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Original article

# Visual preference of trees: The effects of tree attributes and seasons

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ABSTRACT

Trees in cities are often viewed as objects of attraction. Previous literature suggests that some tree attributes, such as height, canopy size and leaf color, are the driving factors for a tree's aesthetic quality. However, the tree attributes used greatly vary among researchers who do not reach an agreement on which attributes affect people's preferences. Also, differences of trees' aesthetic quality in different seasons are poorly understood. To fill these gaps, twenty tree species were photographed in the exact same location in different seasonal stages, their aesthetic quality was judged by the general public using semi-quantitative response variable, and 11 tree attributes were abstracted and quantified to check their effect on the perception of trees' beauty. Statistical analysis showed that the tree possessing the characteristics of higher branching trunk, dense canopy and moderate length of leaves (about 11 cm) was given a high preference rank. Although there is no significant difference among preference scores in four seasons, the tree ranked a high preference in spring or summer was more likely to indicate an intense fluctuation of preference among four seasons. The practical implication is that more tree species with the preferred attributes should be used not only for aesthetic appeal but also for ecological benefits. For the contrast of aesthetic quality in different seasons, the trees which rank as high preference in spring or summer should be planted.

## 1. Introduction

Vegetation is an important element in a landscape, offering multiple benefits to human (Chiesura, 2004), such as reducing air pollution and flood damage (Calfapietra et al., 2009; McPherson et al., 2011), saving energy (McPherson and Simpson, 2003; Lohr et al., 2004), buffering noise (Van Renterghem and Botteldooren, 2002), providing habitat for wildlife (Sanesi et al., 2009; Tsuchiya et al., 2013), enhancing neighborhood ties and sense of community (Kearney, 2006; Maas et al., 2009), and improving mental and physical health (Van den Berg et al., 2010; Nilsson et al., 2011). At the same time, vegetation in cities has been demonstrated to be a strongly positive promoter for aesthetic preference (Herzog et al., 2000; Kaplan et al., 2006; Rogge et al., 2007), and all forms of vegetation contribute to visual improvement: trees break up continuous building facades and provide delineation of space, shrubs anchor structures to the ground, and grass helps to define pavement edges (Smardon, 1988). Therefore, the beauty of a place is closely linked to the vegetation growing there (Kuo et al., 1998; Todorova et al., 2004). A beautiful environment is not just a matter of people's visual appreciation, it also promotes health (Ulrich, 1984; Ulrich et al., 1991; Velarde et al., 2007), improves work efficiency (Leather et al., 1998) and speeds up mental and physical recovery (Kaplan, 2001; Nordh et al., 2009). These findings are very important to urban green space planning, because the world is experiencing a progressive urbanization (United Nations, 2014), especially for the fast developing countries, such as China which is undergoing a rapid and intense urbanization process.

Green space design which considers people's perceptions and preferences will increase residential satisfaction and strengthen the positive physical and psychological effects of green spaces. Thus, the aesthetic preference of the general public should be respected by landscape architects. Comparing to other vegetation, trees are the dominant component of a plant community (Dwyer et al., 1991; Tahvanainen et al., 1996; Misgav, 2000) and the key to the attraction of a place (Todorova et al., 2004). Previous researchers have spent great effort to establish the relationships between people's aesthetic taste and tree attributes to guide the tree selection and management in urban green space (e.g., Balling and Falk, 1982; Mattsson and Li, 1994; Summit and Sommer, 1999; Nelson et al., 2001; Orians, 2001).

Although many studies conclude that people prefer tall trees over dwarf trees (Ulrich, 1986; Mattsson and Li, 1994; Liao and Nogami, 1999), Summit and Sommer (1999) suggest that 54% respondents prefer dwarf trees, comparing to 22.5% respondents preferring tall trees. Similar result is also demonstrated by Heerwagen and Orians (1993) who explain that dwarf trees are easier for human. The risk of people falling from them and the consequences of such falls are slighter

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than with tall trees.

A tree's canopy is essential for its beauty. People prefer trees with a broad canopy and high ratio of canopy size to trunk size (Lin, 2000). Nelson et al. (2001) and Lohr and Pearson-mims (2006) conclude that the tree with a dense canopy is more attractive than the tree with an open canopy, because a dense canopy signals a better prospect and refuge. However, research suggests that participants do not show a preference for a particular canopy density (Lin, 2000). In addition, the trees with complete canopy are more attractive than the trees with damaged canopy (Nelson et al., 2001).

With regard to tree shape, Lin (2000) mentions that tree shape is the most important factor for a tree's beauty; in general, people prefer the conical or spreading trees. Legg and Hicks (1978) demonstrate that spreading branched and vase shaped trees are rated higher in beauty than the cylindrical or narrow conical trees. Some researchers quantify tree shape using the ratio of tree height to tree width. Their results show that the tree with a form of more width than height are usually preferred by people (Balling and Falk, 1982; Orians and Heerwagen, 1992; Sommer, 1997), because this kind of tree is similar to the tree growing in the east African savannah's fertile habitats which is preferred consistently by people across regions and cultures (Kaplan, 1987; Orians, 2001).

Although Hands and Brown (2002) and Kendal et al. (2008) suggest that people's preference for leaf color depends on the environment where the plants grow, people are generally in favor of the tree with green leaves (Balling and Falk, 1982; Heerwagen and Orians, 1993; van den Berg et al., 2003), because the green leaves imply a healthy plant and good environment to support more lives (Orians and Heerwagen, 1992). However, Kendal et al. (2008) argue that the plants with gray and green foliage are preferred equally. No matter in which kind of environment, the plants with abundant flowers always receive a high rating in landscape assessment (Akbar et al., 2003; Todorova et al., 2004; Kaplan, 2007). The reason is that the flowers signify a healthy and reproductive plant and an environment under good management (Nassauer, 1995).

Based on the literature review, we can see that previous preference studies present trees that vary in attributes, and researchers do not reach an agreement on the effects of some tree attributes on people's aesthetic quality. Thus the way to select beautiful trees and maintain them to grow beautifully is still a challenge to landscape architects. On the other hand, trees change a lot in different seasons, especially for deciduous trees. Thus the conclusions found in one season may not apply for people's plant preference in other seasons (Gerstenberg and Hofmann, 2016). We hope the trees selected are beautiful not only in one season, but throughout the year. Unfortunately, to our knowledge, no literature has explored the seasonal effect on individual plant's beauty and the consensus of the beauty through the four seasons in a year. For the reasons mentioned above, this study focuses on answering the following two questions in order to provide guidelines for selection and management of trees in urban green space.

(1) What are the important attributes to maintain a tree's beauty throughout a year in Chinese background?
(2) What are the seasonal effects on a tree's beauty?

## 2. Methods

### 2.1. Tree selection

Twenty tree species were selected in this study, including six evergreen (*Cedrus deodara, Cinnamomum camphora, Photinia serrulata, Osmanthus fragrans, Magnolia Grandiflora, Ligustrum lucidum*) and fourteen deciduous species (*Ginkgo biloba, Sapindus mukorossi, Prunus serrulata, Metasequoia glyptostroboides, Platanus orientalis, Populus tomentosa, Acer buergerianum, Liquidambar formosana, Sophora japonica, Taxodium ascendens, Liriodendron chinense, Koelreuteria paniculata, Bischofia polycarpa, Zelkova serrata*). These trees are popular in urban green space in Xuzhou located in the center of eastern China.

### 2.2. Photographic stimuli

Photographs were used as the surrogate of real landscapes (Tveit 2009; Yao et al., 2012; Zhao et al., 2013). Photograph has been tested to be a valid medium for landscape assessment research (Palmer and Hoffman, 2001). Twenty adult trees (one for each species) standing alone and unconnected with other objects such as plants or buildings were picked out for photographing, and all photographs were taken by an author (Rujia Li). In order to control the light's influence on picture's quality, these photographs were taken on clear or less cloudy days, from 10 a.m. to 4 p.m. at eye level (about 1.6 m above the ground). Because trees, especially deciduous trees, possess various appearances in different seasons, each individual tree was photographed in spring (April 2016), summer (August 2015), autumn (October 2015) and winter (January 2016), respectively, using the same camera and with the photographer standing on the same site. Each photograph was confirmed to contain the whole figure of a tree. In order to understand a tree's size when participants evaluated its aesthetic quality through the picture, a figure of a girl (about 1.6 m tall in real life), with an appropriate proportion to the tree size, was put near the tree's figure in the photograph. All pictures were given the same background using Photoshop software (Fig. 1).

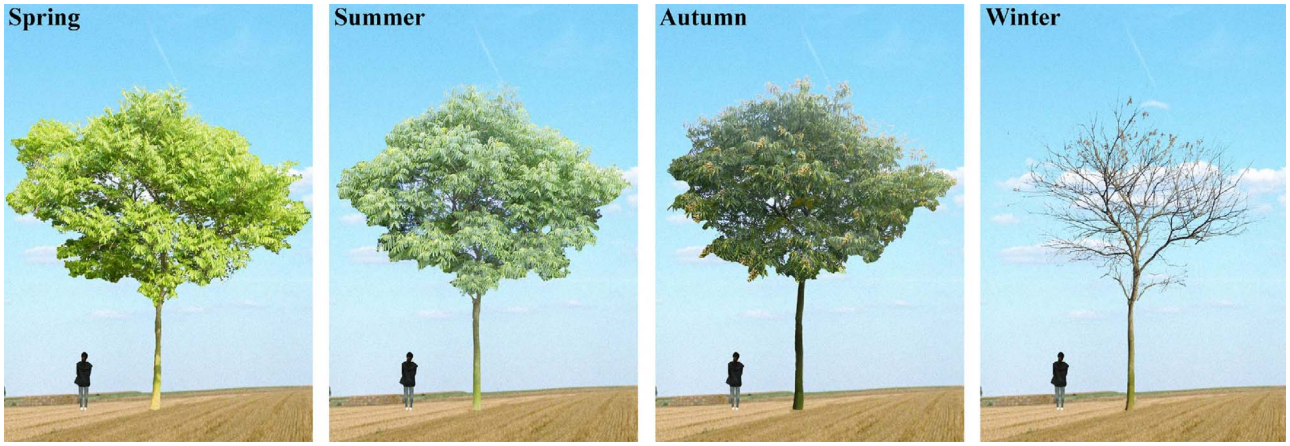


**Fig. 1.** Sample pictures of a tree (*Sapindus mukorossi*) in four seasons.