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An Ordination of Selected Artists, Painters, and Designers: Line, Composition, Color

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ABSTRACT

Scholars and students are often interested in the normative principles described by noted designers, painting, and drawing authorities. This study explores how similar and different these artists are in a quantitative manner. This research transforms a list of 250 principles from twelve artist's(from Europe and North America: Robert Oliver, Michael Doyle, James Richards, William Kent, Humphry Repton, and Jon Burley, Wassily Kandinsky, Thomas Moran, Claude Monet, Robert Wood, and Jackson Pollack into numerical data, and then analyzes the data through Principal Component Analysis (PCA). The result of PCA indicates that there are eight dimensions greater than one (considered meaningful dimensions), explaining 86% of the variance. A plot derived from the two most major dimensions revealed that those addressing drawing and sketching have a stronger emphasis upon line. Those individuals who are interested in planning and designing spaces are centered around composition and were positioned in the middle of the ordination. Many of the painters have a special emphasis related to color and were the most dispersed group. Considering that with 250 variables, the individuals explored could be plotted widely apart, the results revealed the distances between the individuals studied shared numerous ideas and were not excessively different in their approach concerning underlying principle.

Keywords: *Design arts, fine arts, design principles, architectural drawing, drafting techniques*

INTRODUCTION AND ARTISTS/DESIGNERS

This study began as an investigation into the normative principles, methods and techniques of a graphic artist, Mike Lin. He is known for giving numerous workshops and advising individuals concerning how to make better drawings, renderings, and sketches. As the study progressed, a comparison of Mike Lin's advice with other individuals (Robert Oliver, Michael Doyle, and James Richards) were suggested. This comparison grew into including some individuals who were designers (William Kent, Humphry Repton, and Jon Burley) and some painters (Wassily Kandinsky, Thomas Moran, Claude Monet, Robert Wood, and Jackson Pollack). The purpose was not to determine who was better or best, but rather to explore the similarities and differences. Often in the past, such comparisons were made heuristically, meaning an expert would make an educated and informed comments concerning the distinctions and relationships, developing highly intricate decision trees linking and connecting design philosophies. Sir Barrister Flight Fletcher (1866-1953) wrote a well known example concerning this type of study (1896), and it is extremely useful. Charles Jencks (1939-2019) presented such trees/flowcharts, illustrating the rise of postmodernism (1977). However, this form of narrative is often inconsistent from expert to expert and can be strongly subjective. In other words it is not

necessarily reliably nor repeatable from person to person.

Comparing art, design, artists, and designers has often been of interest for those associated with the built and fine arts. Vasari wrote a well-known book (two editions), The Lives of of the Most Excellent Painters, Sculptors and Architects (1568, 1550). The comparisons and assessments are based upon heuristic/expert opinion. Much earlier Jo-Hsu Kuo wrote in a similar heuristic manner about Chinese painters, written in the eleventh century. During the past few decades, scholars have been searching artistic representations for universal properties employing statistical methods from respondent perceptions and spatial properties of images (Redies 2015, Zekiet al. 2014, Yanulevskaya, 2012, Jacobsen 2004, Ramachandran, and Hirstein, 1999. Ruderman1994).

Analytic methods via computing technology has rendered comparisons and relationships for drawings, paintings, and built projects somewhat more objective and reliably repeatable across investigators. For example, YiwenXu (et al. 2016 and et al. 2015) compared tradition Chinese gardens in Suzhou, Jiangsu Province, China to modern Chinese gardens constructed in Xiamen, Fujian Province, China. She employed seventy-five variables to assess the eight gardens with statistical cluster analysis. She discovered that the three traditional gardens were very closely nested together. Experts had claimed that these traditional gardens were attempting to create highly similar gardens but had no objective evidence to support their claims.

YiwenXu provided strong science-based evidence to support such notions. In addition, modernists claim that recent garden designers attempt to make more emphatic individual statements expressing unique ideas (Burley and Machemer 2016). YiwenXu presented evidence that the five modern gardens she studied were in fact widely dispersed with great variance. In another example, HaoxuanXu (et al. 2017b and et al. 2017b) compared traditional Chines burial sites with some modern Chinese cemeteries, some Michigan cemeteries, and one French cemetery.

HauxuanXu employed eighty-seven variables in her cluster analysis. Her results suggested that the cemeteries are ordinated along two dimensions. One dimension plotted the cemeteries along a FengShui (wind and water) axis and in a second dimension, a softscape to hardscape axis. In other words, one could measure a cemetery by using the eighty-seven variables and reliably predict the type of cemetery from Chinese rural burial sites to Imperial Chinese tombs and from Western cemeteries to modern public Chinese cemeteries. The cluster analysis approach has been used in various landscape studies such as by Burley (et al. 2009, 1991, et al. 1989), Burley and Bauer (1993), and Burley and Brown (1995). These studies were in surface mine reclamation modeling, in information science, and in Geographic Information System (GIS) spatial modeling.

This type of cluster analysis and ordination modeling appears to have a wide variety of potential applications from landscape studies in physical science to social science. Therefore, the study team was interested in employing this basic analytical approach to study these selected 12 artists. The following is a brief description of these artists, including comments/observation by Dr. Burley, FASLA a noted landscape historian and scientist, and a lesser known artist (Burley and Machemer 2016, Jin, Darkovskaya, Loures 2013).

The intent was to see how the designers/artists are arranged relative to each other across numerous design principles that each designer employed to create their works. There was no intent to determine who and what were the best, nor most beautiful, but rather to see how they related to each other with similarities, differences, and association.

Mike Lin is a registered landscape architect, a member of the American Society of Landscape Architects (ASLA) and the American Society of Architectural Illustrators (ASAI). He is also an architect, an illustrator, an interior designer, an educator, and an author of Architectural Rendering Techniques (Lin 1985) and Drawing and Designing with Confidence, a step-by-step guide (Lin 1993).

Although he works in different fields, he is most renowned as a gifted and effective graphics educator. Mike has taught design and graphics workshops for more than 45 years. He has taught workshops at over 100 universities and many professional firms all around the world, helping thousands of students. Amorosa (2015) discusses the importance and value of drawing skills, including Mike Lin's approach when creating digital landscape images. Like many noted designers, during the lifetime of the individual, very little scholarly materials may be

written about them, other than the often prolific publications written by the designer. This was true of Frank Lloyd Wright and is true of Mike Lin plus several of the other designers examined in this study. Mike obtained his undergraduate degree in Architecture from Taiwan, and a Master of Science in Landscape Architecture from the University of Wisconsin. He has taught design, graphics, and presentation courses for much of his professional career. He has received many recognitions and awards, including the Outstanding Teaching Award from Kansas State University, due to his uniqueness and effectiveness teaching style.

After he had given numerous graphic workshops and seminars a Kansas State University, he decided to open his own graphic workshop. Lin's workshop is called 'BeLoose,' it helps to improve participants' confidence in design and graphic ability. Lin's ambition to enrich participants' quality of life, encouraging people in his workshop. 'I have known Mike Lin for almost 40 years.' states Dr. Burley. 'He is extremely observant and an excellent teacher. We greatly admire him at Michigan State University. He is a good friend and is so inspirational. There are so many things to learn about drawing, but Mike knows the essentials very well and lets the students discover the rest as they gain confidence. Mike works hard to get the students to relax, become comfortable, and have fun. His books contain a set of normative principles with great insight and technique.' added Dr. Burley.

In this book, Michael Doyle focuses upon color drawing approaches during the early phases of the design process (Doyle, 2007). He believes that people can design quicker and more effective when mastering the approach. Color drawing approach is always changing, adjusting depending on what one desires to communicate within the design. Therefore, people should choose their own combination of approaches to help them the most, and Doyle's book is a good reference to start (Doyle, 2007).

In Color Drawing, Doyle begins the step-by-step drawings with a completed line drawing, uses knowledge of perspective, light, shade, and shadow to communicate the conceptual ideas about form, space, and place. Michael Doyle taught at the University of Colorado and has given numerous workshops around the country. 'Michael Doyle is an extremely kind and thoughtful person. He gave a workshop at Michigan State University (MSU) about 10 years ago.' reflected Dr. Burley. 'Interior design and landscape students truly enjoyed learning from him and the faculty were grateful he came to conduct a workshop at MSU.' reflected Dr. Burley. Robert S. Oliver (1919-2010) was a professional artist and author of The Sketch (1979) and The Sketch in Colors (1983) published by Van Nostr and Reinhold Company in New York. His paintings have gained recognition by winning many awards and being displayed in private collections across the nation.

Oliver was also a professor teaching architectural graphic communications and architectural design at Arizona State University (1964-1989). He was a member in both the American Institute of Architects and the American Watercolor Society. Arizona State University has an archived interview with Robert Oliver (Arizona State University 2010).

Oliver believed that sketching is another form of drawing, and it is 'loose, spontaneous, and not precise' (Oliver, 1979, p. 5). In his book The Sketch (1979), Oliver introduces various techniques. It includes: what materials to choose, what sketch is, line and shape techniques to help form a sketch quickly and effectively, using tone and black strokes or values to create shadows, composition skills, how to draw perspective, creating thumbnail sketches, the relationship between figures and landscape, providing examples and critique, and showing sketch portfolio samples.

Similar to what Lin advocates in his workshop, most of Oliver's sketches are small in size, and he calls them thumbnail sketches. Oliver uses less dots and lines in architectural structures than Lin, and Oliver does not intentionally leave gaps between lines. Oliver displays different styles of line works in his book.

In most of the styles displayed in the book, the void and mass relationship plays a prominent role. Many illustrations have a strong contrast from the white space remaining in planes to the dark shadow areas. In the book The Sketch in Color (1983), Oliver lists his preferences for color choice both for watercolor and for marker as references.

He does not use too many colors in one drawing, all the colors that he uses are relatively simple when compares to other artists. In fact, in both of Oliver's watercolor and color-marker drawings, there are limited color palettes. Oliver's efforts have yet to spark much

posthumous academic interest; although there is much interest in buying and selling his artistic works through the internet.

James Richards, FASLA is a professor at the University of Texas, Arlington. He is known for his urban sketching activities and for the authoring of Freehand Drawing & Discovery: Urban Sketching and Concept Drawing for Designers (2013). Richards has traveled the world freehand sketching and giving workshops. In his book, Richards emphasizes the need to extract the essence of the spatial landscape in simple lines and shapes, setting the horizon line and adding people. He then builds detail and shadow in each of the shapes he has delineated, adding color at the end.

He draws immediately on the spot, with on-lookers, often where ever he goes. He is more than just a sketcher on paper and demonstrates to his students how to use computer technology and images combined with free-hand sketching. 'Being around James Richards is contagious.' states Dr. Burley. 'It is easy to see why he is such a great teacher. He gave a graphic workshop at MSU. Faculty and students had a great time. Robert Chipman (another very good sketcher) an alumnus of MSU and James Richards are good friends and have helped to promote urban sketching at recent ASLA (American Society of Landscape Architects) conferences.' reported Dr. Burley.

Humphry Repton (1752-1818),is a well know and studied landscape architect/designer. He is famous for his 'before and after' images for estate landscapes. His drawing principles were derived from his major publications (Repton 1794, 1803, and 1816) or reproductions/reprints of such works. Daniels and Veale (2014), Rogger (2007), Daniels (1999), Daniels (1996), Harwood (1996) , Hunt (1996), Lard (1996), Carter, Goode, and Laurie (1982), Stroud (1962), present recent studies and investigations concerning Humphry Repton.

While Repton prepared documents during his times and John Claudius Loudon (1783-1843) published some of Repton's works, recently republished in paperback (2010), academic interest in Repton was posthumous, just like the interest in Frank Lloyd Wright.

William Kent was a versatile artist. He was a painter, architect, interior and furniture designer, and landscape gardener (Hunt, 1987, Wilson 1984). Kent was trained as a painter in Rome in his early days, and later as an architect (Sicca, 1986, Jourdain, 1948, Wittkower 1945). Most of his art pieces are presented as historical paintings, interior decorations, and technical drawings of architecture and furniture. There are few landscape drawings or sketches left to show his garden design. Some examples shown in the book The Work of William Kent (Jourdain, 1948) are a drawing of Venus's Vale, located at Rousham, Oxfordshire, England (p. 158), and a sketch for the temple of the Mill and 'Eyecatcher', in Rousham, Oxfordshire, England (p. 163).

In William Kent: Designing Georgian Britain, Weber (2013) provides many other of Kent's landscape sketches. In these sketches, Kent placed simple compositions, spacious white spaces, and vast grasslands and forests, with the highlights of few architectural elements. The topography was usually clear to inform viewers by the contrast of void and mass. Sometimes Kent drew the white space next to the shadow space with the forty-five-degree strokes to show the relationship of void and mass, sometimes with white space and ink washes, and sometimes the white space and the combination of ink washes and pen strokes.

Kent always inserted architectural elements into landscapes, and the structures that often fit the topographic setting where they placed (Weber, 2013). The most famous structure that he put in landscape was ha-ha wall, a retaining wall without interrupted views of landscape. A ha-ha wall prevents access to a garden by animals. 'In 2014, I visited the Victoria and Albert Museum in Greater London where there was a special exhibit concerning William Kent.' communicated Dr. Burley. 'I had learned a little about William Kent in my landscape history class in the 1970s, but this exhibition was so much more informative. I greatly admired his gifted abilities to address so many design subjects. He had a great intellect.' commented Dr. Burley. Figure 1 presents an architectural element William Kent designed for the garden at Stowe. William Kent was known as a designer that blended landscape and architecture into one composition (Balmori 1991). Recently, there has been a debate concerning the origins, sources, and inspirations of Kent's designs, suggesting an Oriental influence (Liu 2019).

Both Kent and Repton are considered part of the landscape architectural canon. Since they both drew and painted, their design approaches and principles can be compared with the approaches by Lin, Doyle, Oliver, and Richards.

Figure1. *An image of the Temple of Virtue by William Kent at Stowe, UK, (copyright 2007 © Jon Bryan Burley, used by permission, all rights reserved).*

The least known of the individuals studied is Dr. Jon Bryan Burley, FASLA. He was chosen through convenience. He has published materials about drawing/painting (Burley and Machemer 2016, Joliet et al. (2011) Mazure and Burley 2008) and has had a paper written by others about his artwork too (Jin, Darkovskaya, and Loures 2013). Thus, there was material that could be used in the study and his artwork and photographs were available for publication, granting permission for use in publication, to illustrate some of the built/graphic/painterly images in the manuscript. In contrast, much of the work of others described in this study is found through books and journals, being protected by publishing houses, art resource institutions, and current copyright protections; thus they are not readily available for reproduction without paying a fee to the appropriate owner. Jon has won minor awards for his work and has one very minor one-person art showing in a small art gallery in East Lansing. His work is presented in Figure 2 and Figure 3. He paints and draws for pleasure and not for commercial purposes (over 1,100 sketches from around the world and over 200 oil paintings).

At Michigan State University, he has taught "drawing as knowing" and had led university level sketching courses overseas in the United Kingdom, France, Spain, Portugal, Italy, Germany, Greece, and Turkey. "I discovered long ago, that if I brought students to a site to draw, they were more interested in going to the pub—sketching was too much effort with so many temptations nearby." states Dr. Burley. "But if I sat down with them and drew too, they would seriously attempt a sketch. I could finish in about 45 minutes, and then walk from student to student to advise them, encourage them, and suggest what they should try and do next. Sketching can be highly personal and students can be quite defensive of their work. But if I tired too, and showed them my efforts, they seemed to be more open and receptive. The goal is not to criticize, but to offer kindly advice along their drawing journey." commented Dr. Burley.

"I did not want them to draw like I drew, but to discover through drawing and to evolve their own style. For some students drawing became a pleasure instead of a task." he added. "Drawing often requires a certain "state-of-mind" both irreverent and yet observant. I clearly understand why the great drawing instructors such as Mike Lin devote time with the students to build their enthusiasm, confidence, and a "care-free" attitude.

If students can learn to comfortably and openly draw with on-lookers, interruptions, and commotion, enjoying the experience, often they begin to quickly grow in their abilities and talents, and they draw more without being told, as drawing has become a joy and learning experience as opposed to an academic requirement for evaluation and a grade. Students start sharing with each other.

I know that I have done my job if they do not really need me anymore." finalized Dr. Burley. "Decades later, students come to my office when they are in town, wanting to show me their sketchbooks and projects. I am very proud of them.

They will remind me of two important aspects of their drawing education: first, as I could somewhat draw, I had credibility which allowed them to listen; second, my desire to have them enjoy the experience of drawing allowed them to personally grow and continue growing facilitated their willingness to continue listening. Now I listen to them." reflected Dr. Burley. An oil painting of Bayon Temple in Angkor Wat, Cambodia, by Jon Burley, while riding on an elephant during the early morning is presented in Figure 2, illustrating Dr. Burley's painting style.

The painting is in a wide landscape format (just as Repton used a long format for his renderings), expressing the breadth of the Cambodian temple. The composition is the play of light and dark (like Monet or Robert Wood)

expressing volume of the foreground to the temples and the depth of space back to the distant trees, but with the wrong color (like Henri Matisse [Whitfield, 1991]) and with large brushes (like Willem de Kooning [Lieber, 2000]). James Richards has also drawn images at Angkor Wat. The painting employs a limited palette (seven colors and no black), similar to Monet who late in life used only nine colors and no black. Shadows are made by mixing various combinations of purple, magenta, blue, and green together.

Figure 2. *A painting by Jon Burley of Bayon Temple, Angkor Wat, Cambodia, (copyright 2018 © Jon Bryan Burley, used by permission, all rights reserved).*

Figure 3. *A drawing by Jon Burley of a waterfall at Danxiashan Geological Park, Guangdong Province, China (copyright 2009 © Jon Bryan Burley, used by permission, all rights reserved).*

"I believe I have a tendency to draw things that others would never draw and would only take a picture. While I drew this picture, I saw hundreds of people walk by and take pictures, then climb the waterfall. I had no interest to climb that waterfall, but a great interest in drawing the activity. My drawings are only adequate. I am happy if the drawing is at least legible—water, vegetation, rocks, people." commented Dr. Burley. An image of a waterfall at Danxiashan Geological Park, in Guangdong Province by Jon Burley is presented in Figure 3. To make this drawing, Jon first uses maker to draw the shadows (only five or six colors), often ignoring objects and subjects he does not want to include (such as additional trees and forest in the upper right of the true environment) then colored pencil (five colors) to blend and mask the marker's colors, finally employing an ink pen to draw selected contours of the subject matter (in this case mostly people climbing the waterfall) (Mazure and Burley2009). Often the contours are drawn without needing any more careful examination of the actual environment to draw the contours, as Jon simply draws what is suggested by the marker and pencil (the

opposite process of James Richards). Almost all sketches are drawn on-site, just as James Richards does and the final effect is somewhat similar. Both use color with restraint and pastel-like.

While Dr. Burley is not widely known, Claude Monet (1840-1926) a French Impressionist pioneer is world famous. He depicted the environments and the activities he has experienced, such as the leisure activities in Argenteuil, Paris' suburb. His landscape painting gained a worldwide recognition because his choices of colors and the light and atmosphere effects. Monet's philosophy of painting was to paint what you really see, such a trains in train stations. For example, one should not paint what one think's what one ought to see, draw and paint (such as someone posing in a studio), nor the object isolated as in a test tube; but the object enveloped in sunlight and atmosphere, with the blue dome of Heaven reflected in the shadows (Perry, 1927).

By painting what he sees, Monet abandons traditional approach to create landscape painting. For example, classical paintings always use dark neutral colors, like black or grey, for shadows. By observation, Impressionists see blue or purple shadows on snow. Monet's ideas are compatible with the sketches and paintings of Richards, Oliver, and Burley.

Monet changed his painting styles through all the years. In his early years in painting, he studied in a classical school in Le Havre, and tried to enter in the official Salon. This period of experience influenced his painting style as well. The Woman in the Green Dress, created in 1866 and displayed in Kunsthalle Bremen, was Monet's early entry for entering in the Salon. In this painting, Monet painted dark background, and depicted a classical pose of Camille Doncieux, who was Monet's model for many other famous portrait paintings and his first wife.

In his later life, he changed his style and was an Expressionist. Most of his famous landscape paintings are painted in Giverny, including the famous water lily series. Giverny was a village that sits on the right bank of the River Seine. He moved to Giverny in 1883 and died in 1926. In this study, the principles in this study are from the documentation of his late-life landscape paintings.

The literature concerning Claude Monet is extensive, much like the proliferation of literature concerning Frank Lloyd Wright. In the late 1980s and early 1990s a retrospective of Monet's series paintings from the 1890s traveled to museums in the United States of American. The bibliography in the book accompanying the exhibition by Tucker (1989) illustrates the breath of the literature concerning Monet. The catalogue was for an exhibition in Boston, Chicago, and London.

"Visiting Giverny, France was a epiphany moment for me." exclaims Dr. Burley. "I am a struggling painter, preferring to live in the countryside, often using a wide format for paintings to portray landscape, a limited color palette (only seven colors and no black), painting atypical subjects, and avoiding many advances in technology.

When I learned that Claude Monet had similar preferences and visiting his restored garden in 2007 and 2012, I realized we shared much in common – although he is famous and I am not – I grew to admire his similar feelings and independence. I felt I understood him well, without ever meeting him." commented Dr. Burley. "In his garden, people are sketching and drawing (Figure 4)."

Figure4. *Dr. Burley drawing in Claude Monet's restored Asian styled Oriental garden, seated with other visitors, some of who are also drawing (copyright 2007 © Jon BryanBurley, used by permission, all rights reserved).*

"Over the last decade there has been an urban sketching movement. I greatly admire the enthusiasm for the movement." notes Dr. Burley. "However, I paint and draw birds, portraits, insects, landscapes, as well as urban scenes. I guess I am a little more independent and tend to go my own direction." observes Dr. Burley. "I am sure my lack of talent and "lone wolf" nature is a good recipe for obscurity." Robert Wood (1889-1979) is a painter of the

American landscapes. He was born in Sandgate, South England in 1889. Sandgate is near White Cliffs of Dover with scenic beauty along the Kent coast. His father was a painter and influenced Wood's education of art at his early ages. During his youth, he studied painting nearby Folkstone, and moved to the United States with his friend after service in the Royal Army.

Flume and Wood (1983) divide Wood's life into three phases: the Early Years (1889-1924), the Texas Years (1924-1941), and the California Years (1941-1979). Although Wood spent a large amount of time in Texas and California, he would to travel to and lived in many different cities in the United States. By going across the continent, he painted different landscapes as important records in his days.

In the book The Last Mountain, the Life of Robert Wood, Flume described how Wood Painted. His painting style is between Realism and Abstractionism and liked to explore the truth or the 'heart' (p. 59) of the subjects that he painted. He painted what he saw and interpreted them into the canvases with a 'light' (p.61) attitude. He told his students to be reasonable to what they could paint, and not to take themselves too seriously. Wood thought painters should enjoy painting as joyful experiences and have fun with these experiences; this is how Wood interpreted 'light' (Flume and Wood, 1983, p.61).

Figure5. *A copy of the Majestic Grant Tetons by Robert Wood, painted by a young Dr. Burley when he was in his teens (copyright 1971© Jon Bryan Burley, used by permission, all rights reserved).*

"Robert Wood's book on painting landscapes and seascapes were very instructional for me when I was a young oil painter of 14 years of age (Figure 5)." states Dr. Burley. "When I was young, I could copy a paintings, but had great difficulty with my own compositions and creations. It was not until a decade later that I began to find myself. Later in life, I learned this was a common problem and process. Vincent Van Gogh's great paintings (the paintings for which he was noted), were produced mostly in the last few years of his life, before that he was struggling to find himself. " advised Dr. Burley.

Like Robert Oliver, Wood's paintings and reproductions was widely available for purchase on the internet. He has yet to be widely studied academically. However, because he was instructional and assisted others to paint, he has a record of his painting/design principles.

The painting illustrates Wood's style for near realism. Oil painting is not necessarily an intuitive process. Robert Wood's instructional material can be very helpful concerning how to start, what to do, and how to arrive at a completed painting (Wood undated). "When I was young, I read and viewed his instructions over and over again, but very little stuck with me. Now many years later, I read his instruction booklets and I understand what he is attempting to convey and it all seems so easy – but back then it did not connect with me." suggested Dr. Burley.

Thomas Moran (1837-1926)was born in Bolton, Lancashire, England and came to the United States in his teenage years. He is known for his scientific color paintings for the US Congress of Yellowstone (Joliet et al. 2011). He is known for his landscape paintings in the American West and in South America. Most of his painting principles were derived from Anderson (et al. 1997). Moran was been widely academically studied and publically acclaimed as illustrated by Clayton (2019), Knox (2018), Gareth (2007), Kinsey (1992), Truettner (1976).

Wassily (Vasily)Kandinsky (1866-1944) was a Russian painter and art theorist who taught at the Bauhaus in Germany and then lived in France. He is known as an early and originator of abstract art (Rapelli 1999). His earlier works were somewhat representational but by the 1920s he had evolved to more abstract shapes during his teachings at the Bauhaus, arriving at a full synthesis of abstract art while in France.

It is his French paintings that are employed in this investigation. The literature concerning the works of Wassily Kandinsky is extensive.

Selected research concerning Kandinsky's work include Braun and Doeschner (2019), Zhang and Yu (2016), Robbins (2015), Buckley (2014), Michel et al. (2014), Ione and Tyler (2003), and Wirth (1979).

Jackson Pollack (1912-1956) was an American abstract expressionist painter (Naifeh and Smith 1998). Pollock explored the use of liquid paint and is well known for his 'drip period 'It is primarily this drip period that is employed for this study. Pollack's paintings have been studied and described by scholars such as Placious et al. (2019), Harrison (2014),Taylor et al. (2011), Solomon (2001), and Landau (1989).

These are the individuals that were included in the study. Either the individuals had published books and articles concerning painting or drawing techniques or have been widely studied by academics illustrating their design principles. The study explores a selected variety of individuals and their approaches, with the principles of Mike Lin, Michael Doyle, Robert S. Oliver, and James Richards, as the initial basis for the ordination study.

METHODOLOGY

Cluster analysis is a multivariate technique to group observation by possessed characteristics (Tryon, 1939); however, before computing, the technique could only explore a maximum of 3 dimensions. However, with computer algorithms, dimensions beyond 3 can be estimated. Many fields of researchers use it group cluster of objects, for example: ecologists can use it determine which objects of a forest are similar with the vegetation growing on a stand (Curtis 1959); medical researchers use it determine which diseases have similar incidence patterns; marketing researchers use it determine which brands of products the public perceives similarly.

Mathematical methods of classification even simply cluster analysis for researchers-it stores the data (characters, usually expressed in number) of the object instead of the real object (Romesburg, 1984). Cluster analysis aims to group data points based on their properties: similar data points are in same groups, and dissimilar data points in different groups.

The study team extracted 250 variables from the normative principles proposed by the various artists. These variables were standardized to a mean of zero and a variance of 1, then entered into Principal Component Analysis on SAS with eleven artists each having 250 observations for a total of 2,750 data entries (Statistical Analysis Software) (SAS Institute 2012).The analysis will reveal a set of eigenvalues (latent dimensions). The sum of the eigenvalues can be total number of variables in the study (250).

The eigenvalues are presented in numerical order with the largest first and the smallest last. The total number of eigenvalues can be fewer than the total number of variables studied. For a large set of variables, a small set of eigenvalues often occurs as many of the variables may covary, eliminating unnecessary, empty orthogonal dimensions.

Associated with each eigenvalue is a vector, known as an eigenvector. This vector has coefficients for each variable weighting the association of the variable with the dimension. The coefficient for each variable will range from minus one to plus one. Negative values indicate an association with one side of the dimension and a positive value indicates an association with the other side of the dimension. Values near zero indicate a weak association.

The eigenvectors can be used to plot the location along the dimension (axis) for any observation set, in this case an artist. Variables strongly negative or positive can assist in labeling the breadth of a dimension, although is a somewhat subject activity. Burley (et al. 2009, 1996) explains this general methodology in greater detail.

For 250 variables, the equations and associated tables are quite long, too long for printing in this journal article, but are easily handled in a spreadsheet. For each dimension, the score of any one artist is calculated variable by variable, taking the score of that artist for that variable, subtracting the mean, dividing by the standard deviation then multiplying by the corresponding eigenvector coefficient, and finally summing the results.

RESULTS

Table 1 presents the eigenvalues rendered in the study. There were only eleven eigenvalues to explain the complete differences and similarities amongst the artists. In other words, the eleven dimensions explain the variance in the data set without losing any of the variance in the data set. The first two dimensions explain 34.66% of the variance.

Interested investigators can contact the corresponding author for the variable list, as the list is too long to publish in this article. In

addition, interested investigators can also inquire about the eigenvectors derived in the study as this table has 3,000 values (12*250), another large table. Table 2 presents the sum of the eigenvectors by eigenvalue for each artist.

Table1. *Eigenvalues of the covariance matrix*

	Eigenvalue	Difference	Proportion	Cumulative
1	46.9188	7.19338	0.1877	0.1877
2	39.7254	5.688	0.1589	0.3466
3	34.0374	8.40366	0.1361	0.4827
4	25.6338	3.60774	0.1025	0.5853
5	22.026	4.35282	0.0881	0.6734
6	17.6732	2.11	0.0707	0.7441
7	15.5632	1.41424	0.0623	0.8063
8	14.149	1.64983	0.0566	0.8629
9	12.4992	0.94367	0.05	0.9129
10	11.5555	1.33709	0.0462	0.9591
11	10.2184	10.2184	0.0409	1

Table 2.*Sum of the eigenvectors coefficient equations by eigenvalue for each artist (Prin 1 and Prin 2), (contact the correspondence author for the spreadsheet table of eigenvector coefficients, variables, and artist scores).*

Artist	PRIN1	PRIN2
Mike Lin	6.3178	6.00269
Jon Burley	2.7106	0.23024
Robert Oliver	4.7955	6.32789
Michael Doyle	5.0199	5.20088
Robert Wood	-4.1616	-0.80432
William Kent	-0.0968	-0.53093
Claude Monet	-5.3196	-4.76116
T. Moran	-8.1178	0.30639
Kandinsky	-10.8672	4.26830
James Richards	7.0250	-2.66561
Jackson Pollock	5.3349	-12.85160

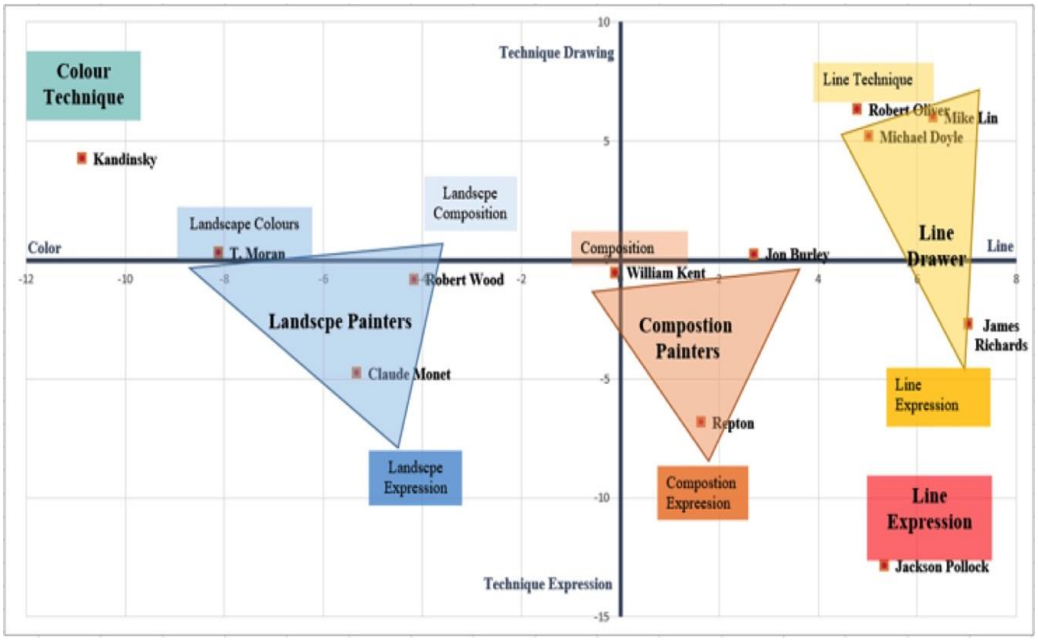

Figure6. *A plot of the first two eigenvalues and associated plots of the artists*

Discussion And Conclusion

The study team had few preconceptions concerning how the data might ordinate itself. This was an investigation of discovery. Figure 6 presents a plot of the first two eigenvalues and associated vectors. The interpretation of the first dimension (horizontal line) suggests that the left-side of the dimension addresses color,

the center composition and the right-side line. For the second dimension (vertical line), the top seems to address technique and the bottom addresses expression. In retrospect, this makes sense as individuals stressing drawing emphasize line, those who create environments emphasize composition, and those who paint emphasize color. Notice that the painter Jackson Pollock with his paint dripping creations is aligned with those who teach drawing and emphasize line.

In addition, all of the artists studied apply in some manner line, composition, and color; yet it is their emphasis that separates them. While the results might make common sense, the nature of this study provides empirical and scientific results to support heuristic thinking. The results are more than just expert opinion with repeatable and possibly less biased evidence.

In the ordination, some of the line artists are plotted fairly close together, suggesting that they actually teach very similar principles (Lin, Doyle, and Oliver). This came as somewhat of a surprise to the study team, as the study team did have a preconception that these artists would be revealed to be highly differentiated. They are not. Instead, it is not what they teach but possibly how they teach that might differentiate them and could be examined in a different study.

In addition, it was thought that the artist Jon Burley would be plotted closer to this group, but he is more similar to Repton and Kent, meaning that his drawings and paintings are about space, environment, and experiential composition, something that the architect, landscape architect, and interior designer might explore. The initial formative beginnings of this study were when one of the investigators desired to examine how Mike Lin might be different from others who taught drawing and rendering. As the study evolved, other designers and painters were added to the study.

And it was revealed that the principles of some of the instructors, including Mike Lin were clustered together. The study was intended to see how the principles of various artists are related relative to each other. The ordination does not imply who is better or worse, but rather presents broad similarities and differences. If fact, with the exception of the instructor from Michigan State University, each of the individuals examined in the study are well noted and very accomplished. It was interesting to note that so few dimensions were necessary to explain the data. With 250 variables, it was certainly possible that if the designers were highly variable, then it is certainly possible that over 100 dimensions could have been necessary to explain the differences; on the other hand, the ordination suggests that there is nothing absolute in unifying the individuals studied and that each individual studied is indeed unique. The differences were relatively compact. In addition, only the two most significant dimensions were assessed. The relationships between the other dimensions merit exploration to explain nuances between the individuals studied.

There are some difficulties in attempting to define an artist, as they evolve and try different techniques as they age. Sometimes, it is hard to define that an artist using a certain principle or not. Some artists change their styles, just as they change their drawing or painting principles. This happens naturally as people grow.

For example, Claude Monet and Jon Burley drew landscape paintings in classic styles in their early times. Then, they both reduced their color choices and creating different styles by their own. Different drawing or painting media may influence artists as they apply different techniques. Lin and Doyle would use different pencils, such as color pencil, charcoal pencil, and carpenter pencils. In future studies, the addition of various artists would influence the ordination.

There are many more artists that could be studied and folded into this study. However, for some artists/designers there is relatively little written about them or their technique.

A more comprehensive and extensive study would take several thousand artists/designers (who have known principles) to investigate and is beyond the reach of this study. This study is not definitive, but rather a view into the relative relationships of the artists selected in this study.

A Chinese art authority wrote about Chinese painting and was considered as a candidate for this study as he published principles for painting (Kuo, 1951). His principles focused upon the content of the paintings such as it is important to know the appropriate clothing style for the time period/dynasty that one was painting.

However, all his principles did not covary with any principle of any other artist studied, meaning that all the other artists were independent of the Chinese authority. In other words, the Chinese authority shared no other

dimension with any of the other artists and thus was not included in the study.

In conclusion, there seems to be three primary clusters in the artists studied: a group emphasizing line (the sketchers and a line painter), a group emphasizing composition (the space designers), and a group emphasizing color (most of the painters). Although as artists, their ideas and principles do overlap; otherwise, they could be far more widely separated along the dimensional axis containing 250 variables.

The designers addressing composition seem to occupy a middle ground in the ordination, applying various artistic principles, but not to any extreme of any dimension. In addition, as other artists and the principles from other cultures are explored, more clusters and groupings may be revealed.

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