

Evolutionary Effect on the Embodied Beauty of Landscape Architectures

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Abstract

According to the framework of evolutionary aesthetics, a sense of beauty is related to environmental adaptation and plasticity of human beings, which has adaptive value and biological foundations. Prior studies have demonstrated that organisms derive benefits from the landscape. In this study, we investigated whether the benefits of landscape might elicit a stronger sense of beauty and what the nature of this sense of beauty is. In two experiments, when viewing classical landscape and nonlandscape architecture photographs, participants rated the aesthetic scores (Experiment 1) and had a two-alternative forced choice aesthetic judgment by pressing the reaction button located near to (15 cm) or far from (45 cm) the presenting stimuli (Experiment 2). The results showed that reaction of aesthetic ratings for classical landscape architectures was faster than those of classical nonlandscape architectures. Furthermore, only the reaction of beautiful judgment of classical landscape architecture photograph was significantly faster when the reaction button was in the near position to the presenting photograph than those in the position of far away from the presenting photograph. This finding suggests a facilitated effect for the aesthetic perception of classical landscape architectures due to their corresponding components including water and green plants with strong evolutionary implications. Furthermore, this sense of beauty for classical landscape architectures might be the embodied approach to beauty based on the viewpoint of evolutionary aesthetics and embodied cognition.

Keywords

evolutionary aesthetics, embodied cognition, sense of beauty, landscape architecture, embodied approach to beauty

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In the framework of evolutionary aesthetics, aesthetic perception and preference are regarded to be one of the evolving behaviors for adapting environment, which have biological groundings, and being conducive to human survival and reproduction (Davies, 2012; Hartmann & Apaolaza-Ibáñez, 2010; Killin, 2013; Seghers, 2015; Ulrich, 1983). Following this viewpoint of evolutionary aesthetics, the “savanna hypothesis” was proposed to hypothesize that people may have innate preference of savanna (Orians, 1980). Researchers provided preliminary evidence that they found participants, especially for young children expressed higher preference for photographs of savannas and hardwood forests, rather than other biomes (Balling & Falk, 1982; Falk & Balling, 2010; Lohr & Pearson-Mims, 2006). However, this hypothesis still seems to be limited supported because the significant preference for savanna-like environments was modulated by the function of age (Balling & Falk, 1982; Hartmann & Apaolaza-Ibáñez, 2010) and visual structural complexity (Synek & Grammer, 1998). Moreover, a multidimensional study of college students

revealed tundra and coniferous forest had the highest rating scores in terms of scenic beauty and interest, but the environment nearest to savanna, grassland had the lowest scores

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(Han, 2007). Therefore, researchers suggested that the preference of environment might be a cumulative process and could change during the life cycle (Lyons, 1983).

Although the inferences drawn about the innate preference for savanna may seem weak, certain features including clear water, green vegetation, and plants are essential for survival and reproduction can generate strong aesthetic perception and preference would be more convincing (Davies, 2012; Dutton, 2003, 2009; Colarelli & Dettmann, 2003). Moreover, a large number of empirical studies also found that human beings could derive benefits from natural landscape with water and green plants, in terms of psychological health and positive affective experience (Bratman, Hamilton, & Daily, 2012; Guittart, Pickering, & Byrne, 2012), social interaction (Zhang, Piff, Iyer, Koleva, & Keltner, 2014), and cognitive processing (Atchley, Strayer, & Atchley, 2012; Berman, Jonides, & Kaplan, 2008; Berman et al., 2012). Landscape architecture is one of the types of artificial environments, which is primarily composed of a series of natural landscape and sceneries (e.g., water, rockeries, trees, and other green plants). According to the viewpoint which argues aesthetic perception and preference are associated with the benefits of living and reproduction of human beings from evolutionary aesthetics, whether the processing of landscape architectures would elicit a higher aesthetic appraisal than other types of architectures is the first question to be explored in the present study.

Furthermore, if the landscape architectures can elicit higher aesthetic appraisal, the second issue to be discussed in the present study is what the nature of the sense of beauty for landscape architectures is. That is, how do people perceive the sense of beauty of landscape architectures? Recent studies proposed that beauty can be embodied and represented as an empathetic experience or mental simulation (Di Dio & Gallese, 2009; Freedberg & Gallese, 2007). This statement was supported by a series of empirical evidence that showed paintings and sculptures of human figures with dancing movements were more appreciative than those only in static condition (Chakravarty, 2010), due to the simulation of movements would elicit strong recurring situational experiences and bodily resonance (Gibbs, Lima, & Francozo, 2004; Koch, 2017). Meanwhile, neuroimaging studies had also found the aesthetic appraisal of visual stimuli typically elicited strong activation of motor-related areas (Calvo-Merino, Jola, Glaser, & Haggard, 2008; Di Dio, Canessa, Cappa, & Rizzolatti, 2011; Di Dio, Macaluso, & Rizzolatti, 2007; Kawabata & Zeki, 2004; Zhang, Lai, He, Zhao, & Lai, 2016; Zhang et al., 2017), suggesting that aesthetic perception and judgments may be implicated in the generation of embodied simulation of action (Di Dio & Gallese, 2009; Freedberg & Gallese, 2007), and embodied approaching motivation for beauty (Kawabata & Zeki, 2004; Zhang et al., 2016, 2017). Because landscape architecture is an important human settlement environment, which is related to strong situational experiences, we hypothesized that these recurring situational experiences may make the sense of beauty of landscape architecture embodied.

In this study, we designed two experiments to investigate whether participants would show higher aesthetic preference for landscape architectures, and what the nature of the sense of beauty for these aesthetic materials is. Methodologically, Chinese classical landscape architectures and classical non-landscape architectures were used in this study, because the corresponding architectural styles of these classical architectures were primarily affected by Chinese traditional culture and become relatively unified, whereas modern architectures styles were affected by multiculture and seem to be more diverse. Moreover, the contemporary architectures we used can help to reduce the confounding effects of design philosophy and prestige. In Experiment 1, participants were asked to give the aesthetic rating scores of stimuli explicitly based on the fully cognitive and disembodied approach to the sense of beauty. We assumed aesthetic perception and judgments would be elicited more easily in the condition of landscape architectures, due to the components of landscape architectures (water and green plants) had strong evolutionary implications and might elicit preferences and generate a greater sense of beauty according to the viewpoint of evolutionary aesthetics and evolutionary psychology (Dutton, 2003; Orians & Heerwagen, 1992).

In Experiment 2, we focused on whether an implicit association between beautiful judgments and approaching tendency existed during the aesthetic judgments of landscape architectures using the action-compatibility effect (ACE) paradigm, which revealed that responses were faster when mental representation of an action was congruent with the performing action than when the action was incongruent (Glenberg & Kaschak, 2002; Zwaan, van der Stoep, Guadalupe, & Bouwmeester, 2012). We expected faster reaction of beautiful judgments should be produced when the pressing button was in the near position to the classical landscape architecture photographs, because the sense of beauty of architecture would be associated with the willingness of living of human beings (Ritterfeld & Cupchik, 1996; Vartanian et al., 2015), which could activate the embodied experience of approaching.

Experiment 1

Method

Participants

Thirty-two healthy, right-handed undergraduate students (19 females) between 18 and 24 years of age (mean age = 19.72, $SD = 1.53$) participated in Experiment 1. They all had normal or corrected-to-normal vision, and none of them had special experience in art or architecture. Written informed consent was obtained from each participant, and the protocol was approved by the Institute Ethics Committee, South China Normal University. The participants were paid for their participation.

Materials

The experimental materials included 24 standardized gray photographs of classical landscape architectures and 24 standardized gray photographs of classical nonlandscape architectures. These photographs were collected from public Internet sources and rated by a separate group of participants who had no special training in art or architecture ($n = 30$).

The ratings contained 102 architecture photographs (51 classical landscape architecture photographs). All of the photographs were rated on a 5-point scale in terms of the aesthetic qualities of the architecture photographs (1 for *not beautiful at all* and 5 for *very beautiful*), the familiarity of the architecture in the photographs (1 for *very unfamiliar* and 5 for *very familiar*), and the complexity of the architecture photographs (1 for *very simple* and 5 for *very complicated*), which according to the following criteria: (i) the number of main buildings of the photographs, (ii) the complexity of the background, and (iii) whether the arrangement of the main architecture and background were disorderly and unsystematic.

Both sets of experimental materials showed no significant difference in terms of the aesthetic qualities of the architecture photographs (3.65 ± 0.26 ; 3.65 ± 0.22 , for classical landscape architectures and nonlandscape architectures, respectively), the complexity of the architecture photographs (3.22 ± 0.21 ; 3.19 ± 0.23 , for classical landscape architectures and nonlandscape architectures, respectively), and the familiarity of the architecture in the photographs (1.10 ± 0.06 ; 1.14 ± 0.19 , for classical landscape architectures and nonlandscape architectures, respectively), $F_s < 1.00$, $p_s > .324$. The architecture photographs were spatially downsized to be equal size in a rectangular “window” sized at 300×200 pixels, and centered in a 600×400 pixels gray background (25% gray scale). Examples of the stimuli are shown in Figure 1.

Design

Experiment 1 involved a single factorial design (types of architectures: classical landscape architecture vs. classical nonlandscape architecture). The dependent variables were two measures of participants' aesthetic judgment task to architecture photographs: aesthetic rating scores and reaction time.

Procedure

Figure 1 illustrates the experimental procedure of Experiment 1. The experiment began with 20 practice trials. Participants were instructed to provide the aesthetic ratings of architecture photographs spontaneously, and as fast as possible by pressing the key “1–5” on the keyboard (1 for *not beautiful at all* and 5 for *very beautiful*). The formal experiment contained 96 test trials (with one repetition of the 48 experimental materials) and was divided into four experimental blocks, each comprising 24 test trials (12 classical landscape architecture photographs and 12 classical nonlandscape architecture photographs). Every test trial was presented in a random order for the maximum allowed

reaction time of 3,000 ms, followed by a red fixation point presented in the middle of the screen for 600 ms. If the rating of photographs was not given within 3,000 ms, the next trial was started. A gray screen was displayed for 800 ms as an interstimulus break between the response and the next trial.

After the experiment, each participant was instructed to have a postexperimental rating of familiarity for architecture photographs, which were identical to those in the experiment. They rated each photograph on a 5-point scale in which 1 for *very unfamiliar* and 5 for *very familiar*.

Results and Discussion

One participant was excluded because of wrong key responses. Data for aesthetic rating scores and reaction time deviating more than 2.5 standard deviations from the average were discarded. In order to control the effect of disproportionate number of female participants, we included gender as a covariate. The remaining data set was submitted to an analysis of covariance (ANCOVA) with subjects as random effect. Figure 2 presents overall means for aesthetic rating scores and reaction time in all conditions.

Aesthetic Rating Scores

Results of aesthetic rating scores revealed effect of gender did not differ significantly between the two sets of materials, $F(1, 29) = 0.01$, $p = .924$, $\eta^2 < .01$. Similar to the findings of the pilot study of materials ratings, there was no significant difference between classical landscape architecture photographs (3.92 ± 0.53) and nonlandscape architecture photographs (3.82 ± 0.54), $F(1, 29) = 1.30$, $p = .263$, $\eta^2 = .04$.

Reaction Time

For reaction time of aesthetic ratings, there was no significant effect of gender, $F(1, 29) = 0.09$, $p = .762$, $\eta^2 < .01$. However, the main effect of types of architectures was significant, which revealed response latencies were faster for classical landscape architecture photographs ($1,074 \pm 238$) than for nonlandscape architecture photographs ($1,263 \pm 345$), $F(1, 29) = 6.41$, $p = .017$, $\eta^2 = .18$.

Postexperimental Ratings of Familiarity

For the mean postexperimental ratings of familiarity, no significant difference for classical landscape architecture photographs (1.29 ± 0.62) and classical nonlandscape architecture photographs (1.47 ± 0.59) was found in Experiment 1, $t(30) = -1.38$, $p = .178$, Cohen's $d = .26$, suggesting that the effect of familiarity on the aesthetic judgments might be ruled out.

In line with our hypothesis, Experiment 1 demonstrates a facilitated effect for aesthetic ratings in the condition of viewing classical landscape architecture photographs. This finding suggests that processing classical landscape architecture photographs can elicit a sense of beauty more easily, due to their corresponding components including water, rockeries, trees,

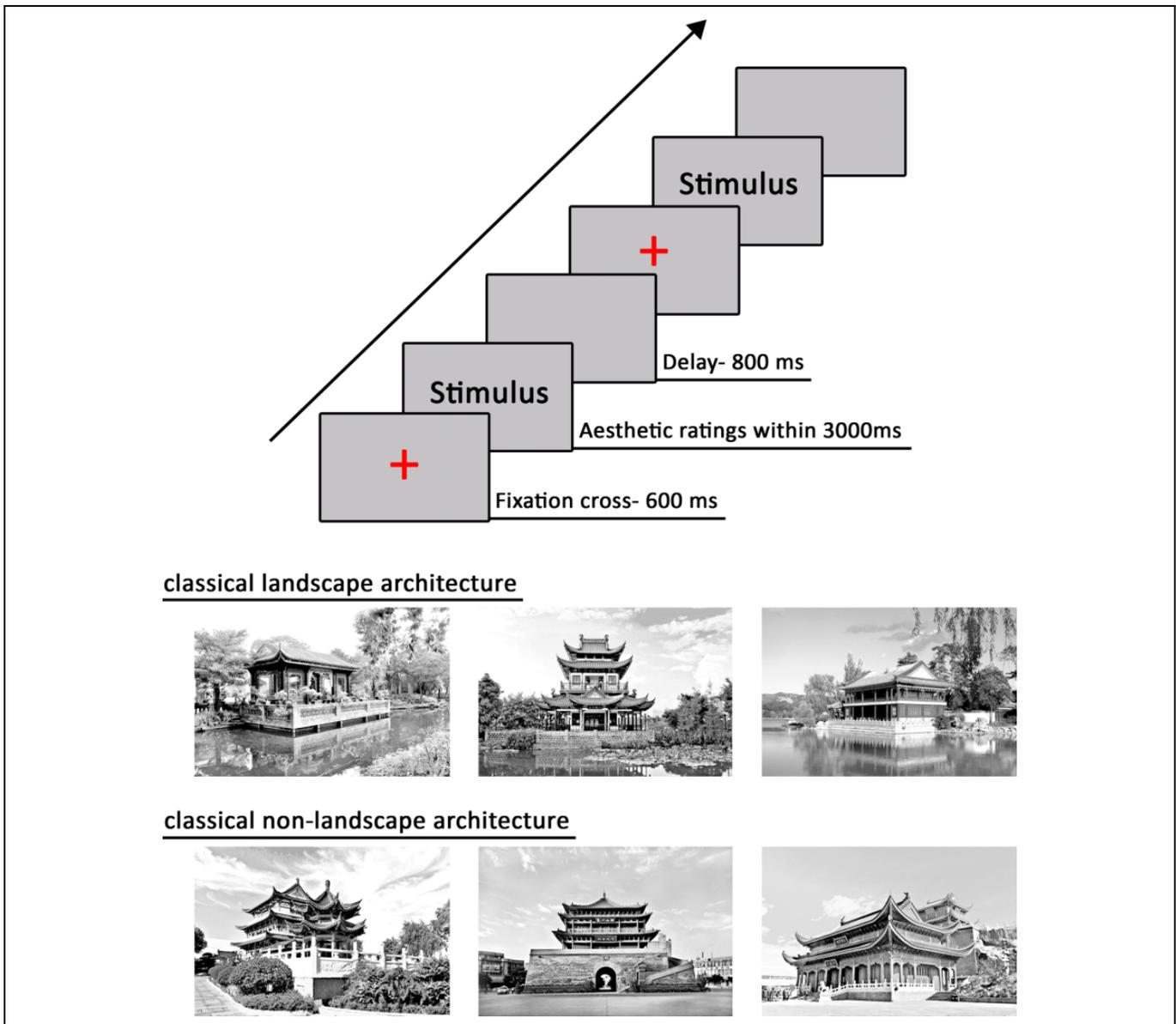


Figure 1. The experimental procedure of Experiment 1 is displayed on the upper center. Examples of classical landscape architecture and nonlandscape architecture are displayed on the lower center.

and other green plants with significant benefits and evolutionary implications to human beings. In such cases, what is the nature of the sense of beauty for landscape architectures? This question would be explored in Experiment 2.

Experiment 2

Method

Participants

A different group of 65 healthy, right-handed undergraduate students (40 females) between 18 and 24 years of age (mean age = 19.77, $SD = 1.63$) participated in Experiment 2. They all had normal or corrected-to-normal vision, and none of them

had special experience in art or architecture. Written informed consent was obtained from each participant, and the protocol was approved by the Institute Ethics Committee, South China Normal University. The participants were paid for their participation.

Materials

The materials were identical to those in Experiment 1.

Design

Experiment 2 involved a 2 (types of architectures: classical landscape architectures vs. classical nonlandscape architectures) \times 2 (reaction directions: located near to the screen vs.

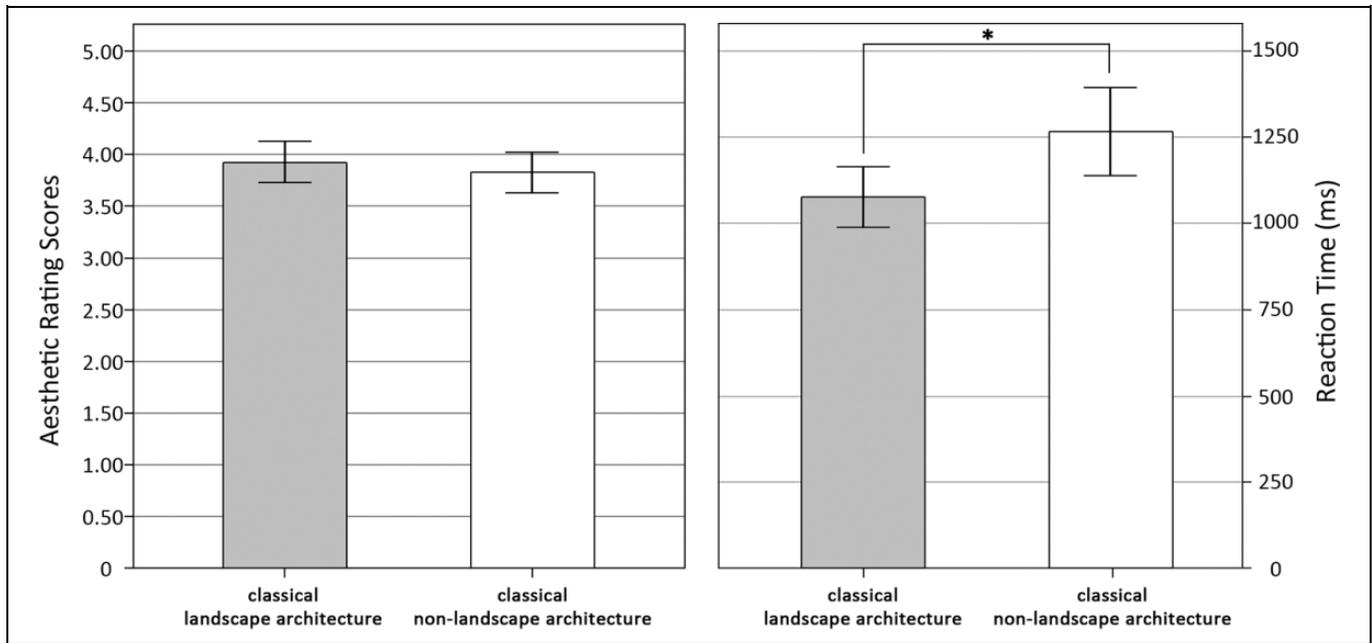


Figure 2. Means and standard errors around (a) aesthetic rating scores and (b) reaction time displayed as a function of the types of architectures, * $p < .05$. ** $p < .01$.

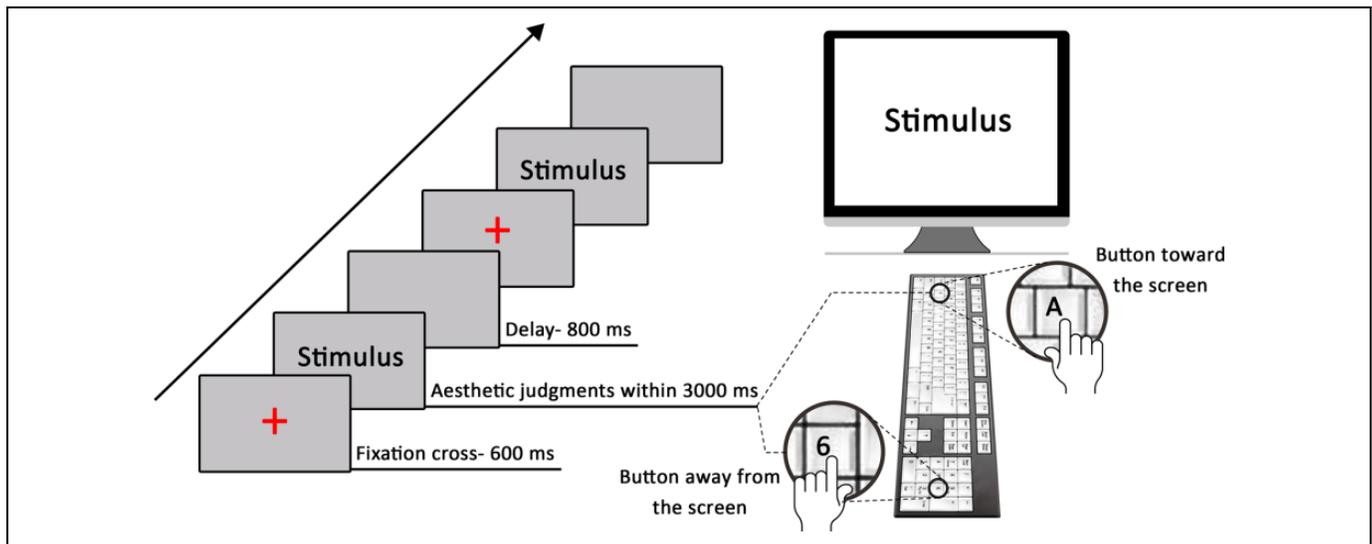


Figure 3. The experimental procedure and the schematic view of the apparatus of Experiment 2.

far away from the screen) mixed design, with types of architectures as a within-subjects factor and reaction directions as a between-subjects factor. The dependent variables were two measures of participants' aesthetic judgment task: reaction rates and reaction time of beautiful judgments of the two sets of architecture photographs.

Procedure

Figure 3 illustrates the experimental procedure and the schematic view of the apparatus of Experiment 2. The procedure

was the same as in the previous experiment, but the task and key press were different. In Experiment 2, the computer keyboard was rotated clockwise by 90° (see Figure 3), which made key "A" near to the screen (15 cm, represented for near to the presenting photograph) and key "6" far away from the screen (45 cm, represented for far away from the presenting photograph). Participants were instructed to respond with a key press on the keyboard within 3,000 ms to judge whether each architecture photograph was beautiful (beautiful vs. not beautiful). The assignment of response keys and finger-response mapping were counterbalanced across participants. Half of the

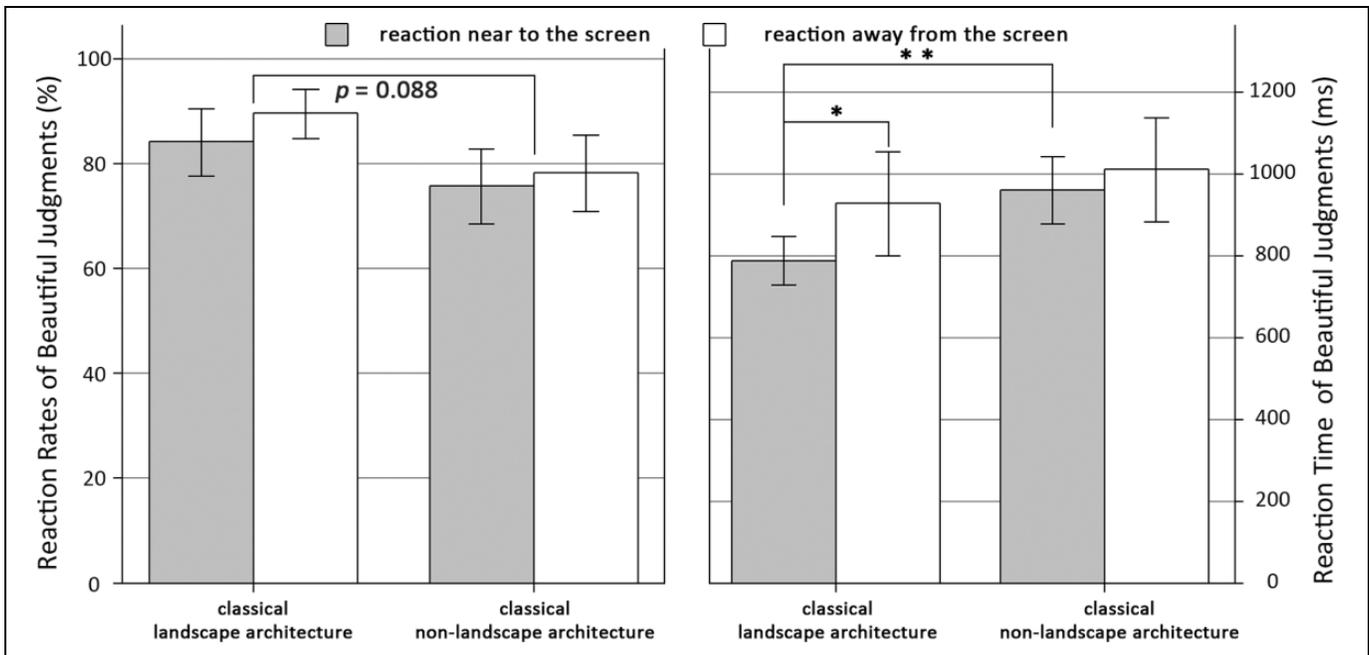


Figure 4. Means and standard errors around (a) reaction rates and (b) reaction time of beautiful judgments displayed as a function of the types of architectures to which the reaction button located near to and far away from the screen, $*p < .05$. $**p < .01$.

participants had to press key “A” when they judged the photograph as beautiful and pressed key “6” when they judged the photograph as not beautiful. The key assignment was reversed for the other half of participants.

In line with Experiment 1, each participant was instructed to have a postexperimental rating of familiarity for architecture photographs. The rating materials and rating criteria were identical to those in Experiment 1.

Results and Discussion

Three participants who had high invalid data rates were excluded. Data for reaction rates and reaction time of beautiful judgments deviating more than 2.5 standard deviations from the average were discarded. In order to control the effect of disproportionate number of female participants, we included gender as a covariate. The remaining data set was submitted to a two-way mixed model ANCOVA with subjects as random effect. Figure 4 presents overall means for reaction rates and reaction time of beautiful judgments in all conditions.

Reaction Rates of Beautiful Judgments

For reaction rates of beautiful judgments, we found no significant effect of gender, $F(1, 59) = 1.60$, $p = .211$, $\eta^2 = .03$. There was a marginal significant effect of types of architectures, $F(1, 59) = 3.00$, $p = .088$, $\eta^2 = .05$, with classical landscape architecture photographs yielded more beautiful judgments (0.87 ± 0.02 vs. 0.77 ± 0.03 , for classical landscape architecture and nonlandscape photographs, respectively). No significant effect of reaction directions was found,

$F(1, 59) = 1.64$, $p = .205$, $\eta^2 = .03$. No significant interaction between types of architectures and reaction directions was found, $F(1, 59) = 0.26$, $p = .614$, $\eta^2 < .01$.

Reaction Time of Beautiful Judgment

For reaction time of beautiful judgments, no significant effect of gender was found, $F(1, 59) = 0.16$, $p = .693$, $\eta^2 < .01$. There was a significant effect of types of architectures, $F(1, 59) = 4.17$, $p = .046$, $\eta^2 = .07$. No significant effect of reaction directions was found, $F(1, 59) = 1.91$, $p = .172$, $\eta^2 = .03$. A significant interaction between types of architectures and reaction directions was found, $F(1, 59) = 4.71$, $p = .034$, $\eta^2 = .07$, which revealed that beautiful judgments were significantly faster to classical landscape architecture photographs when the pressing button was near to the screen (789 ± 163) than those in the condition of pressing button was far away from the screen (928 ± 340), $t(60) = -2.07$, $p = .043$, Cohen's $d = .52$. No significant difference was found for the responses of classical non-landscape architecture photographs in the contrast between pressing button was near to the screen (960 ± 228) and far away from the screen ($1,011 \pm 338$), $t(60) = -0.69$, $p = .490$, Cohen's $d = .18$.

In addition, beautiful judgments were significantly faster to classical landscape architecture photographs than classical nonlandscape architecture photographs when the pressing button was near to the screen, $t(62) = -3.46$, $p = .001$, Cohen's $d = .86$. However, this effect was absent in the condition of pressing button was far away from the screen, $t(58) = -0.95$, $p = .345$, Cohen's $d = .25$.

Postexperimental Ratings of Familiarity

The mean postexperimental ratings of familiarity also revealed no significant difference for classical landscape architecture photographs (1.32 ± 0.67) and classical non-landscape architecture photographs (1.48 ± 0.55) in Experiment 2, $t(122) = -1.45$, $p = .151$, Cohen's $d = .26$, suggesting that the effect of familiarity on the aesthetic judgments might be ruled out.

The results of Experiment 2 replicated the similar findings of Experiment 1, which showed a facilitated effect for the beautiful judgments of classical landscape architecture photographs. Moreover, we also found faster reaction for classical landscape architecture photographs when the pressing button was near to the screen. These findings suggest a clear embodied approach to beauty being elicited for the beautiful judgments of classical landscape architecture photographs.

General Discussion

In the present study, we investigated the nature of the sense of beauty for landscape architectures. To be able to address this issue, we explored how people perceive the sense of beauty of landscape architectures using Chinese classical landscape architectures as materials. We evaluated this in terms of aesthetic rating scores, reaction rates, and reaction time of beautiful judgments. This was done by (i) explicitly instructing participants to give the rating scores of stimuli based on the fully cognitive and disembodied approach to the sense of beauty (Experiment 1) and (ii) by having an embodied two-alternative forced choice (the ACE paradigm), which focused on investigating how the sense of beauty of landscape architectures is embodied (Experiment 2).

As predicted, we found no significant difference between landscape architecture photographs and nonlandscape architecture photographs in the aesthetic rating scores, suggesting the two sets of materials evoke similar degrees of aesthetic feeling. However, a marginal significant difference of reaction rates of beautiful judgments between the two sets of materials was found during the beautiful or not beautiful judgment task. How could this inconsistent result be interpreted? One could attempt to answer this question in terms of the embodiment factor, which was operationalized as the reaction directions (located near to the screen vs. far away from the screen). We assume this embodiment factor may strengthen the aesthetic effect due to more relevant perceptual and motor representations will be activated, making participants engage in higher cognitive stages of judgment of beauty. This assumption was supported by the findings of Louwerse and Jeuniaux (2010), who found the embodiment factor dominated in deeper cognitive tasks, had the strongest effect, and predicted reaction rates better for the judgments of pictures.

For reaction time, in line with prior studies which found there were strong aesthetic preference and visual aesthetic value assessment for landscape and gardening scenarios

(Lindemann-Matthies & Brieger, 2016; Wang, Zhao, & Liu, 2016), our results showed reaction of beautiful judgments for landscape architecture photographs was significantly faster than nonlandscape architecture photographs, regardless of the aesthetic task of average rating scores (5-point scale) or two-alternative forced choice (beautiful vs. not beautiful). As reaction time can be an indicator of emotional reactions for pleasant stimuli (Kissler & Hauswald, 2008; Smith, Dolan, & Rugg, 2004), we infer that the embodied and aesthetic emotions may be activated automatically (Berlyne, 1971; Cupchik, 2002) and independent from cognitive process (Zajonc, 1984).

More importantly, we found that only the beautiful judgments of landscape architecture photographs but not nonlandscape architecture photographs were significantly faster when the pressing button was near to the screen than those in the condition of pressing button was far away from the screen. Collectively, these results confirmed our predictions and suggested that aesthetic preference for landscape architectures might be one kind of embodied beauty which had been discussed in past studies (Zhang et al., 2016, 2017).

How could the sense of beauty for landscape architecture be embodied? One possible explanation might be the activation of the embodied approach to beauty (Kawabata & Zeki, 2004; Zhang et al., 2016, 2017). Because water, trees, and other plants are the important components of landscape architecture, and have strong value and meanings for survival and reproduction (Orians & Heerwagen, 1992), when viewing the landscape architecture photographs, these components with evolutionary implications may elicit stronger preferences and generate a greater sense of beauty according to the viewpoint of evolutionary aesthetics (Dutton, 2003). Meanwhile, this greater sense of beauty of open space (e.g., landscape) would also link to the willingness of living and become one of the strongest determinants of approaching decisions (Ritterfeld & Cupchik, 1996; Vartanian et al., 2015). That is to say, aesthetic perception of landscape architectures with strong evolutionary implications may be associated with the action representation of approaching, which can be regarded as an embodied approach to beauty, and make the sense of beauty for landscape architectures to be embodied.

In summary, this study has shown that the embodiment factor plays a role in the aesthetic perception and judgments as well as providing empirical evidence and theoretical implications for understanding how the sense of beauty for landscape architectures is embodied. However, evidence for the embodied beauty of landscape architectures is mainly from behavioral data, the validation of the cognitive mechanism of the embodied beauty of landscape architectures needs to acquire more evidence using the techniques of neuroscience. Moreover, because both the landscape architectures and non-landscape architectures have buildings, artificial environments, and certain wide horizons, which represent the metaphors of prospect (clear view of the environment) and refuge (safe place to hide; Appleton, 1990), further studies will be necessary to disentangle the effects of "prospect and refuge symbolism" and the aesthetic appraisal of environments.

Declaration of Conflicting Interests

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