■ 研究論文

対植に対する中国成人男性の視覚認知特性に関する研究

Visual Cognitive Characteristics of Chinese Male Adults looking at Pair Planting Variety

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Abstract : This study investigated how viewing a variety of different combination of pair-planting affects the psychological and physiological reactions of Chinese male individuals, and compare to Koreans, Americans and Japanese. For this purpose, eye movement and impression evaluation of 28 Chinese male individuals were collected. The evidences confirmed that Chinese individuals prefer looking at the trees but not the interval space between them. This behavior is similar to American and Korean subjects but differ to Japanese who paid comparatively more attention to the interval space. The results show that, Chinese participants are highly sensitive to size of trees, whereby, they paid more attention for the big trees as compared to the small ones. Impression evaluation showed Chinese participants preferred symmetrical tree pair-planting rather than other patterns, and dislike different sized pair-planting just like Americans and Koreans. On the other hand, a quite number of Japanese subjects preferred asymmetrical pair-planting. Thus, visual cognitive characteristics is considered to be correlated with preference: tree concentrated visual attention correlated to symmetrical tree pair-planting preference, while interval space visual attention correlated to asymmetrical pair-planting preference. Moreover, in case of Chinese subjects, unbalanced visual attention related to negative evaluation especially when the pair-planting is asymmetrical.

Keywords : *Pair Planting, Visual Sence, Chinese male Adults, Cognitive Characteristic, Interval space*

キーワード : 対植, 視覚, 中国人男性, 認知特性, 間

1. Introduction

As indispensable elements of garden, design of plant reflect the thoughts and esthetical consciousness of countries' populations, who have designed and maintained them over the years. The esthetical consciousness is discovered in human's physiological and psychological aspects^{1)~6)}. Previous studies like Park et al.,⁷⁾ compared visual cognitive characteristic between Japanese and Korean male subjects when they were looking at different patterns of pair-planting. Result of this study showed that Japanese subjects paid more visual attention to the interval space than Koreans did. Meanwhile, Japanese like pair-planting which they paid their attention on its interval space regardless the pair-planting was symmetrical or not, while Korean subjects preferred pair-planting in same shape and size and they paid their attention on the trees. It concluded that the difference in cognitive characteristics for different pair-planting patterns could be one of the reasons why Japanese gardens have less pair-planting in the same form but pair-planting in Korean gardens are usually in the same form though both of them are considered as natural style gardens. Sano et al.⁸⁾ did the similar experiment on American male subjects because American gardens including pair-planting are traditionally considered as symmetrical designed. And the result was compared to Japanese and Korean subjects. It was found that American subjects paid their visual attention to the trees and preferred pair-planting in same shape and size just like Koreans. However, Americans chose the fastigiata trees pair as the like one meanwhile Korean subject chose the globe trees pair. Furthermore, American subjects spend longer time on looking at the small trees when the pair-planting were formed by different size of

trees which was not observed on Japanese and Korean subjects. And this phenomenon was correlated to dislike impression evaluation. Both of these experimental studies found that individuals from different cultural region possessed different visual cognitive characteristics for different pair-planting patterns and documented that the difference in cognitive characteristics related to their garden style.

Chinese traditional gardens are considered as natural style gardens evidenced by asymmetrical design and do not have a distinct center^{9)~11)}. Meanwhile, some researches pointed out that even in Chinese traditional gardens, the symmetrical pair-planting can be found as well as asymmetrical pair-planting, especially around the building^{9), 12)}. On the other hand, Japanese gardens were also known as asymmetrical designed garden, and have less pair-planting in the same form¹³⁾. One-side planting (asymmetrical) which is an orthodox technique of Japan that creates a natural planting configuration aims at soften the impact from building to garden. This is one of the critical elements for composing such a natural-style Japanese garden. Contrastively, the pair-planting in front of the buildings in Chinese gardens are usually symmetrical. This difference causes a different feature between Chinese and Japanese gardens, but the reason why symmetrical pair-planting can be found in Chinese gardens stays unknown yet. Previous studies^{7), 8)} showed subjects who from the region have symmetrical pair-planting in traditional gardens preferred pair-planting in same size and shape, and paid more visual attention on the trees. This leads to the hypothesis that, the different patterns of pair-planting might have distinctive visual cognitive effects on

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Chinese individuals somewhat similar to Koreans and Americans but still have its own characteristic.

Therefore, present study examined the visual cognitive characteristics of the different patterns of pair-planting through physiological and psychological responses. The findings were discussed with previous studies' findings and may lead to a better understanding of the esthetical consciousness of Chinese individuals. Furthermore, expose psycho-physiological background of pair-planting usage characteristic of the Chinese landscape architecture.

2. Materials and Methods

(1) Participants and experimental setting

As participants, 28 undergraduate and graduate students majoring the Landscape Architecture, Beijing Forestry University were recruited. To exclude difference of eye movement due to gender, age and culture, all subjects were male from Han ethnic group in their twenties (Mean $\pm$ SD, 19 $\pm$ 1.5 years old). Selected participants were those who had good eyesight or corrected visual acuity of more than 0.7 to distinguish the different patterns of pair-planting. The information of pair-planting patterns was not provided before the experiment. Informed consent to participate in the study was obtained after explaining the aim and process of the research. Human research protocols for the study were approved by the Ethics Committee of Chiba University and Beijing Forestry University. The experiment was conducted in a meeting room at Beijing Forestry University where the same experimental environment could be provided to all participants. Dimension of the meeting room is 720cm long, 540 wide and 327cm high, with white ceiling and walls to exclude visual stimulation from environment. A chair was set for the subject. The distance between wall and objects was set at 50cm, the participant's chair and the trees were set at 350 cm so that they could see the entire tree without having to move their heads (Figure-1).

(2) Visual stimuli

Regarding the fastigiata trees and globe trees were traditionally used as garden planting by pair in East Asia including China and already used in previous studies. Present study selected three fastigiata trees (*Juniperus chinensis*) and three globe trees (*Buxus sinica*). These six trees were combined into six patterns as visual stimuli (Figure-2, Table-1). The distance between the center lines of two trees was set at 120cm, aimed at the subjects can conscious of the two plants are paired^{14), 15)}. All visual stimuli were placed on shelves covered with black cloth at the participants' eye level. Subjects would be exposed to the fewest external influences and go through the test

Figure-1 Experiment setting

Figure-2 Six patterns of pair planting used in experiment

Unit :cm	above-ground part		pot	
tree	height	branch spread	height	diameter
<i>Juniperus chinensis</i> *	97	35	29	34
<i>Juniperus chinensis</i>	97	44	29	34
<i>Juniperus chinensis</i> (small)	59	24	25.5	26.5
<i>Buxus sinica</i> **	50	75	38.5	46
<i>Buxus sinica</i>	50	78	37	46
<i>Buxus sinica</i> (small)	35	58	32	40

The trees with * mark was used in pattern 2 and pattern 3, with ** mark was used in pattern 5 and pattern 6.

Table-1 Size of trees

under the same conditions. In the middle of a shielded room with a white wall and the indoor lighting consisted of fluorescent light bulbs (700 ± 4 lux). A 25 °C temperature and 50 % relative humidity were maintained throughout the experiment.

(3) Measures

In order to expose Chinese participants' visual characteristic and its relationship with their preference of different pair-planting patterns, the study used a combination of biological measures and impression responses. While each subject was viewed the pair-planting, eye tracking and eye fixation were recorded using an eye mark recorder. Eye movement, reflecting unconscious and conscious reactions to visual stimuli, was tracked to investigate cognitive characteristics of the pair-planting with the cornea and pupillary reflex method (EMR-8 ST-560, NAC Image Technology Co., Ltd. Japan). To better understand how subjects responded to the objects, impression evaluation was conducted after the physiological measurements of eye movement. The participants were asked to choose one pattern from the six patterns as the favorite one and one pattern as the disliked one with reasons.

(4) Experimental procedures

After explaining the study details, protocol and other matters that required attention to each participant, the eye mark recorder were attached. During the experiment, subject was comfortably seated at chair and asked to relax fully, after calibration for eye movement was carried out, subject was asked to close his eyes. The first visual object was

prepared. When given a signal to open his eyes, the eye movement was recorded while the participant observed the visual stimulus (1 min) without move his head, no specific task was assigned to the subjects. The six patterns of pair-planting were presented in a random sequence based on the consideration of order effect. Each pattern was presented for 1 minute. After completing the eye movement measurement for all six patterns, participants were asked to fill out the impression questionnaire. The experiment required about 20 min.

(5) Data analysis

The number of eye fixations (the visual points fixed on for 0.2 sec or longer on the visual stimulus; this is based on the fact that more than 0.2 sec is required to consciously recognize the stimuli)¹⁶⁾ and eye fixation duration for 60 sec after exposure to the visual stimuli were analyzed by EMR-dFactory Ver2.7.0.0 (Figure-3). To analyze the distinction of eye movement between the six patterns of pair-planting, present study divided each pair-planting to three parts: left part (tree), middle part (without tree) and right part (tree) based on five degrees what is the diameter of central vision means one can recognize visual object clearly^{17), 18)}, the number of eye fixations and eye fixation duration of each part were compared. Considered the difference of trees size, present study used the average of radius of all six trees branch as 26cm. The range of the middle part that participator could observe was 37.3cm in length as Figure 4. The number of eye fixations and eye fixation duration of each part were counted respectively. The Steel-Dwass Test (two-sided) of *ESUMI EXCEL Statistics Ver. 7.0* software was used to statistically compare the three parts of the different patterns of pair-plantings. Due to the size of trees used for the pair-planting were not the same, direct comparison among Chinese, American, Japanese and Korean participants was not conducted. Data of like-dislike questionnaire were collected and analyzed to indicate the relationship between unconscious and conscious reactions and compared with previous studies' findings. Significance were established at $P < 0.10$, $P < 0.05$ and $P < 0.01$.

2. Results

(1) Eye-movement

As can be seen from Figure-5 and Figure-6, the number of eye fixations and eye fixation duration of the three parts were compared to each other. Participants' data showed significant differences of the number of eye fixations ($P < 0.01$) and eye fixation duration ($P < 0.01$) between middle part and side parts (left and right) from all six patterns.

Eye fixation duration of left tree from pattern 2 was significantly longer than its right tree ($P < 0.1$). Number of eye fixations of right tree from pattern 3 was significantly more than its left tree ($P < 0.1$), and its eye fixation duration of right tree was significantly longer than its left tree ($P < 0.05$). Eye fixation duration of right tree from pattern 6 was significantly longer than their left tree ($P < 0.01$), and its number of eye fixations of right tree was significantly more than its left tree ($P < 0.01$).

Figure-3 Eye tracking data sample (up) and eye fixations data sample (down) analyzed by EMR-dFactory Ver2.7.0.0.

Figure-4 Range of three parts of visual stimuli

(2) Impression evaluations

Figure-7 shows, participants expressed a range of preferences among the presented six patterns of pair-planting. A variety of different comments were made by participants, and some case the reason given as to why someone liked a pattern is the same reason another participant gave for disliking it. In case of pattern 1, eight (28.6%) of the participants liked it mostly because of the two trees' size were equal and the tapered shape. When be asked the reason, one participant answered 'the two trees are in the same shape and size.' another said 'I like tall trees, these two trees are tall and the height is same.' In contrast one (3.6%) participant said 'this pattern is too common.' and disliked it. Regarding to pattern 2, six (21.4%) participants liked it because of the two trees have same shape but in different size. One of them said 'the two have same shape but different size. The big one makes the small one looks cute.'. However, seven (25.0%) participants

* = $P < 0.1$, ** = $P < 0.05$, *** = $P < 0.01$, respectively.

Figure-5 Number of fixations of Chinese individual compared among three parts of six patterns of pair-planting. Significant differences were verified by Steel-Dwass Test (two-sided)

* = $P < 0.1$, ** = $P < 0.05$, *** = $P < 0.01$, respectively.

Figure-6 Eye fixation duration of Chinese individual compared among three parts of six patterns of pair-planting. Significant differences were verified by Steel-Dwass Test (two-sided)

Figure-7 Impression evaluation by Chinese participants n=28 male

disliked it mostly because of imbalance. One said 'the two trees are unbalanced.' Pattern 6 received more negative ratings than positive. Two (7.1%) participants said 'the small one is cute.' and liked it. While eight (28.6%) participants disliked it. One of them said 'the small one is too small.' Contrary, another one said 'the big one is too big.' Otherwise, one participant said 'this kind of globe tree is not existing in nature. I do not like them.' And another said 'they are not healthy.' Overall, from Figure 7, it is clear that pattern 1 was the favorite one. In contrast, pattern 6 was strongly disliked by most of the participants.

3. Discussion

Results from the eye-movement reveal that right and left parts with trees tended to generate higher fixation numbers and longer eye fixation duration from Chinese participants compared with middle part without tree. These results indicate that Chinese participants observed as concentrating on trees while they are looking at pair-planting. This behavior was observed in the previous studies from Korean and American subjects. It shows the Chinese participants have similar visual characteristic. Meanwhile, results from impression evaluations showed Chinese participants preferred Pattern 1 (same size fastigiated tree pair). Previous study showed American subjects preferred pattern 1 (same size fastigiated tree pair) (Figure-8), Korean subjects preferred pattern 4 (same size globe tree pair) (Figure-9). All these patterns were equal sized pair-planting patterns. Besides, unequal sized pair-planting such as pattern 6 (different size globe tree pair) and globe-fastigiated pair (not used in present study) were disliked by these subjects. On the other hand, Japanese subjects paid comparatively more visual attention on the interval space. And, though the favorite pattern of Japanese subjects were equal sized pair-planting (same size globe tree pair), quite a number of subjects preferred unequal sized pair-planting (different size globe pair-planting and fastigiated-globe pair-planting). With regard to these evidences, we suppose that, concentrated visual attention on trees was considered to be correlated to preference of symmetrical pair-planting, visual attention on the interval space lead to preference of asymmetrical pair-planting. Furthermore, it can partially explain why symmetrical pair-planting can be found commonly in Chinese, Korean and American gardens though their traditional garden style is not the same (Chinese and Korean: natural style, American: geometrical style), as opposed to Japanese gardens which are dominated by asym-

- *: 1. Pattern 1 to pattern 6 were same to present study, as figure-7.
2. Fastigated - globe pair and globe -fastigated -pair was not used in present study.

Figure-8 Impression evaluation by American participants
n=11 male.

- *: 1. Pattern 1, 2, 4, 5 were same to present study, as figure-7.
2. Pattern 3, 6 was not used in this study.

Figure-9 Impression evaluation by Korean participants
n=92 (84 male, 8 female).

- *: 1. Pattern 1, 2, 4, 5 were same to present study, as figure-7.
2. Pattern 3, 6 was not used in this study.

Figure-10 Impression evaluation by Japanese participants
n=61 (30 male, 31 female)

metrical pair-planting.

Chinese and American participants shared the favorite pattern of pair-planting: pattern 1. Japanese and Korean participants shared the favorite pattern of pair-planting: pattern 4. Both pattern 1 and pattern 4 were symmetrical pattern but in different shape. As the findings observed in the previous studies declared spreading as the most preferred tree form and columnar and conical as the least preferred tree form^{18) -20)}. Furthermore, other study reported that pyramid-formed trees were the most preferred ones whereas spreading-formed trees were the least preferred ones²²⁾. These different results show that studies about forms of plants should be repeated in different societies.

Eye fixation duration of the big tree was found significantly longer than the small tree from pattern 2, pattern 3 and pattern 6. Number of fixations of the big tree was found significantly more than the small tree from pattern 3 and pattern 6. Regard these results, it is considered that when the

paired trees' size were different, Chinese participants carefully observed the big one compared to the small one. It means Chinese participants were probably highly sensitive to size of trees. Meanwhile, the results from impression evaluations showed Chinese participants disliked pattern 6. The crucial reason of why Chinese subjects' disliked pattern 6 is because they felt it unbalanced. And not a small portion of participants disliked pattern 2 and 3. Regard these results, the unbalanced visual attention is considered as one of the crucial reasons of negative evaluations of Chinese participants. Contrary, previous study reported that American participants showed adverse behavior what is carefully observed the smaller one as evidenced by higher fixation numbers and longer eye fixation duration compared with their responses to the big one. And these patterns were disliked. However, though the type of trees which generated more visual attention were different between Chinese and American participants. These behaviors led negative evaluations. In other words, the unbalanced visual attention is considered as one of the crucial reasons of negative evaluations both of Chinese and American participants, regardless which tree generated more visual attention. On the other hand, these behaviors were not observed from Japanese and Korean participants.

Due to this study and previous studies only conducted on young male participants on eye-movement. And impression evaluation of this study only conducted on Chinese male. Previous study was conducted on Japanese, Korean male and females. The potential difference based on gender and age and major was not discussed.

4. Conclusion

The present study was designed to investigate how viewing a variety of different combination of pair-planting affects the psychological and physiological reactions of Chinese male individuals. The evidences from this study confirmed that Chinese male individuals participated this experiment do different responses to presence of different combinations of pair-planting with different size and shape.

The participants paid less attention through eye movements for the middle part of all patterns of pair-planting possibly because they prefer looking at the trees but not the interval space also called "Ma" between them. This visual characteristic of Chinese male individuals showed more similarity to American and Korean participants. Chinese participants preferred equal sized pair-planting pattern just like Korean and American subjects, whose traditional gardens contain symmetrical pair-plantings. Thus, concentrated visual attention on trees was considered correlated to preference of symmetrical pair-planting and has a connection with pair-planting style in traditional gardens.

Additionally, Chinese participants paid more attention through eye movements for the big tree compared the small tree. And this unbalanced visual cognitive characteristics is considered as one of the crucial reasons of negative evaluations. However, previous study showed American participants paid more attention through eye movements for the small tree compared the big tree and related to negative evaluations.

Reason of this kind of difference between participants from different cultural groups stay unknown, further experimental study is needed. Anyway, without doubt, unbalanced visual attention distribution related to negative evaluation.

The result of eye-movement and evaluation confirmed in this study showed Chinese participants liked symmetrical pair-planting style with paying more visual attention on the trees. Meanwhile disliked asymmetrical pair-planting style with unbalanced visual attention distribution. Though which is cause and which is effect stays unclearly yet, the relationship between eye-movement and the results of impression evaluation suggested there is a certain connection between visual cognitive characteristics of Chinese participants and symmetrical pair-plantings usage around the buildings in Chinese gardens.

The present study was carried out with controlled sample size, gender, and age to reduce confounding variables. However, we recommend further studies to include a large diverse sample so as to generalize findings.

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