Cross-Cultural Ordination Of Burial Sites

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Abstract: - Burial grounds, as one of the most important landscape settings that connect the living and the dead, can often represent culture, tradition, and aesthetic representation of a local community; therefore, understanding the similarities and differences among the burial sites can help people understand the culture and tradition of places behind the burial sites. This research examines the similarities and differences among different Western and Chinese burial sites, including Pere Lachaise in Paris, three municipal cemeteries in Michigan, USA, three public cemeteries in Shanghai, China, two Chinese imperial tombs in Nanjing, China, and two rural ancestral burial grounds in Jiangsu, China. Cluster Analysis with Principal Component Analysis is applied to this research. Eighty-seven significant variables are used for the calculation of Cluster Analysis. Six meaningful latent principal components were discovered further analysis. The first two principal components are used as primary dimensions for burial site comparisons. The result shows that principal component 1 can be used to compare sites along a softscape/hardscape dimension and principal component 2 expresses the level of fengshui elements in the site. And the research further suggests the three public cemeteries in Shanghai are culturally integrated fusion cemeteries that inherit traditional Chinese philosophies and adopt Western influences.

Key-Words: - landscape architecture, environmental design, fengshui, Taoism, picturesque

1 Introduction and Literature Review

Burial sites are common type of landscape setting that can be observed and experienced in many cultures, even though people may practice burial and funerary culture differently, and the idea of burial sites may be expressed uniquely. Therefore, burial sites can represent local culture and the tradition of places. There are many publications on Western burial sites focusing on landscape, environment, and architecture aspects. There are also many publications about Chinese burial ritual and traditional Chinese imperial burial sites. However, there are few publications about Chinese modern burial sites and Chinese rural burial grounds focusing on landscape and environment. In

addition, there is very little literature that compares the burial sites across cultures employing numerical methods.

Thus, in this research burial sites from both Western and Chinese culture located in rural, sub-urban, and urban settings are selected to represent Western and Chinese design philosophies, highlight the contrast between traditional and modern designs, and discover the similarities among them. Furthermore, this research emplys quantitative research that uses mathematic methods to understand the differences and similarities

One of the most famous cemeteries in the world is Pere Lachaise Cemetery in Paris, France. Pere Lachaise, formerly Cimetiere de l'Est, was designed by architect Alexandre Theordore Brongniart [1]. He designed the site based on romantic, natural gardens of eighteenth-century design principles of picturesque that can make the most out the location to get the best views overlooking Paris [1]. Brongniart planned major straight allees with a large number of curved pathways [1]. By doing so, he is able to divide the whole site into sections, which becomes much more manageable to situate each grave or tomb on the grids [1].

According to Thomas Laqueur, Père-Lachaise "very quickly became the symbol of – almost a name for – a kind of burial place that triumphed whatever the new bourgeois civilization of the nineteenth century triumphed or hoped to triumph" [2]. Pere Lachaise became a popular place for visitors, because it was fascinating to see the huge contrast between Pere Lachaise and old-style western burial custom that existed prior to Pere Lachaise in Paris and other European Countries [1]. Every other place wants a burial space like Pere-Lachaise, but the cemeteries are not meant to be the exact copy of Pere-Lachaise instead they are all supposed to have their own unique identities based on the different local context of each place [2] (Figures 1 and 2).

Figure 1. The gravesite of Chopin with sculptures, carving portrait of Chopin, fences, and fresh cut flowers from visitors in Pere Lachaise Cemetery, Paris, France. (Copyright ©2005 Jon Bryan Burley all right reserved used by permission).

Figure 2. Gravesite of James Douglas Morrison with fresh cut flowers from the visitors in Pere Lachaise Cemetery, Paris, France. (Copyright ©2005 Jon Bryan Burley all right reserved used by permission).

Pere La Chaise is the "predecessor" of Parisian style American cemeteries such as Mount Auburn in Boston established in 1831 and Greenwood Cemetery in Philadelphia established in 1838 [1]. Even though the number of monuments have increased dramatically in Pere Lachaise, making the cemetery over crowded with monuments, and not much effort has been put on maintaining the picturesque quality of the cemetery [1]. Pere Lachaise is in fact always the start of modern rural cemeteries that gives many other English and American cemeteries inspirations on how to design and develop picturesque, nature-oriented environments [1].

1.1 American Cemeteries

There were two environmental thoughts in the nineteenth century on whether the existence of open green spaces is the needed for utilitarian function or simply nostalgia from rural pastoral life before industrial revolution [3]. The term "cemetery" was not really a common phrase by 1830s [3]. Before cemeteries were well established, people used churchyards as their burial spaces [3]. Eventually, people had a choice to be buried in a well maintained public landscape, which is supposed to be both good for the dead and the living [3]. In the nineteenth century, "rural cemetery" referred to the type of burial space "located on the outskirts of a city", that are designed and developed based on picturesque design principles evolved from English gardens, and inspired by the famous Pere-Lachaise in Paris [4]. Cemeteries were once viewed as the most

characterized "cultural repository"; compared to the old graveyards, cemeteries provided more pleasant welcoming open green spaces, magnificent monuments, and inspirations, which make cemeteries not only places for burial spaces but also active green parks [1]. In the burial tradition context, people spend far more money in contemporary funerary and burial ritual and practices than necessary "for the sake of pride, prestige, and vainglory" and it has become some kind of "cemetery art" that become very popular in both Europe and United States [5]. In those "empty or nearly empty" cemeteries, many middle-class Americans spend their leisure time and "resorting for pleasure"; this is due to the establishment of the new relationship between "cityscape and landscape" in the accelerating urbanizing America [4].

Mount Auburn, the first rural cemetery in the United States [2], established in 1831 expresses the rural romantic style by using curved pathways and graveyard layouts instead of the straight avenues in Pere Lachaise [2]. As the first garden style urban cemetery; the cemetery really pushed urban public green space movement and pushed the new way of expressing care to the dead by planting garden materials around the graves [3]. Mount Auburn is designed and developed based on the principle and guidelines of picturesque from European gardens instead of sublime from American wildness [3]. Mount Auburn Cemetery propose the idea that rural cemeteries are much "more comforting" to the bereaved compare to the stuffy environment in city churchyards [4]. Mount Auburn became a major tourist attraction during the late 1830s, people came to the cemetery not only to relax or grieve, but also to re-experience their possible new routines on the site such as joy and active behavior [3].

After Mount Auburn became so successful, people started to build similar cemeteries across the whole country; then the rural park style cemeteries really started the revolution of city public parks, which leads to public concerns such as public health, aesthetics, and equal access to green spaces [3]. Laurel Hill Cemetery was established in 1836 in Philadelphia; Greenwood Cemetery was established in 1838 by New York City in Brooklyn; and several similar rural park style cemeteries were established by 1842 in New England [3].

Even though the early American rural park style cemeteries evoke visions of Pere-Lachaise, they in fact have two different relationships between human establishment and nature [4]. Pere-Lachaise was built as a garden and given the function of cemetery; the American rural cemeteries are

intended to preserve the natural beauty of the landscape and incorporate the function of cemetery [4]. Pere Lachaise is now over crowded with monuments along all the narrow pathways, in such case, the original picturesque beauty has been "over-run;" the same is true with other Parisian style cemeteries in United States, such as St. Louis cemeteries in New Orleans [1]. Many other cemeteries are still being maintained to reach the picturesque beauty, because people continue to "romanticize nature" mimicking the "European romantic convention" under the rapidly urbanizing living environment [4].

1.2 Chinese Burial Sites

There is the "archetype" format of all Ming Dynasty and Qing Dynasty Imperial Tombs or Mausoleums, which is a sequence of archway, entrance gates, stone tablet, a bridge, long sacred walkway with mythical creature statues, pillars, a courtyard, main hall, and the actual mound burial site [6]. It was very common for the royalty and the wealthy people to have a long sacred walkway with stone mythical creature statues for their burial grounds before the arrival of the gate to the actual burial spot. There are many old sacred walkways preserved from different dynasties; for example, there is a shared sacred walkway leading to Ming and Qing imperial tombs outside Beijing [7].

The gravesite of Yellow Emperor located on Mount Qiao was first built during the Han dynasty during 206 B.C. to 220 A.D., then the mausoleum was built during the Tang dynasty during 766 to 779 A.D. also has the similar elements in design. There is an entrance archway, a sacred walkway leads to the actual mausoleum with a few stone steps along with stone mythical creature statues such as the lion like "kirin" (supposed to be one of the sons of the Chinese Dragon), and a stone tablet [8].

The Ming Xiaoling Tomb in the tomb complex was built in the Ming dynasty during 1381 to 1431 AD at the base of Purple & Golden Mountain in Nanjing; it is the tomb of "the first Ming Emperor Zhu Yuanzhang and his Empress Ma." [7]. The design of the tomb is very "experiential" [7]; there is a series of gateways, buildings, sculptures and walkways to go through before the arrival of the actual burial site (Figure 3). It first starts with the "Dismounting Archway", then "Great Golden Gate", then "Square City", then "Sacred Way", then "Stone Beasts" sculptures, then "Stone Human Figures" statues, then "Stone Watching Pillar", then "Tablet Hall", then "Treasure City", and

finally the actual burial site [7]. All these elements are located along the continuous long pathway with formal symmetrical design landscape plant materials on the side. On the top of the "Dismounting Archway", there are carved ancient Chinese character informing all officials and visitors must dismount at this point to show great respect to the Emperor and the Empress [7]. The "Square City" is an a few stairs raised courtyard area with a tablet listing the achievements and the "virtues" of the Emperor [7]. The "Sacred Way" is a pathway continues about one mile with stone mythical creature statues that can represent the Emperor [7]. During the Ming dynasty, the tomb was guarded by 5,600 soldiers all the time [7].

Figure 3. The Dismounting Archway with abstract cloud carving decorations and the uphill stone paved pathway with multiple groups of stairs in Ming Xiaoling Tomb, Nanjing, China. (Copyright ©2008 Jon Bryan Burley all right reserved used by permission).

Yuan Shikai's (the first president of the Republic of China) grave adopts the similar design layout pattern of Qing Imperial Mausoleums, which includes a sequence of "stone bridge, ornamental columns, and an epitaph pavilion along the spiritual road, flanked by sculptures of immortal animals and figures, which led to the sacrifice hall and the tomb behind" [6].

Sun Yat-Sen's (the Father of Modern China) Mausoleum located at the Purple Mountain in Nanjing, where the first Ming Emperor (Yuanzhang Zhu) was also buried, was built in the spring of 1929. The two Mausoleums are only one miles apart, and Sun's Mausoleum is 90 yards higher then Ming Mausoleum (Xiaoling Tomb) [6]. Sun's Mausoleum (Figure 4) used both western modern architecture style and traditional Chinese architecture style, which incorporated both Chinese history and the contemporary modern world [6]. Even though Sun's Mausoleum is a modern burial site, it also followed the principle and guidelines of

Fengshui, therefore the Mausoleum is built facing south on a hillside [6]. Sun's Mausoleum also partially adopts the form of Ming Xiaoling Tomb, which is the sequence of "the archway, the tripartite gate, the pillars, the hall, and even the long stairway that is analogous to the spirit road of an imperial tomb" [6]. However, for Sun's Mausoleum, the architect Lu Yanzhi did not use the mythical animal statues and traditional Chinese dragon ornaments because it was considered to be the old Chinese superstition tradition, which does meet with Sun's modern China wish [6].

Figure 4. Dr. Sun Yat-sen's Tomb in rectilinear design with massive stair cases and naturalized landscape. (Copyright ©2017 Zeran Zhu all right reserved used by permission).

In the Chinese tradition, it is very important to maintain the ancestral grave sites, which is a burial site with many mount shape graves in family order on hillsides [9]. Even the traditional rural Chinese graves in the mountain villages try to follow the principle of Fengshui if possible. According to Li, a graveyard with good Fengshui should be located by a mountain, near rivers and with an open view, because good Fengshui will bring good luck to the dead in his or her after life and next life [10]. In addition, the location or Fengshui of a graveyard determines the fate of the deceased's offspring [10[.

The people live in the rural villages feel comfortable to leave the ancestral grave sites on the hillsides with no vegetation such as tall grasses to hide them, because they maintained the graves neat and clean to show pride, dignity, and respect [9].

The size of the ancestral grave sites can vary depends on the size of the family group.

As land becomes scarcer in many Asian cities; cremation has been largely encouraged, and other more sustainable "eco-friendly" form of burials have been evolved, such as "sea and woodland burials" after cremation [11]. Even though cremation is especially encouraged, many people still want grave burial for the urn if they are wealthy enough to afford the cost of the piece of private landscape "as status symbol" [11]. At the same time, the practice of Fengshui and other traditional funerary and burial rituals and festivals such as the grave sweeping ceremonies of Qingming Festival (around April 4th), Chongyang Festival (around October 16th), and the Winter Solstice Festival (around December 22nd) are still continuing [11].

Shanghai as one of the most unique cities in China was once controlled and colonized by Westerners during late nineteenth century to early twentieth century, therefore the city has adopted complex western integrated culture from Britain, France, United States, and Germany [12]. The settlement started with British and French, and later the Americans also becomes part of the settlement, and eventually, it evolved into a diverse Shanghai International Settlement operated by Shanghai Municipal Council [12]. Shanghai then became the fifth largest city in the world and "the center of a cosmopolitan cultural space" in 1930's [12]. The British had the largest influence among all the foreign settlements from both the western world and the eastern world. As the city grows, the boundaries between Chinese and the westerns disappeared quickly, the "neighborhoods were mixed", and the "segregation" between all different country residents was weak [12]. A form of cultural, life, and architectural style must be developed to meet the expectation of people with different nationality, different utilitarian purposes, and different aesthetic taste [12]. The unique fusion style quickly evolved in Shanghai to represent its many contrast and harmony between foreign and Chinese, modern and traditional [12].

1.3 Intent

The literature presents different types of burial sites in both Western World and China, plus the brief history of the burial sites, names the famous examples of different burial sites, elaborates the Western and Chinese design principles and philosophies, and describes the uniqueness of Shanghai in its history and culture. However, most of the studies of burial sites are case studies of individual burial site or comparative studies within the similar culture, very little cross cultural quantitative comparative studies are done in this field of study. Besides, most of the studies in the field focus on the funerary and burial ritual instead of the environmental aspects.

Thus, this investigation will compares the environment, landscape, and architectural aspects of the burial sites cross culturally and find the similarities and differences among them by using a mathematic method called Cluster Analysis. The study sites include four Western cemeteries in Paris and Michigan, three modern public Chinese cemeteries in Shanghai, two traditional Chinese Imperial burial sites in Nanjing, and two rural Chinese ancestral burial grounds in Yancheng and Jingjiang. By comparing these eleven burial sites using Cluster Analysis, the research will be able to ordinate the measurable variables of these four types of burial sites. Therefore, the study intent of this research is to compare the Western and Chinese burial sites in order to provide understanding of modern Chinese public cemetery designs, especially reveal its relationship with Chinese burial culture and western influence. A central hypothesis of this research is that the modern Chinese public cemeteries in Shanghai are fusion cemeteries that integrates the traditional Chinese design principles, traditional Chinese burial culture, and Western influences, due to the unique local context of Shanghai.

2 Study Area and Methods

2.1 Study Areas

In this investigation, there are total of eleven sites selected for comparison study; they are Pere Lachaise in Paris, France, three cemeteries (Mt. Hope Cemetery, Evergreen Cemetery, and North Cemetery) in Michigan (Figures 5 and 6), USA, three modern Chinese public cemeteries (Binhai Guyuan Cemetery, Haiwanyuan Cemetery, and Yongfu Yuanling Cemetery) in Shanghai (Figure 7), China, two Chinese Imperial burial sites (Ming Xiaoling Tomb, and Sun's Tomb) in Nanjing, China, and two group of rural Chinese burial grounds (Ji's Ancestral graves, and Xu's Ancestral Graves) in Jiangsu Province, China (Figure 8). The comparative analysis uses both secondary information and primary information. The study uses secondary information from literature review for three of the eleven sites, and uses primary field study information for the rest of the eight sites. The

information for Pere Lachaise and the two Chinese Imperial burial sites is secondary information learned from published documents. The information of these three sites have been presented in the literature review section. The information of three cemeteries in Michigan, three cemeteries in Shanghai, and the two rural ancestral burial grounds in Jiangsu is primary information collected from field study. In the methodology section below presents the primary information of the eight sites collected from field study.

Figure 5. Lawn graveyard in Mt. Hope Cemetery with information signage and private vehicle accessible driveway, Lansing, MI, USA. (Copyright ©2017 Haoxuan Xu all right reserved used by permission).

Figure 6. Gravestone with portrait, USA flag carving, and memorable in the Little Arlington Veteran Section in Evergreen Cemetery, Lansing, MI, USA. (Copyright ©2017 Haoxuan Xu all right reserved used by permission).

Figure 7. Stone statues of famous ancient scholars along stone paved straight pathway with golden statue of Guanyin in distance in Yongfu Yuanling Cemetery, Shanghai, China. (Copyright ©2017 Aijing Shi all right reserved used by permission).

Figure 8. Xu's rural ancestral burial ground consisting group of bare dirt mound graves with arborvitae trees in agricultural field facing river. (Copyright ©2017 Aijing Shi all right reserved used by permission).

2.2 Analysis Methods

In order to do a cluster analysis for the research to study the sites using mathematical statistical results, the research must generate a data table of elements to be used for statistical analysis. For this research, the elements of all eleven selected cemeteries were chosen based on literature review, site photos, and field study. When reviewing the published documents of Pere Lachaise and the two Chinese imperial burial sites in Nanjing, all the design elements are recorded as candidates of study variables. The same process was done for all the field studies of the other eight sites. Then all the over two hundred candidates are listed in the spread sheet, and categorized into several groups based on their different attributes. The attributes include paving, built structure, plant material, burial element, utility and function, location, design principle and architectural style. Later, in order to eliminate the length of the list to less than one hundred variables, the rare ones and the ones with less noticeable features are excluded from the candidate list.

After the elimination process, 91 elements (variables) are initially used in the study, later four

of the elements were found insignificant for this particular study, therefore was ignored and discarded in the calculation. All these 91 elements have different attributes of different types of pavement, built structures, plants, burial elements, utility and functions, location, design principles, and architectural styles. The following is the list of all 91 variables, and the four with star symbols (Deciduous Tree, Individual Grave, Square Gravestone, and Memorable Element) are the ones discarded (Table 1).

Table 1: The list of all 91 variables include the four insignificant variables labeled with star symbols.

1.Brick Pavement	2. Asphalt
3.Stone Pavement	4. Special Pattern
5. Compact Soil	6. Pavilion
7. Gazebo	8.Main Service Building
9. Ornamental Wall	10. Metal Sculpture
11. Rock Sculpture	12. Large Rocks
13. Artificial Miniature Mountain	14. Waterfalls
15. Pond	16. Straight Bridge
17. Archway	18. Entrance Gateway
19. Mythical Animal Statue/Decoration	20. Zig Zag Bridge
21. Monk/ Buddha/Guanyin Statue	22. Christian Cross
23. Arched Bridge	24. Stone Tablet
25. Plaque on Building	26. Sacrifice Hall
27. Public Memorial	28. Pagoda
29. Bonsai	30. Street Tree
31. Ornamental Tree	32. Evergreen Tree
33. Deciduous Tree***	34. Flowering Tree
35. Lawn	36. Bamboo
37. Magnolia	38. Lotus
39. Boxwood Trimmed Animal Sculpture	40. Rose
41. Christian Style Graveyard	42. Bare Dirt Mound
43. Artistic Gravestone	44. Portrait on Gravestone
45. Individual Grave***	46. Family Grave
47. Couple Grave	48. Square Gravestone***
49. Irregular Gravestone	50. Ornamental Carving/Decoration on Gravestone

51. Grave Sizes Vary with Price	52. Grave with Platform
53. Stairs to Grave	54. Pavilion Covered Grave
55. Censer for Thurification	56. Oblation (Food, Drink, Fake Paper Money)
57. Memorable Elements***	58. Headstone
59. Fresh Cut Flower	60. Obelisk
61. Wall Niche	62. Small Mausoleum
63. Private Vehicle Access	64. Electric Trolley Only Driveway
65. Curb and Gutter	66. Curved Pathway
67. Straight Sacred Pathway	68. Flower Shop
69. Metal Bucket for Burning	70. Maintenance Service
71. Public Transportation Access	72. Wayfinding System
73. Street Light	74. Flag
75. Graveyard Sections with Different Theme	76. Sub-urban Location
77. Rural Location	78. Naturalness
79. High Visual Enclosure	80. Low Visual Enclosure
81. High Physical Enclosure	82. Low Physical Enclosure
83. Symmetrical Design	84. Asymmetrical Design
85. Fengshui	86. Strict Grid System for Graves
87. Picturesque	88. Flying Eaves
89. Red Architecture	90. White Marble Handrail
91. Stone Carving	

Efficiency is the key to statistical analysis; many analysis techniques are invented to analyze different data with different attributes. Cluster analysis is a simple statistical method usually used to put objects into clusters based on their similarities and differences (Xu, 2015).

For this research, principal component analysis (PCA) must be done prior to cluster analysis. The quintessence of PCA is dimension reduction. Large or high dimension means there are a lot of variables, elements or features, and it can be very inefficient to study with. Ideally, if the high dimensional data can be represented by fewer dimensional data that has better generalization; then the process of statistical analysis will be a lot more efficient. PCA is an analysis technique that can the goal of transforming high dimensional data

into lower dimensional representations of the data. The "smaller set of uncorrelated variables" will show maximum variances. [13]

A statistical analysis software called JMP (Version 13; SAS, 2016) was used for building PCA. By running the data spreadsheet of all the original elements (variables) in JMP (Version 13; SAS, 2016), the report will then show the result table of the PCA of the research consisting the list of principal component (PC) with eigenvalue, corresponding percentage (proportion), cumulative percentage, and differences. The PC with the highest eigenvalue is called first principal component, which shows as PRIN1 in the result table; the PC with the second highest eigenvalue is called second principal component, which shows as PRIN2 in the result table; the rest is sorted by the same manner. Even though the PCA result table will first show the summary plots of all the PCs, however, only the PCs with the eigenvalue greater than 1.0 is considered significant and qualify for further analysis uses. The cumulative percentage shows the percentage of variance that the useful PCs can account for [13].

The JMP (Version 13; SAS, 2016) PCA also presents the table of covariance matrix, which compares the similarity of every two variables. The variables with the closer coefficients are more similar. At the same time, the result also has a table of matrix that shows the relationship between variables and PCs, which are the eigenvector coefficients under each PC that "indicate the correlation" among of the variables in each PC. Again, the similar coefficient means the variables are similar, or vice versa.

Cluster analysis also require means and standard deviations of each variable, in order to calculate standard score of a variable (Equation 1). However, the JMP (Version 13; SAS, 2016) PCA analysis does not show the means and standard deviations, therefore, means and deviations are calculated in Excel spreadsheet. Then there are two equations used for the calculations in cluster analysis. The equations are used by Yiwen Xu for identifying Classical Chinese Gardens verses Modern Chinese Gardens, and are now adopted to explore the Western and Chinese burial sites for this research [13].

After calculating with Equation 2, each cemetery will have a score under each PC. The final step of cluster analysis is to plot the scatter graph to show the clustering of the cemeteries. Because PRIN1 and PRIN2 have the highest eigenvalue, so the cemetery scores of principal component one and principal component two are used for plotting graph [13]. Scores of principal component one are on horizontal axis, and scores of principal component two are on vertical axis. The two dimensions used for plotting scatter graph can be named after the feature associate variables with the highest absolute value of eigenvector from the PCA results table. The cemeteries can form into several clusters on the scatter graph, and the cemeteries in a cluster means they are more similar compare to the ones in another cluster, or the ones do not belong to any cluster.

$$\text{Standard Score} = \frac{x - x^{mean}}{SD} \qquad \text{(Eq. 1)}$$

Where:

x = Value of Each Variable
x^{mean} = Mean of the Variable
SD = Standard Deviation of the Variable

$$\text{CemeteryScore} = \left[\frac{(x_1 - x_1^{mean})}{SD1} * k_1 \right] + \qquad \text{(Eq. 2)}$$

$$\left[\frac{(x_2 - x_2^{mean})}{SD_2} * K_2 \right] + \left[\frac{(x_n - x_n^{mean})}{SD_n} * k_n \right]$$

Where:

X_n = Value of Each Variable
X_n^{mean} = Mean of the Variable
SD_n = Standard Deviation of the Variable
k_n = Principal Component Coefficient of Each Variable

3 Results

Table 2 presents the eigenvalues for the 87 significant elements from the JMP (Version 13; SAS, 2016) software, there are total of ten principal component eigenvalue calculated from the software; however, only the first six have the eigenvalues greater than 1. Therefore, only the first six principal components are typically eligible for further statistical analysis. The eigenvalues for the first six principal components are later used to calculate principal component coefficient for each variable. The first six principal component makes up 98 percent of the variance; where the first principal component contains 44.982 percent as the primary candidate, and the second principal component contains 28.559 percent as the secondary candidate for further analysis when plotting cluster analysis scatter graph.

Table 2. Eigenvalues.

Number	Eigenvalue	Percent	Cum Percent
PRIN1	39.1341	44.982	44.982
PRIN2	24.8467	28.559	73.541
PRIN3	12.1856	14.006	87.548
PRIN4	4.8637	5.59	93.138
PRIN5	3.0877	3.549	96.687
PRIN6	1.1432	1.314	98.001

The eigenvector coefficients used in Equation 2 to calculate the standard scores of all eleven burial sites are too lengthy to reproduce in this manuscript, but can be viewed in Xu [13]. The variables have the coefficients with the highest absolute values in Principal Component 1 and Principal Component 2 are later used for naming the dimensions used for plotting scatter graph as discussed earlier. And the variables have the coefficients greater than 0.7 and smaller than -0.4 are considered as distinguishable variables.
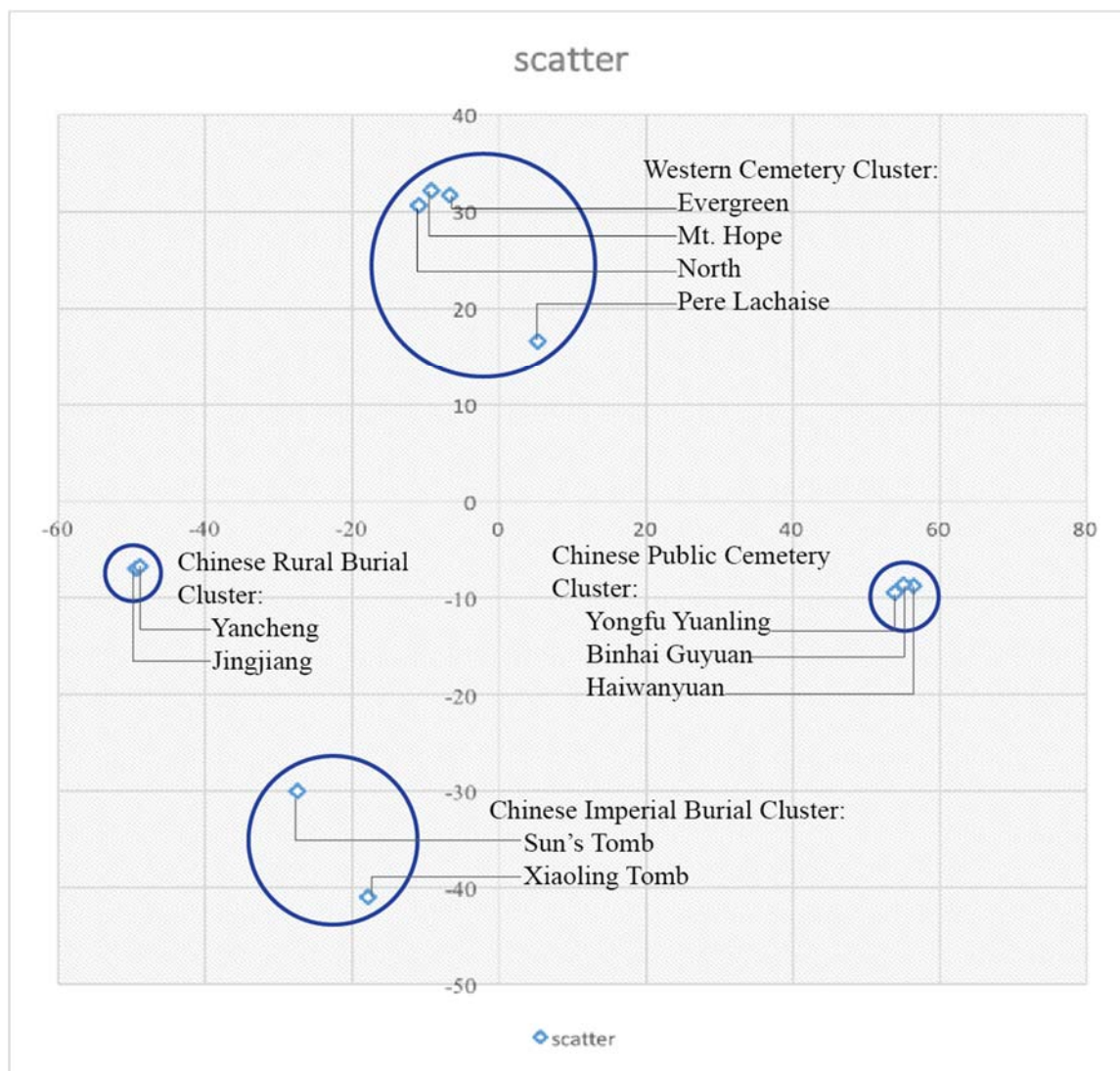

Figure 9. A scatter graph of the relationships among all eleven selected burial sites based on the scores from principal component 1 (Horizontal Axis: Pavilion, Miniature Mountain, and Bridge Dimension) and principal component 2 (Vertical Axis: Censer, Sacred Way, and Fengshui Dimension).

4 Discussion

After all the burial site scores are calculated, the final step of the statistical analysis is to plot scatter graph of the calculation results. Scatter graph is the final step of cluster analysis that plots results into visually identifiable clusters. Since the first two principal component can already account for 73 percent of the variance of the study, the study will use the scores in the first two principal components as representatives for further analysis (Figure 9). Therefore, the scores in principal component 1 and principle 2 are used to plot the scatter graph, where

the scores in principal component 1 are plotted on horizontal axis, and the scores in principal component 2 are plotted on vertical axis. As discussed earlier, the two dimensions can be named after the distinguishable variables, which are the variables with the high absolute value of coefficients in Principal Component 1 and Principal Component 2. Therefore, the Principal Component 1 dimension can be named as the "Pavilion, Miniature Mountain, and Bridge Dimension". Principal Component 2 dimension can be named as the "Censer, Sacred Way, and Fengshui Dimension". And according to the scatter graph show in Figure 9, the result already clearly reveals calculation results in clusters; thus, the study can use the scatter graph of scores in the first two principal components as representatives for further analysis and explanations.

The scatter graph in Figure 9 shows that the eleven burial sites can are distributed into four clusters. When looking at the "Pavilion, Miniature Mountain, and Bridge Dimension", the eleven burial sites can be divided into positive and negative ranges. There are four burial sites in the positive range, which are Pere Lachaise Cemetery, Binhai Guyuan Cemetery, Haiwanyuan Cemetery, and Yongfu Yuanling Cemetery. The rest of the burial sites are all in the negative range, which are Mt. Hope Cemetery, Evergreen Cemetery, North Cemetery, Yancheng Burial, Jingjiang Burial, Xiaoling Tomb, and Sun's Tomb. Thus, principal component 1 can be used to analyze the relationships among all these burial sites considering the differences and similarities within culture and cross culture. The "Censer, Sacred Way, and Fengshui Dimension" divides the eleven burial sites into two groups. All the Western burial sites are in the positive range of the vertical axis, where all the Chinese burial sites are in the negative range of the vertical axis. Therefore, principal component 2 can be used to identify the differences between the Western burial sites and the Chinese burial sites.

The most obvious differences between Western and Chinese burial sites is that the four Western cemeteries have similar scores, where the Chinese burial sites scored differently and dividing them into three groups. The Western cemeteries scored similarly, meaning they are similar in their environmental, landscape, and architectural style even though they are different in sizes and location. Within the Western Cemetery group, the three American cemeteries in Michigan are clustered relatively closer to each other, showing the three Michigan cemeteries are even more similar and on

the other hand, the Pere Lachaise Cemetery in Paris is relatively different. This phenomenon can be explained with previous literature review information. Pere Lachaise is the parent of American rural romantic style cemeteries, which means the American cemeteries adopted the design of Pere Lachaise with some American modifications to suit the American society better with distinguishing American history, culture, taste, preference, and functions. The major differences between Pere Lachaise and the three Michigan cemeteries is that the three Michigan cemeteries are much more simple and open with less design elements and features. For example, the Michigan cemeteries have much simpler pavement style, less architectural elements such as stone archway, and less complex plant material composition.

The Chinese burial sites are divided into three groups; where the three Chinese public cemeteries in Shanghai are clustered very close to each other, the two Chinese rural ancestral graveyards are clustered very close, and the two Chinese imperial tombs are clustered relatively close, but apparently not as close as the members of the other groups. This is an interesting phenomenon because the result shows even though these seven sites are all Chinese burial sites, they are developed and influenced by different historical social and cultural background, school of philosophies, and resource limitations. The three public cemeteries in Shanghai scored very high in principal component 1 because the three sites had all the positive coefficient and they do not associate with any negative coefficient elements in principal component 1. The two rural ancestral graveyards are the total opposite of the public cemeteries in Shanghai; the rural ancestral graveyards included all the negative coefficient elements but have very little association with the positive coefficient elements in principal component 1. The two Chinese imperial tombs are relatively different. They have the similar structure as imperial tombs, such as the stairs, the symmetrical design, the sacrifice hall, the stone animal statues, and the stone tablet; but they are also significantly influenced by different social context within the particular time frame. The Xiaoling Tomb is a classical example of traditional Chinese imperial tombs for emperors. On the other hand, Sun's Tomb is relatively a modern design for imperial tomb due to the characteristics of Sun. Sun is the founding father of the modern China; so, the design of Sun's Tomb follows the wishes of Sun, which is towards Western-influenced modern design. Therefore, the design of Sun's Tomb still follows

the classical structure of an imperial tomb, but it purposely avoided many symbolisms that are used in traditional royal Chinese imperial tomb designs as the representative of rejecting the old feudal society.

After discussing the broader differences and similarities among all these eleven burial sites, the focus of the discussion is to discuss the similarities and differences of the three public cemeteries in Shanghai as compare to the other eight burial sites in the study to provide a better understanding of the design and development of the modern Chinese public cemetery.

The modern Chinese public cemeteries are unique existence; because they are where the Chinese traditional landscape designs and Western influences fuse together. These three cemeteries are very similar, which share the same design layout, design elements, and concepts. Generally speaking, they are carefully designed with Chinese traditional landscape and garden design principles with various landscape and architecture elements can be seen in traditional Chinese gardens to enhance the beauty of the site and to create a place for not only mourning but also joy, such as miniature mountain and waterfall, decorative walls, gazebos, bonsai, pond, zig zag bridges, etc. The design of the three public cemeteries also strictly follows the principle of Fengshui, which is the primary design principle of the Chinese imperial tombs. The modern design mimic the elements used for Chinese imperial tombs to create good Fengshui and generate the sense of solemnity and respect. For example, they consist the sequence of a long sacred way with stone animal statues along the way, the grand entrance archway with the stone plaque on the top, the large stone tablet right after the archway and the bridges that connect to the actual burial site.

Besides, due to the distinctive historical background of Shanghai as discussed in the literature review, the culture and tradition in Shanghai have been incredibly integrated with Western culture. Therefore, the three public cemeteries also adopt many Western design layouts, principles, functions, and even religious practices regarding environmental, landscape, and architectural style. There are mainly two categories of design that are adopted from the Western and now has become the fusion culture in the three public cemeteries; they are the master plan layout and the evolved graveyard style.

First, the master plan layout of the cemeteries is based on the grid system, which is similar with the four Western cemeteries. The traditional layout for Chinese imperial tombs is linear symmetrical design. However, the three public do not apply such design form throughout the whole site; the only adopted part of the linear symmetrical design is the long sacred way with animal statues. The traditional Chinese landscape and garden design are based on irregular, asymmetrical designs with diverse elements installed in a complex form to create the sense of mystery and discovering within and through different places. However, the three public cemeteries do not apply such form throughout the site either; the irregular Chinese garden style design can be seen in a very small portion of the cemeteries for the purpose of garden aesthetic and recreation. The fact is that the three public cemeteries use grid form rectangular design incorporate with curvy pathways to distribute the large site into smaller manageable sections, which is the form the Western cemeteries use for cemetery master plan design. The grid form design makes the large site very manageable and also helps locate each grave as part of the way-finding system that has the purpose of encouraging individualism as discussed earlier in the literature review.

Second, there are plenty of Western-styles built, and design elements throughout the cemeteries and the Western thoughts, philosophies, and religions are percolating into the design and development of the graveyards. Western style design elements include metal sculptures, the use of entrance gate instead of grand archway like the ones in imperial tombs in several places, and the use of open lawn graveyards. Well established way-finding signage system similar to large park way-finding system throughout the site is also one design and functional element that has been adopted from the Western culture. The Western philosophy of being unique to express the idea of self and individualism has also influenced the development of the graveyards significantly, especially on the artistic customizable irregular gravestones. There cemeteries offer services to find the type of stone customers want to use, and offers carving and landscaping services; therefore, most of the gravestones are all different in texture, color, shape, and decorative carvings. The decorative carvings are where personality and characteristics took place. Some gravestones have carved portraits or profile of people; some have carved landscape paintings, and many others have carved plants or animals on the gravestones. Some of the graves even have different landscaping style with the particular types of plant materials they want in the trimming style they like. Also, there is Christian style graveyard sections for people worshiping

Christianity. There is the statue of Jesus in the middle of the sections, and the giant sculpture of Christian Crosses throughout the section.

Even though there are plenty of clear traces of Western influences in the three public cemeteries in Shanghai, they kept the Chinese traditions and cultures that derived from the three major schools of philosophy in China, which are Taoism, Buddhism, and Confucianism. There are the statues of the famous ancient Chinese scholars especially in the school of Taoism and Confucianism with their very famous quotes on understanding life and death in different sections of graveyards. There are also many uses of symbolism in the landscape design; for example, there are lotus flowers and koi fishes in the ponds, and sculptures, carvings, and statues of lotus flowers, Buddha, and Guanyin as symbols of Buddhism. The symbol of Yin-yang from Taoism is also used in many details, such as sculptures, arts, and paving patterns. Other than that, the tradition of ancestor worshiping is originated with Taoist traditions and beliefs, which almost all Chinese follows even when they are not aware of. Therefore, there are many ancestor worshiping elements in the cemeteries just as the ones be seen in the Chinese rural ancestor burial grounds, such as metal buckets for burning fake paper money, censor for thurification, and oblations (food, drink, little objects, etc.).

Therefore, the three public cemeteries in Shanghai are really the fusion cemeteries that integrates traditional Chinese civilian worshiping practices, traditional Chinese school of philosophies and design principles of imperial tombs and gardens, and the Western culture and traditions. In the twenty-first century, with the continued rapid growing of cities that brings more global sharing, the simple traditional only designs may not be suitable for people's modern life; thus, the fusion cemeteries can offer the variety of choices for people who have different interests and expectations.

The research compares the Western and Chinese burial sites cross-culturally and within culturally, and provides guides of designing burial sites according to the local context of the location in the future. The research result shows the different type of burial sites (cemeteries, imperial tomb, and ancestral graves) in the various area the built in the different period consist different lists of site elements, which makes the burial sites easily identifiable and can be distinguished from one another. Furthermore, the research explores and provides an understanding of the Chinese rural ancestral burial grounds regarding their environment and landscape style in detail instead of funerary and burial ritual, which is not previously discussed very much in other studies. Thus, help ordinary readers and researchers have a better understanding of the role of ancestral worshiping, environment, landscape, and Fengshui in rural China, which is still the majority type of land and lifestyle in China.

Also, the research studies and describes the three fusion cemeteries in great detail, which also provides design concepts and guidelines for culturally integrated cemeteries. The research elaborates the uniqueness of the modern fusion style Chinese public cemeteries in Shanghai. The concept of fusion cemetery is to integrate different culture and tradition with distinctive design elements to celebrate the uniqueness of different culture. This particular concept may perhaps be adopted and evolved by many cultures not only in Shanghai or other large cities in China but also large cities with great diversity around the world. Therefore, the fusion cemeteries in Shanghai may become the parent of future culturally integrated cemeteries around the world, just like how Pere Lachaise has become the parent of all modern picturesque style cemeteries in the world. Even though, the actual design and design elements of future fusion cemeteries will be based on the local context of their location, the research as case studies of the three fusion cemeteries in Shanghai, can still provide some basic design guidelines of how the integration can be done through various site organizing and site managing strategies in terms of master plan layout.

First, the research uses four group of burial sites to elaborate in detail; however, the groups are relatively small with the great local context that may not be able to represent other burial sites. In the result, the selected site in within the same geographic region are very similar with the similar scores and are clustered very closely on the scatter graph. It might be the result of small study groups, due to the time and geographic limitation of the research. However, there are a large number of other burial sites in Michigan, Shanghai, and Jiangsu established during the similar time frame, that can be studied for future research. Even more, the burial sites all over the world can be explored in the future for more comparison studies both horizontally and vertically.

Second, the data and information of eight burial sites are primary information collected in field studies because the lack of literature review secondary information, therefore the primary information are based on personal understanding

and experiences that may not be comprehensive and involve personal biases. Especially, there is very little secondary information on the environment, landscape, and architecture style of modern Chinese urban public cemeteries. And all the secondary information on the Chinese rural ancestral burial ground focuses on its religious importance to the community and its ritual practice. However, there is no secondary information describing the environment and landscape aspects of Chinese rural ancestral burial ground other than its application of Fengshui when possible. The information of these five selected sites (three public cemeteries in Shanghai, and two rural burial grounds in Jiangsu) are significantly dependent on personal observations. Thus, further studies can focus on collecting more information on the modern Chinese public cemeteries and rural burial grounds, and accomplish more data collection research method for these burial sites; to contribute to the literature pool in this field. For example, more sites in various places in China can be studied and documented to discover the commonality among the sites in the different location with relatively different local context.

Finally, future research in the field can also adopt the equations used for this research to test if the equation work for other burial sites among the four group of burial sites studied in this research or even another type of burial sites. Thus, more studies can contribute to the data pool of the field of burial site environment, landscape and architecture style research in the future.

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