EMILY CHRISTIANSEN
Portfolio 2023

Contents

Beyond the Senses: An Imagined World of Virtue in the *Lady with the Unicorn* Tapestries

A maiden stands at a positive organ[1] and plays it, aided by a diminutive, attendant lady opposite her. The positive organ is adorned with a carved lion and a carved unicorn atop the two ends of the instrument. The maiden wears a long red, gold, and blue-green dress. The dress' trim is embroidered with jewels, and she wears a thick, jeweled gold necklace around her neck. Her headdress is similarly elaborate, trimmed with small flowers and topped with a golden coil and tufts. The positive organ rests on ornate fabric, covered in a geometric pattern filled with flowers and a border of repetitive and geometric patterns. The attendant, her dress partly obscured by the table holding the positive organ, wears a slightly simpler blue and red dress, also patterned with long, drooping sleeves. The maiden's companion also dons a transparent veil and a gold necklace with two separate chains; on the lower chain a flower with a red pistil is attached. She seems to look out and slightly up at the lady or the positive organ. Emerging from this attendant's skirts is the unicorn, holding a pole on which flies three crescents on blue ground–the heraldic emblem of the Le Viste family. The lion also holds a pole with a banner on the opposite side of the tapestry, creating some rough visual symmetry. The flag held by the unicorn blows in a breeze, with two tails curling in the air. The unicorn lays on the circular bed of flowers which grounds the whole scene, its long head turned slightly down, its mouth open as if neighing or exclaiming. Its long horn points upwards, almost parallel with the pole it holds. Behind the unicorn's head and horn is a fruit tree, with orange fruits and white, five-petaled blossoms. Another tree rises up from behind this tree, its leaves drooping downward, clusters of them connected by orange and red berries. Aligned with these two trees are two more on the opposite side of the tapestry. Together they form a square and frame the figures in the garden. Behind the lower tree, parallel with the unicorn, sits the lion. It sits upright and has a pursed mouth, wide, staring eyes, large paws, a thick mane, and wispy trail. The lion's body is turned away from the lady, yet its face is portrayed frontally, eyes looking at the maiden. These four figures and the positive organ in the middle of the tapestry are the focus of the work.

They rest in a roughly circular garden. The garden has a green background and is densely covered by flowers of all different varieties. Six animals are also dispersed throughout the garden: from left to right, two rabbits, a cougar, a dog, another rabbit, and a fox. These animals almost lie on the same horizontal plane, similar to four more animals above the figures in the red background. These animals are a sheep, fox, and two more rabbits. Another rabbit is placed higher in the composition by one of the Le Viste flags, and at the very top of the composition are two birds with their wings outstretched. The setting for all of this is a *millefleurs* background: the many plants and flowers that fill the otherwise negative space characterize this style. This garden and floral background serves as the setting for all six tapestries; in this case for the Lady, her attendant, and the positive organ.

"Hearing," as this tapestry is now called, is one of six tapestries that make up the *Lady with the Unicorn* series. All the tapestries center on a Lady, the lion, and the unicorn. Most scholars accept A. F. Kendrick's interpretation that the tapestries depict an allegory of the senses. Accordingly, in the scholarly literature each tapestry is named for a sense, precisely which sense is dependent upon the action of the lady in each tapestry.[2] She strokes the unicorn and holds a mirror in "Sight" (Figure 1); she plays a positive organ in "Hearing" (Figure 2); she grasps a pole and the unicorn's horn in "Touch" (Figure 3); she picks up a sweet in "Taste" (Figure 4); she makes a

[1] A positive organ is a portable pipe organ popular from the tenth through the eighteenth centuries. It would be used to play both religious and secular chamber music, often in a small setting such as a chapel.

[2] The tapestries are called "Sight," "Hearing," "Touch," "Taste," "Smell," and "My Sole Desire" and do not follow a particular order.

garland of flowers in "Smell" (Figure 5); and she holds a casket standing under a banner reading "Mon Seul Desir" in "My Sole Desire" (Figure 6). Heraldic emblems of three white crescents on a blue stripe and red background pepper each tapestry, as well as recurring but varied trees and bushes. Small animals also surround the main scene; they are interspersed with other floral ornamentation, all over a deep red background. The meandering foliage in the background of each tapestry indicates the *millefleurs* style used for the *Lady with the Unicorn* tapestries.[3]

The Mysterious History and Context of the Tapestries

Scholars agree on approximately where and when the *Lady with the Unicorn* tapestries were manufactured. The series was completed in 1500; this date aligns with the dates of production of other Flemish tapestries, of which many examples exist. Though a precise production location has not been established, one can roughly determine the region where the tapestries were made. Scholars have suggested that the *Lady with the Unicorn* tapestries were made in either Parisian, Flemish, or other French tapestry workshops. Flemish tapestries were largely produced in Brussels, and many French patrons commissioned works produced there. At the same time, several towns in France, such as Tournai and Arras, blossomed as centers of tapestry production for specific windows of time in the period in which the tapestries were created. Several scholars have conjectured that the *Lady with the Unicorn* tapestries were *designed* in Paris, potentially by Jean of Ypres, the Master of Anne of Brittany (active circa 1480 to 1508), and may have been produced in a separate location (such as a Flemish workshop).[4]

The tapestries' heraldic iconography and their discovery in the Boussac Chateau make it clear that the tapestries were commissioned by a French family, and have likely remained in France since their production. Some of the mystery surrounding the *Lady with the Unicorn* tapestries results from the fact that they were only "rediscovered" in the Boussac Chateau in 1815. Thus much of the tapestries' history in the period between their commission and 1815 is unaccounted for. However, given the recurring blue and white three crescent emblem in the series, which appears in the form of banners, oriflammes, cloaks, and shields, scholars believe that a member of the Le Viste family commissioned the tapestries. This emblem represented the Le Viste family and can also be seen on architectural elements, such as a fireplace at the Montbrian Castle in Ain, France (Figure 7). Many scholars, including Patrice Foutakis, who has recently published on the series, believe that Jean IV Le Viste (ca. 1432 - 1500) commissioned the tapestries around 1500, during the period of his increased political and social status in the French Parliament.[5] It remains, however, unclear as to why Jean Le Viste would have been drawn to the particular subject matter - the Lady, unicorn and lion - of the series. Tapestries were often given as marriage gifts, but because this series lacks a female coat of arms in addition to the Le Viste emblem, this motivation seems unlikely.

The production of these tapestries came at a time of immense popularity for the medium, especially in western Europe. Around 1500, when the series was likely commissioned, tapestries were valuable, symbolic, and significant objects, portable and functional as well as descriptive,

---

[3] The *millefleurs* style meant covering the background of a work, often tapestries, with flowers, plants, and other vegetation. The term *millefleurs* translates from French to "a thousand flowers," explaining the scattering of many flowers in works of this style. The style developed in French tapestry production in the 15th century and spread throughout the Low Countries in the following century.

[4] These scholars include Foutakis, Williams, Delahaye, Rorimer, and The Art Gallery of New South Wales.

[5] Carmen Decu Teodorescu argues that the tapestries may be from multiple commissions, using the varying coats of arms as evidence for this. She believes the heraldry represented Antoine Le Viste, not Jean IV Le Viste, which may have implications on who commissioned the tapestries.
Decu Teodorescu, Carmen, "La Tenture de la Dame à la Licorne: Nouvelle lecture des armoiries," *Bulletin Monumentalde la Société Française d' Archéologie* 168:4 (2010), 355-67.

informative, and beautiful. Wealthy, often noble families would frequently commission tapestries to display power, wealth, and status. Tapestries depicted many different subjects, including classical or Biblical stories or figures, secular allegories and tales, or purely decorative vegetal motifs. The large scale of tapestries further contributes to a sense of grandeur and importance; being hung on walls turned them into an architecturally-informed and -adjacent object type. Each tapestry in the *Lady with the Unicorn* series slightly differs in size, but they average 11 feet wide by 13 feet tall. They could be moved from court to court, where they would likely be displayed. Thus, the audience of these tapestries would go beyond the Le Viste household to include other members of court life - the audience was likely somewhat restricted to who visited the space where the tapestries were displayed, but this audience was well educated and understood many visual conventions and themes.

While some debate exists regarding whether these tapestries indeed form a cohesive set, their visual similarity, namely the recurring presence of a Lady, unicorn, and lion on a rich red background, imply production by the same artist or workshop. The tapestries' relationships to one another is only one of several mysteries surrounding the *Lady with the Unicorn* tapestries. As mentioned, scholars remain uncertain about where they were produced, who designed them, who specifically commissioned them and for what purpose. Further, the overall and more specific iconographic meaning alike remains debated. While Kendrick's hypothesis remains popular, scholars have since presented other possible explanations for the iconography. Perhaps most divergent of these hypotheses is Patrice Foutakis', who purports that the tapestries are not an allegory for the senses, and in fact belong to several different series.[6] Kristina Gourlay argued that the tapestries depict a romance between the Lady and the unicorn, and perhaps commemorated a marriage in the Le Viste family. Marie-Elisabeth Bruel argued that the tapestries portray the cardinal virtues[7] and were heavily influenced by literary works of the period – other scholars have continued in this direction, especially those who have considered the influence of Christine de Pizan.[8] While many elements of the tapestries fit into iconographic and visual traditions of the period and place, the way the elements are combined is unusual. The inclusion of the three main figures - the Lady, the unicorn, and the lion - in every tapestry eschews conventions. While we often see a Lady and a unicorn, or other pairings of two among these three figures - take for example the woman and unicorn in a woodcut from the *Ortus sanitatis*[9] - rarely do objects depict all three together, and present them as central components of an artwork. Given their size and repetition throughout the series, they clearly carry a significance for the visual experience and a deeper meaning - but this meaning cannot be immediately parsed out using familiar iconographic traditions.

In this essay, I will explore the unusual iconography of the *Lady with the Unicorn* tapestries, specifically examining the Lady, the lion, and the unicorn. First I will examine the *millefleurs* style

---

[6] She considers the possibility that the tapestries represent the senses, the liberal arts, the cardinal virtues, and other popular cycles in "The Lord and the Allegories of The Lady with the Unicorn," and determines that these interpretations do not fit the *Lady with the Unicorn* series, judging by traditional iconography.

[7] The cardinal virtues are a medieval Christian idea (though many western ideas about virtue derived even earlier from the Greeks), extensively developed by Thomas Aquinas. There were four cardinal virtues: prudence, justice, temperance, and fortitude. For more on the cardinal virtues, see *The Cardinal Virtues: Aquinas, Albert, and Philip the Chancellor*, translated by R. E. Houser.

[8] Foutakis, Patrice. "The Lord and the Allegories of The Lady with the Unicorn." *International Journal of Art and Art History*, 8, No. 2 (December 2020): 40-53.
Gourlay, Kristina. "*La Dame à licorne*: A Reinterpretation," *Gazette des Beaux-Arts* 130 (Sept. 1997): 215-232.
Bruel, Marie-Elisabeth. "*La tapisserie de la Dame à la Licorne*, une représentation des vertus allégoriques du Roman de la Rose de Guillaume de Lorris," *Gazette des Beaux-Arts* (Dec. 2000): 215-232.

[9] V*nicornus uarius* from the Images from the History of Medicine collection at the Natural Library of Medicine. Doi: https://collections.nlm.nih.gov/catalog/nlm:nlmuid-101456940-img

of the tapestries and the setting, which informs and contextualizes the iconography and messages of the series. I will use the bestiary tradition to understand the conventional meanings and connotations of many of the animals in the *Lady and the Unicorn* tapestries in the late Middle Ages and early Renaissance, and provide an overview of that tradition before exploring specific iconography, such as the lion and unicorn, in the tapestries. I will then analyze the Lady's appearance and actions in every tapestry. Synthesizing the style, iconography, and the Lady allows me to make an argument about the tapestries' intention and meaning that somewhat departs from scholarly consensus. Finally, I will explore the use of heraldic emblems and how that expands the moral claim the tapestries make. I hypothesize that the inclusion of all three figures is motivated by both the bestiary traditions and the courtly visual language of the period as well as, perhaps, the patron's personal interests. Thus, a variety of visual elements inform the meaning of the *Lady and the Unicorn* tapestries: scale, iconography, setting, and style, and all of these features coalesced into a heretofore unrecognized moralizing message which was tied to gender and class. The message of the tapestries goes beyond representing the senses; they make a claim about the virtue of women in late Medieval France.

I focus my analysis on the Lady, lion, and unicorn iconography because these figures are centered and emphasized in the works and collectively make this series unique. The centrality of the three figures is derived from both the cartoonist's placement and their large size. This clear significance partly informed my decision to focus on the figures; another notable factor is rooted in the figures' meaning. As stated, the iconography of these figures is unusual because they are rarely pictured together in the period. Individually, each element has an art historical (and wider historical) precedent, but there are no other objects, to my knowledge, that contain all three figures. Given the wider concerns about what this series truly represents, be it the five senses (plus one), the cardinal virtues, or the liberal arts,[10] I think that an understanding for such key visual and iconographic elements can help to answer that question.

[10] Foutakis suggests several iconographic interpretations for the tapestries besides the five senses, arguing that they could fit into cycles representing different popular themes, such as those listed in this paper.

Depicting “The Demon King Zahhak”

Tales of powerful Persian kings make up Firdowsi’s illustrious *Shahnama*, mingling mystical elements with cultural traditions to create a volume that both utilizes and shares styles of art and social practices. The story of “The Demon King Zahhak” uses these methods to articulate a warning, shown through both Firdowsi’s text and Tahmasp’s rich visual representation - conducive to the format of Shahnamas. In a colorful folio, *The Snakes of King Zahhak* combines numerous artistic styles and motifs to portray a moment significant to the story’s progression and antagonist. This complex scene draws on geometric patterns and abstractions, lush vegetation, individualized figures and text itself to form a fittingly busy depiction of a narrative turning point. Through specific pictorial references to Firdowsi’s textual descriptions, as well as by way of imported styles of representation, the artist captures a key moment in the character development of King Zahhak, transcendent between Shahnamas.

The multitude of elements in *The Snakes of King Zahhak* are organized and offset by panels and geometric designs, which help the viewer navigate the busy scene. Though small, King Zahhak takes the focus of the folio, centered in a smaller panel asymmetrically placed within a greater rectangle. A wider margin of sorts lies to the right of this smaller panel, encompassing (from top to foreground,) the longest text panel, a variety of plants, and several figures. At the base of the image on the left half lies only two squatter boxes of text, also contributing to a theme of asymmetry. Zahhak himself exists in his own frame, isolated from other figures and elements to emphasize his distinction as King as well as his otherworldly, non-human qualities. His costume accentuates Zahhak’s personal distinction further: atop his head is a large crown; a sizable dagger typical of Persian figures hangs from a belt; the two snakes that effectively mark his evil rule menacingly extend out from his shoulders. Zahhak only takes up the lower half of the panel he exists in; behind him a large tree emerges upwards to the left of his head and disappears into an ornamented border, accompanied by another blooming plant.

These vegetal representations connect this space to the exterior-like, rightmost section of the image, separated from the rest of it but united by way of alike content. The plethora, variation in, and blooming quality of the flora give the image a lush, rich feel suggestive of abundance. While smaller, another tree spontaneously grows from the side of the larger rectangle, blooming with bright purple and white blossoms. The trunk of a more translucent tree flanks the other side, topped with thick green foliage, and a leafy bush sprouting large red flowers grows between them. A vibrant green ground roots the plants, holding yet another trunk and flowers in the foreground. One figure interacts with this tree, bending over in examination. Another two figures converse behind him, on the same plane as many of the people in the rectangle holding Zahhak.

Moving one’s eye across from these three figures horizontally, the viewer is presented with several more similarly distant characters. Individualized by their costumes, they sit on a section of blue tile, three to one side and one on the right. Another male seems to exist in this same certain space, yet actually sits in a different portion by himself, next to some text and a couple vessels. The final row of figures flank King Zahhak. They lie on the same level as him, two sitting fully within the frame and the remaining people emerging from the border, similar to the tree on the opposing side of the right divider. Two men seem to present the King with large vessels, indicating his power and wealth. Distributed amongst the figures are various vessels and foods, also suggesting abundance and plenty at his court. The figures all cross into the different plane above them, drawing them together to create a more cohesive image amidst the two-dimensional depiction of space.

Abstract and geometric designs add a busy richness to the image, also marking the medium of Persian miniatures. As typical of Islamic art, these repetitive designs embellish the image and get mimicked and varied throughout. Curving, vegetal abstractions border the interior rectangle in the

form of columns that develop into an arch; this pattern gets repeated atop the panel as well. It is also mimicked over a gold background and diversifies further to separate the text panels. Finally, the same pattern is tied into a section of floor directly beneath Zahhak. A contrasting hexagonal-star pattern flanks Zahhak in two rectangle sectors, similar to the blue hexagonal panel further down the image. Underlying the entire smaller rectangle is a green, black, and blue zigzag arrangement diversifying the types of patterns even more so, in turn adding to the fantastical splendor. Lack of dimensions along with the dizzying geometric panels contributes to a feeling of otherworldliness, matching a subject who is somewhat inhuman, especially given the addition of snakes growing from his body.

There is a wealth of rich colors, patterns, and motifs and elements in the image that heighten Zahhak's power yet also contrast with the dark nature of his character in the *Shahnama's* text. *The Snakes of King Zahhak* portrays a moment which adds a nonhuman and decidedly evil quality to Zahhak: the growth of two snakes from his shoulders. These snakes symbolize Zahhak's emerging evil in the *Shahnama*, making it an important feature to visually represent (as they are in this image). At the end of "Eblis Makes Himself a Cook", Zahhak tries to expel the snakes with the help of doctors, which the viewer sees here. Firdawsi states that the snakes, "grew again on his shoulders like the limbs of a tree," articulated directly in the form of snakes and by way of other pictorial devices. The snakes themselves stretch outwards like branches, and therefore draw an immediate relationship to the text. Then, they are indirectly referred back to by the abundance of plant growth behind Zahhak and to the right of him, the limbs mimicking the shape of the snakes very closely. Described as "in distress" in the *Shahnama*, one sees that emotion in Zahhak here as well through his perhaps frantic arm gestures and furrowed brow. Many of the figures in the image also suggest the recent development of the snakes and the collection of doctors Zahhak calls upon for help. Several of them seem to be reacting in surprise; two men to the sides of Zahhak put their fingers to their mouth in a gesture of contemplation, perhaps as doctors trying to unwrap this rare occurrence. One man covers his ears in what could be fright or shock - understandable given the circumstances. The two men on the outer right edge of the panel look as if they are gossiping, talking to one another while one points in Zahhak's direction. Even more men in the center of the image gesture towards Zahhak, not only directing the viewer's eye but suggesting a significant event. In this part of the text, Eblis also disguises himself as a doctor and offers the solution of human brains. The artist depicts these elements by way of the placid, devious-looking man in blue to the left of Zahhak and the two figures carrying dishes, emerging from the right. Many details from this portion of the text seem to be reflected in the image, the two mediums corresponding enough from the viewer to connect them.

Zahhak receives the daughters of Jamshid, whose throne he has usurped, c.1500s, Nasser D. Khalili Collection of Islamic Art, London, illuminated manuscript

Can Money – Spent on the Arts – Make People Happy?
An OLS Regression Model of Government Spending on Culture and Life Satisfaction

Introduction

Although quality of life may be a subjective topic, political scientists have nonetheless attempted to measure and study quality of life in many countries, relating it to a variety of factors. Some social scientists have considered the impact of culture, another ambiguous yet real aspect of society, on quality of life. Quality of life can further be connected to governments; scholars ask questions of whether people in certain countries are happier, and what differentiates those countries (like its government). More satisfied people may have different opinions on democracy and democratic values than those who are less satisfied. Would people with different levels of quality of life have different and correlated beliefs on democratic ideals and values of government? Empirical evidence demonstrating that these questions are being asked exists in surveys like the World Values Survey (WVS). In this dataset, researchers survey "values" ranging from perceived quality of life, to government opinions and satisfaction, to economic well-being, and to many other beliefs. This breadth of topics explored in the WVS reflects how distinct elements, like quality of life and government, have the capacity to be related in research and life. Ultimately, questions on how to achieve greater happiness and quality of life are relevant to most people, though what causes this remains uncertain. Further, many people would agree that an important job of any government is to ensure a decent quality of life for its citizens.

This research will explore the connection between government spending on culture and support for democratic values on quality of life. Although prior research tends to focus on the relationship between economic factors and quality of life or happiness, a more subjective measure such as access to culture can bring a new (and understudied) perspective to the discussion. Considering the role of and people's perspectives on government bookends this research: first, I will examine government spending, and lastly I will assess two democratic values, a reflection of government. Examining connections between government spending and quality of life provides a measure to use to reflect again on government - does cultural spending predict improved life satisfaction and support for democratic values in European states?

Existing Research on Culture and Happiness

My research spans and merges several discrete topics of literature, namely quality of life and life satisfaction, engagement or spending on the arts and culture, and assessments of democratic values. Scholars have understood attitudes towards democracy and perceptions of life satisfaction using specific cases and methods. Government support for the arts and culture is usually not associated with those topics, although a few scholars have connected government arts support with life satisfaction or democracy, and I will use literature on both to further connect the two. Culture is an ambiguous term that can encompass many entities; it is also a term used by many scholars in the research on these topics. I will use the term and concept "culture" largely because data exists on culture spending. Literature also refers to "the arts" - culture is a broader term that, while being less precise, has more data available to analyze. Given the limited amount of literature on the intersection of democratic support, life satisfaction, and government support for culture, I have examined literature on each topic, and some pieces that consider two of these elements.

Many scholars have tackled the question of quality of life, studying it independently or attached to other variables. "Quality of life" shows up as an independent phenomenon, though scholars also study life satisfaction or happiness, broadening the scope of literature that discusses attitudes towards quality of life and life happiness. A recent example of this includes Lopez-Ruiz et

al.: “The relationship between happiness and quality of life: A model for Spanish society” (2021). These highly subjective and intangible topics have been examined through case studies and with empirical tools. Several authors take a positivist approach and attempt to quantify quality of life with measurements (for example, a QoL measure), exploring how to measure and define quality of life. They use specific research methods, like in “Do the Arts Make You Happy? A Quantile Regression Approach” (Hand, 2017), or “On the Use of Life Satisfaction Data for Valuing Cultural Goods: A First Attempt and a Comparison with the Contingent Valuation Method” (del Saz-Salazar et. al., 2019). Others have related quality of life to cultural topics, such as cultural engagement, the arts, sports, and recreation, such as broad pieces like “Subjective Well-Being and Engagement in Arts, Culture and Sport” (Wheatley and Bickerton, 2016). These studies often engage with specific places or physical examples. Further literature only examines highly specific events or places, attempting to understand happiness, satisfaction, or quality of life through examples; for example, Alex Michols’ “Arts and the Quality of Life: An Exploratory Study” (2005) examines the topic in British Columbia. Michalos and Kahlke research the relationship of the arts to quality of life and have studied the concept more broadly, seen in “Impact of arts-related activities on the perceived quality of life” (2008). Much of the literature on happiness relates it to economics and uses geographically specific case studies. The article “Don’t Worry, Be Happy: A Survey of the Economics of Happiness” (Majumdar and Gupta, 2015) demonstrates the theme of economics and its association with happiness. Some literature also considers qualities of government and their effects on happiness, such as “Good Governance and Happiness: Does Technical Quality of Governance Lead to Happiness Universally in both Rich and Poor Countries?” (Woo, 2018). This research will draw from the niche of culture in the quality of life and life satisfaction literature, as very little literature on quality of life and support for democratic values exists.

A variety of literature exists on spending on government spending and policy on culture, especially at the state (federal) level. Most literature analyzes a practice or policy or its impact for a specific location, such as Daniel Reed’s “An American Vision of Federal Arts Subsidies: Why and How the U.S. Government Should Support Artistic Expression” (2009), although some books consider culture and economic policy more broadly, including *Arts and Economics: Analysis and Cultural Policy* or *The Economics of Cultural Policy* (Frey, 2000). Support for culture takes on different forms in the literature: some literature emphasizes the economic components while other literature considers policy and public opinion. Economically focused research often uses an economic lens and theories, considering how policies, like subsidies, work. Some literature examines the impact of funding, while other literature focuses on how the funding happens and through what entities, like through taxation: “My Taxes Paid for That?! or Why the Past Is Prologue for Public Arts Funding” (Harsell, 2013). Literature also considers the distinction between public and private support for the arts and culture. Finally, some literature simply reviews the state of funding, whether in the 20th century or current government funding for the arts; for example, “Arts Funding: Growth and Change between 1963 and 1983” (Goody, 1984). The literature on cultural support generally relies on or studies western countries, particularly the United States and Canada - an example of research within this scope includes “The Subsidized Muse: Government and the Arts in Western Europe and the United States” (Zimmer and Toepler, 1999). This suggests using western countries for research on government spending on culture.

In a somewhat more removed field, literature on democratic support and attitudes often takes empirical and sometimes broad approaches. Scholars have taken an interest in how democracy compares across countries and regions; plenty of comparative and global data on democracy exists. Empirical methods such as surveys will measure opinions on democracy, whether assessing critical opinions or how people understand democracy. The WVS provides data on international opinions of governments; the WVS is referenced across different social sciences’ literature. This research is

particularly interested in opinions about democracy in different countries, of which literature exists. Understanding those opinions in relationship to government spending on culture expands the scope of existing literature.

Research Design

I hypothesize that countries with higher government spending on culture will have higher measures of quality of life and support for democratic values; in other words, there will be a positive relationship between government spending on culture and perceived quality of life and thus democratic values. The null hypothesis is that government spending on culture has no effect on measures of quality of life or democratic values. I expect that higher numbers of spending on culture will correlate with higher ratings of democratic support and quality of life.

Because I have the continuous values of spending and GDP, life satisfaction and support for democracy, I will use OLS Regression to measure the relationship between these variables. I treated the indexes life satisfaction and support for democracy as continuous for the purpose of the analysis. Using OLS regression I will look at the slope of the line, shape and patterns of the data, and whether the relationship is significant.

I will use previously collected and compiled data to create my own dataset including ratings on quality of life, support for democratic values, and government spending on culture. To make the index I will take results from the *Compendium for Cultural Policies and Trends*, the *World Values Survey* (WVS), and the WRLD dataset. I selected different variables from each of these datasets and merged them into one dataset, CULTSAT. All of the data comes from between 2000 and 2017.

Cultural spending addresses how support for the arts may impact quality of life, and thus support for democratic values. The data for government spending on culture was compiled by the *Compendium for Cultural Policies and Trends* and is sourced from the gross public cultural expenditure by each government. The organization is managed by the *Kulturpolitische Gesellschaft e.V.* in Germany. Spending is measured in euros. Using spending as a variable provides me with a tangible entity to concretely measure and study, which is especially helpful when examining subjective, conceptual topics like the arts and support for democratic values. I want to measure how government support for the arts, measured in spending, impacts the dependent variables, quality of life, and then how that may change support for democratic values.

I used two different independent variables to measure government spending on culture. One variable was government spending per capita and the other was the difference in spending per capita between 2000, 2005, 2010, and the most recent year. The average "most recent year" is 2015, though specified countries have data from a different year instead. I only used 2000 and the most recent year's spending per capita; I did not use the spending per capita for the years 2005 and 2010 because of problems with collinearity. I wanted more distance in time between the values to reduce the chances of the values being similar (which would result in a collinearity problem). Cultural Spending Per Capita, in years, measures the average spending on culture at all levels of government for each country, in euros, and is represented in my model as the variables CS PerCap 2000 and CS PerCap Recent. For CS PerCap 2000, the mean is 105.84 and the standard deviation is 97.74 euros. For CS PerCap Recent, the mean is 153.7 and the standard deviation is 141.31 euros. I will also calculate the difference between governments' spending on culture per capita for different years. I will use the total mean spending on culture per capita for each and find the difference between those means. The mean for the difference in spending between 2000 and 2005 is 17.92 euros, and the standard deviation is 25.822. This variable is represented in my model as Dif. CS 2000-2005. The mean for the difference in spending between 2005 and 2010 is 25.57, and the standard deviation is 21.054. This variable is represented in my model as Dif. CS 2005-2010. The mean for the difference

between 2010 and the most recent year is 19, and the standard deviation is 39.729. This variable is represented in my model as Dif. CS 2010-Recent.

The *World Values Survey*, from which I will compile data on quality of life, measures 1200 to 1500 responses from participants in different countries, which assess values and beliefs within each country. I can relate one of these values in particular to spending on culture. I will use question 49, "satisfaction with your life," to assess degree of life satisfaction. The question asks respondents, "All things considered, how satisfied are you with your life as a whole these days?". This question is scored on a scale of one to ten, where one is completely unsatisfied and ten is completely satisfied. As stated, life satisfaction is an aggregate of satisfaction from about 1200 - 1500 observations per country measured through the WVS. The mean life satisfaction among all the countries is 7.131 and the standard deviation is 0.753.

I wanted to consider other variables that may impact life satisfaction, and thus also accounted for measures of democratic support in my models. Many other variables could impact life satisfaction; part of the difficulty in assessing life satisfaction is the ambiguity and subjectiveness of that concept. I have looked through the WRLD dataset to identify potential intervening variables. While I could not include all possible intervening variables, I tried to choose variables that seemed most likely to have a direct and significant impact on life satisfaction. I used the democracy score, which is represented in my model as Support for Democracy. This measure scores countries' democracies on a scale of one to ten, with one being the least and ten being the most democratic. This data comes from 2014, and thus fits in the time frame my other data sources are from. The mean is 7.616 and the standard deviation is 1.509691. I also included GDP, which measures a country's GDP per capita in 10,000 USD; this is represented in my model just as GDP. The mean is 1.4529 and the standard deviation is 1.255.

This data is hard to conceptualize and imagine in physical terms. "Cultural spending" itself is a broad phrase, so I am not fully able to articulate for myself or others what the "arts" or "culture" means to my research. It is also complicated by the fact that the government expenditures are total values, so each value reflects funding of a wide variety of cultural spending and practices at all levels of government. The broadness and vagueness of the data complicates the research design and analysis; both the independent and dependent variables measure relatively ambiguous factors.

Analysis of Results

Model Outline

The results from the five models I ran are organized in Table 1. Model 1 uses the independent variables: government spending on culture per capita in 2000 and the differences in spending per capita between the three time intervals, 2000 - 2005, 2005 - 2010, and 2010 - most recent year. Model 2 uses the same variables except for spending per capita in 2000, which is replaced by spending per capita in the most recent year. Both Models 1 and 2 attempt to capture government cultural spending and avoid collinearity by using differences in addition to spending per capita. Model 3 demonstrates the collinearity problem with the cultural spending variables. It compares cultural spending per capita in 2000 and the most recent year. Model 4 examines two variables from the WRLD dataset: support for democracy and GDP. Model 5 runs the significant variables, cultural spending per capita in 2000 and support for democracy. The regression equation for my highlighted model is:

$$satlife.m \sim b_0 + b_1 CSPerCap2000 + b_2 SupportforDemocracy$$

Technically Models 1 and 2 perform the best, but I chose Model 5 because it compares the two variables I am most interested in, and performs nearly as well as Models 1 and 2.

Reflection on Main Table

Four of the five models have significant variables; Model 3 does not, and instead presents a problem of collinearity. In Model 1, government spending on culture per capita in 2000, CS PerCap 2000, is significant below the 0.01 level. None of the measures for difference in spending per capita between years are significant. Similarly in Model 2, cultural spending on culture per

Table 1. Multiple OLS Regression Results

	Dependent variable:				
	Life Satisfaction				
	(1)	(2)	(3)	(4)	(5)
CS PerCap 2000	0.004***		0.001		0.002*
	(0.001)		(0.002)		(0.001)
CS PerCap Recent		0.004***	0.004		
		(0.001)	(0.003)		
Dif. CS 2000-2005	-0.006	-0.002			
	(0.005)	(0.004)			
Dif. CS 2005-2010	0.002	0.007			
	(0.008)	(0.007)			
Dif. CS 2010-Recent	-0.006	-0.001			
	(0.004)	(0.003)			
Support for Democracy				0.199**	0.200**
				(0.089)	(0.072)
GDP				0.150	
				(0.109)	
Constant	6.713***	6.713***	6.687***	5.557***	5.515***
	(0.165)	(0.165)	(0.137)	(0.568)	(0.478)
Observations	19	19	21	24	25
R^2	0.656	0.656	0.637	0.616	0.649
Adjusted R^2	0.558	0.558	0.597	0.580	0.617
Residual Std. Error	0.411 (df = 14)	0.411 (df = 14)	0.413 (df = 18)	0.388 (df = 21)	0.370 (df = 22)
Note:					*p<0.1; **p<0.05; ***p<0.01

capita in the most recent year, CS PerCap Recent, is significant below the 0.01 level, although the differences in spending between years are not significant. In Model 4, Support for Democracy is significant below the 0.05 level, while GDP is not significant. I included cultural spending per capita in 2000 and Support for democracy in Model 5, as those were both significant and allowed for a comparison between cultural spending and support for democratic values. Both variables are significant; CS PerCap 2000 is significant at the 0.1 level and Support for Democracy is significant below the 0.05 level. All five models performed at about the same strength. Model 1 has a an R-squared value of 0.656, Model 2 has a an R-squared value of 0.656, Model 3 has a an R-squared value of 0.637, Model 4 has a an R-squared value of 0.616, and Model 5 has a an R-squared value of 0.649. The R-squared values between 0.6 and 0.7 suggest the models fit for over half of the data. The models perform reasonably well, and do not overperform or not fit the data at all. As touched

on, the first three models also demonstrate the collinearity problem present in the cultural spending variables. The problem is greatest in Model 3, where the coefficients are 0.001 and 0.004 and nearly the same. Yet the differences in spending per capita do not fully avoid the collinearity problem either, as the coefficients for those variables in Models 1 and 2 are also very similar. All of the values are so small they are essentially zero, indicating very little effect of or difference between the variables.

Substantive Meaning of the Main Table

The coefficients of all of the variables are small, being equal to or below a value of 0.200. The coefficients of government spending on culture per capita in 2000 and the most recent year represent essentially the same measure, just in different years. Cultural spending on culture per capita in 2000 appears in Models 1, 3, and 5, and cultural spending on culture per capita in the most recent year appears in Models 2 and 3. The coefficients for the variables measuring difference in spending per capita between years, which appear in Models 1 and 2, also hold the same substantive meaning, with only a difference in when the measurement was taken.

In Model 1, the coefficient of CS PerCap 2000 is 0.004, meaning that for every euro increase in government spending per capita on culture, the rating of life satisfaction increases by an average of 0.004 points. The coefficient in Model 1 of Dif CS 2000-2005 is -0.006, which means that for every euro increase in the difference in spending per capita between 2000 and 2005, the rating of life satisfaction decreases by an average of -0.006 points. The coefficient of Dif CS 2005-2010 is 0.002, which means that for every euro increase in the difference in spending per capita between 2005 and 2010, the rating of life satisfaction increases by an average of 0.002 points. The coefficient of Dif CS 2010-Recent is also -0.006, which means that for every euro increase in the difference in spending per capita between 2010 and the most recent year, the rating of life satisfaction decreases by an average of -0.006 points. The coefficient in Model 2 for Dif CS 2000-2005 is -0.002, which represents the average change in spending on culture per capita between 2000 and 2005. The coefficient for Dif CS 2005-2010 is 0.007, which means that for every euro increase in the difference in spending per capita between 2005 and 2010 the reported rating of life satisfaction increases by an average of 0.007 points. The coefficient of Dif CS 2010-Recent is -0.001, which means that for every euro increase in the difference in spending per capita between 2010 and the most recent year, life satisfaction decreases by an average of -0.001 points. In Model 3, the coefficient of CS PerCap 2000 is 0.001, meaning that for every euro increase in government spending per capita on culture, the rating of life satisfaction increases by an average of 0.001 points. The coefficient of CS PerCap Recent is 0.004, which is nearly the same as the coefficient of CS PerCap 2000 - this value means that for every euro increase in government spending per capita on culture, the rating of life satisfaction increases by an average of 0.004 points. The similarity of these coefficients indicates that on average, government spending on culture did not increase a lot between 2000 and (approximately) 2015. This is where the problem with collinearity arises from: because spending does not change much from year to year, the values compared to one another are similar enough as to appear the same.

In Model 4, the coefficient of Support for Democracy is 0.199, which means that for every unit increase in a particular country's democracy score, the rating of life satisfaction increases by an average of 0.199 points. The coefficient of GDP is 0.150; this value indicates that for every $10,000 increase in GDP, life satisfaction increases by an average of 0.150 points. The coefficient of CS PerCap 2000 in Model 5 is 0.002, and the coefficient of Support for Democracy is 0.200. For every unit increase in spending per capita, life satisfaction increases by an average of 0.002 points, and for every increase in democracy score, life satisfaction increases by an average of 0.200 points.

Hypotheses

The significance of the coefficients in Model 5 suggests a relationship between cultural spending, support for democracy, and life satisfaction. Though the evidence for the alternative hypothesis is not very strong, the significance of certain measures for cultural spending and support for democracy do not disprove the null hypothesis and indicate some relationship. An important consideration is the size of the coefficients, which measures the amount of impact each variable has on life satisfaction, the dependent variable. Support for Democracy is more significant and has a larger coefficient than CS PerCap 2000, which may indicate that it has a stronger effect on life satisfaction. The significance of Support for Democracy and CS PerCap 2000 in the other models also points to the impact both independent variables have on life satisfaction. Certain examples in particular, such as Norway, evidence a relationship: Norway had the highest spending on culture per capita as well as the highest life satisfaction. The regression results, especially the results from Model 5, suggest that cultural spending and support for democracy positively affect life satisfaction.

A weakness of my results is the small coefficients. The variables for spending were especially small, with values of smaller than 0.008. Given that answers to the question on life satisfaction were measured on a ten point scale, a smaller coefficient does not necessarily indicate no effect. Yet the coefficients of the cultural spending variables are small enough that I question the impact of spending on culture as captured by the coefficients, even though they are statistically significant. For example, the coefficient for CS PerCap 2000 in Model 5 is only 0.002, which indicates only a 0.002 unit increase in life satisfaction for every additional euro spent per person on culture. Thus while cultural spending and support for democracy seem to have an effect on life satisfaction, the effect is undeniably small.

Diagnostic Statistics

The diagnostic statistics tests indicated that the OLS Regression I ran had few errors, although the tests were not all without some error. Plotting the residuals visually demonstrated a lack of heteroskedastic error or extreme outliers (Figure 1). The residuals also fall along a relatively straight line in the Normal Q-Q Plot, indicating normal distributions (Figure 2). Testing for outliers indicated a potential problem: the mean hat value is not half of the max value. The mean is 0.14 while the max hat value is 0.73. Further, a histogram of the residuals shows that the data is right skewed (and therefore not evenly distributed), with one outlier to the left (Figure 3). The Bonferroni adjusted outlier test produced a p-value of 0.0139 and is therefore statistically significant. Given this p-value, I do not have significant outliers. The Breush-Pagan test produced a large p-value of 0.29, which suggests that I do not have a problem with heteroskedasticity. This aligns with the visual evidence in the aforementioned residuals plot. The Durbin Watson test also produced a large p-value; at 0.146, it is not statistically significant and demonstrates that I do not have a problem with autocorrection. Avoiding collinearity was important in my research and led to several design changes, thus it was reassuring that the mean vif was not large. The mean vif was 2.6259, evidencing a limited amount of collinearity. The vif score and Breush-Pagan values are listed in Table 2.

The Cook's Distance Plot indicated one notable outlier, case 21 (Figure 4). The case was outside of both Cook's distance lines and the otherwise clustered data points. This case is Azerbaijan, which has unique values for both support for democracy and spending on culture. Between 2000 and 2010, Azerbaijan's government spending on culture multiplied by over fifteen times the value in 2000. In 2000, Azerbaijan spent 1.98 euros per capita on culture, and this number jumped to 31 euros per capita. Further, Azerbaijan had the lowest score on support for democracy: 2.83. No other country had a democracy level nearly this low, nor saw such an increase in spending

on culture in the time period measured in this research. Thus this outlier is a unique case that may not reflect the general relationship between the variables.

Possible Qualitative Directions

Several components of my research that could be improved with other types of case studies, especially in considering the specificity of cases and variables selected. As previously noted, the subjectivity surrounding both of my key variables, culture (or the arts) and life satisfaction, makes them difficult to measure independently and in terms of a relationship. Resultantly, several components of my research could be altered to capture a closer, more specific relationship and produce more useful results. Time is also necessary to consider when thinking about alternate research methods - the impact of the independent variable government spending on culture (or the difference in spending) would occur over an extended period of time. As with life satisfaction, my dependent variable, change within a large population such as a country would likely occur slowly. Thus any further research should allow for the passing of time when considering if there is an impact.

The cases chosen should also be selected more intentionally. I chose about nineteen European countries because the data available on governments' cultural spending existed for those countries. While they are linked by geography, these countries do not do a good job of representing the world. Even if I leveraged them to represent the western or more economically developed world, countries integral to those groups have been excluded, like the United States or Canada. Further, the European countries used were not linked by any qualitative or quantitative factor - the selections were completely random and thus lacking in intentionality. Comparing a more selective group of countries, or looking at the spending in a single country, could be a more valuable method of research. Other scholars have studied individual countries, regions, or cities, which presents another option for choosing a case in which to measure cultural support and life satisfaction.

While there may be a relationship between government spending on culture and life satisfaction, this relationship is made especially difficult to measure due to many possible confounding variables or other linking mechanisms. There may be intermediary variables between government spending on culture and life satisfaction. The question of who uses or is impacted by spending on culture was not accounted for, and measuring differences between users of cultural spaces and amenities and non-users may produce different results. Culture itself is also very vague and broad - as stated, this variable includes spending at all levels of government. Selecting more specific variables for culture, like spending on museums, spending on performing arts venues, or spending at only one level of government, and then comparing that to life satisfaction, may be capturing a more direct relationship. As also mentioned, measuring who uses cultural services versus who do not and comparing their life satisfaction would be another more direct research method.

Conclusion

While a relationship between spending on culture, support for democracy, and life satisfaction is demonstrated by the OLS regression results, more research is needed to assess how much impact support for culture and the arts, through spending or otherwise, has on life satisfaction. The small coefficients for CSPerCap 2000 (cultural spending per capita in 2000) and Support for Democracy do not demonstrate a particularly strong relationship, although both values are significant and a part of a relatively well-performing model. In sum, my results are not especially conclusive, but suggest room for further research and that there is potential for literature to consider this relationship more directly. Given the existing research on happiness, democracy, and culture, there are methods and frameworks available that could be used to study the relationship of question

in this research. There are also preexisting beliefs and accepted theories within the scope of my research, and those beliefs and research could further direct new research. As previously mentioned, all of the variables under consideration in this research are subjective and difficult to quantify. This complicates creating a strong research design which captures the variables in question. Yet the arts and questions of happiness or values should not be avoided in research because they are qualitative and subjective; especially given the limited consideration they sometimes receive, exploring them further in research could present new and expansive ideas.

With some evidence of a positive relationship between life satisfaction and support for culture in spending and democracy, governments should intentionally consider their cultural spending. Even within European countries only, there are discrepancies between how much each country spends on culture as well as in level of democracy. Countries could better identify what makes up cultural spending for themselves and on what level of government it is happening. They should also consider private spending on culture, as well as who actually accesses culture. There is a lot of space for more research and data collection on cultural spending alone, let alone assessing personal experiences. Given the relationship presented by this regression, it seems wise for governments to consider how they spend on culture and the effects of that, as it may improve both life satisfaction.

Introduction

Why should a person be interested an inventory of houses on one side of a lake? Perhaps the scale is small, the data reflective of a microcosm which is highly locally rooted - in the smaller city of Minneapolis, nonetheless. Maybe the person is interested because, like me, they have spent countless hours moving by these properties and do not cease to be impressed by their appearance, size, and so on; like the houses, they are also local. Architecture can tell a story, and I was curious as to what stories these locally infamous homes hold. Are they simply icons of wealth and 20th century construction? Aside from those obvious features, what are the differences within this world of "starter castles?" I have compiled data of both a couple basic architectural qualities as well as the value of houses on the east side of Lake Harriet to discern what links and differentiates the properties.

The variables of this data set that I will test the include the estimated value of homes, age, and architectural style. The first confidence interval will estimate the mean estimated value of homes around Lake Harriet, measured in the unit of USD (Figure 7). For a hypothesis test, I will conduct a permutation test for correlation between the age of houses ("Decade Built") and Estimated Value (or "Zestimate") (Figure 8). A t-test for difference in mean will be used to estimate whether there is a true difference in the mean Estimated Values of Tudor and Arts and Crafts houses.

Methods

Data Sources

Several categories of the data were compiled by me, just through observation of the exterior of the houses. These variables include number of stories and general architectural style. I walked along East Lake Harriet Boulevard and recorded this information for each address facing that street. Most of these homes were not currently on the market, but I wanted a sense for the value of the homes and variation and range within that. After researching several websites that provide estimates of home values, I concluded that the "Zestimate" service on zillow.com had the most accurate estimates (when considering off-market value). I took the "Zestimate" from each address and inputted it into my data table; acknowledging that these values are not completely accurate, but still allow for a general idea of the homes' values. I also used the data of home construction listed on each address posting on zillow.com, though inputted the decade the home was built instead of the specific year (i.e. Constructed in 1947 -> Decade Built: 1940). I put all this information into my own csv file.

I am estimating the mean estimated house value for all the houses around Lake Harriet; this includes both East and West Lake Harriet Boulevard. The sample includes only the houses on East Lake Harriet Boulevard, while the population I am estimating for is all the houses around the lakes. Each case is an individual house on Lake Harriet, with a singular estimate for monetary value of that house. The sample used to estimate the population mean is portrayed in a histogram of Estimated Value (Figure 3).

The hypothesis test looks at correlation between value and age. I want to examine if the age of a house relates to its price, because several pieces of data exploration visually suggest this possibility. The histogram, showing the distribution of Estimated Values is right skewed (Figure 3), with a high outlier and two other peaks to the right of the most common value. Additionally, the histogram of distribution of Decade Built is slightly right-skewed, with a center around the decade 1920 and two high outliers of houses built in the 21st century (Figure 2).

Another confidence interval will compare two styles of houses, a qualitative variable in the study with several categories. The null hypothesis states that there is no difference, but the alternative favors Tudor homes as having a higher mean Estimated Value. This is because the average mean is higher and the range of values is higher than Arts and Crafts homes, as displayed in a boxplot comparing styles (Figure 5). These two styles were chosen and isolated from other architectural styles observed because they were the two most common, seen in Figure 1. Both Figures 4 and 5 also show that there is a difference in house style and estimated value.

Additionally, Figure 6 demonstrates that Arts and Crafts homes are generally older than Tudor homes, and age may play into Estimated Value, as explored by the permutation test for correlation (Figure 8).

Statistics for Bootstrap Sample

Sample mean: $\bar{x}$ = 2036893

```
##   mean(Estimated.Value.....Zestimate..)
## 1                               2036893
```

Sample size: n = 49

Standard Deviation: s = 868084.2

```
##   sd(Estimated.Value....Zestimate..)
## 1  868084.2
```

Population mean: μ_h

I will use a bootstrap distribution to estimate the mean estimated value for all homes on Lake Harriet, at a 95% confidence interval. I will use the statistics of the sample mean and standard deviation to conduct this test.

Hypotheses for Permutation Test for Correlation

ρ = the true correlation between Decade Built and Estimated Value

Significance Level: $\alpha = 0.05$

H_0: $\rho = 0$ There is not a correlation between Decade Built and Estimated Value.

H_a: $\rho \neq 0$ There is a correlation between Decade Built and Estimated Value.

Hypotheses and Statistics for T-Test for Mean

```
##   mean(Estimated.Value....Zestimate..)
## 1                               1762312
```

```
##   mean(Estimated.Value....Zestimate..)
## 1                               2108897
```

Sample means for Estimated Value:

Tudor Houses: $\bar{x}$ = 2108897

Arts and Crafts: $\bar{x}$ = 1776312

Population means for Estimated Value:

Tudor Houses: μ_t

Arts and Crafts: μ_a

Significance Level: $\alpha = 0.05$ I will use a 95% confidence interval.

H_0: $\mu_t = \mu_a$ There is no difference in the true mean Estimated Values of Tudor houses and Arts and Crafts houses.

H_a: $\mu_t > \mu_a$ The true mean Estimated Value of Tudor houses is greater than the true mean Estimated Value of Arts and Crafts Houses.

Variables

Qualitative:

- Address: four-digit address on E Lake Harriet Blvd
- Estimated Value, or "Zestimate:" $ (dollars)
- Decade built: every 10 years; 1900 through 2000
- Number of floors: single digit reflecting variable of floors

Qualitative:

- Architectural Style of House:
  - Arts and Crafts
  - Beaux Arts
  - Bungalow
  - Colonial Revival
  - Contemporary
  - French Eclectic
  - Mediterranean (including Spanish and Italian Revival)
  - Ranch
  - Renaissance Revival
  - Tudor

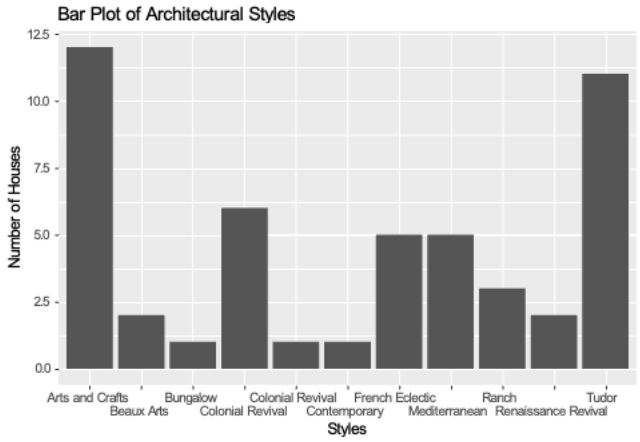


Figure 1: Architectural Style

The most common styles were Arts and Crafts and Tudor, with Contemporary, Bungalow, and Renaissance Revival the least common - only one house in each of those categories (Figure 1).

There appears to be variation among the estimated values of each style (Figure 4). The Ranch homes are perhaps most clustered, with similar estimated values and decades built. Alternatively, the Colonial Revival style has a relatively large range in estimated values and decades built. There may be a relationship between higher value and newer construction - the two most valuable homes (by the Zestimate) were the two homes built after 2000. The oldest home, conversely, has the lowest estimated value.

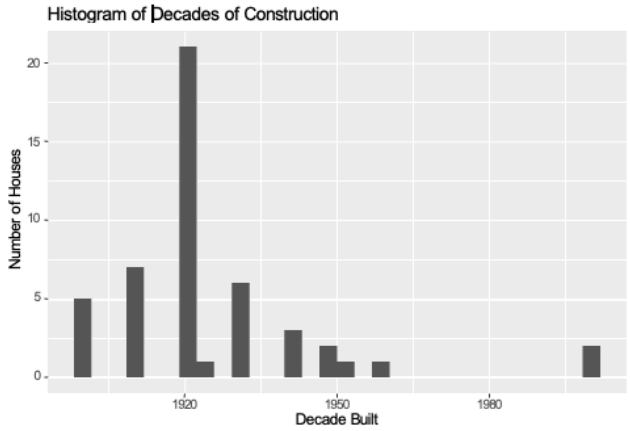


Figure 2: Decades Built Histogram

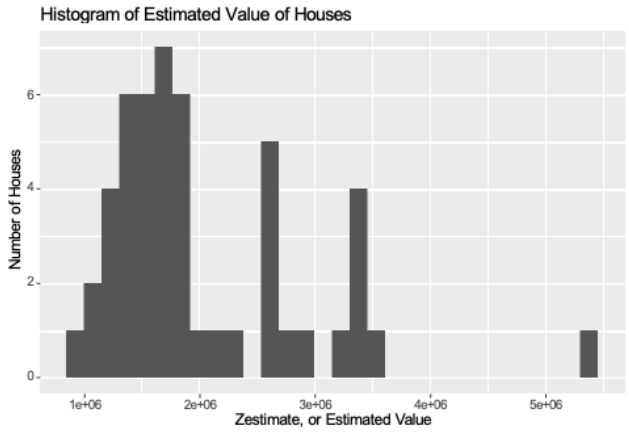


Figure 3: Estimated Value Histogram

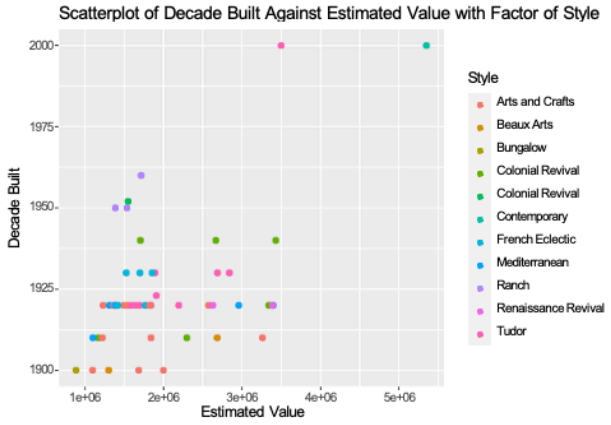


Figure 4: Scatterplot of Estimated Value and Decade Built

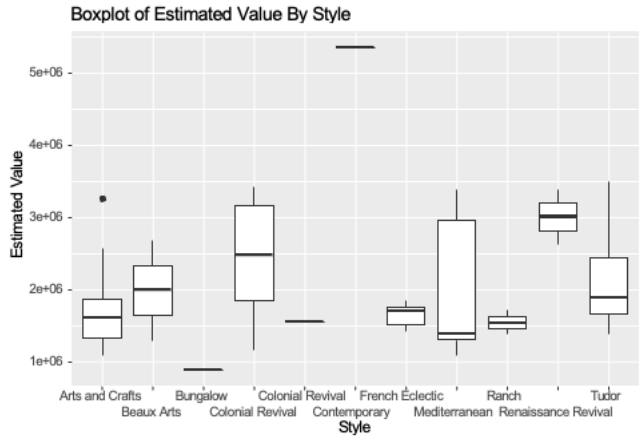


Figure 5: Estimated Values by Architectural Style

These boxplots reflect the estimated value of houses within each architectural style (Figure 5). There is a tangible level of variation between the ranges of estimated values and the styles, although with fewer samples for certain styles it is harder to draw conclusions. The Bungalow has the lowest estimated value, while the single Contemporary home has an estimated value far higher than any other property observed. The Colonial Revival, Mediterranean, and Tudor styles have similar ranges, though their centers are all different. Conversely, the Ranch and French Eclectic styles have the smallest range of estimated values (not considering the styles with only one observed home). The Arts and Crafts style is the only style with a (high) outlier, and the Beaux Arts and Ranch styles appear to have the most symmetric distributions of estimated values.

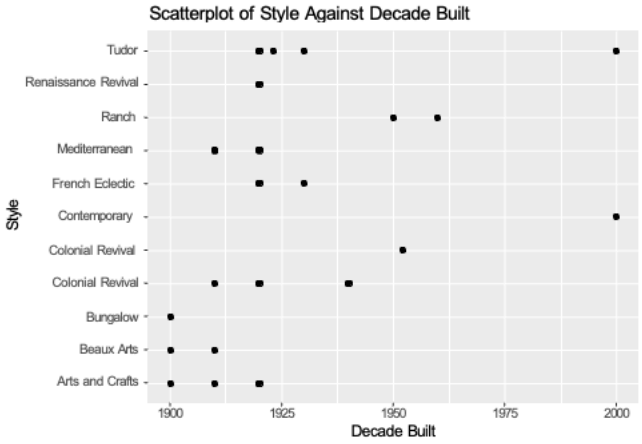


Figure 6: Style and Decade Built

As displayed in Figure 6, large majority of the properties were built before 1960, with only 2 built in the 20th century. None were built before the 20th century. As might be expected, the Contemporary house is one of these 2 recent builds, with a Tudor house as the other. This gives the Tudor style the largest range of time, otherwise clustered in the early 20th century. The Arts and Crafts, Beaux Arts, and Bungalow styles are generally the oldest constructions. All the Ranch homes were built in the 1950s or 60s, while all the French Eclectic homes were built in the same size range, but from 1920 through 1940. The greatest number of homes were built in the 1920s.

Results

Confidence Interval

```
##
##  ** Bootstrap interval for statistic
##
## Observed Estimated.Value....Zestimate.. : 2036893
##  Mean of bootstrap distribution: 2035394
##  Standard error of bootstrap distribution: 121539.7
##
##  Bootstrap percentile interval
##     2.5%    97.5%
## 1806788 2286372
##
##        * ---------------------*
```

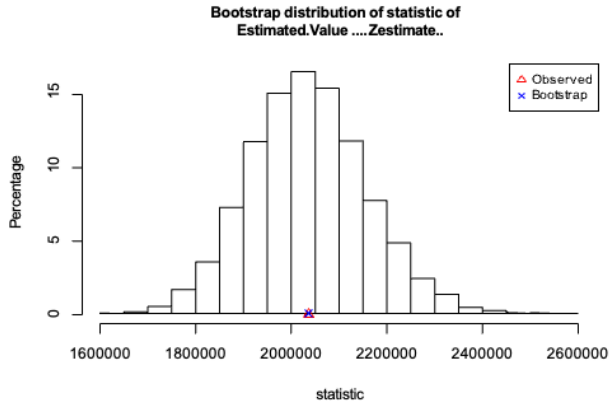


Figure 7: Bootstrap Distribution of Mean Estimated Value

Hypothesis Test

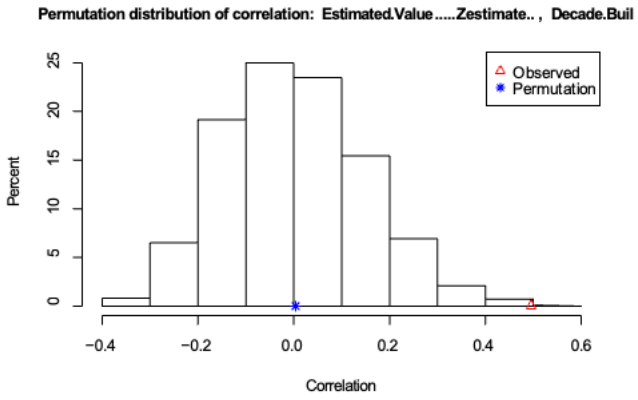


Figure 8: Corrletion Between Decade Built and Estimated Value

```
##
##  ** Permutation test: Correlation **
##
```

```
##  Permutation test with alternative: two.sided
##  Observed correlation between Estimated.Value....Zestimate.. , Decade.Built : 0.495
##  Mean of permutation distribution: 0.0037
##  Standard error of permutation distribution: 0.0037
##  P-value:  0.004
##
##  *--------------------*
```

The observed correlation between Estimated Value and Decade Built is 0.495 (Figure 8). The p-value = 0.004 = 0.4%, which is smaller than α and thus statistically significant.

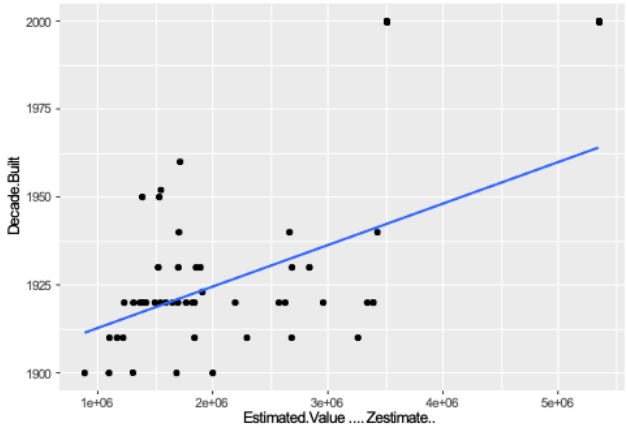


Figure 9: Scatterplot of Decade Built and Estimated Value

```
## [1] 0.4950248
```

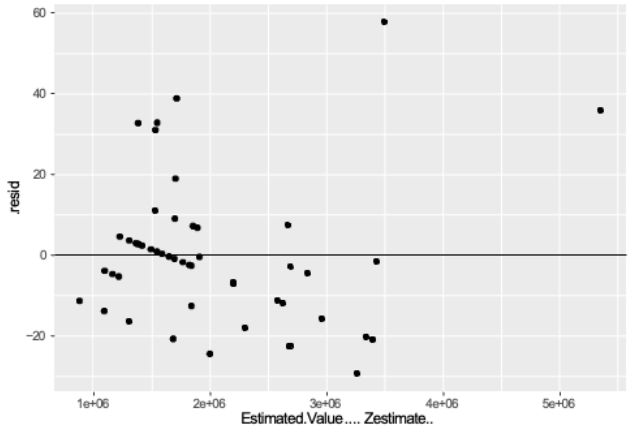


Figure 10: Residual Plot of Estimated Value

The residual points seem to be generally scattered evenly around y = 0, though they are more dispersed and evenly distributed on the negative side (negative y-values) (Figure 10). There appears to be about an even number of points on both side of the y = 0 line, suggesting that a permutation test for correlation may be an appropriate hypothesis test. Figure 9 displays how closely the values themselves follow a linear pattern.

T-Test

```
##   Welch Two Sample t-test
##
## data:  Estimated.Value....Zestimate.. by Style
## t = -1.3116, df = 20.692, p-value = 0.204
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -896599.2  203429.9
## sample estimates:
## mean in group Arts and Crafts          mean in group Tudor
##                       1762312                      2108897
```

The t-value is -1.3116, the degrees of freedom are 20.692, and the p-value = 0.204, or 20.4%, which is greater than α and thus not statisically significant. The confidence interal is the mean difference in Estimated Value of Tudor and Arts and Crafts houses, which is between $203430 and $896600.

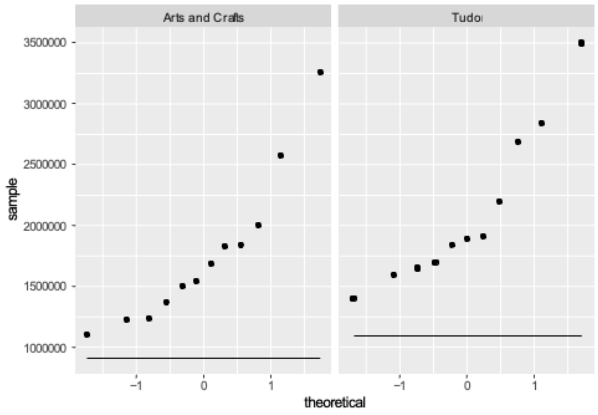


Figure 11: Plots of Normalitiy for Arts and Crafts and Tudor Estimated Values

To check the normality assumption, the qqplot function was used to create two comparable linear models that display the shape of the data points in comparison to a straight line (Figure 11). While both plots have several outliers, the majority of the points lie along the straight line. The normality is likely met, though the outliers indicate the possibility that this is not true, and in that case a t-test would not be appropriate.

Discussion

We are 95% confident that the true mean of the estimated value of all homes around Lake Harriet is between $1,806,788 and $2,286,372. The sample used for the bootstrap distribution (Figure 7) reflects around half of the homes on the lake, thus the sample measures that same value - estimated house value - for the entirety of the lake.

The results of the permutation test for correlation between the age of a house and its estimated value are statistically significant because of the small p-value of 0.4%. We have evidence to support the alternative hypothesis, because the tested correlation is 0.495, which is not 0 - the alternative hypothesis states that the correlation between the two variables is not equal to 0.

We do not have enough evidence to support the alternative hypothesis because the p-value was very large at 20.4%, thus we cannot conclude that there is a difference in mean Estimated Values of Tudor and Arts and Crafts houses. Were the test to be statistically significant, we have the values $896600 and $203429.9, which would be the average difference in means.

I do not have total confidence that the normality assumption was met for the t-test for difference in mean, due to the outliers in both Arts and Crafts and Tudor houses plots. This may be a weakness for this method

of testing.

An obvious limitation is in the data obtained online; online postings for houses often do not come from the owner and have missing or incorrect information. Especially regarding the estimated home value, there is a level of uncertainty for the accuracy of these values.

There are many possible variables to consider in terms of these houses, and I observed a limited number. It is possible that a greater number of variables or different types of variables altogether would be more useful for drawing conclusions about these homes. The scope of my study in terms of number of houses studied is also quite small. For the sake of time and data collection, I only observed houses on the east side of Lake Harriet. A more comprehensive or accurate study would likely include a larger sample size, such as all the houses around that lake or even all the houses around the other connecting lakes (Bde Maka Ska, Lake of the Isles, Lake Cedar).

This was an observational study, and considering my limited experience with identifying houses, it has a perhaps inaccurate or at least fluid bias regarding that variable. My categorizations of each house were based on personal opinion derived from past knowledge and some research on architectural styles, so they are really just estimations. Further, there are substyles within some of the categories not accounted for in the study. The degree of specificity in this study could be heightened in several ways, so it provides more the beginning for an understanding for types of houses on Lake Harriet as opposed to an entirely comprehensive summary.

More extensive research could compare houses on the lake(s) to those in surrounding neighborhoods, whether regarding value, size, or style. A study could also consider the demographics of people who live in these houses; for example, whether there is a correlation between gender or race and value of house owned, or if ownership is generally male or female, or average age of the owner.

DRAWING

Sayles Hill Campus Center

Scoville Hall

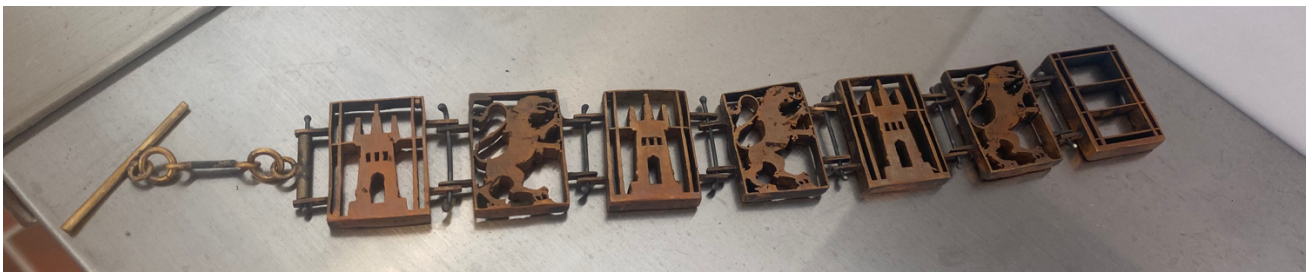
West Gym

JEWELRY

Honeycomb Suite

Necklace, Earrings, & Ring

Cast Honeycomb in Brass with Silver Chain and Fabricated Copper



Alcazar Bracelet

Cast printable resin in brass with silver

Gate from the Alcázar de los Reyes Cristianos in Cordoba, Spain
Links designed off of gate panels

Additional Modeling Renderings

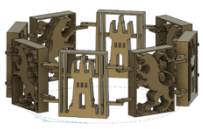
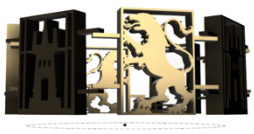


Image from Fusion360



Finished Rendering

Left, Alcazar Gate in Cordoba, Spain

Above, Renderings in AutoCad of Link and Full Bracelet