.345**								
	Sig. (2-tailed)	0.000								
	N	454								
Style elements	Pearson's correlation	0.301**	0.069							
	Sig. (2-tailed)	0.000	0.141							
	N	454	454							
Gender	Pearson's correlation	0.058	0.003	−0.029						
	Sig. (2-tailed)	0.219	0.948	0.539						
	N	454	454	454						
Age	Pearson's correlation	0.017	0.086	−0.029	−0.126**					
	Sig. (2-tailed)	0.710	0.069	0.538	0.007					
	N	454	454	454	454					
Income	Pearson's correlation	0.066	0.062	−0.014	−0.217**	0.369**				
	Sig. (2-tailed)	0.158	0.186	0.758	0.000	0.000				
	N	454	454	454	454	454				

(continued)

Table 2.18 (continued)

	Index	Scene elements	Construction elements	Style elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Education	Pearson's correlation	0.079	0.066	0.032	−0.013	−0.159**	0.024			
	Sig. (2-tailed)	0.094	0.163	0.493	0.780	0.001	0.606			
	N	454	454	454	454	454	454			
Profession	Pearson's correlation	0.007	−0.042	0.049	0.028	−0.278**	−0.052	0.214**		
	Sig. (2-tailed)	0.878	0.371	0.300	0.545	0.000	0.271	0.000		
	N	454	454	454	454	454	454	454		
Duration of residence in Beijing	Pearson's correlation	0.083	0.289**	−0.077	0.061	0.253**	0.219**	−0.069	−0.061	
	Sig. (2-tailed)	0.078	0.000	0.100	0.192	0.000	0.000	0.141	0.192	
	N	454	454	454	454	454	454	454	454	

Note **Correlation is significant at the 0.01 level (2-tailed) memory elements will be simultaneously analyzed when other elements are investigated, so here they will not be considered (similarly hereinafter). The construction elements include the intrinsic characteristics of historic buildings, such as the geographical location, the construction age, architectural type, architectural function, historical function and other memories. A positive correlation exists between the duration of residence in Beijing and the construction elements because the residents who lived longer in Beijing have more accesses to this type of information and acquisition opportunities are more frequent, which aids in the memorization of this type of simple, objective information.

② Correlation relationships for Time–Subject memory

Based on the Pearson's correlation analysis (Table 2.19), people's age has a significant influence on the symbol elements. The correlation coefficient is above 0.05, and the significance level is 0.1, which is regarded as a low correlation. Residents' age, income, and duration of residence in Beijing have an obvious influence on the distinctive elements; the correlation coefficient for age is above 0.01, and significance level is 0.124, which is regarded as a low correlation; the correlation coefficient for income is above 0.01, and the significance level is 0.150, which is regarded as a low correlation. Meanwhile, the correlation coefficient for duration of residence in Beijing is above 0.01, and the significance level is 0.200, which is regarded as a low correlation. The residents' educational status has significant significance in relation to the feeling elements, with a correlation coefficient above 0.01 and significance level of 0.148, which is also regarded as a low correlation. The residents' professions have a significant influence on the feeling elements, with a correlation coefficient above 0.01 and significance level close to 0.1, which is also regarded as a low correlation.

The symbol elements include the memory of the name replacements of historic buildings, the literal materials, the literary works, as well as the stories and legends. The symbol elements usually exhibits a positive correlation with age, indicating that people have more chances of gaining knowledge with the increase in age, the richer experiences, as well as the inheritance from the previous generations; therefore, the symbolized memories have been gradually accumulated. Much of the intangible cultural heritage of historic buildings is passed on by word of mouth, but with passing away of the elderly people, this intangible information is easily lost; this becomes one of the reasons why Time–Subject memories disappear.

The distinctive elements include iconic identification and cultural feature, and these two variables are usually regarded as a group of comparatively symbolized variables that require certain accumulation and generalization. The age of residents and the duration of residence in Beijing exhibit positive correlations with these variables, indicating that people's cultural experiences are deepening with the passing of time. Furthermore, people's sense of protection for self-cultural features are becoming increasingly distinctive with improvements in income, which can also indicate that the poverty-stricken areas are short of capital for the protection and repair of historic buildings; therefore, their own culture is becoming more susceptible to cultural invasion. The developed areas have enough capital for the

Table 2.19 Correlation analysis of Time–Subject memory

Correlations

	Index	Symbol elements	Distinctive elements	Feeling elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Symbol elements	Pearson's correlation									
	Sig. (2-tailed)									
	N									
Distinctive elements	Pearson's correlation	0.799**								
	Sig. (2-tailed)	0.000								
	N	454								
Feeling elements	Pearson's correlation	0.068	0.044							
	Sig. (2-tailed)	0.148	0.347							
	N	454	454							
Gender	Pearson's correlation	0.026	0.001	0.082						
	Sig. (2-tailed)	0.584	0.979	0.082						
	N	454	454	454						
Age	Pearson's correlation	0.099*	0.124**	−0.019	−0.126**					
	Sig. (2-tailed)	0.036	0.008	0.692	0.007					
	N	454	454	454	454					

(continued)

Table 2.19 (continued)

Correlations

	Index	Symbol elements	Distinctive elements	Feeling elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Income	Pearson's correlation	0.074	0.150**	0.039	−0.217**	0.369**				
	Sig. (2-tailed)	0.114	0.001	0.412	0.000	0.000				
	N	454	454	454	454	454				
Education	Pearson's correlation	0.042	−0.055	0.148**	−0.013	−0.159**	0.024			
	Sig. (2-tailed)	0.369	0.244	0.002	0.780	0.001	0.606			
	N	454	454	454	454	454	454			
Profession	Pearson's correlation	−0.075	−0.085	0.097*	0.028	−0.278**	−0.052	0.214**		
	Sig. (2-tailed)	0.109	0.071	0.039	0.545	0.000	0.271	0.000		
	N	454	454	454	454	454	454	454		
Duration of residence in Beijing	Pearson's correlation	0.069	0.200**	−0.034	0.061	0.253**	0.219**	−0.069	−0.061	
	Sig. (2-tailed)	0.144	0.000	0.465	0.192	0.000	0.000	0.141	0.192	
	N	454	454	454	454	454	454	454	454	

Note *Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

protection of historic buildings, and they also pay more attention to the protection of cultural features as well as the reshaping of iconic identification.

The feeling elements, including sign interpretation, travelling notes, knowledge learning and other variables, deepen residents' memory processes by means of initiative learning. Educational status exhibits a positive correlation with the feeling elements, indicating that people with a higher educational status are better at learning and deepening their Time–Subject memories through initiative study. In the category of profession, the scores of professions that require a higher degree of knowledge, such as teachers, civil servants, technicians, and students are higher, demonstrating a similar correlation with educational status.

③ Correlation analysis of Object–Subject memory

Based on the Pearson's correlation analysis, residents' educational status and profession have significant influences on the associative elements. The correlation coefficient for the former is above 0.01, and the significance level is 0.182, which is regarded as a low correlation; meanwhile, the correlation coefficient for the latter is above 0.05, and the significance level is 0.104, which is also regarded as a low correlation. Residents' income and educational status have obvious influences on the participation elements. The correlation coefficient for income is above 0.01, and the significance level is 0.149, which is regarded as a low correlation; the correlation coefficient for educational status is above 0.01, and the significance level is 0.143, which is regarded as a low correlation. The correlation coefficient for residents' educational status and duration of residence in Beijing has significant influences on the participation elements. The correlation coefficient for educational status is above 0.05, and the significance level is 0.111, which is regarded as low a correlation. The correlation coefficient for the duration of residence in Beijing is above 0.01, and the significance level is 0.157, which is also regarded as a low correlation. The details are shown in Table 2.20.

The associative elements include residents' competence for remembering the historic buildings by looking at pictures and listening to stories and legends. With increases in educational status, people's field of vision is broadened, and thus their relevant associative memories are enriched accordingly. Meanwhile, the profession elements also demonstrates a relationship that is similar to educational status.

The participation elements include the opportunities for people to participate in activities and watch performances in the historic buildings. Higher incomes generally indicate greater ability to pay for such performances; the higher people's educational status, the higher their enthusiasm becomes, and the greater their chances of watching and participating in performances; in this way, the degree of Object–Subject memory is deepened.

The experience elements include shopping, cuisine tasting and other activities with which the educational status has weak correlation. This weak correlation indicates that the higher people's educational status is, the more their requirements for experiences will become. Meanwhile, the longer their duration of residence in Beijing, the more frequent their experiences will be, and thus their memories can deepen accordingly.

Table 2.20 Correlation analysis of Object–Subject memory

Correlations

	Index	Associative elements	Participation elements	Experience elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Associative elements	Pearson's correlation									
	Sig. (2-tailed)									
	N									
Participation elements	Pearson's correlation	0.636**								
	Sig. (2-tailed)	0.000								
	N	454								
Experience elements	Pearson's correlation	0.135**	0.354**							
	Sig. (2-tailed)	0.004	0.000							
	N	454	454							
Gender	Pearson's correlation	−0.030	0.054	0.086						
	Sig. (2-tailed)	0.526	0.254	0.069						
	N	454	454	454						
Age	Pearson's correlation	−0.006	0.069	−0.013	−0.126**					
	Sig. (2-tailed)	0.898	0.143	0.785	0.007					
	N	454	454	454	454					

(continued)

Table 2.20 (continued)

Correlations

	Index	Associative elements	Participation elements	Experience elements	Gender	Age	Income	Education	Profession	Duration of residence in Beijing
Income	Pearson's correlation	0.046	0.149**	0.014	−0.217**	0.369**				
	Sig. (2-tailed)	0.328	0.001	0.771	0.000	0.000				
	N	454	454	454	454	454				
Education	Pearson's correlation	0.182**	0.143**	0.111*	−0.013	−0.159**	0.024			
	Sig. (2-tailed)	0.000	0.002	0.018	0.780	0.001	0.606			
	N	454	454	454	454	454	454			
Profession	Pearson's correlation	0.104*	0.045	−0.020	0.028	−0.278**	−0.052	0.214**		
	Sig. (2-tailed)	0.027	0.341	0.671	0.545	0.000	0.271	0.000		
	N	454	454	454	454	454	454	454		
Duration of residence in Beijing	Pearson's correlation	0.003	0.076	0.157**	0.061	0.253**	0.219**	−0.069	−0.061	
	Sig. (2-tailed)	0.941	0.104	0.001	0.192	0.000	0.000	0.141	0.192	
	N	454	454	454	454	454	454	454	454	

Note *Correlation is significant at the 0.05 level (2-tailed)
**Correlation is significant at the 0.01 level (2-tailed)

In this section, the six elements of residents' population characteristics (gender, age, income, educational degree, profession, and duration of residence in Beijing) are taken as independent variables, while the nine elements including the scene elements, construction elements, style elements, symbol elements, distinctive elements, feeling elements, associative elements, participation elements and experience elements are taken as dependent variables to carry out the Pearson's correlation analysis. By contrast, the influence that population characteristics have on Object–Time memory is comparatively small; thus, Object–Time memory belongs to the superficial layer of memory, for which discrepancies are not large among different types of people. Meanwhile, Time–Subject memory belongs to a higher layer of knowledge memory, for which the discrepancies among population characteristics such as different ages, incomes, educational statuses and professions are relatively distinct. The memory method of participating and experiencing is considered to be more suitable to the people who have higher incomes and educational statuses. The detailed correlation relationships for respective element are shown in Fig. 2.21. The correlations in this research are generally characterized as low correlations because each individual's understanding competence and memory method is unique. Only some weak general characteristics and correlation relationships can be found in it, and they cannot be considered definitive.

(2) **Analysis of variance of the influence factors**

The basic correlation relationships between the population characteristics and the urban memory elements are obtained through the correlation analysis presented in the previous section. Obviously, correlations with the element "gender" can be neglected, so the other five variables with existing correlation relationships can be utilized to examine whether the influence of the following groups of variables is obvious through one-way analysis of variance (ANOVA) (Table 2.21). The S–N–K

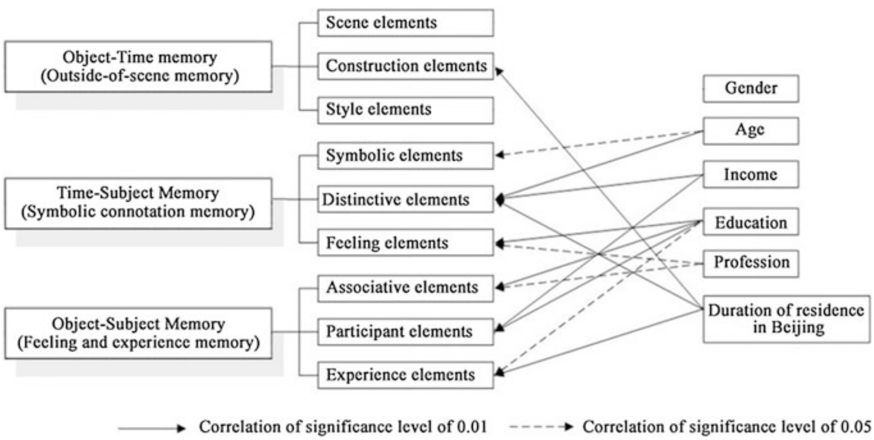

Fig. 2.21 Correlation between population characteristics and urban memory elements (*Source* Drawing by Ming Jiang)

Table 2.21 The variable grouping for one-way analysis of variance (ANOVA)

Independent variables	Dependent variables
Age	Symbol elements, Distinctive elements
Income	Distinctive elements, Participation elements
Education	Feeling elements, Associative elements, Participation elements, Experience elements
Profession	Feeling elements, Associative elements
Duration of residence in Beijing	Construction elements, Distinctive elements, Experience elements

method can be used to compare any two factors with obvious influences to determine which factor has the strongest influence.

① Age

To study whether obvious differences exist between the symbol elements and the distinctive elements among different age groups, one-way analysis of variance (ANOVA) is conducted according to the normalized factor score; if the significance is less than 0.05, significant differences exist. The results are shown in Table 2.22. The significance of the symbol elements is greater than 0.05, indicating that no obvious differences exist; the significance of the symbol elements being less than 0.05, age has an obvious influence on the distinctive elements. To further analyze the influences and differences changing rules of different age groups have on the distinctive elements, the S–N–K comparison and the mean value graph analysis are required.

As is evident from the S–N–K comparison (Table 2.23), the distinctive elements can be divided into two groups that exhibit significant differences in terms of age; ≤20 years old belongs to a group by itself, while 21–30, 31–40, 41–50, 51–60 and >60 belong to another group. From the mean value graph of the distinctive elements (Fig. 2.22), we can see that people's memory level can become more clearly correlated with the characteristics element with the increase in age. The older you become, the more you are able to clearly understand the iconic identification and cultural features of a place. The so-called nostalgia, fallen leaves

Table 2.22 The one-way analysis of variance (ANOVA) for age and urban memory

		Sum of squares	Df	Mean square	F	Sig.
Symbol elements	Between groups	117.772	5	23.554	1.875	0.097
	Within groups	5,629.268	448	12.565		
	Total	5,747.040	453			
Distinctive elements	Between groups	49.915	5	9.983	3.223	0.007
	Within groups	1,387.671	448	3.097		
	Total	1,437.586	453			

Table 2.23 The S–N–K comparison for the distinctive elements

Age	N	Subset for alpha = 0.05	
		1	2
≤20 years old	42	6.43	
21–30 years old	261		7.29
31–40 years old	73		7.49
41–50 years old	41		7.59
51–60 years old	24		7.63
>60 years old	13		8.15
Sig.		1.000	0.279

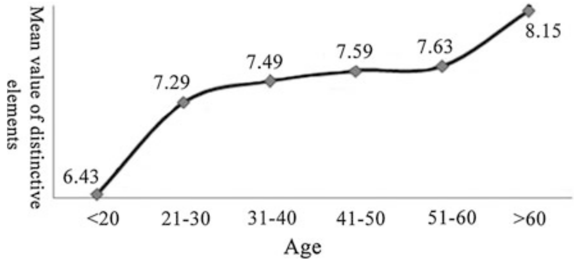

Fig. 2.22 The mean value graph for age and the distinctive elements (*Source* Drawing by Ming Jiang)

returning to the roots, and other descriptions rightly indicate that the older you become, the more distinctive your feelings will become on the emotional characteristics of a place.

② Income

To study whether significant differences exist between the distinctive elements and the participation elements among different income groups, one-way analysis of variance (ANOVA) is conducted on the basis of the normalized factor score; a significance less than 0.05 is usually regarded as indicating significant differences. The results are shown in Table 2.24. The significance for the distinctive elements are greater than 0.05, indicating that no obvious differences exist; the significance of the participation elements being less than 0.05, income has an obvious influence on the participation elements. To further analyze the influences and differences changing rules of different income groups have on the distinctive elements, the S–N–K comparison and the mean value graph analysis are required.

As is evident from the S–N–K comparison (Table 2.25), the memory level of the participation elements becomes more distinctive with an increase in income level. When income reaches a certain level, this correlation tends to stabilize (Fig. 2.23). For the group of people whose incomes are between 5001–8000 and more than 8000, participation preferences and requirements tend to convergence, and no significant differences exist.

Table 2.24 The one-way analysis of variance (ANOVA) for income and urban memory

		Sum of squares	Df	Mean square	F	Sig.
Participation elements	Between groups	40.062	4	10.015	3.218	0.013
	Within groups	1,397.524	449	3.113		
	Total	1,437.586	453			
Distinctive elements	Between groups	46.431	4	10.608	2.264	0.061
	Within groups	2,302.027	449	5.127		
	Total	2,348.458	453			

Table 2.25 The S–N–K comparison for the participation elements

Income	N	Subset for alpha = 0.05
		1
≤1,000	163	6.43
1,001–3,000	129	7.50
3,001–5,000	101	7.50
>8,000	22	7.64
5,001–8,000	39	7.64
Sig.		0.223

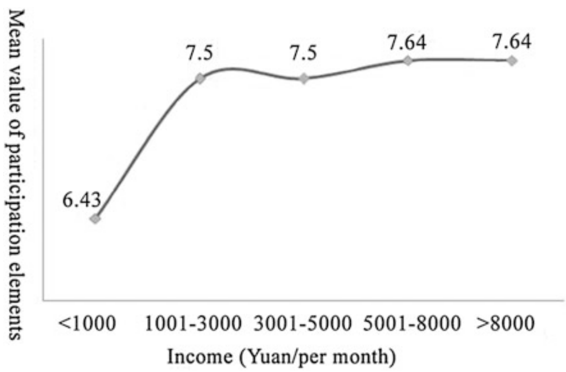

Fig. 2.23 The mean value graph for income and the distinctive elements (*Source* Drawing by Ming Jiang)

③ Education

To study whether obvious differences exist between the feeling elements, the associative elements, the participation elements and the experience elements in different educational statuses, one-way analysis of variance (ANOVA) is conducted according to the normalized factor score. If the significance is less than 0.05, the elements have obvious differences in educational status. Based on the result presented in Table 2.26, the significances of the participation elements and the experience elements are greater than 0.05, indicating that no obvious differences exist. Meanwhile, the significances of the feeling elements and the associative elements are less than 0.05, indicating that educational status has an obvious

Table 2.26 The one-way analysis of variance (ANOVA) for education and urban memory

		Sum of squares	Df	Mean square	F	Sig.
Feeling elements	Between groups	863.317	5	172.663	5.155	0.000
	Within groups	15,006.121	448	33.496		
	Total	15,869.438	453			
Associative elements	Between groups	32.664	5	6.533	2.462	0.032
	Within groups	1,188.913	448	2.654		
	Total	1,221.577	453			
Participation elements	Between groups	25.960	5	5.192	1.002	0.416
	Within groups	2,322.498	448	5.184		
	Total	2,348.458	453			
Experience elements	Between groups	31.194	5	6.239	0.974	0.433
	Within groups	2,868.145	448	6.402		
	Total	2,899.339	453			

Table 2.27 The S–N–K comparison for the feeling elements

Educational status	N	Subset for alpha = 0.05	
		1	2
Junior high school or less	26	3.65	
Senior high school or technical secondary school	46	4.24	
Junior college	73	5.68	
Master	109		6.88
Bachelor	182		7.83
Doctor or above	18		8.06
Sig.		0.055	0.243

influence on the two elements. Thus, for these elements, the S–N–K comparison and the mean value graph analysis are required.

According to the S–N–K comparison (Table 2.27), in terms of the feeling elements, people with different educational statuses can be divided into two groups: those with lower education (Junior high school or less, senior high school or technical secondary school, and junior college) form one group; and those with higher education (bachelor, master and doctoral education) form another. Figure 2.24 shows that the less educated people perform worse in learning-oriented memory, including word recording and sign interpretation, while the higher educated people are more interested in such learning-oriented feeling memory.

In terms of the associative elements, people with different educational statuses can also be divided into two groups: those with the educational statuses of Junior high school or less, senior high school or technical secondary school, junior college and bachelor belong to a group, while those with the educational statuses of master

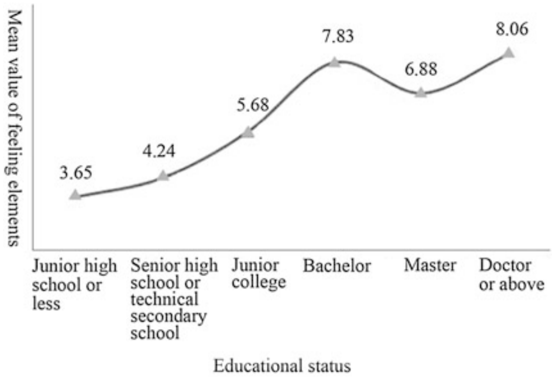

Fig. 2.24 The mean value graph for educational status and the feeling elements (*Source* Drawing by Ming Jiang)

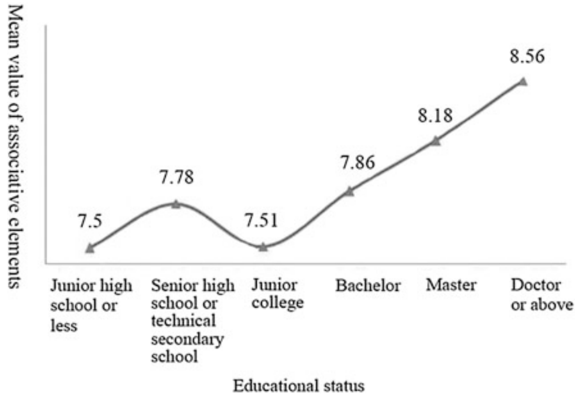

Fig. 2.25 The mean value graph for educational status and the associative elements (*Source* Drawing by Ming Jiang)

and doctoral education belong to another. The associative elements do not imply that the less educated people have poor imaginations but show that the higher educated people are better at connecting different historic buildings with their cultural forms, stories and legends to aid their memorization (Table 2.28, Fig. 2.25).

④ **Profession**

To study whether obvious differences exist between the feeling elements and the associative elements among different professions, one-way analysis of variance (ANOVA) is conducted according to the normalized factor score; if the significance is less than 0.05, obvious differences exist. The results are shown in Table 2.29. The significance of the associative elements is greater than 0.05, indicating that no obvious differences exist; the significance of the feeling elements being less than 0.05, profession has an obvious influence on the feeling elements. To further analyze the influences and differences of various professions in relation to the

Table 2.28 The S–N–K comparison for the associative elements

Educational status	N	Subset for alpha = 0.05	
		1	2
Junior high school or less	26	7.50	
Junior college	73	7.51	
Senior high school or technical secondary school	46	7.78	
Bachelor	182	7.86	
Master	109		8.81
Doctor or above	18		8.56
Sig.		0.311	0.135

Table 2.29 The one-way analysis of variance (ANOVA) for profession and urban memory

		Sum of squares	df	Mean square	F	Sig.
Feeling elements	Between groups	976.376	9	108.468	3.234	0.001
	Within groups	14,893.062	444	33.543		
	Total	15,869.438	453			
Associative elements	Between groups	24.211	9	2.690	0.998	0.441
	Within groups	1,197.366	444	2.697		
	Total	1,221.577	453			

feeling elements, the S–N–K comparison and the mean value graph analysis are required.

According to the S–N–K comparison (Table 2.30), in terms of the feeling elements, people with different professions can also be divided into two groups: civil servants, students, technicians, company employees and teachers belong to one

Table 2.30 The S–N–K comparison for the feeling elements

Profession	N	Subset for alpha = 0.05	
		1	2
Worker	12	2.08	
Farmer	7	2.14	
Retiree	18	3.89	
Self-employed businessman	24	4.17	
Soldier	6	5.00	
Teacher	58		5.95
Company employee	76		7.11
Technician	80		7.19
Student	135		7.41
Civil servant	38		8.55
Sig.		0.140	0.248

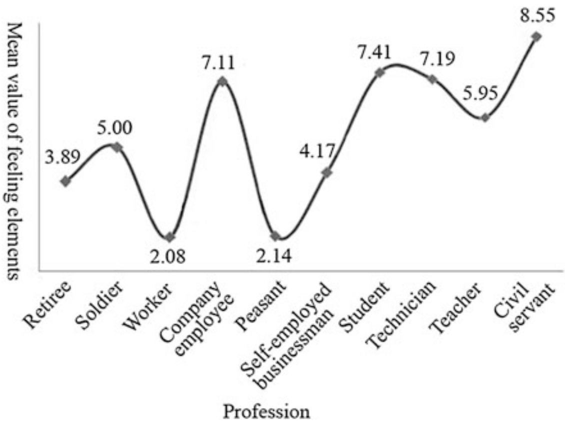

Fig. 2.26 The mean value graph for profession and the feeling elements (*Source* Drawing by Ming Jiang)

group; workers, farmers, self-employed businessmen, solders and retirees belong to another. From Fig. 2.26, the associative elements indicate that people with the professions requiring more cultural education perform well in learning-oriented and feeling-oriented memory such as word recording and sign interpretation, and the reverse is true of professions requiring less cultural education.

⑤ Duration of residence in Beijing

To study whether obvious differences exist between the duration of residence in Beijing and the construction elements, the distinctive elements and the experience elements, one-way analysis of variance (ANOVA) is conducted according to the normalized factor score; if the significance is less than 0.05, significant differences exist. The results are shown in Table 2.31. The significances of the distinctive elements and the experience elements are greater than 0.05, indicating that no obvious differences exist; the significance of the construction elements being less than 0.05, duration of residence in Beijing has an obvious influence on the

Table 2.31 The one-way analysis of variance (ANOVA) of duration for residence in Beijing and urban memory

		Sum of squares	df	Mean square	F	Sig.
Construction elements	Between groups	542.953	4	135.738	10.645	0.000
	Within groups	5,725.099	449	12.751		
	Total	6,268.053	453			
Distinctive elements	Between groups	13.316	4	3.329	1.049	0.381
	Within groups	1,424.270	449	3.172		
	Total	1,437.586	453			
Experience elements	Between groups	41.341	4	10.335	1.624	0.167
	Within groups	2,857.999	449	6.365		
	Total	2,899.339	453			

Table 2.32 The S–N–K comparison of the construction elements

Duration of residence in Beijing	N	Subset for alpha = 0.05		
		1	2	3
<1 year	109	16.23		
1–3 years	82		17.09	
3–5 years	77		17.49	
5–10 years	81			18.81
>10 years	105			18.98
Sig.		0.111	0.446	0.757

construction elements. To further analyze the influences and differences of the duration of residence in Beijing in relation to the construction elements, the S–N–K comparison and the mean value graph analysis are required.

Based on the S–N–K comparison (Table 2.32), the construction elements can be divided into three groups with differences based on the duration of residence in Beijing: those living in Beijing for less than 1 year belong to a group by themselves; residents for 1–3 and 3–5 years belong to a group; while residents for 5–10 years and more than 10 years belong to another group. A positive correlation exists between the duration of residence in Beijing and the construction elements. The longer people stay in Beijing, the more they are able to understand construction features such as geographical location, construction age and the historical function of the historic buildings. The slopes for the categories of 5–10 years and more than 10 years change little, which indicates that when the duration of residence reaches a certain number of years, the ability to build memory tends to stabilize (Fig. 2.27).

Above all, population characteristics influence the urban memory level for historic buildings: (1) A correlation exists between age and both symbol elements and distinctive elements, with age having an obvious influence on the distinctive elements. The older people become, the more accurately they understand the distinctive elements and the higher the memory level becomes. (2) A correlation exists between income and both distinctive elements and participation elements, with income having an obvious influence on the distinctive elements. The sense of participation will strengthen with an increase in income level, but when income

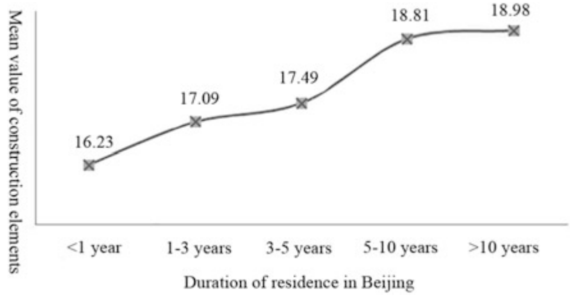

Fig. 2.27 The mean value graph for duration of residence in Beijing and the construction elements (*Source* Drawing by Ming Jiang)

reaches a certain level, this correlation tends to stabilize. (3) A correlation exists between educational status and the feeling elements, associative elements, distinctive elements and participation elements, with educational status having an obvious influence on both the feeling elements and the associative elements. More highly educated people are more interested in the learning-oriented feeling memory and are better at connecting different historic buildings with their cultural forms to aid their memorization. (4) A correlation exists between profession and both the feeling elements and the associative elements. Profession has an obvious influence on the feeling elements, which also demonstrates that people with the professions requiring more cultural education perform well in learning-oriented feeling memory. (5) A correlation exists between the duration of residence in Beijing and all three of the construction elements, the distinctive elements and experience elements, with duration of residence in Beijing having an obvious influence on the construction elements.

2.4.2 Analysis of Memory Level and Memory Temporal Characteristics

This section addresses the relationship between the memory level and the memory temporal characteristics. The concept and the grading of memory level was presented initially. The memory level was calculated by adding the 29 observational variables forming memories, and the sum of the mean values minus the standard deviations was taken as the grading standard. Next, analysis of the scores for three variables (visiting times, visiting date and retention time) was conducted by means of the fuzzy evaluation method to obtain the evaluation values for the temporal characteristics of memory. Finally, the memory level–memory time curve model was built using regression analysis to demonstrate the changing rules between them.

(1) **The memory level grading of Object–Time memory model**

The selected results of the evaluation model for memory level include 29 observational variables. The scores, which were obtained using a 5-point Likert scale, reflect each individual's memory level with regard to the historic buildings. The formula is as follows.

$$\mathrm{S_{cog}} = \sum_{i=1}^{29} a_i \qquad \mathrm{i} = 1, 2, 3, \ldots, 29 \tag{2.5}$$

Formula 2.5: Scores of urban memory level

In Formula 2.5, S_{cog} represents scores of the urban memory level for historic buildings. a_i represents scores of the urban memory variables for historic buildings in every questionnaire. There are 29 score variables and the total score is 145. Based on the formula above, the mean memory level for historic buildings is 82.46 and the standard deviation is 13.77.

Referring to the study by Yan (2009) about the cognitive grading of urban memory, the research classified the memory levels of the sample into three types: memory scores higher than the mean value plus 0.5 standard deviation belong to the third level, called the high memory level; memory scores lower than the mean value minus 0.5 standard deviation belong to the first level, called the low memory level; and memory scores between the other two groups belong to the medium memory level. The formula is as follows.

$$\begin{aligned} &\text{If}\ \ S_{cog} > 82.46 + 0.5 \times 13.77 = 89,\ R_{cog} = 3 \\ &\text{If}\ \ 76 = 82.46 - 0.5 \times 13.77 \le S_{cog} \le 82.46 + 0.5 \times 13.77 = 89,\ R_{cog} = 2 \\ &\text{If}\ \ S_{cog} < 82.46 - 0.5 \times 13.77 = 76,\ R_{cog} = 1 \end{aligned} \tag{2.6}$$

Formula 2.6: Grading of urban memory level

Based on Formula 2.6, scores of the memory level of 17 varieties of historic buildings show that the mean values for the imperial palaces and the administrative buildings fit into the high memory level; values for the buildings for managing foreign affairs, the common residences and the commemorative buildings fit into the low memory level; and values for other historic buildings fit into the medium memory level (Fig. 2.28).

Based on the subdivision of the urban memory levels of different historic buildings (Fig. 2.29), more than half of the samples of the imperial palaces, the cultural and educational buildings and the administrative buildings belong to the high memory level, demonstrating that people have the deepest memories regarding these types of buildings, which also conforms to the whole impression of “royal city,” “capital” and “political center” that Beijing usually gives to people. In the samples of the categories of the commercial service buildings, the buildings for managing foreign affairs, the common residences and the commemorative buildings, the low memory level accounts for more than a half because these types of buildings do not have distinguishing features and can not leave deep impressions on people. In particular, the sample area for the commercial service buildings category is located in the Dashilar commercial area at Qianmen Gate, but people have no deep impressions and do not think highly of the reconstructed Qianmen Street.

(2) **The fuzzy evaluation of memory temporal characteristics**

The German psychologist H. Ebbinghaus found that information is lost immediately after learning and the forgetting process is not even. The sharpest increase in information loss occurs after the first recall attempt and the rate then gradually

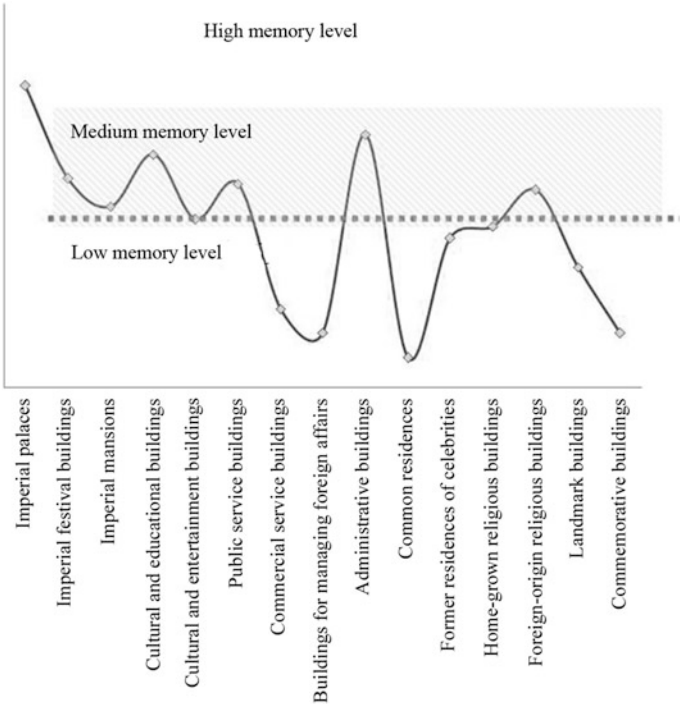

Fig. 2.28 Grading of the urban memory levels of different historic buildings (*Source* Drawing by Ming Jiang)

stabilizes. He thought that the retention and forgetting are the time function, and he draw the curve to describe the forgetting process based on his study result. This curve has become well-known as the Ebbinghaus forgetting curve (Tan 2008) (Fig. 2.30). Based on the retention time, he divided retention memory into two types: short-term memory and long-term memory. According to the forgetting curve, forgetting usually happens following the law of "fast at first and slow later". Therefore, constant review and repetition can lead to permanent and long-term memory (Fig. 2.31).

Urban memory is a collection of individual memories. The urban memory of historic buildings is part of the long-term memory that has been handed down and also follows the basic memory method of people. In the research, the temporal characteristics of urban memory are classified into three types: visiting times, visiting date and retention time. Visiting times are relevant to the review process, and the more times people visit a place, the more easily a permanent memory can form; visiting date is relevant to the time that has passed since acquiring the memory information, and the more distant the visiting date, the more information is lost; retention time is relevant to the duration of the memory process, and the longer people stay, the more easily a deep memory can form. Based on the three variables

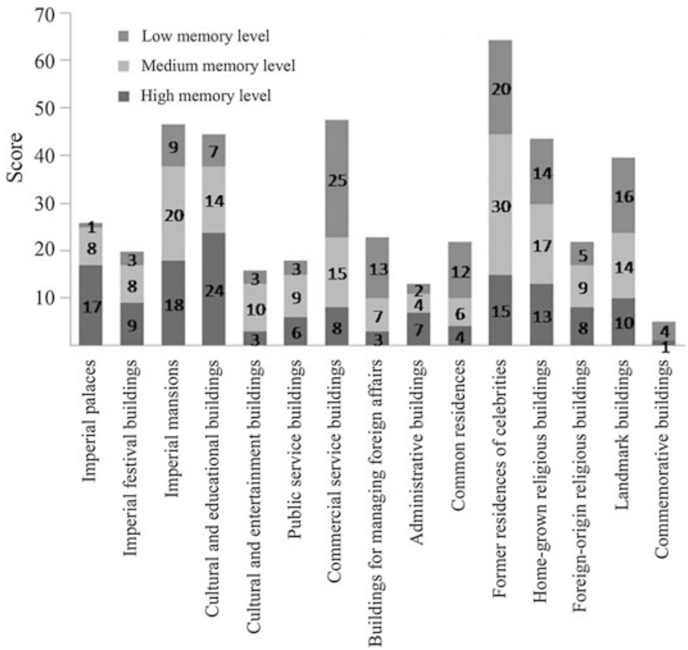

Fig. 2.29 Scores of the urban memory levels of different historic buildings (*Source* Drawing by Ming Jiang)

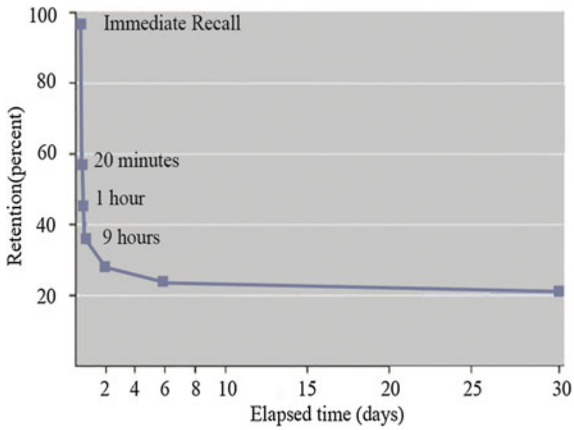

Fig. 2.30 The Ebbinghaus forgetting curve (*Source* Drawing by Hermann 1964)

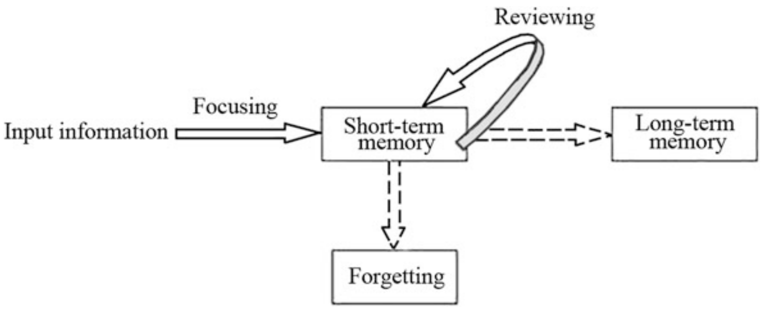

Fig. 2.31 Short-term and long-term memory (*Source* Picture redrawn by Jian Liu based on the original by Hermann 1964)

above, the fuzzy evaluation method is applied to evaluate the temporal characteristics of urban memory.

First, adopting the expert assessment method, weights for visiting times, visiting date and retention time are assigned as 0.35, 0.3 and 0.35. The assessment levels are determined, and by default, more visiting times, a closer visiting date and longer retention time can be associated with a clearer memory and higher scores (Table 2.33).

According to the assessment level, the scores for single variables of different historic buildings are presented in Table 2.34.

Table 2.33 The assignment scale of temporal variables in urban memory

Visiting times	Visiting date	Length of stay	Score
Perennial living	Within 1 month	More than 1 day	5
More than 5 times	1–3 months	1 day	4
4–5 times	3–6 months	Half a day	3
2–3 times	6–12 months	2–4 h	2
1 time	More than 1 year	Less than 2 h	1

Table 2.34 The assessment form for temporal variables of imperial palaces in urban memory

Assessment variable set (U)		Visiting times (U1)	Visiting date (U2)	Length of stay (U2)
Weight (W)		0.35	0.3	0.35
Assessment level	5	0	1	0
	4	1	0	9
	3	5	5	14
	2	7	3	3
	1	13	17	6

The fuzzy evaluation matrix of historic buildings to assessment level equals the weight of the variable multiplied by the membership grade of each variable in its assessment level.

$$\mathrm{R}_1 = \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{pmatrix} = \begin{Bmatrix} \frac{U15}{N} & \frac{U14}{N} & \frac{U13}{N} & \frac{U12}{N} & \frac{U11}{N} \\ \frac{U25}{N} & \frac{U24}{N} & \frac{U23}{N} & \frac{U22}{N} & \frac{U21}{N} \\ \frac{U35}{N} & \frac{U34}{N} & \frac{U33}{N} & \frac{U32}{N} & \frac{U31}{N} \end{Bmatrix} = \begin{Bmatrix} \frac{0}{26} & \frac{1}{26} & \frac{5}{26} & \frac{7}{26} & \frac{13}{26} \\ \frac{1}{26} & \frac{0}{26} & \frac{5}{26} & \frac{3}{26} & \frac{17}{26} \\ \frac{0}{26} & \frac{9}{26} & \frac{14}{26} & \frac{3}{26} & \frac{6}{26} \end{Bmatrix}$$

$$S_1 = WR_1 = \begin{pmatrix} w_1 & w_2 & \cdots & w_n \end{pmatrix} \circ \begin{pmatrix} r_{11} & r_{12} & \cdots & r_{1m} \\ r_{21} & r_{22} & \cdots & r_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ r_{n1} & r_{n2} & \cdots & r_{nm} \end{pmatrix} = \begin{pmatrix} s_1 & s_2 & \cdots & s_m \end{pmatrix}$$

$$= \begin{pmatrix} 0.35 & 0.3 & 0.35 \end{pmatrix} \begin{Bmatrix} 0 & 0.04 & 0.19 & 0.27 & 0.5 \\ 0.04 & 0 & 0.19 & 0.12 & 0.65 \\ 0 & 0.35 & 0.54 & 0.12 & 0.23 \end{Bmatrix}$$

$$= \begin{pmatrix} 0.012 & 0.135 & 0.131 & 0.169 & 0.371 \end{pmatrix}$$

The fuzzy evaluation value for the memory time of imperial palaces category N_1 is calculated and the "weighted average method" is used to collect vector statistics for the assessment level membership grade.

$$N_1 = S_1 E^T = \begin{pmatrix} 0.012 & 0.135 & 0.313 & 0.169 & 0.371 \end{pmatrix} \begin{pmatrix} 5 \\ 4 \\ 3 \\ 2 \\ 1 \end{pmatrix} = 2.25 \qquad (2.7)$$

Formula 2.7: Formula for the fuzzy evaluation method

In Formula 2.7, R_1 represents the membership grade matrix, S_1 represents the fuzzy evaluation matrix, W represents the weight of the variable, N_1 represents the fuzzy evaluation value, and E^T represents the assessment level priority.

By adopting the same method, the evaluation values for the temporal characteristics of different buildings are calculated (Table 2.35).

The fuzzy evaluation results for the temporal characteristics of different buildings show that the temporal characteristics value and the memory level present the same changing trend, which indicates that more visiting times to the historic buildings, closer visiting date and longer retention time lead to a more permanent memory.

Further explanation is required on some special points: the imperial palaces category presents a low evaluation value for temporal characteristics but a high

Table 2.35 The fuzzy evaluation values for temporal characteristics of different buildings

Building category	Mean value of the memory level	Evaluation value of the temporal characteristics
Imperial palaces	93.58	2.25
Imperial festival buildings	86.30	2.16
Imperial mansions	84.11	2.46
Cultural and educational buildings	88.22	2.47
Cultural and entertainment buildings	83.13	2.15
Public service buildings	85.89	2.67
Commercial service buildings	76.10	2.43
Buildings for managing foreign affairs	74.26	1.96
Administrative buildings	89.77	3.35
Common residences	72.27	2.70
Former residences of celebrities	81.63	2.14
Home-grown religious buildings	82.55	2.57
Foreign-origin religious buildings	85.41	2.84
Landmark buildings	79.38	2.30
Commemorative buildings	74.20	1.87

memory level, which indicates that people use less time to memorize but have deeper impressions. Buildings in the imperial palaces category are famous landmarks and tourist attractions, which people do not often visit in daily life, but because of their distinguishing features and the many opportunities to transfer information concerning them, they leave a deep impression on people in a short time.

Meanwhile, the common residences work in the opposite way. This category presents a high evaluation value for temporal characteristics but a low memory level, which indicates that people spend more time in such buildings but do not form deep memories. The common residences are buildings where people live and pay visits to relatives and friends, but because they have fewer characteristics and have no cultural features and rules to follow, people can not form conscious memories about them (Fig. 2.32).

(3) **Regression analysis of memory level and memory time**

Based on the relationship between memory level and memory time introduced in the previous section, a regression analysis can be conducted to build the memory level–memory time curve model and predict the rule that memory level changes with the temporal characteristics of memory.

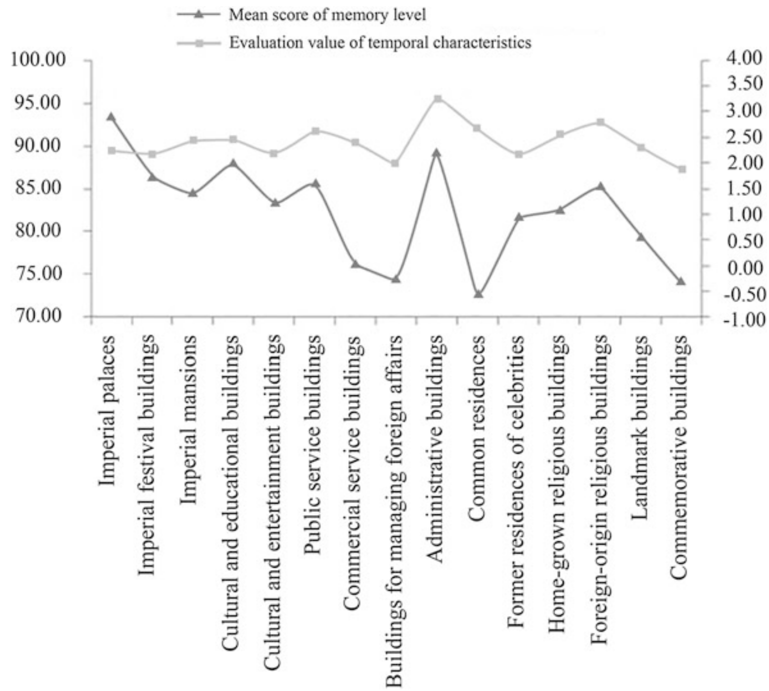

Fig. 2.32 Mean values of memory level and evaluation values for the temporal characteristics of memory (*Source* Drawing by Ming Jiang)

Based on the analysis in the previous section, the two special cases of imperial palaces and common residences were deleted, and the remaining 13 sets of data were analyzed using curvilinear regression analysis. The SPSS curvilinear evaluation method was adopted. The application of the fitting quadratic curve achieved the best effect. When R = 0.721, the fitting degree is good and Sig. = 0.025 < 0.05; thus, the variation test is passed.

The memory level–memory time model is as follows.

$$Y = 32.770 + 31.227X - 4.313X^2$$

Formula 2.8: Memory level–Memory time model

In Formula 2.8, *X* represents the evaluation value for temporal characteristics of memory, *Y* represents memory level.

As is evident from the memory level–memory time model (Fig. 2.33), urban memory level strengthens with the significance of the temporal characteristics of memory. When the memory time that people spend reaches a certain amount, the memory level will not continue to strengthen. In other words, the memory level–memory time curve reflects the same laws as the Ebbinghaus forgetting curve. The process of urban memory also presents a rule of changing fast at first and slowly

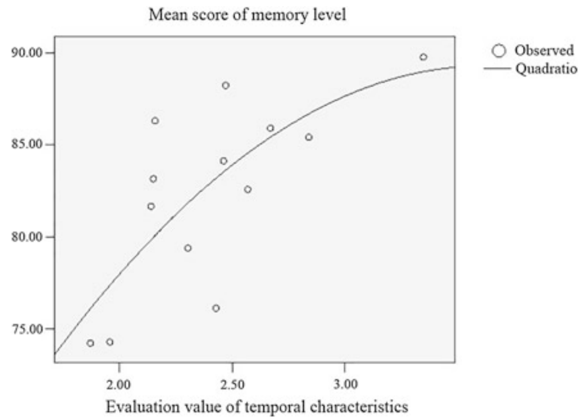

Fig. 2.33 The memory level–memory time model fitting curve (*Source* Drawing by Ming Jiang)

later. The initial memory, which is called the first impression, can be obtained quickly, and then, with the mind filled up with memories, the ability to remember also declines.

The memory level–memory time curve shows a basic fitting development trend, but there are also some special cases, such as very distinguishing features and very impressive experiences, that may change people's memory ability and memory speed related to urban historic buildings.

This section added together 29 variables for urban memory to establish the concept of urban memory level and divided it into three types: high, medium and low memory levels. The historic buildings in the inner city of Beijing were classified to obtain the memory level for different types of buildings. The imperial palaces and the administrative buildings fit into the high memory level; the buildings for managing foreign affairs, the common residences and the commemorative buildings fit into the low memory level; and other types of historic buildings fit into the medium memory level, demonstrating the differences in people's memories of different historic buildings. Next, the fuzzy evaluation method was adopted to score the three variables of visiting times, visiting date and retention time and to obtain the evaluation value for the temporal characteristics of memory, which shows the time people spend memorizing different historic buildings. Finally, the memory level–memory time model was built, which fit with the quadratic curve, demonstrating the rule that memory level changes in relation to memory time, decreasing fast at first and slowly later; the initial memory can be quickly obtained, but when the memory time reaches a certain amount, the memory level will not continue to strengthen.

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