Research on low-carbon behavioural identity with the New Environmental Paradigm Scale

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Abstract. The environmental pollution problem has led to a lot of research and discussion on low-carbon strategies. It is our responsibility to notify the environmental attitude and behaviour so that the environmental pollution problem might be reduced dramatically. Shanghai has advocated the concept of energy-saving and low-carbon life since 2009. Therefore, this study tries to understand the current problem of environmental pollution, the degree of public awareness and recognition of low-carbon behaviours. In this study, the New Environmental Paradigm (NEP) scale was cited as the survey item of environmental attitude. Meanwhile, according to the low-carbon strategy advocated at present, the recognition scale of low-carbon behaviours was sorted out by combining the analysis of Shanghai's urban environment status and the daily life behaviours of citizens. This study adopts the form of network questionnaire to investigate, recover and analyze (N=219). According to the NEP scale score, the sample was divided into three attitude groups as high, medium and low. According to the analysis of one-way ANOVA, the recognition of different attitude groups on low-carbon strategy related behaviours was significantly different.

1. Introduction

Carbon emission is the key cause of environmental greenhouse effect, ozone layer destruction and air pollution. The greenhouse effect is mainly caused by modern industrial society burning too much coal, oil and natural gas, releasing a large amount of carbon dioxide gas (CO\textsubscript{2}) into the atmosphere. The heat absorption and heat insulation of CO\textsubscript{2} produces a greenhouse effect and global warming. The serious consequences may occur such as drought which leads to crop failures, the rising sea level, the floodplain, and the abnormal reproduction of animal and plant species. Carbon emissions lead to the destruction of the ozone layer in the atmosphere. Harmful radiation increases the incidence of skin and eye diseases. Air pollution is a common phenomenon of carbon emissions. To improve and reduce carbon emission, the Shanghai government revised Municipal Environmental Protection Regulations which was published in 2016, and implemented the basic principles of "wide participation, green development, comprehensive supervision, and strict enforcement". "Overall supervision, strict law enforcement" aims at the implementation of relevant environmental protection standards in strict accordance with the law for heavy polluting production enterprises, and "wide participation, green
"Development" refers to promoting the participation of all citizens in environmental protection and creating a pattern of social co-governance [1]. "Green development" refers to highlighting source prevention and control, and promoting ecological environmental protection from changing production and lifestyle; As the main forces of city and the consumers of energy, do people realize that environmental protection is closely related to their daily activities? The purpose of this study is to investigate people's attitudes towards the environment and their recognition of low-carbon behaviours in order to understand citizens' awareness of environmental protection.

2. Research method
In this study, an online survey was used to limit the answer within the Shanghai area. A total of 219 valid questionnaires were collected (Gender distribution: male=30.6%, female=69.4%, Age distribution: under 22=16.4%, 22~30=16.4%, 31~40=42.5%, 41~50=13.2%, over 50=11.4%)

2.1. The New Environmental Paradigm (NEP) Scale
Environmental awareness is an important prerequisite for low-carbon behaviours. The new environmental paradigm was proposed in 1978[2]. It is a new thinking of the interaction between man and nature, including the importance of the natural environment, the general concern for species, all ethnic groups, future generations of human beings, and the belief that growth is limited[3]. It clarifies that the Earth's load carrying capacity is limited and raises the importance of the entire ecosystem balance. The New Environmental Paradigm (NEP) scale contains a total of 12 questions with the limit of growth, anti-anthropocentrism and balance of nature as the main aspects[4]. The NEP scale is now the most widely used environmental concern indicator in the world and is used in hundreds of studies in dozens of countries. This study used the NEP scale translated by Zhang Zichao in 1995[5]. The Likert 5-point scale was used to prepare the first part of the survey to measure people's environmental attitudes as the premise of low-carbon behavioural willingness measurement. The measurement results of environmental attitudes are used to better understand the willingness of subjects to low-carbon behaviours.

2.2. Low-carbon behavioral intention scale
Low-carbon strategies implemented in accordance with the 2014-2015 Action Plan for Low-carbon Development of Energy Conservation and Emission Reduction [6]. The main low-carbon strategies can be summarized into five mainly aspects: low-carbon construction, low-carbon transportation, energy conservation, low-carbon consumption, and sustainable circulation. Based on the current situation of Shanghai's environment, the low-carbon behaviours that are closely related to the daily life of social groups were listed, and the survey was made in the form of Likert 5-point scale, which was taken as the second part after the NEP scale. This study attempts to understand the public's level of environmental awareness about these five low-carbon strategies. In terms of NEP scale, the sample was divided into three groups of high, medium and low environmental attitude groups. The analysis of one-way ANOVA was used to understand whether there are significant differences of low-carbon behaviour awareness among different groups.

3. Results & Discussion
This questionnaire contains 5 low-carbon strategies and 6 low-carbon behaviours questions each. The reliability of the 30 low-carbon behaviours questions is 0.951. The mean scores of the five low-carbon strategies show that the behavioural strategies of low-carbon buildings are highly recognized, followed by low-carbon transportation, and the sustainable circulation is perpetually centered, while the identity of relevant behavioural strategies for energy conservation and low-carbon consumption is relative lower. Through the NEP scale, the total score of 12 questions is divided into three categories of high, medium and low environmental awareness groups. The lower the total score, the higher the degree of environmental awareness, and vice versa. The total score of 13~24 is a high awareness group 1 (N=77), 25~28 is the general awareness group 2 (N=86), and 29~38 is a low awareness group 3


(N=56). Multiple comparisons were made among the three groups by using the method of one-way ANOVA, and the differences of five low-carbon strategies for different environmental awareness groups were analyzed.

| Table 1. Differences in recognition of low-carbon building behaviours |
|---------------------------------------------|
| Low-carbon building | M   | F   | Sig. | Post Hoc(Scheffe) |
| Q1. Implement greening of buildings        | 1.58 | 9.342 | 0.000 | 3>1 3>2         |
| Q2. Use environmental protection building materials | 1.38 | 24.198 | 0.000 | 3>1 3>2         |
| Q3. Implement hierarchical scheduling of public elevators | 1.66 | 12.695 | 0.000 | 3>1 3>2         |
| Q4. Public area facilities adopt inductive switch energy saving | 1.59 | 14.811 | 0.000 | 3>1 3>2         |
| Q5. Set the temperature standard for cold and warm supply | 1.67 | 13.273 | 0.000 | 3>1 3>2         |
| Q6. Set up the grading of toilet flushing flow | 1.57 | 25.479 | 0.000 | 3>1 3>2         |

Note: 1. The six questions in the low-carbon building strategy part are Q1 ~ Q6
2. 1 is the high awareness group (N=77); 2 is the general awareness group (N=86); 3 is the low awareness group (N=56)

In terms of low-carbon building strategies (Table 1.), there are significant differences in the degree of recognition among three groups. Group 3 with low environmental awareness had significant differences with group 1 and group 2 in the recognition of all low-carbon building behaviours. According to statistics, the mean of the six questions about the three environmental awareness groups from high to low shows a low to high increase, which indicates that the better the environmental attitude is, the higher the identity of low-carbon building behaviours.

| Table 2. Differences in recognition of low-carbon transportation behaviours |
|---------------------------------------------|
| Low-carbon transportation | M   | F   | Sig. | Post Hoc(Scheffe) |
| Q7. Update buses and taxis for electric vehicles | 1.77 | 11.068 | 0.000 | 3>1 3>2         |
| Q8. Eliminate emissions of substandard motor vehicles | 1.62 | 3.049 | 0.049 |            |
| Q9. Choose public transportation | 1.63 | 13.518 | 0.000 | 3>1 3>2         |
| Q10. Buy or replace electric vehicles | 1.97 | 7.118 | 0.001 | 3>1 3>2         |
| Q11. Strengthen the safety management of bicycle lanes | 1.43 | 16.579 | 0.000 | 3>1 3>2         |
| Q12. Strengthen the management of bicycle parking spots | 1.45 | 20.047 | 0.000 | 3>1 3>2         |

Note: 1. The six questions in the low-carbon transportation strategy questionnaire are Q7~Q12
2. 1 is the high awareness group (N=77); 2 is the general awareness group (N=86); 3 is the low awareness group (N=56)

In terms of low-carbon transportation strategies (Table 2.), there are significant differences in the degree of recognition among three groups. Group 3 with low environmental awareness had significant differences with group 1 and group 2 in the recognition of all low-carbon transportation behaviours except for the question of eliminating emissions of substandard motor vehicles. The possible reason may be attributed to the government's achievement in the implementation of the project, which has achieved the relative consistency of the majority of the audience through comprehensive publicity and institutionalization. According to statistics, the mean of the six questions about the three environmental awareness groups from high to low shows a low to high increase, which indicates that the better the environmental attitude is, the higher the recognition of low-carbon transportation behaviours.

| Table 3. Differences in recognition of energy conservation behaviours |
|---------------------------------------------|
| Energy conservation | M   | F   | Sig. | Post Hoc(Scheffe) |
| Q13. Reduce urban lighting projects | 1.84 | 7.616 | 0.001 | 3>1 3>2         |
| Q14. Turn off the computer power after work or rest | 1.55 | 16.508 | 0.000 | 3>1 3>2         |
| Q15. Replace electric and gas water heaters for solar ones | 1.99 | 7.586 | 0.001 | 3>1 3>2         |
| Q16. Insist on hand washing light clothes | 1.92 | 5.643 | 0.004 | 3>1 3>2         |
| Q17. Unplug the power plug after using the appliance | 1.75 | 6.390 | 0.002 | 3>1 3>2         |
| Q18. Staggered peak use of electrical appliances | 1.82 | 5.399 | 0.005 | 3>1 3>2         |

Note: 1. The six questions in the energy conservation strategy questionnaire are Q13~Q18
2. 1 is the high awareness group (N=77); 2 is the general awareness group (N=86); 3 is the low awareness group (N=56).

In terms of energy conservation strategies (Table 3.), there are significant differences in recognition among three groups. Group 3 with low environmental awareness had significant differences with group 1 and group 2 in the recognition of all energy conservation behaviours. According to statistics, the mean of the six questions about the three environmental awareness groups from high to low shows a low to high increase, which indicates that the better the environmental attitude is, the higher the recognition of energy conservation behaviours.

Table 4. Differences in recognition of low-carbon consumption behaviours

| Low-carbon consumption                              | M     | F       | Sig.   | Post Hoc(Scheffe) |
|-----------------------------------------------------|-------|---------|--------|-------------------|
| Q19. Prioritize the selection of locally produced   | 1.87  | 8.30   | 0.000  | 3 > 1, 3 > 2      |
| Q20. Use a handkerchief instead of paper towels     | 2.05  | 6.016  | 0.003  | 3 > 1, 3 > 2      |
| Q21. Insist on carrying shopping bags               | 1.57  | 17.292 | 0.000  | 3 > 1, 3 > 2      |
| Q22. Buy less clothing per season                  | 1.95  | 7.718  | 0.001  | 3 > 1, 3 > 2      |
| Q23. Don't buy a new phone if it works              | 1.77  | 9.510  | 0.000  | 3 > 1, 3 > 2      |
| Q24. Daily meals and no waste meals                | 1.62  | 24.270 | 0.000  | 3 > 1, 3 > 2      |

Note: 1. The six questions in low-carbon consumption strategy questionnaire are Q19 ～ Q24

In terms of low-carbon consumption strategies (Table 4.), there are significant differences in recognition among three groups. Group 3 with low environmental awareness had significant differences with group 1 and group 2 in the recognition of all low-carbon consumption behaviours. According to statistics, the mean of the six questions about the three environmental attitude groups from high to low shows a low to high increase, which indicates that the better the environmental attitude is, the higher the recognition of low-carbon consumption behaviours.

In terms of sustainable circulation strategies (Table 5.), there are significant differences in recognition among three groups. There is a significant difference in Q25 and Q26 between group 1 and group 3. Based upon the mean, the recognition of the two questions of vegetarian diet per week and no using disposable utensils is relatively low, the two projects are not publicly promoted yet. Based on the mean, people have a higher degree of recognition for promoting waste sorting and participating in urban greening activities. Both of these are promoted for years by the public sector. The results show that the strategies of public advocacy and organization for sustainable circulation have positive effects on most citizens. There is no significant difference among the three groups of Q28 which replace treadmill exercise with outdoor running. It can be realized that outdoor running has positive energy saving effect, but maybe the negative impact of outdoor air pollution on health is a factor to be considered. According to statistics, the mean of the six questions about the three environmental awareness groups from high to low shows a low to high increase, which indicates that the better the environmental attitude is, the higher the recognition of sustainable circulation behaviours.

Table 5. Differences in recognition of sustainable circulation

| Sustainable circulation                          | M     | F       | Sig.   | Post Hoc(Scheffe) |
|-------------------------------------------------|-------|---------|--------|-------------------|
| Q25. Go vegan one day a week                     | 2.15  | 5.839  | 0.003  | 3 > 1             |
| Q26. Do not use disposable utensils              | 1.84  | 7.114  | 0.001  | 3 > 1             |
| Q27. Reusing domestic water resources in turn    | 1.74  | 5.335  | 0.005  | 3 > 1, 3 > 2      |
| Q28. Outdoor running replaces treadmill exercise | 1.75  | 2.435  | 0.090  |                   |
| Q29. Cooperate with garbage sorting and recycling| 1.45  | 34.300 | 0.000  | 3 > 1, 3 > 2     |
| Q30. Participate in urban greening activities    | 1.44  | 20.361 | 0.000  | 3 > 1, 3 > 2     |

Note: 1. The six questions in sustainable circulation strategy questionnaire are Q25 ～ Q30

2. 1 is the high awareness group (N=77); 2 is the general awareness group (N=86); 3 is the low awareness group (N=56)
4. Conclusions
It is found that the propaganda by the public sector has a positive role in promoting the recognition of low-carbon behaviours. In the process of implementing low-carbon strategies, multi-channel publicity is an important way. People have a relatively low recognition of low-carbon behaviours which break original habits and cause greater inconvenience. The implementation of low carbon strategies also requires the public sectors to make good suggestions or solutions and do a good job in guidance. The level of environmental awareness directly affects the degree of identity with low-carbon behaviours, and the implementation of low-carbon strategy depends on the improvement of people's environmental attitude. A good environmental attitude should be cultivated from an early age, and the content of environmental attitude can be tried to be integrated into school classroom education. The related public sectors can also combine the education of environmental attitudes with community activities to establish the correct environmental values of the people to reduce environmental damage and pollution.

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