A DIMENSIONAL COMPARISON OF SELECTED JAPANESE GARDENS, CLASSICAL CHINESE GARDENS AND MODERN CHINESE GARDENS

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ABSTRACT

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The relationships between Japanese gardens and Chinese gardens have been studied and discussed for a long time. This study focuses on the topic by a quantitative method. A cluster analysis is conducted to define the similarities and differences between these two kinds of gardens. The distinctive varieties in the result shows the elements that presents the relationships most distinctively. For this study, the data is collected in both Chinese gardens and Japanese gardens in order to show more persuasive results illustrating the relationships between these gardens. Principal component analysis is used to analyze the data, and to show intuitional visual results by graphs. The statistic software output shows a set of principal components. First three principal components contain roughly 59% of the variance. The design elements that distinctively effect the relationship are also indicated in the results, which lead further interpretation. The scatter graph shows distinct differences between Chinese gardens and Japanese gardens. Major elements divided Chinese gardens and Japanese gardens, traditional gardens and modern gardens, and Japanese gardens. This research can be used by garden designers and researchers to gain an insight concerning of the similarities and differences between Japanese gardens and Chinese gardens.

Keywords: Landscape Architecture, Environmental Design, Asian Studies, Garden Design, Aesthetic Principles, Cultural Context, Oriental Gardens, Garden History

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TABLE OF CONTENTS

LIST OF TABLES ..... **vi**

LIST OF FIGURES ..... **vii**

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW **1**
1.1 Introduction 1
1.2 Literature Review of Chinese Gardens 1
1.3 Literature Review of Japanese Garden 3
1.3.1 Brief History of Japanese Gardens 4
1.3.2 Design Techniques and Concepts in Japanese Gardens 8
1.4 Literature Review of Principal Component Analysis 15
1.5 Summary 17

CHAPTER 2: METHODOLOGY **19**
2.1 Purpose of Study 19
2.2 Study Sites 19
2.2.1 Classical Chinese Gardens and Modern Chinese Gardens 19
2.2.2 Traditional Japanese Gardens in Kyoto 20
2.2.3 Japanese Gardens outside Kyoto 20
2.2.3.1 Gyokudo Art Museum 21
2.2.3.2 Jomyo-ji 23
2.2.3.3 Meigetsu-in 25
2.2.3.4 Genkyu-en 27
2.2.3.5 Ryotan-ji 29
2.2.3.6 Seigan-ji 31
2.2.3.7 Kongobu-ji 34
2.2.3.8 Kishiwada Castle 36
2.2.3.9 Hōkoku Shrine 38
2.2.3.10 Nanshu-ji 39
2.3 Data Collection 41
2.4 Analysis Techniques 41

CHAPTER 3: RESULTS **44**

CHAPTER 4: DISCUSSION **48**
4.1 Two-Dimensional Model and Axis Meanings 48

4.2 Comparison of Gardens and Garden Elements 53

CHAPTER 5: CONCLUSION AND SUGGESTION 61
5.1 Future Implication 61
5.2 Limitations and Suggestion for Future Research 62

APPENDIX 64

BIBLIOGRAPHY 93

LIST OF TABLES

Table 1: First 30 Principal Components and eigenvalues, difference, proportion, and cumulative proportion..... 45

Table 2: Site scores in the first three principal components. 46

Table 3: Abbreviations of the study sites shown in the graphs 48

Table 4: List of the distinctive variables with the largest and the smallest coefficients in principal component 1..... 52

Table 5: List of the distinctive variables with the largest and the smallest coefficients in principal component 2..... 52

Table 6: List of the distinctive variables with the largest and the smallest coefficients in principal component 3..... 53

Table 7: List of one hundred and thirty-four variables. 66

Table 8: List of design elements in the three classical Chinese gardens and five modern Chinese gardens from previous study by Yiwen Xu (2015). 70

Table 9: List of design elements in the eight traditional Japanese gardens and two Shinto Shrines from previous study by Dexin Chen (2018). 75

Table 10: List of design elements in the Japanese gardens outside Kyoto City..... 80

Table 11: Means and standard deviation of the corresponding variables from the SAS software program. 86

Table 12: Principal Component Analysis eigenvalue coefficient for each element. 90

LIST OF FIGURES

Figure 1: A Zen garden in Kogonbu-ji, Wagayama Prefecture representing a dragon flying among the clouds. (Copyright ©2019 Yige Qu all right reserved used by permission). 6

Figure 2: A stroll garden, Genkyu-en, in Hikone City, Shiga Prefecture. (Copyright ©2019 Yige Qu all right reserved used by permission). 7

Figure 3: An architect with natural wood color, and rustic rocks presenting wabi-sabi concept. (Copyright ©2019 Yige Qu all right reserved used by permission). 12

Figure 4: The Zen garden at Ryotan-ji following the three, five, and seven arrangement of rock clusters (Copyright ©2019 Yige Qu all right reserved used by permission). 13

Figure 5: The rock arrangement at Seigan-ji representing a waterfall and the ocean beneath. (Copyright ©2019 Yige Qu all right reserved used by permission). 14

Figure 6: The garden of Gyokudo Art Museum with Mitake Mountain in the distance. (Copyright ©2019 Yige Qu all right reserved used by permission). 22

Figure 7: The entrance of Gyokudo Art Museum. (Copyright ©2019 Yige Qu all right reserved used by permission). 23

Figure 8: The entrance to the tea house in Jomyo-ji. (Copyright ©2019 Yige Qu all right reserved used by permission). 24

Figure 9: The viewing terrace and the garden in Jomyo-ji. (Copyright ©2019 Yige Qu all right reserved used by permission)..... 25

Figure 10: The rabbit statues can be found everywhere in Meigetsu-in. (Copyright ©2019 Yige Qu all right reserved used by permission). 26

Figure 11: The framed view of the back courtyard in Meigetsu-in, which is called “Window of Enlightenment”. (Copyright ©2019 Yige Qu all right reserved used by permission). 27

Figure 12: Genkuyu-en is borrowing the view of Hikone Castel in the distance. (Copyright ©2019 Yige Qu all right reserved used by permission). 28

Figure 13: The tea house by the lake at Genkuyu-en. (Copyright ©2019 Yige Qu all right reserved used by permission). 29

Figure 14: The entrance to Ryotan-ji. (Copyright ©2019 Yige Qu all right reserved used by permission). 30

Figure 15: The dry landscape garden in Ryotan-ji is presenting the scenes in Buddhism stories. (Copyright ©2019 Yige Qu all right reserved used by permission). 31

Figure 16: The garden in Seigan-ji in dry seasons. (Copyright ©2019 Yige Qu all right reserved used by permission). 32

Figure 17: The "Karetaki" in Seigan-ji representing the scene of a waterfall. (Copyright ©2019 Yige Qu all right reserved used by permission). 33

Figure 18: The Banryu-tei in Kongobu-ji. (Copyright ©2019 Yige Qu all right reserved used by permission). 34

Figure 19: A small courtyard garden in between the buildings in Kongobu-ji. (Copyright ©2019 Yige Qu all right reserved used by permission). 35

Figure 20: The building of Kishiwada Castle and the garden in front of it. (Copyright ©2019 Yige Qu all right reserved used by permission). 37

Figure 21: The view of the garden from the top of the castle building. (Copyright ©2019 Yige Qu all right reserved used by permission). 37

Figure 22: The garden of Hokoku Shrine with the red concrete gourd. (Copyright ©2019 Yige Qu all right reserved used by permission). 38

Figure 23: The gourds on the viewing terrace in the front of the garden. (Copyright ©2019 Yige Qu all right reserved used by permission). 39

Figure 24: A stone lantern and a handwash basin in Nanshu-ji (Copyright ©2019 Yige Qu all right reserved used by permission). 40

Figure 25: A scatter graph showing the relationship among all twenty-eight sites based on the site scores of principal component 1 (horizontal axis) and principal component 2 (vertical axis). 49

Figure 26: A scatter graph showing the relationship among all twenty-eight sites based on the site scores of principal component 1 (horizontal axis) and principal component 3 (vertical axis). 50

Figure 27: A scatter graph showing the relationship among all twenty-eight sites based on the site scores of principal component 2 (horizontal axis) and principal component 3 (vertical axis). 51

Figure 28: Geometrical design in Kishiwada Castle. (Copyright ©2019 Yige Qu all right reserved used by permission). 56

Figure 29: Geometrical design in a modern Chinese garden called “Bamboo Garden”. (Copyright ©2014 Jon Burley all right reserved used by permission)..... 56

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

1.1 Introduction

Japanese gardens and Chinese gardens are somewhat similar to each other. China, as Japan's neighbor, influenced Japan for a long period of time (Burley, & Machemer, 2016). In terms of gardens, the Japanese gardens share many common design features with Chinese gardens. On the other hand, the uniqueness and characteristics of Japanese gardens was developed in an island country which is different from China in terms of natural resources, geography, and climate conditions (Burley, & Machemer, 2016). Though being in the same East Asian cultural sphere, Japanese gardens and Chinese gardens each have their own unique charm that attract people all over the world. The similarities and differences between them are an interesting topic in academia. These differences and similarities were debated using heuristic methods by experts. The quantitative methods seem not to be broadly used in this topic. Garden designers, and researchers can benefit from a quantitative approach, to refute as confirm the similarities and differences between Japanese gardens and Chinese gardens.

1.2 Literature Review of Chinese Gardens

Classical Chinese gardens designers have their own unique approach as pursuing "nature". By artistically imitating nature, the gardens are designed to stimulate the pleasant experiences for the visitors in (Xu, Burley, Machemer, & Allen, 2016). As a space with limited size, classical Chinese gardens seek to create more feelings of the space. A garden is often dived into numerous

parts with different sizes to create different views and scenes, which the visitors can enjoy by discovering these different sub-spaces. In order to enhance the view, garden designers use different techniques such as borrowed scenery, framed scenery, and visual buffers, to increase the interests and varieties of the view (Xu et al., 2016). A Chinese garden itself is also closely connected to the architects and the interior display of the buildings as an entity (Yi. 1998). The visitors enjoy the classical Chinese gardens in many different ways. They stroll around the garden and look at the different scenes, listen to the pleasant sound of birds and insects, or enjoy the shade underneath the canopy trees (Liu, Burley, & Partin, 2014).

The garden designs of classical Chinese gardens often involve the theme of fine arts and literature. The visitors are expected to emotionally share the spiritual experiences with the author of these arts associated with gardens. Thus, some special design elements in classical Chinese gardens usually include profound meanings that was mentioned and expressed in well-known paintings, articles, and poetries, such as home sickness, and the lament of time passing. The visiting to the gardens is not only a visual experience, but also emotional sharing, and communication about the design intent (Xu et al., 2016).

In the city of Suzhou, Jiangsu Province in China, there are a group of traditional Chinese gardens. Most of the classical Chinese gardens in China are unfortunately gone. The gardens in Suzhou City are probably not the best gardens at that time when they were built, but considering the cultural and historical significance of these gardens, they are the best sample of classical Chinese gardens that exist (Liu et al., 2014).

In late 20th century, the design practices of Chinese gardens were influenced by modern landscape theories from other countries. Different from the classical Chinese gardens that emphasize "nature", modern gardens often feature artificial forms like geometrical shapes (Burley, 2006). Western garden designers focus more on human needs and functions. Nowadays, landscape architects in China are working on practices implementing traditional garden designing techniques into new gardens, in order to innovate the traditional concepts to meet the needs of new era (Xu et al., 2016).

1.3 Literature Review of Japanese Garden

Japanese gardens are the epitome of Japanese culture. Japanese gardens sublime the history, nature, and culture, integrate these contexts into "beauty of gardens" in limited sized spaces. In order to achieve that, Japanese garden designers have been pursuing unique garden values and techniques (Shinji, 2008). The notable Japanese gardens are emphasizing the beauty of the proportion theories, sequence, time, and aging. They can be generalized into garden constructions that premeditate the aesthetic technologies from macro to micro scales, such as site location, topography, vegetation, masonry, planting, and rock arrangement (Shinji, 1998). In Japanese, the word for "Garden" is *teien* (庭園), which can be divided into *niwa* (庭) and *sono* (園). The meaning of these two Chinese characters can explain the early root of Japanese gardens. *Niwa* is referring to either open spaces with pebbles for sacred ceremonies, or bare clay area around the architectures for daily activities. *Sono* is an agricultural term, describing farmlands for rice planting. The

farmland term also involves other modifications, such like irrigation, plant removing, and wall constructions (Young, Young, & Yew, 2019). These early meaning of the terms reflect that the development of Japanese gardens have religious and agricultural background

1.3.1 Brief History of Japanese Gardens

The history of Japanese gardens can be traced back to Asuka Period (538-710). The name of the period, Asuka, was from the Asuka area near the city of Nara. It was a time when Japan was underneath the huge influence of continental culture. They started to interact with their neighbor, China. The Japanese people were inspired by the beauties of the Chinese gardens, and attempted gardening practices in their own country (Young et al., 2019).

In Nara period (710-794), the first authentic Japanese garden, according to the existence of the relic remains, was built in Nara prefecture. The garden includes a winding stream with shore rocks on the edge. It was inspired by traditional activities among Chinese poetry writers called “winding stream party”. The poets sitting along the stream have to finish a nice poetry before the floating wine bottle in the water reaches them (Ono, 2015). During the same period, the number of Buddhism temples and associated arts showed an increase in spurts (Young et al., 2019). The rocks engraved into shapes showing the figures and scenes in Buddhism fairy tales were found in historical sites from Nara period. It developed into the one of the unique techniques of Japanese garden designs, smart utilization of the rocks in the nature (Shinji, 2008).

Japan continuously received influence from China in Heian period (794-1185). On the other

hand, the interaction between two countries reduced. During Heian period, Japanese gardens developed in a comparatively closed environment. More unique and distinctive characteristics were produced in the process of self-development (Shigemori, 2013). Shinden-tsukuri, which is the style of residential garden of nobles in this period, created the early version of traditional Japanese gardens (Burley, & Machemer, 2016). The first book about gardening techniques, the well-known Sakuteiki, was also written in this period. Before that, most garden techniques were delivered by oral communications and on-site practices (Hida, 1985).

As a result of Zen Buddhism culture popularity in Kamakura and Muromachi period (1185-1573), there was a huge flourishing of the related arts, including tea ceremony, flower arrangement, garden making. Zen gardens, which aim to evoke deep meditation, appears in this period. Dry landscape garden is the most common Zen garden. Without using water feature like ponds and streams, it represents the natural landscape by rocks, gravels, moss and pruned trees (Ono & Edwards, 2001). At the same time, the profession of “Gardening” and “Garden Designing” was clarified. It was also a period when the Japanese garden developed its stable features and uniqueness recognized by the rest of world (Shinji, 2008). In Figure 1 is an example of dry landscape garden consists of gravels, rocks, and moss.

Figure 1: A Zen garden in Kogonbu-ji, Wagayama Prefecture representing a dragon flying among the clouds. (Copyright ©2019 Yige Qu all right reserved used by permission).

Japanese gardens developed constantly. In Edo period (1615-1867), the size of the gardens increased significantly. During Edo period, an isolationism policy was implemented throughout the country. Japan was closed for most communication with foreign countries. Stroll gardens like

Genkyu-en in Figure 2, developed from Shinden-tsukuri style, appeared with this political background. This kind of garden showed great influence of Chinese inspirations (Burley, & Machemer, 2016). A lot of stroll gardens are designed based on the intent of mimicking different landscapes in China, showing the longing of the beautiful, vast view of the outside world on the other side of the ocean (Shinji, 2008).

Figure 2: A stroll garden, Genkyu-en, in Hikone City, Shiga Prefecture. (Copyright ©2019 Yige Qu all right reserved used by permission).

After Japan was open for foreign countries again, the modernization process in Japan initiated modern garden design techniques. New laws in Meiji and Taisho period (1868-1926) promoted the designs and constructions of new public greenspaces, and transformed many old residential gardens into public gardens. Private gardens, except the ones owned by royal members, bureaucrats, and plutocrats, were evident among ordinary residences in Taisho period (Ichikawa,

2000). Foreign design elements, such as obelisk, were introduced into Japanese garden designs by Japanese Missions sent to foreign countries for diplomatic visiting (Kobayashi, & Kunii, 2011). At the same time, Japanese gardens began to be appreciated by people from other countries. Japan started to participate in World's Fair and build Japanese gardens during the exhibitions to present traditional culture, which made Japanese gardens noticed by people from all over the world (Sato, 1985). The Japanese garden presented during the St Louis World's Fair in 1904 was the most influential Japanese stroll garden in the western countries (Goto, 2007). Private owned Japanese garden became a new trend in early 1900s among wealthy elites in the United States (Goto, Ristovska, & Fujii, 2014). From the time of Showa period (1926-1989) till now, Japanese gardens merges more diverse forms, shapes, and plant species. The styles of Japanese garden were modernized and diversified (Shinji, 2008).

Beside The period based on Dynasties, the existing literature indicated that the history of Japanese gardens can also be divided into three periods: the preclassic Shinto/Animist period, the classic Buddhist/Chinese influence period, and the postclassic Japanese/Western Fusion period. The author expounded that the detailed period of Japan is not as important as the design development through the history, and the design principals evolved (Burley, & Machemer, 2016).

1.3.2 Design Techniques and Concepts in Japanese Gardens

The techniques to design a Japanese garden are recorded in a book called S*akuteiki* on gardening and is completed during Heian period (Takei, & Keane, 2001). All the words are

simplified and abstracted. Specific details and constructions are not described. Much of these details depend on the site and designer's personal preferences. Most traditional Japanese gardeners have been designing the gardens based on their own instincts. Disciples have been taught by oral instructions and on-site practicing. Because of the abstract words in *Sakuteiki* and the strict disciple system, it is believed that, in the process of the techniques being handed down to present age, some subtle unique effects and traditional designing techniques may have disappeared over the centuries (Miya, Shimomura, & Ono, 2000).

Chen, and Burley (2018) discussed the features of authenticity in Japanese gardens. The authors mentioned that Japan, though being a smaller country with less natural resources, and less history of garden making than China, borrowed many design ideas from Chinese gardens. Three Japanese traditional gardens: Kochi-in, Tenryu-ji, and Daisen-in in Kyoto City were selected to be studied. The results showed that the main features of the traditional Japanese gardens can be generalized as "tranquility, simplicity, and harmony". The designs were borrowed and studied from China, but changed to adapt the conditions in the country. The Japanese traditional religious, aesthetic culture fused with the gardening techniques and designs, formed the uniqueness of the Japanese traditional gardens. This existing literature provides background on Japanese gardens, in both their cultural and design aspects.

A creative study is about the garden design and the effect of moonlight in gardens. The authors, Mitani and Okabe (2006) and Mitani (2011) mentioned that moonlight is as important as sunlight in traditional Japanese gardens. In *Sakuteiki*, the way to design a water feature with

moonlight effect is described. The aim of this study is to find out the spatial characteristics of Japanese gardens in the moonlight environment. The 3D model application “Form Z” is used to create models of 5 gardens from Ryoan-ji, Daisen-in, Shoden-ji, Shisen-do, and Jisho-ji. The amount of brightness is calculated by a radiosity program based on the photographs took by digital cameras and the rendered stimulations of the 3D models. The results demonstrated that the moonlight reflected by gravel in these gardens is 15 times brighter than soil surfaces in common gardens, and the interior environment of the buildings of temples with pebbles and gravels reflect 1.9 times more light than common garden interiors. The focus on optimizing the garden for moonlight observation, makes the gardens quite unique. Pebbles and gravels in the garden decrease the contrast between the interior building and exterior garden, so that the light reflected is softer and more visual pleasant. Pebbles and gravels, thus, are important design elements in Japanese gardens that enhance visitor’s experiences. 3D modelling and simulation are effective methods for optimizing moonlight reflection, allowing for the garden to be observed regardless of weather.

Previous studies also involve visitor’s feelings and experiences. What design elements and features make visitors feel healing by the garden? A study conducted by Taniguchi, Chang, Aida, and Suzuki (2003) utilized semantic differential method to gather data from thirty-three people, about their feelings of 40 images from different elements in gardens. The images of garden elements that make people feel healing are mostly from the garden of Saiho-ji in Kyoto City, which is also called “Temple of Moss”. These images have unique common features, which are

humid open spaces, moss, and rocks in their natural form. Oppositely, some traditional Japanese garden elements, such as colorful flowers and red maple leaves that are vibrant and bright, do not make people feel being healed. Authors also believed that the moss is a unique design element in only Japanese gardens, that cannot be found in other countries. In fact, moss can be found in western gardens too. For example, a moss garden designed by Annie Martin located in North Carolina features moss on the roof top of the building. She mentioned that the moss does not die back in winter, producing continued beauty for the garden (Martin, 2015).

Japanese gardens are regarded as reflections of the traditional Japanese aesthetic concept, wabi-sabi (Figure 3), which emphasize the irregularity, asymmetry, ancientness and breakage (Weiss, 2010). In a research conducted by Suzuki, Tazaki, and Shinji (1988) about the image of Japanese gardens, the results was that most Japanese people described the sample gardens as "gloomy, dark, and quiet", which are reflections of the wabi-sabi. The concept origins from ancient Chinese Taoism. In the middle of 16th century, the idea of wabi-sabi spread in Japan. Painting, tea ceremony, interior design, flower arrangement, and gardening, wabi-sabi then influenced different aspects of artistic expressions in Japan. In a book, *Wabi-Sabi for Artists, Designers, Poets and Philosophers*, the author stated that wabi-sabi is a representation of naturalness, which is pure, humble, unmediated, and no intentional human interference (Koren, 1994). Perfection, actually, cannot be achieved. The ability to appreciate the irregularity, imperfection that cannot be predicted, not treading these as negative parts, is the main idea of wabi-sabi. It challenges the conventional aesthetics, "treating imperfection as the natural

condition of things" (Orgad, 2017).

In Hisamatsu Shinichi (1982)'s book *Zen and the Fine Arts*, he identified seven principles to achieve wabi-sabi in art: kanso (simplicity); fukinsei (asymmetry, irregularity); koko (rustic, weathered); shizen (naturalness, absence of pretense); datsuzoku (unbounded by convention, freedom from routine); sei-jaku (tranquility, calmness) and yūgen (profound grace, not obvious) (Lomas, Etcoff, Van Gordon, & Shonin, 2017).

Figure 3: An architect with natural wood color, and rustic rocks presenting wabi-sabi concept. (Copyright ©2019 Yige Qu all right reserved used by permission).

According to Miya, Takayama and Shimomura (2000, 2003), one of the unique characteristics of arrangement in Japanese gardens is asymmetry. Asymmetry is regarded as one of the key techniques of Japanese garden designing (Shingen, 1930). Van Toner and Lyons

(2005) indicated that asymmetrical design is more natural and equilibrium. Previous studies by Van Toner, Lyons, and Ejima (2002) found that Japanese art emphasized bilateral asymmetry in design. Asymmetrical design allows more visual interactions from the visitors. Symmetrical rock clusters will disturb the visual perception of the garden, being like a separate figure to vie for attention. Miya and Takayama (2006) stated in their study that designers tend to choose odd number of rocks to make a cluster such as three, five and seven (Figure 4). Cluster consisted by two rocks can also be seen, but there are big differences in sizes and the heights of the two rocks in those cluster to achieve asymmetrical look (Miya, Takayama, & Shimomura, 2000). Weiss (2010) discussed how asymmetrical design is a part of wabi-sabi concept, where wabi refers to asymmetrical harmony. Zen inspired the aesthetic of Wabi-Sabi and dives the original meaning of withered, chill, loneliness to a positive aesthetic perspective (Koren, 1994).

Figure 4: The Zen garden at Ryotan-ji following the three, five, and seven arrangement of rock clusters (Copyright ©2019 Yige Qu all right reserved used by permission).

According to Zhang, Yamaguchi, and Kawasaki (2018), traditional Japanese gardens, were designed to evoke vague imagery within the viewers. Different elements in Japanese gardens are meant to symbolize the oceans and mountains, like the rocks representing waterfall in Figure 5. This aesthetic focus is referred to as “Okufukasa”, which emphasizes the profoundness and deep meanings of spaces (Kondo & Takano, 2001). In the previous study (Zhang, Yamaguchi, & Kawasaki, 2018); the researchers defined the visual axis and visual width of the water surface, along with the perspective and scenic layers of the islands as the main research subjects. By examining the pond in Katsura Imperial Villa, the characteristics of the pond, such as water body shape and rocks edge of the lake, which achieved Okufukasa were clarified (Zhang et al., 2018). This study is creative, because it examined the abstract design concept, Okufukasa, by a quantitative method.

Figure 5: The rock arrangement at Seigan-ji representing a waterfall and the ocean beneath. (Copyright ©2019 Yige Qu all right reserved used by permission).

The metaphors and symbolic meanings associate with the Okufukasa concept in Japanese gardens are also of interest to many researchers. How do the unique materials (rocks and gravel) in Ryoan-ji have semiotic possibilities which allow the awareness of the specific textual implications? McGovern (2004) analyzed line and texture, dynamic and static representation, and text interpretation in Ryoan-ji. His findings showed that the rough and natural materials used in the garden allowed the interpretation of specific semiotic meanings. The complicated philosophical and religious meanings of the gardens can be seen in how the gardens are designed. For example, the lines of the raked gravel are connecting the other elements of the garden, creating a unified unit. But the rocks, regarded as static elements, and the lines as moving elements, create a paradoxical relationship. However, although the author identified core philosophical and religions meanings in the gardens, he did not effectively expand on these interpretations. The study also made suggestions to other researchers conducting similar studies on other kinds of gardens in different countries.

1.4 Literature Review of Principal Component Analysis

Principal component analysis (PCA) is a key method to process large amount of sample data. The variables in the data can be interpreted more efficiently with reduced size and dimensions (Burley & Brown, 1995). It helps to clarify the crucial data from a larger sample, and represent it with a smaller size group of data, which are principal components, and finally present the data as a chart (Abdi & Williams, 2010). In that way, researchers can process the data

with this method, and identify the most important information from it.

In a previous study regarding a study area located in southern Michigan, the authors conducted Principal Component Analysis to the data. It brought the original data of fifteen overlays to seven dimensions. The new data contains 65% of the original data structures, and also displayed more useful information. The authors suggested that the strategy of principal component analysis, though not being an easy and straightforward way, can significantly reduce the complexity of the data analysis (Burley & Brown, 1995).

Bai, Chang, Guo, Burley, and Partin (2016) utilized PCA method to study about the relationship between the plant growth, and soil quality. They attempted to build a predictive model for the reconstruction of the soil being disturbed by mining activities for common plants and crops in one county in Wisconsin, and three counties in Georgia. The attempt was successful. It is possible to build a model predicting plant productivity in these counties. However, in the model for Wisconsin, the effective principal component contains only 41% of the information in the original data set, which means that there is about 60% of the variance could not be represented in the model. The study suggested that this method can be implicated into more regions to create models that is applicable for the whole country.

Considering about the PCA method in similar research with this approach, there are several examples. The comparison studies between different types of gardens were conducted by Dexin Chen (2018), and Yiwen Xu (2019). PCA method helped them generated several scatter graphs from a large data set. The relationships between different types of gardens are clearly shown in the

graphs. Furtherly, the authors explained the relations between gardens more detailly with the most critical information in the new data set generated by PCA. The study conducted by Chen (2018) utilized the method to study the relationship between Japanese gardens and Chinese gardens. A critical limitation to the study is that the selected sites in Japan are all located in the same city, which is not an ideal sample considering about the lack of randomness and reliability of the samples. A new study with sample supplement should be conducted. Other relevant studies about the comparison analysis include burial sites study by Haoxuan Xu (2017). The authors suggested that more studies can be done with the similar method to study different kinds of sites. These studies indicate the possibility of applying the method to clarify the similarities and differences between different varieties of gardens, which provide important methodological examples to this study.

1.5 Summary

Japanese gardens share common characteristics with Chinese gardens, as the huge continental influences shed to Japan from China in centuries. At the same time, Japanese garden has its own unique features and beauty being developed based on the condition of itself as an island country. Because of that, the similarities and differences between Chinese gardens and Japanese gardens have huge research potential, and is always a huge interests for both scholars and common people.

There are many existing literatures about Japanese garden focusing on its charming designs,

including different aspects like techniques, elements, and concepts. Using both quantitative and qualitative methods, the designs of Japanese garden are examined and interpreted by different researchers detailly. The results and explanations of these existing literatures are ideal background information for garden designers and researchers. Further study, including the comparison analysis between Japanese gardens and Chinese gardens, can be conducted more smoothly based on these existing studies.

After reviewing the exiting literature about the method, Principal Component Analysis, it is clear to see that this method is applicable for this study. It can reduce the data size, showing the important information, which makes the study more efficient. The existing studies about gardens in different cultures show the detailed procedure of applying this study. A previous study about Japanese gardens and Chinese gardens utilized PCA method. But the study is considered to have limitations about the study sites, which are all located in one place, Kyoto City. Thus, a continued study of Japanese gardens, both inside and outside Kyoto City, and Chinese gardens is necessary.

CHAPTER 2: METHODOLOGY

2.1 Purpose of Study

The study, as a continuation of the existing one conducted by Dexin Chen (2018), makes comparison between traditional Japanese gardens located in Kyoto City, traditional Japanese gardens located outside Kyoto City, classical Chinese gardens, and modern Chinese gardens. This study examines different design elements with quantitative methods. The relationships between the study sites are discussed in this study after the statistics calculation. Distinguishable design elements and other related background information are used to explain the relationships.

This research seeks the answers of the following questions:

1. How are these gardens similar and different from each other?

2. What are the main distinctive design elements that effect the relationship the most?

3. Do the distinctive design elements indicate any general design characteristics of the gardens?

4. Why do these characteristics appear in some of the gardens?

2.2 Study Sites

2.2.1 Classical Chinese Gardens and Modern Chinese Gardens

In previous study conducted by Xu, the study sites include three classical Chinese gardens in Suzhou and five modern Chinese gardens (Y. Xu, 2015). The classical Chinese gardens are: Humble Administrator's Garden, Master of Nets Garden, and Lingering Garden in Suzhou.

Modern ones are the Bamboo Garden, Net. Wet. Garden, Learning Garden, Sugar Cane Garden, and Landscape New Wave Garden in Xiamen. Y. Xu described detailed about the information of these gardens in the study (Y. Xu et al., 2015). In this study, these Chinese gardens are selected as part of the study sites with permission from the author, Yiwen Xu.

2.2.2 Traditional Japanese Gardens in Kyoto

Ten Japanese gardens in Kyoto City in an existing study conducted by Chen are selected as study sites for this study with permissions, including eight traditional Japanese gardens and two Shinto Shrines (Chen, 2018). The Japanese gardens in Kyoto City are: Daitoku-ji, Ryoan-ji, Kinkaku-ji, Tenryu-ji, Shisen-do, Kiyomizudera, Daikaku-ji, Byodo-in, Yasaka Shrine, and Fushimi-Inari Taisha. Descriptions of these sites can be found in Chen's work (Chen, 2018).

2.2.3 Japanese Gardens outside Kyoto

Additionally, ten Japanese gardens were selected to be studied with a quantitative method. In this study, the selection of the gardens is based on this definition and two criteria. First, the gardens are outside Kyoto City. Secondly, the gardens are open and are available for data collection and photo shooting. According to these criteria, ten Japanese gardens are selected: Gyokudo Museum, Jomyo-ji, Meigestu-in, Genkyu-en, Ryotan-ji, Seigan-ji, Kongobu-ji, Kishiwada Castle, Hōkoku Shrine, and Nanshu-ji. By adding these new study sites, the sample size of the Japanese gardens is increased. It aims to solve the limitation of previous study that the selected study sites are all

located within the same city.

2.2.3.1 Gyokudo Art Museum

Gyokudo Art Museum is located along the Tama River at Ome City. It is sitting quietly among the numerous mountains in the Okutama area near Tokyo City, which is the capital of the country. The building was initially Gyokudo Kawai (1873-1957)'s private residence, where he spent the last decade of his life at. He was one of the masters of traditional Japanese painting. To commemorate his achievements and contributions to traditional Japanese culture, the art museum was built in 1961 (Shinji, 2008).

The garden in the art museum was designed by the world-known outstanding landscape architect Ken Nakajima in 1961. Located at the north of the buildings, it is a flat area of dry landscape style garden. Tama River is located at the north side of the museum and runs through Ome. Though the river itself is not visible from the site, the delightful sound of the water flows among the pebbles and rocks becomes a permanent sound element of the garden. The gravels and large rocks are carefully selected from the Valley of River Tama in front of the art museum, and then being raked and arranged to represent the water flow of the River Tama. The plants in the garden blend into the natural wood land in front of the art museum. In the distance, Mitake Mountain becomes the background by being "borrowed" into the view (Figure 6), which is a way to enhance the view by external elements without disturbing the arrangement in the garden (Shinji, 1986). The rocks, gravels, and plants in the garden are extended and expanded into the natural

woodland, River Tama, and the mountains outside. The design achieved the concept of "unlimitation" by blending the elements inside and the surrounding environment (Shinji, 2008).

Figure 6: The garden of Gyokudo Art Museum with Mitake Mountain in the distance. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 7: The entrance of Gyokudo Art Museum. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.2 Jomyo-ji

Jomyo-ji is located in Kamakura City, Kanagawa Prefecture near Tokyo City. It is one of the five temples called “Kamakura’s Five Mountains”. This Buddhism temple was built by priest Taiko Gyoyu in 1188 as Gokuraku-ji and was changed into Jomyo-ji in between 1257-1259. This name has been used since then (Harada, 2007). Currently, the tea house, Kisen-an, in the temple is one of the main points of interest on the site (Figure 8). As many other tea houses in Japan, the architect features wide eaves, making a dark, dim environment with shadows (Bullen, 2015). It is said that this tea house was the place where monks and priests used to hold meetings and enjoy tea

back to 16th century. The restoration was conducted in 1991. After that, Kisen-an was opened to the public. Apart from the buzz of the Kamakura City, people can enjoy Matcha and Japanese style dessert in this quiet and calm space. The dry landscape garden in the front of the tea house provides elegant view for the visitors while enjoying their time sitting on the viewing terrace in Jomyo-ji (Figure 9).

Figure 8: The entrance to the tea house in Jomyo-ji. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 9: The viewing terrace and the garden in Jomyo-ji. (Copyright ©2019 Yige Qu all right reserved used by permission)

2.2.3.3 Meigetsu-in

Meigetsu-in, located in Kamakura City, was founded in 1160. The Japanese world “Meigetsu” means “Bright Moon” (Mutsu, 2002). The concept of moon can be found in many places on the site. The famous “Window of Enlightenment” (Figure 11) in the main building is a window framing the view of the pond and gardens in the back courtyard. The round shape of the window is considered to be from the concept of moon. Furthermore, the stone statues of rabbits (Figure 10) can be found at a lot of places around the temple. The rabbit is a symbol of moon based on the fairy tale in Asian area.

The temple itself is a huge garden with numerous flowers, emphasizing the seasonal view:

Peach, and magnolia in spring, hydrangeas, and irises in summer, Osmanthus, and chrysanthemum in fall, plums, and camellias in winter. Especially in summer, Meigetsu-in is famous for thousands of hydrangeas and irises on the site. It is also called “Temple of Hydrangeas” because of that. The beautiful flowers in summer attract visitors from all over the world.

Figure 10: The rabbit statues can be found everywhere in Meigetsu-in. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 11: The framed view of the back courtyard in Meigetsu-in, which is called “Window of Enlightenment”. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.4 Genkyu-en

Genkyu-en is located in Hikone City, Shiga Prefecture. It was originally a part of a private residence owned by the Ii family, who were the lord of the area. In 1677, the fourth lord of the Hikone area, Ii Naoki, started the construction of Genkyun-en. The garden was named after a Chinese imperial building. It was designed based on the concept of “Eight Views in Xiaoxiang, Hunan, China” (Main, & Platten, 2002).

Genkyu-en is a stroll garden, which is typically a lake with circular walkway around it. When people are strolling around the garden, the view is also changing. From the garden, the beautiful

white building of the Hikone Castle standing high up on the hill can be seen (Figure 12). The view of the castle is “borrowed” into the garden and forms the background of the garden. There is a boat house on the site, indicating that the family used to enjoy the boat around the lake (Main, & Platten, 2002).

Figure 12: Genkuyu-en is borrowing the view of Hikone Castel in the distance. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 13: The tea house by the lake at Genkuyu-en. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.5 Ryotan-ji

The temple called Ryotan-ji was built in 733. It is located in Hikone City. The family grave of the lord of the area, Ii family, locates in the temple. There are one dry landscape garden and one stroll garden on the site, both borrowed the view of Mountain Sawa. The dry landscape garden was designed based on a Buddhism fairy tale (Figure 15). The stroll garden is a small scale one, features a small pond and the pathway around it, representing the Buddhism world with sacred animals like cranes and turtles (Main, & Platten, 2002).

The temple used to serve as a dormitory for monks to gather for Zen Buddhism culture

studying. One of the Zen practice was “garden making”. In Ryotan-ji, a special department of gardening was formed. The courtyard for students to practice gardening techniques still exists on the site. It is believed that the monks studied gardening in Ryotan-ji were participating in constructions of gardens all around Japan. Because of that, Ryotan-ji was also called “Temple of Gardening” (Main, & Platten, 2002).

Figure 14: The entrance to Ryotan-ji. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 15: The dry landscape garden in Ryotan-ji is presenting the scenes in Buddhism stories. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.6 Seigan-ji

Seigan-ji, being located in Maibara City, can be traced back to more than 600 years ago. It is famous for the garden in the temple. The garden features many structures of rock groups and a large area of moss. In the rainy seasons, the garden is a stroll garden with the pond, bridges, and paths around the garden. In dry seasons, lack of water makes the garden into a dry landscape garden (Figure 16). The type of the garden changes based on the climate. This characteristic makes the garden at Seigan-ji a rare one.

The garden was built on a natural slope at the foot of Mountain Ta'o. The pattern of the moss

on the bottom of the pond is representing the flow of the water. The garden is representing the view of the Buddhism world. The group of the tallest rocks is called “Karetaki” which means dry waterfall (Figure 17). The arrangement of the rocks was designed to intimate the waterfall in the nature. The “water” flows down the cliff and forms a river that runs through the mountain valley created by rocks, and finally feeds into the sea.

Figure 16: The garden in Seigan-ji in dry seasons. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 17: The “Karetaki” in Seigan-ji representing the scene of a waterfall. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.7 Kongobu-ji

The temple was originally built in 1593. It is the head temple of a group of large number of temples in the area of Mount Koya. Banryu-tei on the site, which means “Garden of Dragons” was the largest dry landscape garden in Japan (Figure 18). The dry landscape garden was constructed in 1984. It shows a pair of dragons flying up and down from the sea to the clouds. The two dragons surrounding the main temple building were represented by huge granite stones. The white gravels, taken from Kyoto City, are designed to show sea waves and clouds (Main, & Platten, 2002). The temple also includes several other gardens varies from small courtyard garden between the buildings (Figure 19), and stroll gardens.

Figure 18: The Banryu-tei in Kongobu-ji. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 19: A small courtyard garden in between the buildings in Kongobu-ji. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.8 Kishiwada Castle

Kishiwada is a town located at the southern Osaka, Japan. The original castle on the site was built in 16th century as a private residence (Figure 20). The garden was constructed in 1953. Mirei Shigemori, a famous Japanese landscape architect, designed the garden based on the concept of moats and ancient Chinese battle camps (Tschumi, 2007).

The site is enclosed by a moat and a stone wall. As Mirei Shigemori mentioned in his notes, the main reason he designed a rock garden is durability. Because castles are supposed to be stable and last forever, the garden related to a castle should also be durable. The garden slopes up toward the central point in three levels. The boarders of each level consist of sharp- angled lines made by stone enclosing the edge of these different levels of gravels and rocks. According to Mirei Shigemori's notes, his inspiration was the "Eight-Fold Battle Camp" in ancient China. The eight groups of rocks, representing the eight different camps, surround the central group of rocks as the main camp for the captain in the battle. The name of the camps are sky, ground, wind, cloud, dragon, tiger, bird, and snake (Tschumi, 2007). The visitors can not only view this garden from a controlled viewpoint like other dry landscape garden, but can also walk around the garden along the pathway surrounding the garden.

Figure 20: The building of Kishiwada Castle and the garden in front of it. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 21: The view of the garden from the top of the castle building. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.9 Hōkoku Shrine

The shrine was constructed in memory of Toyotomi Hideyoshi, who was the famous landlord, warrior, and politician in Japan during the Sengoku Period. Japanese people worship him as a god in traditional religion, Shintoism. The shrine was built after he died in 1598, yet being destroyed after Hideyoshi's rival took over the power. The shrine was moved to its current location in 1964 (Tschumi, 2007).

The garden on the site was designed by Mirei Shigemori in 1972. Gourd, which was the representation of the warriors, is the main concept of this dry landscape garden. The garden is a rectangular shape and is enclosed by white walls (Figure 22). The large gourd shape in the surface was made by red concrete, with other smaller gourd shaped "island" consisting by rocks and moss spreading among the concrete gourd surface and the gravel area. The concrete viewing terrace is also carved in gourd shapes (Tschumi, 2007) (Figure 23).

Figure 22: The garden of Hokoku Shrine with the red concrete gourd. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 23: The gourds on the viewing terrace in the front of the garden. (Copyright ©2019 Yige Qu all right reserved used by permission).

2.2.3.10 Nanshu-ji

Nanshu-ji was located at a city near Osaka City called Sakai. The origin of it can be traced back to 1526. The dry landscape garden on the site consists of groups of rocks in the back, and a

flat area with white gravels in front of the temple building.

One of the unique design elements on the site was “Suikinkutsu” which is a traditional sound device in Japanese garden. The sound of it is made by water dripping down into the ground, where a ceramic jar being buried underneath. This device creates bell-like refreshing sounds (Kishizuka, 1991). The sound of the Suikinkutsu in Nanshu-ji can be heard by holding a bamboo tube close to the ear and another side to the Suikinkutsu. It is places by the hand wash basin be the teahouse on the site, so that the water drips down when the guests wash their hand before entering the tea house.

Figure 24: A stone lantern and a handwash basin in Nanshu-ji (Copyright ©2019 Yige Qu all right reserved used by permission).

2.3 Data Collection

There are total one hundred and thirty-four variables as shown in Table 7. The first seventy-four varieties are from the list of variables in "A Cluster Analysis Comparison of Classical Chinese Gardens with Modern Chinese Gardens" by Yiwen Xu and other authors (2015). The other of sixty variables from the previous study conducted by Dexin Chen, "A Cluster Analysis Comparison of Selected Traditional Japanese Gardens, Classical Chinese Gardens and Modern Chinese Gardens" are also used as variables for this study (Chen, 2018). The list of one hundred and thirty-four variables are presented in Table 7.

2.4 Analysis Techniques

In order to analyze and compare the sites and data more efficiently, the cluster analysis method is utilized to group similar sites into clusters. In this way, it is easier to see the similarities and differences among the gardens. Principal component analysis (PCA) of the variables should be conducted before the cluster analysis. It is a technique that can keep the original meaning and characteristics of the variables set, but reduce the amount of data to a new set of less variables that is not corelated to the original ones (Y. Xu et al., 2015). It aims to discover the most distinctive information from a group of data, and represent it as a new set of variables called principal component, and finally present the variables as dots in graphs (Abdi & Williams, 2010).

In order to conduct the PCA process, a software SAS (version: 9.4 TS Level 1M2,

X64_8PRO platform, English, Copyright© 2002-2012 by SAS Institute Inc., Cary, NC, USA.) is used to run statistic calculation. After the data collection, the recorded data is put into a text file and being calculated by the software. The results present a set of principal components along with their eigenvalues, differences, proportions, and cumulative proportions. The principal components are numbered by the order of the largest proportions to the smallest (Prin 1, Prin 2, Prin 3, etc.), which means the percentage of variances of the original data set it contains (Y. Xu et al., 2016). Principal components with eigenvalues smaller than 1.0 are not considered to be analyzed (Burley, Fowler, Polakowski, Brown, 2001). Additionally, mean and standard deviation of each variable are also calculated. The numbers generated by SAS (version: 9.4 TS Level 1M2, X64_8PRO platform, English, Copyright© 2002-2012 by SAS Institute Inc., Cary, NC, USA.) is then utilized to calculate the standard score of each variable in the following step. The equation is the one below (Equation 1).

$$\text{Standard score of a variable} = \frac{X - \bar{X}}{SD}$$

In the equation,

X = Each Value of Variable

$\bar{X}$ = Mean of the Variable

SD = Standard Deviation of the Variable

The next step is the calculation of the site scores with the scores of variables. In this step, site scores of all twenty-eight sites in each principal is generated. The equation (Equation 2) is:

$$\text{Site Score} = \left(k1 \times \frac{X1 - \bar{X}1}{SD1}\right) + \left(k2 \times \frac{X2 - \bar{X}2}{SD2}\right) + \left(k3 \times \frac{X3 - \bar{X}3}{SD3}\right) + \cdots + \left(k134 \times \frac{X134 - \bar{X}134}{SD134}\right)$$

In the equation,

X# = Each Value of Variable

$\bar{X}$# = Mean of the Variable

SD# = Standard Deviation of the Variable

k# = Each Principal Component Coefficient of the Variable

The equations are from the existing study about classical and modern Chinese gardens (Y. Xu et al., 2015). It presents in several other studies using the similar method about burial sites (H. Xu et al., 2017) and Japanese gardens (Chen, 2018). In this study, both equations are calculated by Excel (Microsoft® Excel® for Office 365 MSO, version: 16.0.11629.20238).

After the site scores of each principal component is calculated, scatter graphs are created for cluster analysis. In this study, the first three principal components with the highest eigenvalues cover more than half of the total variances of the original data. Thus, the site scores of the first three principals are going to be the focus of this study. The scatter graphs locate the site scores in different principal components on horizontal and vertical axes, forming a visualized relationship between these gardens. Closer sites on the graph present more similarities. The axis meaning and definition of the dimensions can be defined by the varieties with the largest and smallest principal component coefficients. In that way, the pattern of the sites, and their similarity and differences can be detailly explained and interpreted.

CHAPTER 3: RESULTS

As shown in Table 8, Table 9, and Table 10, the one hundred and thirty-four design elements and twenty-eight study sites included both Chinese gardens and Japanese gardens are included. The number “zero” is recorded if the design element is absent from the garden, and “one” is recorded if it can be found in the garden. Table 8 and Table 9 is from the existing study conducted by Y. Xu (2015) and Chen (2018). Table 10 is completed during the process of data collection for this study by site visits.

In the next step, Table 8, Table 9, and Table 10 are combined into one data set. SAS (version: 9.4 TS Level 1M2, X64_8PRO platform, English, Copyright© 2002-2012 by SAS Institute Inc., Cary, NC, USA.) was used to complete the statistic process. Output, including means and standard deviations, is listed in Table 11.

After the calculation of mean and standard deviations, the software also calculated the principal component eigenvalues. Principal components with eigenvalues larger than 1.0 are capable for further analyze (Burley, Fowler, Polakowski, Brown, 2001). The results in Table 1 show 21 principal components that are greater than 1.0. The first three principal component cover 59% of the information in the original data. The principal component 4 to 21 covers less variance. In this study, the first three principal components are selected to be further analyzed.

Table 1: First 30 Principal Components and eigenvalues, difference, proportion, and cumulative proportion.

Principal Component #	**Eigenvalue**	**Difference**	**Proportion**	**Cumulative**
1	44.91344	22.52547	0.3455	0.3455
2	22.38797	13.31546	0.1722	0.5177
3	9.072514	1.835227	0.0698	0.5875
4	7.237287	1.351587	0.0557	0.6432
5	5.8857	0.73476	0.0453	0.6884
6	5.15094	1.003206	0.0396	0.7281
7	4.147734	0.53393	0.0319	0.76
8	3.613804	0.384544	0.0278	0.7878
9	3.22926	0.483316	0.0248	0.8126
10	2.745944	0.303271	0.0211	0.8337
11	2.442673	0.06968	0.0188	0.8525
12	2.372993	0.424323	0.0183	0.8708
13	1.94867	0.056212	0.015	0.8858
14	1.892458	0.187707	0.0146	0.9003
15	1.704752	0.10737	0.0131	0.9134
16	1.597382	0.164519	0.0123	0.9257
17	1.432863	0.101617	0.011	0.9367
18	1.331246	0.129935	0.0102	0.947
19	1.201311	0.092727	0.0092	0.9562
20	1.108584	0.076025	0.0085	0.9648
21	1.032559	0.173367	0.0079	0.9727
22	0.859192	0.031671	0.0066	0.9793
23	0.827521	0.115972	0.0064	0.9857
24	0.711549	0.154772	0.0055	0.9911
25	0.556777	0.091034	0.0043	0.9954
26	0.465743	0.336607	0.0036	0.999
27	0.129136	0.129136	0.001	1
28	0	0	0	1
29	0	0	0	1
30	0	0	0	1

The output of the principal component eigenvalues for each element is generated by SAS (version: 9.4 TS Level 1M2, X64_8PRO platform, English, Copyright© 2002-2012 by SAS Institute Inc., Cary, NC, USA.) As shown in Table 12. The eigenvalues are then utilized to calculate the site scores with the scores of variables.

Site scores of all twenty-eight sites in each principal is generated in the following step by Equation 2 (Y. Xu, 2015). For example, the site score of Gyukodo Art Museum in the first principal component is calculated as below (Equation 2):

Site Score of Gyukodo Art Museum = $\left(0.142 \times \frac{1-0.821}{0.390}\right) + \left(0.005 \times \frac{0-0.036}{0.189}\right) + \cdots + \left(0.142 \times \frac{1-0.821}{0.390}\right)$ = -0.424

The site scores are calculated by Excel (Microsoft® Excel® for Office 365 MSO, version: 16.0.11629.20238). In Table 2, the site scores calculated by the first three principals are listed.

Table 2: Site scores in the first three principal components.

	prin1	prin2	prin3
Humble Administrator's Garden	1.099225	13.93055	-0.20355
Master of the Nets Garden	0.408826	12.14849	-0.62904
Lingering Garden	0.595506	13.34179	-0.47936
Bamboo Garden	-12.7816	-0.5911	0.135453
Net. Wet. Garden	-15.9341	-1.40374	5.958755
Learning Garden	-11.8559	-0.5624	-0.86791
Sugar Cane Garden	-14.6674	-2.10095	2.262445
Landscape New Wave	-12.1296	-0.59069	-1.80235
Daitoku-ji	4.840268	-0.27288	1.906672
Ryoan-ji	5.720583	-1.35097	3.526236
Kinkaku-ji	4.975652	-1.87753	2.872103

Table 2 (cont'd)

Tenryu-ji	5.08117	-1.48044	3.27892
Shisen-do	3.318796	-1.0816	2.332396
Kiyomizu-dera	4.70918	-1.35928	3.02236
Daikaku-ji	5.799463	-1.48816	3.186605
Byodo-in	5.197441	-0.02241	2.539527
Yasaka Shrine	1.368454	-2.62	-1.04153
Fushimi-Inari Taisha	3.30766	-2.44705	1.837666
Gyokudo Museum	-0.42382	-2.27549	-5.10426
Jomyo-ji	2.097221	-3.23076	-3.4062
Meigestu-in	4.564651	-2.45759	1.295698
Genkyu-en	1.85958	0.512173	-1.85268
Ryotan-ji	3.876863	-1.79533	-0.235
Seigan-ji	2.648257	-2.80397	-3.71158
Kongobu-ji	3.834583	-2.03688	-0.85241
Kishiwada Castle	-1.41892	-0.87693	-6.33375
Hōkoku Shrine	0.906099	-2.95599	-4.9007
Nanshu-ji	3.001852	-2.25088	-2.73451

CHAPTER 4: DISCUSSION

4.1 Two-Dimensional Model and Axis Meanings

To visualize the result, three two-dimensional charts are created. Each chart shows two of the three sets of site scores calculated by the previous steps. Each point in the scatter charts represents one site in this study. As the final step of cluster analysis, these charts visualized the clusters of the points, showing the groups of similar sites. The first chart is created to show the principal 1 and 2 site scores. The second chart is showing principal 2 and 3 site scores, while the third one is showing scores in principal 1 and 3. These charts was created using the "insert"-"chart" function in Excel (Microsoft® Excel® for Office 365 MSO, version: 16.0.11629.20238). In Figure 25 to 27, the scatter charts created are shown for further discussions. The abbreviations in the scatter graphs are indicated in Table 3.

Table 3: Abbreviations of the study sites shown in the graphs

Name of the Study Site	**Abbreviation**
Humble Administrator's Garden	hasg
Master of the Nets Garden	mast
Lingering Garden	ling
Bamboo Garden	bamb
Net. Wet. Garden	netw
Learning Garden	lear
Sugar Cane Garden	Suga
Landscape New Wave	Land
Daitoku-ji	Dait
Ryoan-ji	Ryoa
Kinkaku-ji	Kink
Tenryu-ji	Tenr

Table 3 (cont'd)

Shisen-do	Shis
Kiyomizu-dera	Kiyo
Daikaku-ji	Daik
Byodo-in	Byod
Yasaka Shrine	Yasa
Fushimi-Inari Taisha	Fush
Gyokudo Museum	GKD
Jomyo-ji	JMJ
Meigestu-in	MGT
Genkyu-en	GKE
Ryotan-ji	RTJ
Seigan-ji	SGJ
Kongobu-ji	KGB
Kishiwada Castle	KSW
Hōkoku Shrine	HKK
Nanshu-ji	NSJ

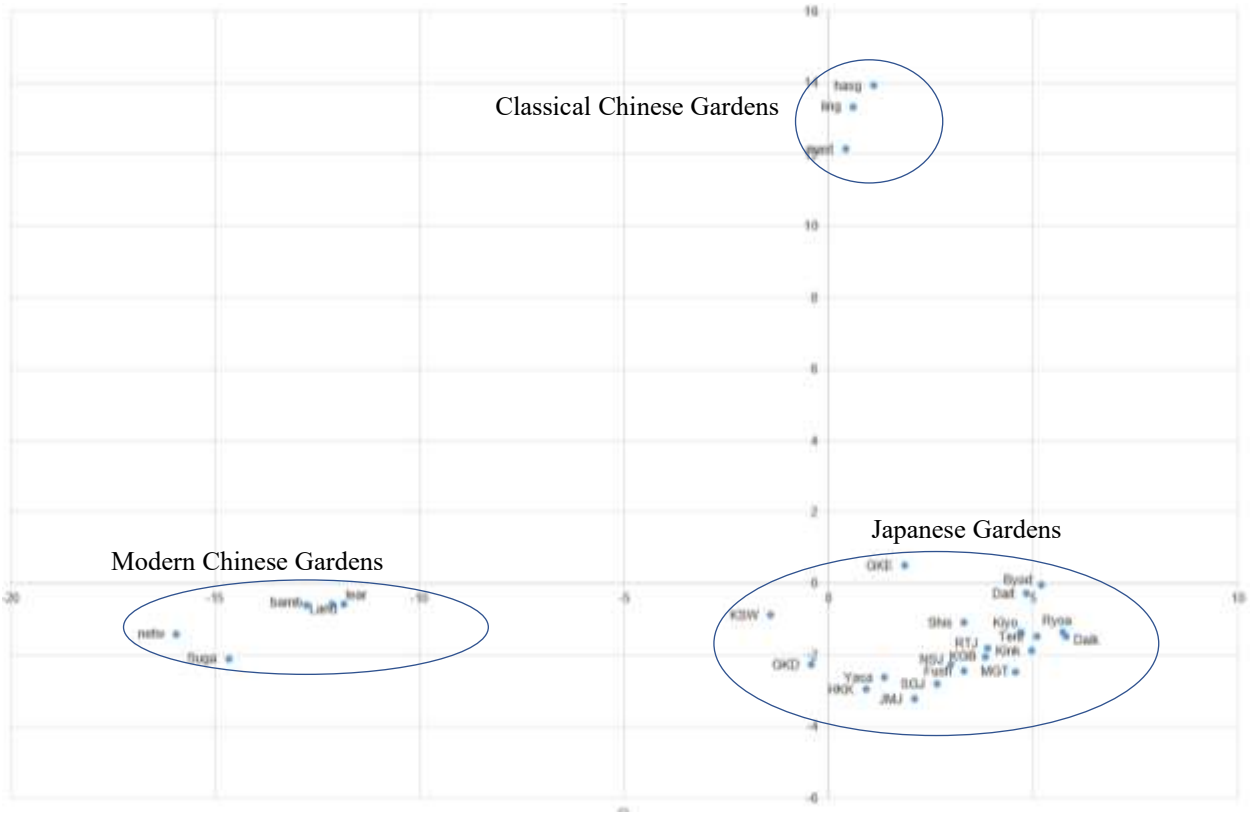

Figure 25: A scatter graph showing the relationship among all twenty-eight sites based on the

site scores of principal component 1 (horizontal axis) and principal component 2 (vertical axis).

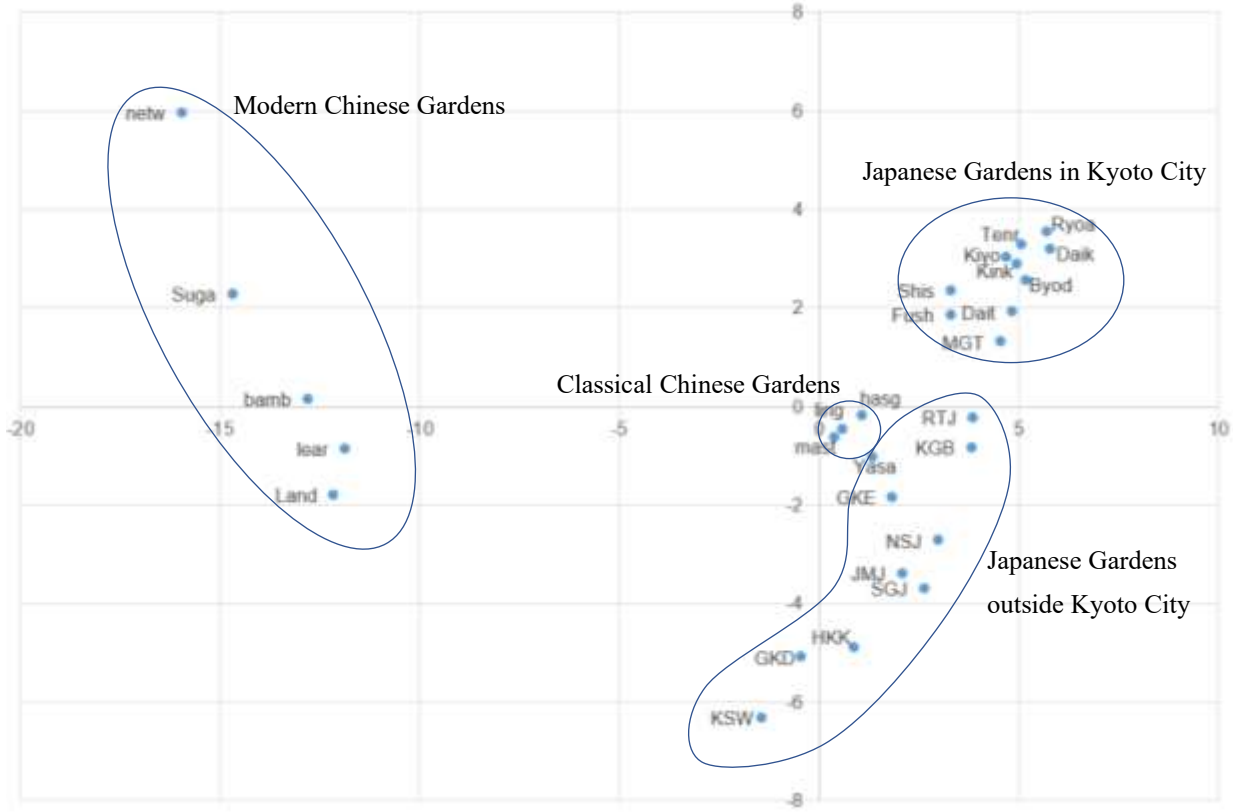

Figure 26: A scatter graph showing the relationship among all twenty-eight sites based on the site scores of principal component 1 (horizontal axis) and principal component 3 (vertical axis).

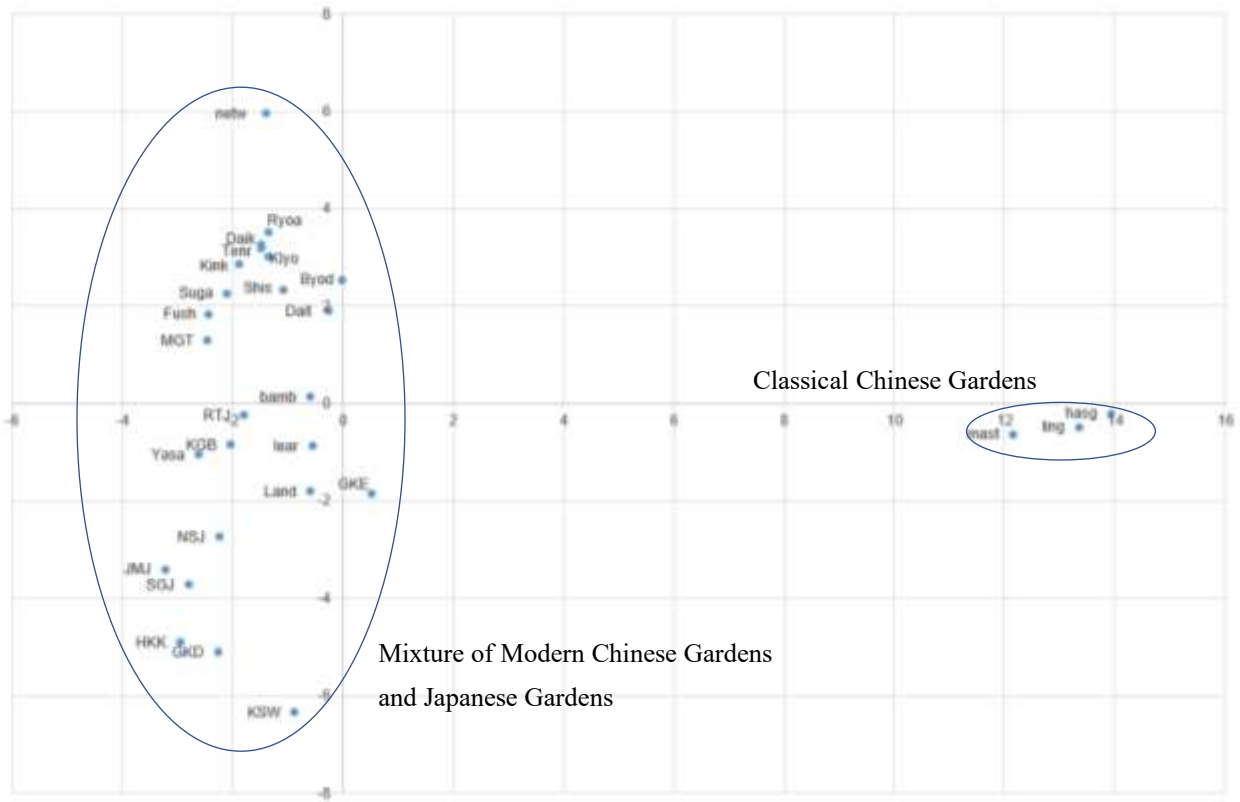

Figure 27: A scatter graph showing the relationship among all twenty-eight sites based on the site scores of principal component 2 (horizontal axis) and principal component 3 (vertical axis).

These scatter charts are generated by the site scores calculated by Equation 2. In the following step, the meanings of both vertical and horizontal axis are determined by the variables with the highest and the lowest eigenvalue coefficients in each principal component. The higher absolute value of the coefficient means that the variable distinguishes more from the other in terms of locating the sites on the charts. For the first principal component, the highest and the lowest coefficients are approximately 0.14 and -0.09. For principle 2, the numbers are 0.21 and -0.21. For principle 3, they are 0.23 and -0.14. The lists of the most distinctive variables are presented in Table 4, Table 5, and Table 6. These design elements significantly influence the site

scores, and the pattern of the scatter graphs

Table 4: List of the distinctive variables with the largest and the smallest coefficients in principal component 1.

Distinctive Variables with the Largest Coefficients	**Distinctive Variables with the Smallest Coefficients**
The great halls (ting tang)	Openwork brick walls
Unpainted structures or elements	Glass carvings
Fall color of plant material	Wetland
Plaque	Small scale
Lifted base of building	
Japanese Maple	
Multiple layers of entry sequence	
Multiple layers of edges	
Foreground, Midground, and Background	
Chinese characters	
Animistic believes	
Tranquility	
Harmony	

Table 5: List of the distinctive variables with the largest and the smallest coefficients in principal component 2.

Distinctive Variables with the Largest Coefficients	**Distinctive Variables with the Smallest Coefficients**
Zigzag wall	Viewing terrace
Meandering walls	Pebbles area
Zigzag Bridge	Abstract geometrical composition
Moon Gate	Bronze components
Brick carvings	Stairs
Taihu rocks /scholars' stone	Signage stone
Willow	Wabi-sabi
Confucianism	

Table 6: List of the distinctive variables with the largest and the smallest coefficients in principal component 3.

Distinctive Variables with the Largest Coefficients	**Distinctive Variables with the Smallest Coefficients**
Reflecting Pond	Straight Pathway
Fish pond	Trees
Shadow	Located in urban
Borrowed scenery	Varied spaces with visual devices
	Opposite scenery
	Ophiopogon japonicus
	Trimmed plant material

4.2 Comparison of Gardens and Garden Elements

The first scatter graph (Figure 25) is showing the site scores of each site in principal component 1 and 2. In the graph, the traditional Chinese gardens, modern Chinese gardens, and Japanese gardens form clusters of dots indicating each site. The horizontal axis shows the site scores in first principal component. The site scores calculated by the second principal component is shown on the vertical axis. Traditional Chinese gardens, which are Humble Administrator's Garden, Lingering Garden, and Master of the Nets Garden are located within the positive dimension of both horizontal and vertical axes. Modern Chinese gardens (Bamboo Garden, Learning Garden, Net.Wet. Garden, Sugar Cane Garden, and Landscape New Wave Garden) are all located within the negative dimension of both axes. Most of the Japanese gardens are located in the part with positive dimension of principal 1, and negative dimension of principal 2. In this chart, a clear cluster pattern of three different types of gardens is generated.

According to Table 4 and 5, the meaning of the axes of the first scatter graph can be defined. The distinctive variables for principal component 1 are including the general design elements in traditional oriental architectures (The great halls, Plaque, Lifted base of the building, Multiple layers) and general design elements in modern gardens like Wetland, Small scale, and Glass carvings. As for principal component 2, it can be defined as design elements in both Chinese (Moon gate, Taihu rocks, Zigzag bridge) and Japanese (Pebbles area, Signage stone) gardens (Chen, 2018).

The variables with the largest eigenvalue coefficient are distinguishable design elements that bring the dot representing the site to the positive dimension, and the ones with the smallest eigenvalue coefficients distributes the dots to negative dimension. Considering the axes meaning, the pattern of the first scatter graph (Figure 25) can be explained. The traditional oriental design elements bring the traditional Chinese and Japanese gardens to the positive dimension of the horizontal axis. Meanwhile, modern gardens design elements locate the modern Chinese gardens to the left side. Traditional Chinese gardens and Japanese gardens are separated by the principal component 2, and locate on each side of the vertical dimension.

In the first scatter graph, it is easy to notice that the modern Chinese gardens are in the same dimension with Japanese gardens on the vertical axis, which means that there are many same varieties shared by these two kinds of gardens. In the previous research, the authors mentioned that modern Chinese gardens reflect the result of global sharing and global cultural influences (Y. Xu et al., 2016). In that way, these modern Chinese gardens display similarities with these

Japanese gardens belonging to foreign culture. Moreover, these modern Chinese gardens are mostly built to be public places for people to enjoy their time. Most classical Chinese gardens was originally private residential projects designed for highly social-ranked people. In Table 5, elements with the largest eigenvalue coefficients, such as brick carvings, Taihu rocks, and Moon gate, illustrate the decoration emphasizing the aesthetic value and presents of wealth. In contrary, Japanese gardens, which are often associate with religious sites like shrines and temples, are usually open to public for religious related activities, thus closer related to the modern Chinese gardens with the consideration of functions.

The scatter graph generated by the site scores of principal components 1 and 2 present an interesting fact: three sites of this study are located outside the dimension where all the other Japanese gardens are located within. Gyokudo Art Museum, Kishiwada Castle and Genkyu-en. Gyokudo Art Museum and Kishiwada Castle are in the same dimension of modern Chinese gardens, which is negative dimension of both principal 1 and 2. Genkyu-en is located in the same dimension with classical Chinese gardens.

Considering about the date of construction, Gyokudo Art Museum was built in 1961, the garden of Kishiwada Castle was built in 1953. Thus, both these gardens can be considered as modern gardens. Both of them serve as non-religious sites featuring geometrical designs (Figure 28). Comparing to the other Japanese gardens included in the study sites which mostly all either Shintoism or Buddhism related sites, the non-religious sites are different from the other study sites.

Geometrical compositions can be found in more recent garden designs (Figure 29), which makes the modern gardens similar to each other (Burley, 2006).

Figure 28: Geometrical design in Kishiwada Castle. (Copyright ©2019 Yige Qu all right reserved used by permission).

Figure 29: Geometrical design in a modern Chinese garden called “Bamboo Garden”. (Copyright ©2014 Jon Burley all right reserved used by permission).

However, being different from the modern Chinese gardens serving as public open spaces with less architectures (Y. Xu et al., 2016), both Gyokudo Art Museum and Kishiwada Castle were served as private residences originally before the gardens were built. Therefore, these sites contain more traditional architecture elements like Lifted base and Plaque, which locate the site to the right of the modern Chinese gardens on the horizontal axis.

As mentioned in the study sites in chapter 2, Genkyu-en is considered to be designed with the concept of "Eight Views in Xiaoxiang, Hunan, China". It is named after an imperial villa in China during Tang Dynasty (Main, & Platten, 2002). Based on the intent of creating a garden with the yearning for Chinese style, the design elements like Pavilion and Boating pond are main elements in the garden. Additionally, the style of Genkyu-en is a stroll garden, which is also called Shinden-zukuri style. This kind of gardens was firstly created under the huge influence of Chinese culture in Heian period. Water features like boating ponds can usually be found in these kind of gardens (Burley, & Machemer, 2016). Many traditional Chinese garden design elements can be found in Genkyu-en. Therefore, the dot representing Genkyu-en is located within the dimension of traditional Chinese gardens.

The cluster pattern of the first scatter graph (Figure 25) showing the site scores of principal components 1 and 2 is similar to the same graph in Chen's study (Chen, 2018). One crucial reason is that the variables in this study used the same list generated by Yiwen Xu (2015) and Dexin Chen (2018). There are no new varieties added to the list of elements. Therefore, the original data set collected by Dexin Chen remains the same as the one in the previous study.

Additionally, sites newly selected for this study are “Japanese gardens outside Kyoto City”, which are the same type of garden as the ones in the previous study. The new study sites and previous ones share many design elements in common. The new site scores do not significantly influence the original relationship among the classical Chinese gardens, modern Chinese gardens, and Japanese gardens. Consequently, the cluster showing the similarity and differences do not change to great extent.

The second scatter graph (Figure 26) presents the site scores of principal components 1 and 3, with site scores of principal components 1 on the horizontal axis and the scores of 3 on the vertical one. In this graph, three classical Chinese gardens are located in the dimension of positive dimension of horizontal axis, and the negative dimension of the vertical axis, but are gathered close to the point of 0. Modern Chinese gardens and Japanese gardens both form a stripe shape. All modern Chinese gardens are located at the negative dimension of horizontal axis representing principal 1. Most of the dots representing Japanese gardens are at the positive dimension of the horizontal axis.

As discussed above, the principal component 1, which is on the horizontal axis in this scatter graph, divide modern gardens and traditional gardens. Looking at the pattern of the scatter graph on the vertical axis, it can be interpreted by analyzing the distinctive varieties in principal 3. According to the table of distinctive elements (Table 6), the meaning of the vertical axis can be defined as “Location, large water features, and plants”. The positive dimension represents the

large water features, and the location in Kyoto City. Outside Kyoto City, less water features, Trees, and Ophiopogon japonicus, are the meaning for the negative dimension.

The Japanese gardens located outside Kyoto City are mostly at the negative dimension of the principal component 3. Kyoto City is now a major city in Japan, and one of the most popular tourists' destinations. A large number of visitors from all over the world visit the city every day. The urban area in the city, nowadays, are mainly business buildings and hospitality infrastructures. These areas are the evidence of economy growth for the huge city, and they accommodate the large number of visitors. In that way, most famous gardens in Kyoto City, are the ones "survived" from the speedy process of urbanization and urban crawl. Due to the fact of that, the location of the gardens in Kyoto City are often in suburban. Being in the suburban, the scales of the gardens are usually larger. In that way, larger water features like reflecting ponds and fishponds can be included. Borrowed Scenery technique is also commonly used, because of the fact that these gardens are located in the suburban area, more natural sceneries and views, like mountains, can be "borrowed" into the garden for better views.

The dot of Yasaka Shrine is located closer to the dots of Japanese gardens outside Kyoto City. The reasons are the absent of the water feature elements, and the location in urban. Similarly, Meigetsu-in is closer to Japanese gardens in Kyoto City than to the ones outside the city, due to the water features and the location in suburban.

Classical Chinese gardens, being located at the same dimension of the Japanese gardens outside Kyoto City, can be explained by the location. All three classical Chinese gardens are

located inside the urban area in Suzhou City. Also, it can be noticed that the element “Tree” from Table 6 can be found in all Classical Chinese gardens and Japanese gardens, but being absent from some of the modern Chinese gardens. Ophiopogon japonicus, being absent from all modern Chinese gardens, is planted in all classical Chinese gardens and many Japanese gardens outside Kyoto City.

Third scatter graph (Figure 27) presents the site scores of principal components 2 (horizontal axis) and 3 (vertical axis). The classical Chinese gardens and modern Chinese gardens are divided by the principal 2, which is defines as design elements in Chinese and Japanese gardens. Modern Chinese gardens are in the same dimension of Japanese gardens. Most of the Japanese gardens located in the Kyoto City are in the positive dimension of principal 3, which is “Location, large water features, and plants” axis. The Japanese gardens and modern Chinese gardens are mixed in one cluster, which means they are similar to each other. The explanation of this pattern is explained above when the distinctive variables in principal 2 and 3 are discussed, because the first two scatter graphs cover the information of site scores and distinctive variables in all three principal components.

CHAPTER 5: CONCLUSION AND SUGGESTION

5.1 Future Implication

As a continued study of "A Cluster Analysis Comparison of Selected Traditional Japanese Gardens, Classical Chinese Gardens and Modern Chinese Gardens" by Dexin Chen (2018), this study further implicates the method of cluster analysis and principal component analysis. Along with the existing studies by Dexin Chen (2018), Haoxuan Xu et al. (2017), and Yiwen Xu et al. (2015), this study provides another example of analyzing the similarities and differences of gardens in a quantitative method based on the data, which produce more convincible results. This study encourages more related research to be conducted in the future.

The existing study by Chen also focused on Japanese garden (2018). However, all sites, as stated, are located in Kyoto City. This study adds more gardens outside the city to the study sites, which avoid the possibility that the gardens are similar due to the same geology, microclimate, and culture environment. It increases the sample size, objectivity, and reliability of the study, making the result more persuadable.

As mentioned in the previous chapters, this study help enhancing the clarity of the abstract design principles and techniques in prior studies and existing classic literatures, such like *Sakuteiki*, by listing the distinctive design elements in Japanese gardens. Literary and historical references have been the focus of garden history related studies, but the garden itself and the design can also provide potential information (Henderson, 2016). The elements discovered in this study can be used as references of further design and construction of traditional Asian gardens. The authenticity

of a design can be enhanced by adding listed distinctive design elements to the garden. It can promote the protection of traditional Japanese gardening techniques. By examine the similarities and differences between Chinese gardens and Japanese gardens by a quantitative method, this study will help researchers, designers and students to learn about the design principles and techniques of Japanese gardens, and to understand the cultural background in the Japanese gardens.

5.2 Limitations and Suggestion for Future Research

The selected gardens are all located along the major railway lines in Honshu island for the convenience of the researcher. Therefore, one of the limitations of this study is only focusing on gardens that can be reached by public transportation in the main island, despite there being many other beautiful gardens in other parts of Japan. The selected sites of Chinese gardens have the same issue. All traditional Chinese gardens are located in the same city. The modern ones are all located in another city. In order to obtain more objective results, and to exclude the influence of the same climate, geology, and cultural environment, both Japanese and Chinese gardens in the other areas should be added as new study sites in further researches.

Most selected Japanese gardens are old. Though “the selected gardens have a high probability that they have maintained their original designs from when they were first created”, there is still a possibility that the overall appearance and some elements of the gardens have changed over the centuries (Seo, & Morimoto, 1996). For example, during the visit to Kishiwada Castle, the tour guide mentioned that there were more water features like streams on the site and

in the surrounding area decades before. The number of plants increased significantly. In an existing research about the changes in a Japanese garden called Kouraku-en, the authors found that evergreen trees are significantly increasing in the garden, and is taking place of other trees in the garden (Nakajima, 2007). This fact might lead to the conclusion of inaccurate data might be collected, comparing to the original garden proposed by the designer.

Moreover, this study used the same list of variables of the previous study. Extra variables can be added to further studies, for example, "specific design concept", like the Meigetsu-in with the concept of moon, Kogonbu-ji with the concept of double dragons. Further implementations of the method about other types of gardens should include more variables associated with the category of the garden.

Additionally, many historical and modern sources about Japanese gardens are not translated into English or Chinese. Due to it being the author's third language, there is a possibility that the author is not able to fully understand the nuances of the texts. Researchers who are native Japanese speakers should be encouraged to participate in future studies about Japanese gardens. Better ability of understanding the language and cultural contents can improve the quality of the interpretation in the research.

Considering about the methodology, in principal component analysis, adding new sites and varieties can lead to different result of the previous data. Some information about the relationship between the sites is possibly lost when new objects are added to the study (Burley et al., 2009). Another fact is that the coefficients of the distinctive variables have small absolute values

comparing to the previous studies. That means that the pattern of the sites on scatter graph is not influenced significantly by some elements, but by the entirety of the variables. Thus, is difficult to define the axis meaning with these elements. This is probably a consequence of the increasing number of sample data. Because of that, further implication of this method should be aware of the influence on the results by the sample size. To find out design elements that influence the pattern more distinctively, the amount of the data should be reduced to gain clearer results for discussion.

Looking forward, future studies should consider the limitations of the existing literature. Additionally, more gardens in Japan should be considered as potential research sites. New variables should be added according to the new study sites. Furthermore, there are many sources about Japanese gardens that are only available in Japanese. The lack of translations makes it difficult for researchers in other counties to conduct further research based on those sources. Therefore, more Japanese sources should be translated into other languages for further research. Finally, gardens in countries like Korea and Singapore, belonging to the East Asian cultural sphere, should be considered to be studies by the same method. There are huge research potentials in the relationship between the gardens these countries being influenced by the same larger cultural system historically.

APPENDIX

Table 7: List of one hundred and thirty-four variables.

1. The Great Halls (ting tang)
2. Covered Stone Boat (fang)
3. Viewing Towers (lou ge)
4. Studies (shufang)
5. Covered Walkways (lang)
6. Pavilions (ting xie)
7. Viewing terrace
8. Black tile pavement
9. Brick paving
10. Cracked Ice Stone paving
11. Pebbles area
12. Mosaic pave with special pattern
13. Whitewashed walls
14. Grey Stone Walls
15. Openwork Brick walls
16. Curved top walls
17. Zigzag wall
18. Meandering walls
19. Bamboo paved pathway
20. Boardwalk
21. Curved Pathway
22. Straight Pathway
23. Zigzag Bridge
24. Semi-circular Bridge
25. Straight Bridge
26. Wall holes with symbolized shape
27. Lattice window
28. Moon Gate
29. Wood carvings
30. Glass carvings
31. Brick carvings
32. Reflecting Pond
33. Stream
34. Fish pond
35. Wetland
36. Island

Table 7 (cont'd)

37. Artificial mountains
38. Sculptural rocks
39. Pond bank rocks
40. Taihu Rocks
41. Trees
42. Shrubs
43. Ground covers
44. Turf area
45. Pine
46. Bamboo
47. Plum
48. Magnolias
49. Camellia
50. Crepe myrtles
51. Sweet osmanthus
52. Peony
53. Willow
54. Lotus
55. Reed
56. Sugar cane
57. Moon
58. Clouds
59. Rain
60. Wind
61. Shadow
62. Originally private
63. Public
64. Located in suburban
65. Located in urban
66. Design concept
67. Poem and painting concept
68. Naturalness
69. Varied spaces with visual devices
70. Borrowed scenery
71. Enframed scenery
72. Opposite scenery
73. Contrast

Table 7 (cont'd)

74. Deep implication
75. Abstract geometrical composition
76. Miniature of natural landscapes
77. Boating pond
78. Stepping stones
79. Yellow painted wall
80. Unpainted structures or elements
81. Fall color of plant material
82. Metal components in wooden structures
83. Courtyard/atrium
84. Wooden / bamboo fences and railings
85. Bench
86. Pagoda
87. Adjacent to burial site
88. Stairs
89. Geomancy rules/Fengshui
90. Stone lanterns
91. Wooden lanterns
92. Trellis/pergola
93. Obviously exposed drainage ditch/gutter
94. Signage stone
95. Elevation change
96. Plaque
97. Lifted base of building
98. Building partially painted in red
99. Strings implied enchantment boundary
100. Raked sand design
101. Stone hand wash basin
102. Well
103. Bell
104. Shishiodoshi
105. Grouping stones
106. Ophiopogon japonicas
107. Hydrangea
108. Japanese maple
109. Moss
110. Azalea

Table 7 (cont'd)

111. Trimmed plant material
112. Weeping form plant material
113. Multiple layers of entry sequence
114. Multiple layers of edges
115. Control view point
116. Foreground, Midground and Background (visual technique)
117. Large scale
118. Small scale
119. Located on the foot of mountain
120. Location adjacent to Shinto shrine
121. Curved roof
122. Chinese characters
123. Wabi-sabi
124. Religious property
125. Tea
126. Sense of sacred place
127. Animistic believes
128. Buddhism
129. Shinto
130. Confucianism
131. Imperial background
132. Simplicity
133. Tranquility
134. Harmony

Table 8: List of design elements in the three classical Chinese gardens and five modern Chinese gardens from previous study by Yiwen Xu (2015).

	Classical Chinese Gardens			**Modern Chinese Gardens**				
Design elements	**Humble Administrator's Garden**	**Master of the Nets Garden**	**Lingering Garden**	**Bamboo Garden**	**Net. Wet. Garden**	**Learning Garden**	**Sugar Cane Garden**	**Landscape New Wave**
The great halls (ting tang)	1	1	1	0	0	0	0	0
Covered stone boat (fang)	1	0	0	0	0	0	0	0
Viewing towers (lou ge)	1	1	1	0	0	0	0	0
Studies (shufang)	1	1	1	0	0	0	0	0
Covered walkways (lang)	1	1	1	0	0	0	0	0
Pavillions (ting xie)	1	1	1	0	0	0	0	0
Viewing terrace	0	0	0	1	0	1	0	0
Black tile pavement	1	1	1	0	0	0	1	0
Brick paving	1	1	1	0	0	0	0	0
Cracked ice stone paving	1	1	1	0	0	1	0	0
Pebbles area	0	0	0	1	0	1	1	0
Mosaic pave with special pattern	1	1	1	0	0	1	0	1
Whitewashed walls	1	1	1	1	0	1	0	0
Grey stone walls	1	0	0	1	0	0	1	0
Openwork brick walls	1	1	1	1	1	1	0	1
Curved top walls	1	0	1	0	0	0	0	0
Zigzag wall	1	1	1	1	0	0	0	0
Meandering walls	1	0	1	0	0	0	0	0
Bamboo paved pathway	0	0	0	0	1	0	0	0
Boardwalk	0	0	0	0	1	0	0	0
Curved Pathway	1	1	1	1	1	0	1	0
Straight Pathway	1	1	1	1	0	1	0	1
Zigzag Bridge	1	1	1	1	0	0	0	0

Table 8 (cont'd)

Semi-circular bridge	1	1	0	0	0	0	0	0
Straight Bridge	1	1	1	1	0	1	0	0
Wall holes with symbolized shape	1	1	1	1	0	0	0	0
Lattice window	1	1	1	0	0	0	0	0
Moon Gate	1	1	1	0	0	0	0	0
Wood carvings	1	1	1	0	0	0	0	0
Glass carvings	0	0	0	0	0	1	0	1
Brick carvings	1	1	1	0	0	0	0	0
Reflecting Pond	1	1	1	1	0	1	1	1
Stream	1	1	0	0	0	0	0	0
Fish pond	1	1	1	0	1	0	0	0
Wetland	0	0	0	1	1	0	0	0
Island	1	0	1	1	0	0	0	0
Artificial mountains	1	1	1	0	0	0	0	0
Sculptural rocks	1	1	1	1	1	1	0	1
Pond bank rocks	1	1	1	0	0	0	0	0
Taihu rocks /scholars' stone	1	1	1	0	0	0	0	0
Trees	1	1	1	1	0	1	0	1
Shrubs	1	1	1	0	0	1	0	1
Ground covers	1	1	1	0	0	0	1	1
Turf area	1	0	0	1	0	0	0	1
Pine	1	1	1	0	0	1	0	0
Bamboo	1	1	1	1	0	1	0	1
Plum	1	1	1	0	0	0	0	0
Magnolias	1	1	1	0	0	0	0	0
Camellia	1	1	1	0	0	0	0	0
Crepe myrtles	1	1	1	0	0	0	0	0
Sweet osmanthus	1	1	1	0	0	1	0	0
Peony	1	1	1	0	0	0	0	0
Willow	1	1	1	0	0	0	0	0
Lotus	1	1	1	0	0	1	0	1
Reed	0	0	0	1	1	0	0	0
Sugar cane	0	0	0	0	0	0	1	0
Moon	1	1	0	0	0	0	0	0
Clouds	0	1	1	0	0	0	0	0

Table 8 (cont'd)

Rain	1	0	1	0	0	0	0	0
Wind	1	1	1	0	0	0	0	0
Shadow	1	0	0	0	1	1	0	0
Originally private	1	1	1	0	0	0	0	0
Public	0	0	0	1	1	1	1	1
Located in suburban	0	0	0	1	1	1	1	1
Located in urban	1	1	1	0	0	0	0	0
Design concept	1	1	1	1	1	1	1	1
Poem and painting concept	1	1	1	0	0	1	0	1
Naturainess	1	1	1	0	1	0	1	1
Varied spaces with visual devices	1	1	1	1	0	1	1	1
Borrowed scenery	1	1	1	0	1	0	0	0
Enframed scenery	1	1	1	1	1	1	0	1
Opposite scenery	1	1	1	1	0	1	0	1
Contrast	1	1	1	1	1	1	1	1
Deep implication	1	1	1	1	1	1	1	1
Abstract geometrical composition	0	0	0	1	1	1	1	1
Miniature of natural landscapes	1	1	1	0	0	0	0	0
Boating pond	1	0	1	0	0	0	0	0
Stepping stones	0	0	0	0	0	0	0	0
Yellow painted wall	0	0	0	0	0	0	0	0
Unpainted structures or elements	1	1	1	0	0	0	0	0
Fall colour of plant material	1	1	1	0	0	0	0	0
Bronze components	0	0	0	0	0	0	0	0
Courtyard/atrium	1	1	1	0	0	0	0	0
Wooden /bamboo fence/railings	1	0	0	1	0	1	0	1
Bench	0	0	0	1	0	1	0	1
Pagoda	0	0	0	0	0	0	0	0
Adjacent to burial site	0	0	0	0	0	0	0	0

Table 8 (cont'd)

Stairs	0	0	0	1	0	0	1	1
Geomancy rules/Fengshui	1	1	1	0	0	0	1	0
Stone lanterns	0	0	0	0	0	0	0	0
Wooden lanterns	0	0	0	0	0	0	0	0
Trellis/pergola	1	1	1	0	0	0	0	0
Obviouly exposed drainage ditch/gutter	0	0	0	0	0	0	0	0
Signage stone	0	0	0	0	0	0	0	0
Elevation change	1	1	1	0	0	0	0	0
Plaque	1	1	1	0	0	0	0	0
Lifted base of building	1	1	1	0	0	0	0	0
Building partially painted in red	1	1	1	0	0	0	0	0
Strings implied enchantment boundary	0	0	0	0	0	0	0	0
Raked sand design	0	0	0	0	0	0	0	0
Stone hand wash basin	0	0	0	0	0	0	0	0
Well	1	1	1	0	0	0	0	0
Bell	0	0	0	0	0	0	0	0
Shishiodoshi	0	0	0	0	0	0	0	0
Grouping stones	1	1	1	0	0	0	0	0
Ophiopogon japonicus	1	1	1	0	0	0	0	0
Hydrangea	0	0	0	0	0	0	0	0
Japanese Maple	1	1	1	0	0	0	0	0
Moss	0	0	0	0	0	0	0	0
Azalea	1	1	1	0	0	1	0	1
Trimmed plant material	1	1	1	1	0	1	0	1
Weeping form plant material	1	1	1	0	0	0	0	0
Multiple layers of entry sequence	1	1	1	0	0	0	0	0

Table 8 (cont'd)

Multiple layers of edges	1	1	1	0	0	0	0	0
Control view point	1	1	1	1	0	0	0	1
Foreground, Midground, and Background	1	1	1	0	0	0	0	0
Large scale	0	0	0	0	0	0	0	0
Small scale	1	1	1	1	1	1	1	1
Located on the foot of mountain	0	0	0	0	0	0	0	0
Location adjacent to Shinto Shrine	0	0	0	0	0	0	0	0
Curved roof	1	1	1	0	0	0	0	0
Chinese characters	1	1	1	0	0	0	0	0
Wabi-sabi	0	0	0	0	0	0	0	0
Religious property	0	0	0	0	0	0	0	0
Teaism	1	1	1	0	0	0	0	0
Sense of sacred place	1	1	1	0	0	0	0	0
Animistic believes	1	1	1	0	0	0	0	0
Buddhism	1	0	1	0	0	0	0	0
Shinto	0	0	0	0	0	0	0	0
Confucianism	1	1	1	0	0	0	0	0
Imperial background	0	0	0	0	0	0	0	0
Simplicity	1	1	1	1	1	1	1	1
Tranquility	1	1	1	0	0	0	0	0
Harmony	1	1	1	0	0	0	0	0

Table 9: List of design elements in the eight traditional Japanese gardens and two Shinto Shrines from previous study by Dexin Chen (2018).

	Tradition Japanese Gardens								**Shinto Shrines**	
Design elements	**Daitoku-ji**	**Ryoan-ji**	**Kinkaku-ji**	**Tenryu-ji**	**Shisen-do**	**Kiyomizu-dera**	**Daikaku-ji**	**Byodo-in**	**Yasaka**	**Fushimi-Inari Taisha**
The great halls (ting tang)	1	1	1	1	1	1	1	1	1	1
Covered stone boat (fang)	0	0	0	0	0	0	0	0	0	0
Viewing towers (lou ge)	1	1	1	1	1	1	1	1	1	1
Studies (shufang)	1	1	1	1	1	1	1	1	1	1
Covered walkways (lang)	1	1	1	1	0	1	1	1	1	1
Pavillions (ting xie)	1	1	1	1	0	1	1	1	1	1
Viewing terrace	1	1	1	1	1	1	1	1	1	1
Black tile pavement	0	0	0	0	0	0	0	0	0	0
Brick paving	1	0	0	0	0	0	0	0	0	0
Cracked ice stone paving	1	1	0	1	1	1	0	0	0	0
Pebbles area	1	1	1	1	1	1	1	1	1	1
Mosaic pave with special pattern	0	0	0	0	0	0	0	0	0	0
Whitewashed walls	1	1	1	1	0	1	1	1	1	1
Grey stone walls	1	0	0	0	1	1	0	0	1	1
Openwork brick walls	0	0	0	0	0	0	0	0	0	0
Curved top walls	0	0	0	0	0	0	0	0	0	0
Zigzag wall	0	0	0	0	0	0	0	0	0	0
Meandering walls	0	0	0	0	0	0	0	0	0	0
Bamboo paved pathway	0	0	0	0	0	0	0	0	0	0
Boardwalk	0	0	0	0	0	0	0	0	0	0
Curved Pathway	1	1	1	1	1	1	1	1	0	1
Straight Pathway	1	1	1	1	1	1	1	1	1	1
Zigzag Bridge	0	0	0	0	0	0	0	0	0	0
Semi-circular bridge	1	1	0	0	0	0	1	1	0	0
Straight Bridge	1	1	0	1	1	0	0	1	0	1

Table 9 (cont'd)

Wall holes with symbolized shape	0	0	0	0	0	0	0	0	0	0
Lattice window	1	1	1	1	1	1	1	1	1	1
Moon Gate	0	0	0	0	0	0	0	0	0	0
Wood carvings	1	1	1	1	0	1	1	1	1	1
Glass carvings	0	0	0	0	0	0	0	0	0	0
Brick carvings	0	0	0	0	0	0	0	1	0	0
Reflecting Pond	1	1	1	1	1	1	1	1	0	1
Stream	1	1	1	1	1	1	1	1	1	1
Fish pond	1	1	1	1	1	1	1	1	0	1
Wetland	0	0	0	0	0	0	0	0	0	0
Island	1	1	1	1	1	1	1	1	0	0
Artificial mountains	0	0	0	0	0	0	0	0	0	0
Sculptural rocks	1	1	1	1	1	1	1	1	1	1
Pond bank rocks	1	1	1	1	1	1	1	1	0	0
Taihu rocks /scholars' stone	0	0	0	0	0	0	0	0	0	0
Trees	1	1	1	1	1	1	1	1	1	1
Shrubs	1	1	1	1	1	1	1	1	1	1
Ground covers	1	1	1	1	1	1	1	1	0	1
Turf area	0	0	0	0	0	0	0	1	0	0
Pine	1	1	1	1	1	1	1	1	1	1
Bamboo	1	1	1	1	1	1	1	1	1	1
Plum	1	1	1	1	1	1	1	1	1	1
Magnolias	1	1	1	1	1	1	1	1	1	1
Camellia	1	1	1	1	1	1	1	1	0	1
Crepe myrtles	1	1	1	1	1	1	1	1	1	1
Sweet osmanthus	1	1	1	1	1	1	1	1	1	1
Peony	0	1	0	1	0	0	0	0	0	0
Willow	0	0	0	0	0	0	0	0	0	0
Lotus	0	1	1	0	0	0	1	1	0	0
Reed	0	1	1	1	1	0	1	0	0	0
Sugar cane	0	0	0	0	0	0	0	0	0	0
Moon	0	0	0	0	1	1	1	0	1	1
Clouds	0	1	0	0	1	1	1	0	1	1
Rain	0	1	0	0	1	1	1	1	0	1
Wind	0	0	0	0	1	0	1	0	0	0

Table 9 (cont'd)

Shadow	1	1	1	1	1	1	1	1	1	1
Originally private	1	1	1	1	1	1	1	1	0	0
Public	0	0	0	0	0	0	0	0	1	1
Located in suburban	0	1	1	1	1	1	1	1	0	1
Located in urban	1	0	0	0	0	0	0	0	1	0
Design concept	1	1	1	1	1	1	1	1	1	1
Poem and painting concept	1	1	1	1	1	1	1	1	0	0
Naturainess	1	1	1	1	1	1	1	1	1	1
Varied spaces with visual devices	1	1	1	1	1	1	1	1	1	1
Borrowed scenery	1	1	1	1	1	1	1	1	1	1
Enframed scenery	1	1	0	1	1	1	1	1	0	1
Opposite scenery	1	1	1	1	1	1	1	1	1	1
Contrast	1	1	1	1	1	1	1	1	1	1
Deep implication	1	1	1	1	1	1	1	1	1	1
Abstract geometrical composition	1	1	1	1	1	1	1	1	1	1
Miniature of natural landscapes	1	1	1	1	1	1	1	1	0	0
Boating pond	0	0	1	0	0	0	1	1	0	1
Stepping stones	1	1	1	1	1	0	1	1	0	0
Yellow painted wall	1	1	1	1	1	0	1	0	0	0
Unpainted structures or elements	1	1	1	1	1	1	1	1	1	1
Fall colour of plant material	1	1	1	1	1	1	1	1	1	1
Bronze components	1	1	1	1	1	1	1	1	1	1
Courtyard/atrium	1	1	1	1	1	0	1	1	0	1
Wooden /bamboo fence/railings	1	1	1	1	1	1	1	1	1	1
Bench	0	1	1	1	0	0	0	0	0	1
Pagoda	1	1	1	1	1	1	1	1	0	0
Adjacent to burial site	1	1	1	1	0	1	1	1	1	1
Stairs	1	1	1	1	1	1	1	1	1	1
Geomancy rules/Fengshui	1	1	1	1	1	1	1	1	1	1

Table 9 (cont'd)

Stone lanterns	1	1	1	1	1	1	1	1	1	1
Wooden lanterns	1	1	0	0	0	1	1	0	1	1
Trellis/pergola	0	1	1	1	0	1	0	1	0	0
Obviouly exposed drainage ditch/gutter	1	1	1	1	1	1	1	1	1	1
Signage stone	1	1	1	1	1	1	1	1	1	1
Elevation change	1	1	1	1	1	1	1	1	1	1
Plaque	1	1	1	1	1	1	1	1	1	1
Lifted base of building	1	1	1	1	1	1	1	1	1	1
Building partially painted in red	1	0	0	0	0	1	1	1	1	1
Strings implied enchantment boundary	0	0	0	0	0	0	0	0	1	1
Raked sand design	1	1	1	1	1	0	1	0	0	0
Stone hand wash basin	1	1	1	1	1	1	1	1	1	1
Well	1	1	1	1	1	1	1	1	1	1
Bell	1	1	1	1	0	1	1	1	1	1
Shishiodoshi	0	0	0	0	1	0	0	0	0	0
Grouping stones	1	1	1	1	1	1	1	1	0	0
Ophiopogon japonicus	0	0	0	0	0	0	0	1	0	0
Hydrangea	1	1	1	1	1	1	1	1	1	1
Japanese Maple	1	1	1	1	1	1	1	1	1	1
Moss	1	1	1	1	1	1	1	1	0	1
Azalea	1	1	1	1	1	1	1	1	1	1
Trimmed plant material	1	1	1	1	1	1	1	1	1	1
Weeping form plant material	1	1	1	1	0	1	1	1	0	1
Multiple layers of entry sequence	1	1	1	1	1	1	1	1	1	1
Multiple layers of edges	1	1	1	1	1	1	1	1	1	1
Control view point	1	1	1	1	1	1	1	1	1	1
Foreground, Midground, and Background	1	1	1	1	1	1	1	1	1	1
Large scale	0	1	1	1	0	1	1	1	0	1
Small scale	1	0	0	0	1	0	0	0	1	0

Table 9 (cont'd)

Located on the foot of mountain	0	1	1	1	1	1	1	1	1	1
Location adjacent to Shinto Shrine	1	1	1	1	1	1	1	1	1	1
Curved roof	1	1	1	1	0	1	1	1	1	1
Chinese characters	1	1	1	1	1	1	1	1	1	1
Wabi-sabi	1	1	1	1	1	1	1	1	1	1
Religious property	1	1	1	1	1	1	1	1	1	1
Teaism	1	1	1	1	1	0	1	1	0	0
Sense of sacred place	1	1	1	1	1	1	1	1	1	1
Animistic believes	1	1	1	1	1	1	1	1	1	1
Buddhism	1	1	1	1	1	1	1	1	0	0
Shinto	0	1	0	0	0	1	1	0	1	1
Confucianism	0	0	0	0	1	0	0	0	0	0
Imperial background	1	1	1	1	1	1	1	1	1	1
Simplicity	1	1	1	1	1	1	1	1	1	1
Tranquility	1	1	1	1	1	1	1	1	1	1
Harmony	1	1	1	1	1	1	1	1	1	1

Table 10: List of design elements in the Japanese gardens outside Kyoto City.

Design elements	Gyokudo Museum	Jomyo-ji	Meigestu-in	Genkyu-en	Ryotan-ji	Seigan-ji	Kongobu-ji	Kishiwada Castle	Hōkoku Shrine	Nanshu-ji
The great halls (ting tang)	1	1	1	1	1	1	1	1	1	1
Covered stone boat (fang)	0	0	0	0	0	0	0	0	0	0
Viewing towers (lou ge)	0	0	0	0	0	0	0	1	0	0
Studies (shufang)	1	0	1	1	1	1	1	1	0	1
Covered walkways (lang)	1	1	1	1	1	1	1	0	1	1
Pavillions (ting xie)	0	0	0	1	0	0	1	0	0	0
Viewing terrace	1	1	1	1	1	1	1	1	1	1
Black tile pavement	0	0	0	0	0	0	0	0	0	1
Brick paving	0	0	0	0	1	0	0	0	0	0
Cracked ice stone paving	0	0	0	0	0	0	0	0	0	0
Pebbles area	1	1	1	1	1	1	1	1	1	1
Mosaic pave with special pattern	0	0	0	0	0	0	0	0	0	0
Whitewashed walls	1	1	0	1	1	1	1	1	1	1
Grey stone walls	0	0	0	0	0	0	0	1	0	0
Openwork brick walls	0	0	0	0	0	0	0	0	0	0
Curved top walls	0	0	0	0	0	0	0	0	0	1
Zigzag wall	0	0	0	0	0	0	0	0	0	0
Meandering walls	0	0	0	0	0	0	0	0	0	0
Bamboo paved pathway	0	0	0	0	0	0	0	0	0	0
Boardwalk	0	0	0	0	0	0	0	0	0	0
Curved Pathway	0	1	1	1	1	1	1	1	0	1

Table 10 (cont'd)

Straight Pathway	1	1	1	1	1	1	1	1	1	1
Zigzag Bridge	0	0	0	0	0	0	0	0	0	0
Semi-circular bridge	0	0	1	1	0	1	0	0	0	0
Straight Bridge	0	0	1	1	1	1	1	1	0	1
Wall holes with symbolized shape	0	0	1	0	1	0	0	0	0	0
Lattice window	1	1	1	1	1	1	1	0	1	1
Moon Gate	0	0	0	0	0	0	0	0	0	0
Wood carvings	1	1	1	1	1	1	1	1	1	1
Glass carvings	0	0	0	0	0	0	0	0	0	0
Brick carvings	0	0	0	0	0	0	0	0	0	0
Reflecting Pond	0	0	1	1	1	0	1	0	0	0
Stream	1	0	1	1	1	0	1	0	0	0
Fish pond	0	0	1	1	1	0	1	0	0	0
Wetland	0	0	0	1	0	0	0	0	0	0
Island	0	1	0	1	1	0	0	0	0	0
Artificial mountains	0	0	0	1	0	1	0	0	1	0
Sculptural rocks	1	1	1	1	1	1	1	1	1	1
Pond bank rocks	0	0	1	1	1	0	1	0	0	0
Taihu rocks /scholars' stone	0	0	0	0	0	0	0	0	0	0
Trees	1	1	1	1	1	1	1	1	1	1
Shrubs	1	1	1	1	1	1	1	1	1	1
Ground covers	1	1	1	1	1	1	1	1	1	1
Turf area	0	1	0	1	0	0	0	1	0	0
Pine	1	1	1	1	1	1	1	1	1	1
Bamboo	0	1	1	1	1	0	0	0	0	1
Plum	0	1	1	1	1	1	1	0	1	1
Magnolias	0	0	1	0	1	0	0	0	0	1
Camellia	0	1	1	0	1	1	1	0	1	1
Crepe myrtles	0	1	1	0	1	1	0	0	1	1
Sweet osmanthus	0	0	1	0	0	0	0	0	1	1
Peony	0	1	0	0	1	0	0	0	0	0
Willow	0	0	0	0	0	0	0	0	0	0
Lotus	0	0	1	1	0	0	1	1	0	0

Table 10 (cont'd)

Reed	0	0	1	1	0	0	1	0	0	0
Sugar cane	0	0	0	0	0	0	0	0	0	0
Moon	0	0	1	1	1	1	0	1	0	0
Clouds	0	0	1	0	1	0	1	1	0	0
Rain	1	1	0	0	1	1	1	0	0	0
Wind	0	0	0	1	0	1	1	1	0	1
Shadow	0	0	1	1	1	0	0	0	0	0
Originally private	1	0	0	1	0	0	0	1	0	0
Public	0	1	1	0	1	1	1	0	1	1
Located in suburban	1	1	1	0	1	1	0	0	0	1
Located in urban	0	0	0	1	0	0	1	1	1	0
Design concept	1	1	1	1	1	1	1	1	1	1
Poem and painting concept	1	1	1	1	1	1	1	1	1	1
Naturainess	1	1	1	1	1	1	1	1	1	1
Varied spaces with visual devices	1	1	1	1	1	1	1	1	1	1
Borrowed scenery	1	0	1	1	1	0	0	0	0	0
Enframed scenery	0	1	1	0	1	0	1	0	0	1
Opposite scenery	1	1	1	1	1	1	1	1	1	1
Contrast	1	1	1	1	1	1	1	1	1	1
Deep implication	1	1	1	1	1	1	1	1	1	1
Abstract geometrical composition	1	1	1	1	1	1	1	1	1	1
Miniature of natural landscapes	1	1	1	1	1	1	1	1	1	1
Boating pond	0	0	0	1	0	0	0	0	0	0
Stepping stones	1	1	1	1	1	1	1	1	0	1
Yellow painted wall	0	0	1	0	0	1	1	0	0	0
Unpainted structures or elements	1	1	1	1	1	1	1	1	1	1

Table 10 (cont'd)

Fall colour of plant material	1	1	1	1	1	1	1	1	1	1
Bronze components	1	1	1	1	1	1	1	1	1	1
Courtyard/atrium	1	1	1	0	1	1	1	0	1	1
Wooden /bamboo fence/railings	1	1	1	1	1	1	1	1	1	1
Bench	1	0	1	1	0	0	0	1	0	1
Pagoda	0	0	1	1	1	1	1	0	0	1
Adjacent to burial site	0	1	1	0	1	1	1	0	0	1
Stairs	1	1	1	1	1	1	1	1	1	1
Geomancy rules/Fengshui	1	1	1	1	1	1	1	1	1	1
Stone lanterns	0	1	1	1	1	1	1	0	1	1
Wooden lanterns	1	1	1	1	1	1	0	0	1	1
Trellis/pergola	0	0	0	1	0	0	0	0	0	0
Obviouly exposed drainage ditch/gutter	0	1	1	1	1	1	1	0	1	1
Signage stone	1	1	1	1	1	1	1	1	1	1
Elevation change	1	0	1	1	1	1	1	1	0	1
Plaque	1	1	1	1	1	1	1	1	1	1
Lifted base of building	1	1	1	1	1	1	1	1	1	1
Building partially painted in red	1	0	0	0	0	0	0	0	0	0
Strings implied enchantment boundary	0	1	1	1	1	0	0	0	0	0
Raked sand design	1	1	1	0	1	0	1	1	1	1
Stone hand wash basin	1	1	1	0	1	1	1	0	1	1
Well	0	1	1	1	0	1	1	0	0	1
Bell	0	1	1	0	1	1	1	0	0	1
Shishiodoshi	0	1	1	0	0	1	0	0	0	0

Table 10 (cont'd)

Grouping stones	1	1	1	1	1	1	1	1	1	1
Ophiopogon japonicus	0	1	1	1	1	0	1	1	1	1
Hydrangea	0	1	1	0	1	1	1	1	1	1
Japanese Maple	1	1	1	1	1	1	1	1	1	1
Moss	1	1	1	1	1	1	1	1	1	1
Azalea	1	1	1	1	1	1	1	1	1	1
Trimmed plant material	1	1	1	1	1	1	1	1	1	1
Weeping form plant material	0	0	1	1	0	0	1	0	0	0
Multiple layers of entry sequence	1	1	1	1	1	1	1	1	1	1
Multiple layers of edges	1	1	1	1	1	1	1	1	1	1
Control view point	1	1	1	1	1	1	1	1	1	1
Foreground, Midground, and Background	1	1	1	1	1	1	1	1	1	1
Large scale	0	0	1	0	1	0	1	0	1	1
Small scale	1	1	0	1	0	1	0	1	0	0
Located on the foot of mountain	1	1	1	1	1	1	1	0	0	1
Location adjacent to Shinto Shrine	0	0	0	0	0	0	0	0	1	0
Curved roof	1	1	1	1	1	1	1	1	1	1
Chinese characters	1	1	1	1	1	1	1	1	1	1
Wabi-sabi	1	1	1	1	1	1	1	1	1	1
Religious property	0	1	1	0	1	1	1	0	1	1
Teaism	0	1	1	1	0	1	1	0	0	1
Sense of sacred place	0	1	1	0	1	1	1	0	1	1
Animistic believes	1	1	1	1	1	1	1	1	1	1

Table 10 (cont'd)

Buddhism	0	1	1	0	1	1	1	0	0	1
Shinto	0	0	0	0	0	0	0	0	1	0
Confucianism	0	0	0	0	0	0	0	0	0	0
Imperial background	0	1	1	0	0	0	1	0	1	0
Simplicity	1	1	1	1	1	1	1	1	1	1
Tranquility	1	1	1	1	1	1	1	1	1	1
Harmony	1	1	1	1	1	1	1	1	1	1

Table 11: Means and standard deviation of the corresponding variables from the SAS software program.

Design elements	**Mean**	**Standard Deviation**
The great halls (ting tang)	0.8214286	0.390021
Covered stone boat (fang)	0.0357143	0.1889822
Viewing towers (lou ge)	0.5	0.5091751
Studies (shufang)	0.75	0.4409586
Covered walkways (lang)	0.75	0.4409586
Pavillions (ting xie)	0.5	0.5091751
Viewing terrace	0.7857143	0.4178554
Black tile pavement	0.1785714	0.390021
Brick paving	0.1785714	0.390021
Cracked ice stone paving	0.3214286	0.4755949
Pebbles area	0.8214286	0.390021
Mosaic pave with special pattern	0.1785714	0.390021
Whitewashed walls	0.8214286	0.390021
Grey stone walls	0.3214286	0.4755949
Openwork brick walls	0.25	0.4409586
Curved top walls	0.1071429	0.3149704
Zigzag wall	0.1428571	0.3563483
Meandering walls	0.0714286	0.2622653
Bamboo paved pathway	0.0357143	0.1889822
Boardwalk	0.0357143	0.1889822
Curved Pathway	0.8214286	0.390021
Straight Pathway	0.9285714	0.2622653
Zigzag Bridge	0.1428571	0.3563483
Semi-circular bridge	0.3214286	0.4755949
Straight Bridge	0.6428571	0.48795
Wall holes with symbolized shape	0.2142857	0.4178554
Lattice window	0.7857143	0.4178554
Moon Gate	0.1071429	0.3149704
Wood carvings	0.7857143	0.4178554
Glass carvings	0.0714286	0.2622653
Brick carvings	0.1428571	0.3563483
Reflecting Pond	0.7142857	0.4600437
Stream	0.6071429	0.4973475

Table 11 (cont'd)

Fish pond	0.6071429	0.4973475
Wetland	0.1071429	0.3149704
Island	0.5	0.5091751
Artificial mountains	0.2142857	0.4178554
Sculptural rocks	0.9642857	0.1889822
Pond bank rocks	0.5357143	0.5078745
Taihu rocks /scholars' stone	0.1071429	0.3149704
Trees	0.9285714	0.2622653
Shrubs	0.8928571	0.3149704
Ground covers	0.8571429	0.3563483
Turf area	0.25	0.4409586
Pine	0.8571429	0.3563483
Bamboo	0.75	0.4409586
Plum	0.75	0.4409586
Magnolias	0.5714286	0.5039526
Camellia	0.6785714	0.4755949
Crepe myrtles	0.6785714	0.4755949
Sweet osmanthus	0.6071429	0.4973475
Peony	0.25	0.4409586
Willow	0.1071429	0.3149704
Lotus	0.4642857	0.5078745
Reed	0.3571429	0.48795
Sugar cane	0.0357143	0.1889822
Moon	0.4285714	0.5039526
Clouds	0.4285714	0.5039526
Rain	0.4642857	0.5078745
Wind	0.3571429	0.48795
Shadow	0.5714286	0.5039526
Originally private	0.5	0.5091751
Public	0.5	0.5091751
Located in suburban	0.6785714	0.4755949
Located in urban	0.3214286	0.4755949
Design concept	1	0
Poem and painting concept	0.8214286	0.390021
Naturainess	0.9285714	0.2622653
Varied spaces with visual devices	0.9642857	0.1889822
Borrowed scenery	0.6428571	0.48795

Table 11 (cont'd)

Enframed scenery	0.7142857	0.4600437
Opposite scenery	0.9285714	0.2622653
Contrast	1	0
Deep implication	1	0
Abstract geometrical composition	0.8928571	0.3149704
Miniature of natural landscapes	0.75	0.4409586
Boating pond	0.25	0.4409586
Stepping stones	0.5714286	0.5039526
Yellow painted wall	0.3214286	0.4755949
Unpainted structures or elements	0.8214286	0.390021
Fall colour of plant material	0.8214286	0.390021
Bronze components	0.7142857	0.4600437
Courtyard/atrium	0.6785714	0.4755949
Wooden /bamboo fence/railings	0.8571429	0.3563483
Bench	0.4285714	0.5039526
Pagoda	0.5	0.5091751
Adjacent to burial site	0.5357143	0.5078745
Stairs	0.8214286	0.390021
Geomancy rules/Fengshui	0.8571429	0.3563483
Stone lanterns	0.6428571	0.48795
Wooden lanterns	0.5	0.5091751
Trellis/pergola	0.3214286	0.4755949
Obviouly exposed drainage ditch/gutter	0.6428571	0.48795
Signage stone	0.7142857	0.4600437
Elevation change	0.75	0.4409586
Plaque	0.8214286	0.390021
Lifted base of building	0.8214286	0.390021
Building partially painted in red	0.3571429	0.48795
Strings implied enchantment boundary	0.2142857	0.4178554
Raked sand design	0.5	0.5091751
Stone hand wash basin	0.6428571	0.48795
Well	0.6785714	0.4755949
Bell	0.5357143	0.5078745
Shishiodoshi	0.1428571	0.3563483
Grouping stones	0.75	0.4409586
Ophiopogon japonicus	0.4285714	0.5039526
Hydrangea	0.6428571	0.48795

Table 11 (cont'd)

Japanese Maple	0.8214286	0.390021
Moss	0.6785714	0.4755949
Azalea	0.8928571	0.3149704
Trimmed plant material	0.9285714	0.2622653
Weeping form plant material	0.5	0.5091751
Multiple layers of entry sequence	0.8214286	0.390021
Multiple layers of edges	0.8214286	0.390021
Control view point	0.8928571	0.3149704
Foreground, Midground, and Background	0.8214286	0.390021
Large scale	0.4285714	0.5039526
Small scale	0.5714286	0.5039526
Located on the foot of mountain	0.6071429	0.4973475
Location adjacent to Shinto Shrine	0.3928571	0.4973475
Curved roof	0.7857143	0.4178554
Chinese characters	0.8214286	0.390021
Wabi-sabi	0.7142857	0.4600437
Religious property	0.6071429	0.4973475
Teaism	0.5714286	0.5039526
Sense of sacred place	0.7142857	0.4600437
Animistic believes	0.8214286	0.390021
Buddhism	0.5714286	0.5039526
Shinto	0.2142857	0.4178554
Confucianism	0.1428571	0.3563483
Imperial background	0.5	0.5091751
Simplicity	1	0
Tranquility	0.8214286	0.390021
Harmony	0.8214286	0.390021

Table 12: Principal Component Analysis eigenvalue coefficient for each element.

Design elements	**Prin1**	**Prin2**	**Prin3**
The great halls (ting tang)	0.142439	0.022264	-0.059519
Covered stone boat (fang)	0.004797	0.121946	-0.004397
Viewing towers (lou ge)	0.072885	0.079743	0.1268
Studies (shufang)	0.120369	0.042903	0.024261
Covered walkways (lang)	0.122432	0.02704	-0.015599
Pavillions (ting xie)	0.07903	0.081152	0.137193
Viewing terrace	0.080178	-0.139857	-0.049893
Black tile pavement	-0.020217	0.14875	-0.018673
Brick paving	0.022878	0.158436	0.003765
Cracked ice stone paving	0.024132	0.115878	0.102031
Pebbles area	0.054888	-0.158749	-0.029772
Mosaic pave with special pattern	-0.046266	0.162318	-0.041682
Whitewashed walls	0.073679	0.032383	-0.105161
Grey stone walls	-0.017728	0.008977	0.033632
Openwork brick walls	-0.094622	0.136084	0.019552
Curved top walls	0.012296	0.131421	-0.044293
Zigzag wall	-0.02471	0.180265	-0.013478
Meandering walls	0.005329	0.17203	-0.01063
Bamboo paved pathway	-0.069529	-0.012288	0.128719
Boardwalk	-0.069529	-0.012288	0.128719
Curved Pathway	0.0468	0.038194	0.143573
Straight Pathway	0.096219	0.022107	-0.127968
Zigzag Bridge	-0.02471	0.180265	-0.013478
Semi-circular bridge	0.055724	0.063291	0.051999
Straight Bridge	0.039375	0.067477	-0.008761
Wall holes with symbolized shape	-0.004414	0.136893	-0.001131
Lattice window	0.135751	0.024253	0.006325
Moon Gate	0.005507	0.207051	-0.017004
Wood carvings	0.126401	0.025063	-0.078341
Glass carvings	-0.075417	-0.007273	-0.041565
Brick carvings	0.016895	0.182905	0.014063
Reflecting Pond	0.013901	0.066231	0.188779
Stream	0.098719	0.01339	0.130345
Fish pond	0.07172	0.069384	0.225766
Wetland	-0.070313	-0.007787	0.054974

Table 12 (cont'd)

Island	0.058934	0.042998	0.13328
Artificial mountains	0.014836	0.135294	-0.115057
Sculptural rocks	0.064002	0.018391	-0.048872
Pond bank rocks	0.090735	0.080489	0.158419
Taihu rocks /scholars' stone	0.005507	0.207051	-0.017004
Trees	0.096219	0.022107	-0.127968
Shrubs	0.113582	0.021512	-0.10831
Ground covers	0.090721	0.024035	-0.04794
Turf area	-0.030065	0.034256	-0.101129
Pine	0.128463	0.021757	-0.075086
Bamboo	0.046856	0.054226	0.117404
Plum	0.129431	0.031519	0.053248
Magnolias	0.094687	0.062098	0.165862
Camellia	0.114408	0.036555	0.074213
Crepe myrtles	0.110132	0.034527	0.07259
Sweet osmanthus	0.071361	0.057191	0.122644
Peony	0.035306	0.118415	0.017146
Willow	0.005507	0.207051	-0.017004
Lotus	0.014047	0.093387	0.003208
Reed	0.010882	-0.044942	0.166331
Sugar cane	-0.064002	-0.018391	0.048872
Moon	0.051613	0.031715	-0.018894
Clouds	0.059048	0.026184	0.045606
Rain	0.067839	0.024041	0.019713
Wind	0.035739	0.099658	-0.094354
Shadow	0.045701	-0.018963	0.223223
Originally private	0.067637	0.090477	0.064639
Public	-0.067637	-0.090477	-0.064639
Located in suburban	-0.023397	-0.108424	0.123487
Located in urban	0.023397	0.108424	-0.123487
Design concept	0	0	0
Poem and painting concept	0.081839	0.038865	-0.095802
Naturainess	0.077467	0.007276	0.011402
Varied spaces with visual devices	0.069529	0.012288	-0.128719
Borrowed scenery	0.068217	0.061028	0.185828
Enframed scenery	0.008518	0.053936	0.158042
Opposite scenery	0.096219	0.022107	-0.127968

Table 12 (cont'd)

Contrast	0	0	0
Deep implication	0	0	0
Abstract geometrical composition	-0.005507	-0.207051	0.017004
Miniature of natural landscapes	0.117241	0.038702	-0.060014
Boating pond	0.042703	0.082347	0.07314
Stepping stones	0.089955	-0.081377	-0.026669
Yellow painted wall	0.070714	-0.051655	0.118752
Unpainted structures or elements	0.142439	0.022264	-0.059519
Fall colour of plant material	0.142439	0.022264	-0.059519
Bronze components	0.116988	-0.122883	-0.038817
Courtyard/atrium	0.105508	0.033368	0.004457
Wooden /bamboo fence/railings	0.068491	-0.102067	-0.081484
Bench	-0.016525	-0.05334	-0.046574
Pagoda	0.096247	-0.06422	0.116851
Adjacent to burial site	0.099083	-0.089558	0.092314
Stairs	0.054309	-0.158869	-0.039553
Geomancy rules/Fengshui	0.121957	0.014614	-0.039224
Stone lanterns	0.113412	-0.105168	0.059096
Wooden lanterns	0.071707	-0.087062	-0.065834
Trellis/pergola	0.051405	0.117719	0.103643
Obviouly exposed drainage ditch/gutter	0.113412	-0.105168	0.059096
Signage stone	0.116988	-0.122883	-0.038817
Elevation change	0.120369	0.042903	0.024261
Plaque	0.142439	0.022264	-0.059519
Lifted base of building	0.142439	0.022264	-0.059519
Building partially painted in red	0.045465	0.098102	0.042125
Strings implied enchantment boundary	0.033696	-0.047662	-0.033237
Raked sand design	0.074782	-0.082628	-0.041436
Stone hand wash basin	0.109553	-0.114619	0.031893
Well	0.111712	0.04575	0.093453
Bell	0.099083	-0.089558	0.092314
Shishiodoshi	0.029225	-0.044446	-0.039978
Grouping stones	0.117241	0.038702	-0.060014
Ophiopogon japonicus	0.042582	0.07979	-0.144126
Hydrangea	0.107871	-0.109877	0.021606

Table 12 (cont'd)

Japanese Maple	0.142439	0.022264	-0.059519
Moss	0.11079	-0.109752	-0.028608
Azalea	0.113582	0.021512	-0.10831
Trimmed plant material	0.096219	0.022107	-0.127968
Weeping form plant material	0.084206	0.08168	0.155932
Multiple layers of entry sequence	0.142439	0.022264	-0.059519
Multiple layers of edges	0.142439	0.022264	-0.059519
Control view point	0.111159	0.021362	-0.095306
Foreground, Midground, and Background	0.142439	0.022264	-0.059519
Large scale	0.083412	-0.070652	0.103984
Small scale	-0.083412	0.070652	-0.103984
Located on the foot of mountain	0.101038	-0.100009	0.040659
Location adjacent to Shinto Shrine	0.074985	-0.056402	0.152347
Curved roof	0.126401	0.025063	-0.078341
Chinese characters	0.142439	0.022264	-0.059519
Wabi-sabi	0.116988	-0.122883	-0.038817
Religious property	0.108185	-0.104884	0.073187
Teaism	0.090069	0.064272	0.057262
Sense of sacred place	0.120729	0.028369	0.067479
Animistic believes	0.142439	0.022264	-0.059519
Buddhism	0.100406	0.012355	0.099945
Shinto	0.043045	-0.048386	0.05501
Confucianism	0.012548	0.177988	0.01169
Imperial background	0.090243	-0.080191	0.125053
Simplicity	0	0	0
Tranquility	0.142439	0.022264	-0.059519
Harmony	0.142439	0.022264	-0.059519

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