Driving Force of Housing Industrialization Based on Brain Cognitive Neuroscience

Chenghua Zhang[1]*, Jisheng Qiu[1], Xiao Guan[1], Piji Hou[1], Wei Huang[2]

ABSTRACT

Originated from the 1990s, cognitive neuroscience is a new branch of science combining cognitive science and neuroscience. It has become a mainstream trend in the development of scientific research and has been widely used in many fields. The study of cognitive neuroscience is of great significance for human development. This study mainly deals with the issues of China's housing industrialization based on the related theories of brain cognitive neuroscience through using factor analysis. The study finds that since China put forward housing industrialization officially in 1994, China's housing industrialization has been developing very rapidly. Both the newly-started area of housing industrialization and the housing industrialization (main structure) output value have increased year by year. Through factor analysis, it is found that enterprises' cognition of policies can be divided into five dimensions: policy understanding, policy evaluation, evaluation of policy competent departments, satisfaction of policy implementation, and damage to corporate interests, and the cross-correlation between dimensions is not serious. At the same time, the enterprises' evaluation of policies is the most important factor affecting cognition degree.

Key Words: Cognitive Neuroscience, Factor Analysis, Housing Industrialization, Driving Force of Participation

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Introduction

The 21st century is regarded as the age of brain science by most people. The multi-disciplinary and multi-level analysis and study of advanced cognitive functions, such as human brain language, thinking, and learning has become the mainstream trend of scientific development (Lieberman, 2007). Traditional cognitive psychology only studies human cognitive activities from the behavioral and cognitive perspective while cognitive neuroscience, as a new research field, closely links computers, cognitive sciences, with neurosciences, as well as conducts in-depth study of the brain processes and neural mechanisms of various cognitive activities (Hedden and Gabrieli, 2004). Cognitive neuroscience has a very broad research field. As long as it involves cognition, it can be studied by using neuroscience. At present, the main research directions are social cognition, decision-making, neuroimmunology and cognition-related researches (Decety and Sommerville, 2003). In the international scientific community, the study of cognitive neuroscience is of great significance for human development (Kiehl, 2006).

At present, many experts and scholars at home and abroad have conducted in-depth study on the issues related to housing industrialization and have formed a series of research results. Some scholars have studied the restraining factor of housing industrialization (Näätänen and Winkler, 1999; Aron and Poldrack, 2005; Magrini *et al.,* 2017; Guazzi *et al.,* 2017). Some scholars have analyzed from the perspective of customer

Corresponding author: Chenghua Zhang
Address: [1] Xi'an University of Science and Technology, School of Architecture and Civil Engineering, Department of Mining Construction, Xi'an 710054, China; [2] Xi'an University of Architecture and Technology, School of Civil Engineering, Department of Construction Engineering, Xi'an 710055, China
e-mail ✉ zch-0819@163.com
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needs (Pascual-Leone *et al*., 2000). Some scholars have studied how to better promote the housing industrialization (Bergero *et al*., 2017; Gallagher and Porzecanski, 2010; Semache *et al*., 2015;). This study mainly deals with the issues of China's housing industrialization based on the related theories of brain cognitive neuroscience through using factor analysis, which has a certain degree of innovation and practical value.

Introduction of Related Theories

Cognitive neuroscience

Originated from the 1990s, cognitive neuroscience is a new branch of science combining cognitive science and neuroscience. It mainly studies the brain mechanisms of cognitive activities, that is, how to mobilize various parts of the human brain to achieve cognitive activities (Jiang *et al*., 2016). Cognitive neuroscience is featured in a large number of subjects and levels (Bourdieu and Kesztenbaum, 2014). Through organic combination of brain mechanisms, cognition, and human behavior, it organically combines behavior, cognition, and brain mechanisms. It comprehensively expounds human's information processing process and their neural mechanisms in perceiving objects and infering decision-making at the macroscopic level of neurons, and macroscopic level of systems and behaviors (Yip and Grange, 2006).

Factor analysis

Factor analysis, first proposed by the British scholar Spearman in 1904, is a statistical technique to study the extraction of common factors from variable groups (Stommel *et al*., 1992). By factor analysis, we can find a representative factor among many variables, and classify variables of the same nature into one factor. By calculating the weight of each factor, the final result is more reasonable and objective (Birnbaum *et al*., 2015). Assume that the total number of samples is N. Each sample has k original indicators, which are X_1, X_2,..., X_k. The j-th indicator of the i-th sample is expressed as X_{ij}=(i=1, 2, ..., N; j=1, 2, ..., k), and the indicators are processed by the following steps:

(1) Standardized processing

Usually, there is no comparability between a large number of selected indicators, and standardized processing is required to conduct on indicator data before comparison (Lorber, 1985). The dimensionless method of raw data can both ensure the consistency of directions and eliminate the influence of dimensions (Trevisan *et al*., 2008). At present, the Z-score method is commonly used in the international community and the conversion formula is:

$$X'_{ij} = X_{ij} - \frac{\overline{X_j}}{S_j} \quad (1)$$

Where,

$$\overline{X_j} = \sum_{i=1}^{n} \frac{x_{ij}}{n} \quad (2)$$

$$S_j^2 = \sum_{i=1}^{n} \frac{(X_{ij} - \overline{X_j})^2}{n-1} \quad (3)$$

After the data goes through standardized processing, it needs to satisfy:

$$\mathrm{E}(X'_{ij}) = 0, \mathrm{Var}(X'_{ij}) = 1 \quad (4)$$

(2) Calculation of the eigenvalue and eigenvector of the correlation coefficient matrix R.

The eigenvalue λ_m (m=1,2, ..., k; m<k) is obtained by the characteristic equation |R-λE=0|. Then, the eigenvector F_m corresponding to the eigenvalue λ_m is obtained by the equation set $(R-\lambda E)F_m=0$. The eigenvector F_m is a linear combination of X_1, X_2, ..., X_k (Apley and Shi, 2001).

(3) Rotation of the factor load matrix

Rotation of the initial factor load matrix usually uses the Varimax method to redefine the common factors through several indicators with higher weights in the linear combination, achieving effective simplification (Haig, 2005).

(4) Establishment of a comprehensive evaluation model to calculate factor scores.

Express the indicator variable as a linear combination of common factors:

$$X\_i = a\_i1\ F\_1 + a\_i2\ F\_2 + \cdots + a\_im\ F\_m \quad (\mathrm{i} = ,2,\cdots,\mathrm{m},\mathrm{m} < k) \quad (5)$$

Under normal conditions, the common factors can be expressed as a linear combination of variables, that is:

$$F_j = \beta_{j1}X_1 + \beta_{j2}X_2 + \cdots + \beta_{jm}X_m \quad (\mathrm{j} = 1,2,\cdots,\mathrm{m},\mathrm{m} < k \quad (6)$$

B_{jm} is the factor score of the common factors F_j on the indicator variable X_n. The

weighing sum is calculated of contribution rate of each common factor and finally the comprehensive factor score is obtained:

$$F = \sum_{i=1}^{m} \alpha_i F_i \quad (7)$$

Where,

$$\alpha_i = \frac{\lambda_i}{\sum_{i=1}^{m} \lambda_i} \quad (8)$$

λ_i is the variance contribution rate, and $\lambda_i/\sum\lambda_i$(i= 1, …, m) is the cumulative variance contribution rate.

Analysis of the Driving Force of Housing Industrialization

The status quo of the development of China's housing industrialization

In the total investment of China's construction, the investment in residential construction accounts for more than half of the total (see Figure 1), which is large in quantity and area. Therefore, the housing industrialization is the main battle position for the implementation of architectural industrialization. In 1994, China officially proposed housing industrialization. The number of housing industrialization bases has gradually developed from 4 to 40. The areas involved range from a single structure, home development to real estate development, mechanism research, standardization, and demonstration cities. The country has adopted a series of measures and formulated preferential policies to promote the development of housing industrialization. The newly-started area of housing industrialization in China has increased year by year (see Figure 2, unit: 10,000 m^2), and the housing industrialization (main structure) output value has also increased year by year (see Figure 3, unit: 100 million yuan).

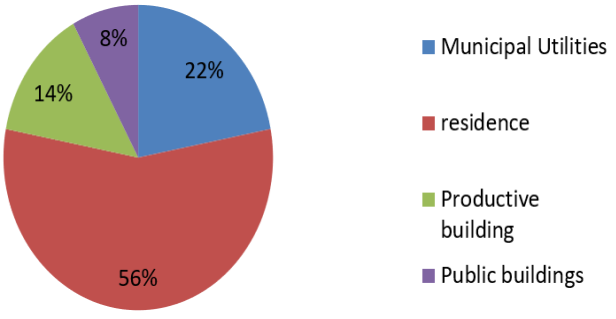

Figure 1. Total construction investment in China

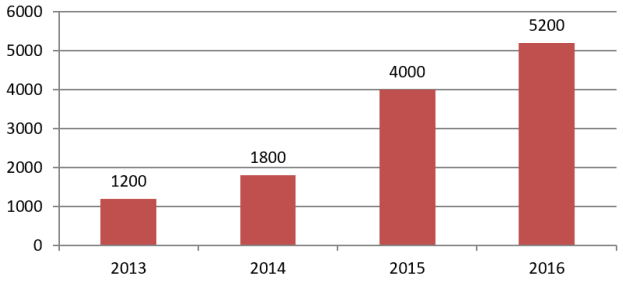

Figure 2. New construction area of housing industrialization in China

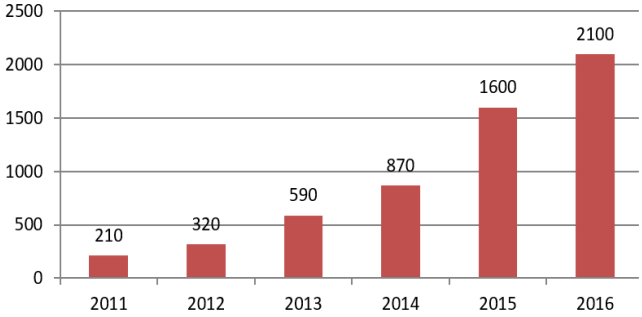

Figure 3. The growth of China's housing industrialization value (the main body of the building)

Cognition of housing industrialization policies

In the process of researching housing industrialization, this study mainly analyzes the enterprises' cognition of policies. The administrative staff of the enterprises will evaluate and perceive the country's relevant policies to decide whether to make corresponding policies or not. Enterprises can better promote the development of housing industrialization after fully perceiving the country's policies.

Table 1. Basic information description table

Variable		Number	Proportion
Gender	Male	245	70.6%
	Female	102	29.4%
Age	Under 25 years of age	43	12.4%
	26-30	56	16.1%
	31-40	142	40.9%
	41-50	82	23.6%
	Over 51 years of age	24	7.0%
Education	Specialist and below	46	13.3%
	Undergraduate	166	47.8%
	Master	119	34.3%
	Doctorate and above	6	4.6%
Working life	5 years and below	74	21.3%
	6-10 year	89	25.6%
	11-15 year	69	19.9%
	16-20 year	64	18.4%
	21 years and above	51	14.8%

In the process of analysis, questionnaires are distributed to managers of enterprises' projects

to study their cognition of housing industrialization policies. A total of 400 questionnaires are distributed and 372 questionnaires are collected, of which 347 are valid questionnaires. Table 1 mainly shows the basic information of the investigated persons.

(1) KMO and Bartlett test

There are many ways to judge whether the results of the questionnaire can be conducted factor analysis. This study mainly uses KMO test and Bartlett sphericity test. In general, when a KMO value is greater than 0.9, it shows that it is very suitable; when a KMO value is less than 0.5, it indicates that it is extremely unsuitable. According to the Bartlett sphericity test, the correlation matrix is judged to be a unit matrix or not first, and then the value of the statistics is observed. If the value is large and p is less than the value of 0.05 in the significance level, then the variables in the original variable are correlative and factor analysis can be used.

Table 2. KMO and Bartlett test

KMO statistics		0.826
Bartlett spherical test	Approximate chi square	6973.65
	Df	1345
	Sig.	0.000***

It can be seen from the data in Table 2 that the statistics of KMO is 0.826 and the Bartlett's sphericity test is 6973.65, and the p is 0.000, which is less than the significance level of 0.05. Therefore, this study is suitable for using factor analysis.

(2) Factor analysis

The SPSS15.0 software is used to analyze the raw data obtained from the questionnaires and the principal components whose latent root is greater than 1 are selected. The specific results are shown in Table 3.

Table 3. The total variance of the component interpretation of the characteristic root greater than 1

Component	Characteristic value	Variance (%)	Cumulative Variance(%)
1	9.387	23.862	23.862
2	7.632	21.745	45.607
3	5.486	20.737	66.344
4	3.624	10.244	76.588
5	3.746	9.883	86.471

It can be found from Table 3 that there are a total of five principal components whose latent root is greater than 1. The contribution rates of these five principal components are 23.862%, 21.745%, 20.737%, 10.244%, and 9.883% respectively. The cumulative contribution rate reaches 86.471%, greater than 85%, which is in line with the principle.

For the five factors in Table 3, the Varimax method is used for rotation to obtain rotation component matrix of five factors, as shown in Table 4.

It can be seen from Table 4 that each factor contains specific items. At the same time, by observing each factor, it can be found that all factor loads are higher than 0.7, indicating that the relationship between each common factor and each variable is strong. According to the content of the scale and combined with previous research results, the author names the eight factors respectively: F1 is policy evaluation, F2 is policy understanding, F3 is satisfaction of policy implementation, F4 is evaluation of policy competent departments, and F5 is damage to corporate interests.

Table 4. Rotational component matrix

	F1	F2	F3	F4	F5
Necessity of site construction	0.839				
Effectiveness of site construction	0.857				
Recognition of site construction	0.792				
The necessity of providing incentive for construction enterprises	0.774				
Do you need to add the details of the operation	0.784				
Bring benefits to construction enterprises	0.812				
Degree of understanding of guidance		0.748			
Understanding of prefabricated components		0.831			
Understanding of material		0.859			
Knowledge of equipment		0.809			
Understanding of the relevant subjects		0.731			
Understanding of the competent department		0.709			
Implementation of the situation			0.769		
Implementation			0.815		
The fairness of the award by the competent authorities				0.743	
The degree of encouragement by the competent authorities				0.837	
Damage the interests of the enterprise					0.906

(3) Credibility analysis

Credibility refers to reliability. It refers to the degree of consistency in the results of repeated measurements on the same object in the same way. This study mainly uses Cronbach's alpha coefficient method to carry out credibility analysis. In general, if the Cronbach's alpha coefficient is higher than 0.7, the credibility is good. If the Cronbach's alpha coefficient is lower than 0.35, the credibility is not high. The credibility test is performed on the measured items of five factors and the questionnaires, as shown in Table 5. As can be seen from the table, the overall new coefficient of the questionnaires is 0.849, which is is the very credible category, showing that the questionnaires used in this study have a very good credibility, that is to say, they have a strong credibility. In addition, the credibility coefficient of each factor is higher than 0.7, indicating that the measurement results of the questionnaires are very stable.

Table 5. Results of questionnaire reliability analysis

	Number	Cronbach's Alpha
Enterprise's evaluation of policy (F1)	6	0.869
Enterprise's understanding of policy (F2)	6	0.854
The satisfaction of the enterprise to the implementation of the policy (F3)	2	0.732
An enterprise's evaluation of the policy authorities (F4)	2	0.702
Overall reliability	17	0.849

(4) Correlation analysis

It can be seen from the correlation analysis results in Table 6 that the correlation between variables is generally lower than 0.4, and the highest correlation coefficient is the enterprises' satisfaction of policy implementation (F3) and damage to corporate interests (F5). The correlation degree is 0.521, but it is also far less than 0.7, indicating that the cross-correlation between the factors is not serious. Regression analysis is conducted on the factors of career satisfaction and 8 satisfaction factors, as shown in Table 7.

Table 6. Correlation analysis

	F1	F2	F3	F4	F5
F1	1				
F2	0.103	1			
F3	0.254	0.196	1		
F4	0.051	0.166	0.048	1	
F5	0.391	0.274	0.521	0.118	1

Table 7. The correlation coefficient between the recognition and the factors

	F1	F2	F3	F4	F5
Awareness	0.596	0.398	0.352	0.308	0.131

From the regression results, it can be found that there is a positive relationship between career satisfaction and 8 impact factors.

Conclusions

(1) Since China officially proposed housing industrialization in 1994, China has adopted a series of measures and formulated preferential policies to promote the development of housing industrialization. The housing industrialization in China is developing very rapidly with the newly-started area of housing industrialization and the housing industrialization (main structure) output value increasing year by year.

(2) Through factor analysis, it can be found that enterprises' cognition of policies are mainly divided into five dimensions: enterprises' evaluation of policies, enterprises' understanding of policies, enterprises' satisfaction of policy implementation, enterprises' evaluation of policy competent departments, and damage to corporate interests, and the cross-correlation between dimensions are not serious. At the same time, the enterprises' evaluation of policies is the most important factor affecting cognition degree.

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