Venetian Time:

An Examination of Time and Space in Venice

An Interdisciplinary Qualifying Project
submitted to the faculty of
Worcester Polytechnic Institute
in partial fulfillment of the requirements of the
Degree of Bachelor of Science

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Abstract

This project was conducted to increase understanding of perceptions of time in Venice. Locations of clocks in Venice have been recorded and evaluated for implementation on veniceprojectcenter.org. The project involved evaluation of yearly and daily time cycles which use information collected by the Venice Project Center over its 25 years. Field work conducted established a pace of life for Venice in order to compare to other cities. This measurement was calculated to study correlations between pace of life and other community variables. The project involved creation of an isochrone map to show how tourists impact Venetians with regard to mobility.

Executive Summary

This project explores the perceptions of time in Venice through a variety of topics. By observing time keepers, characterizing time, as well as looking at travel times, this project begins to develop a greater understanding of time in Venice. These methods involve conducting field work and collecting time related data from past project teams for publication in order to explore real-world applications.

One prominent connection to time in Venice includes the study of clocks. The division of clocks as observed by our team is shown in Figure 1. By observing the number, location, and accuracy of many clocks in Venice, the project explores how precisely Venetians measure time.

Figure 1: Clocks Studied in Venice

In addition to measuring time by clocks, the team collected information on bell ringing times. Bells in Venice play a special role as time keepers. As people become more accustomed to their surroundings, bells often aide in their understanding of time. The team has consolidated information from past teams with our own field work.

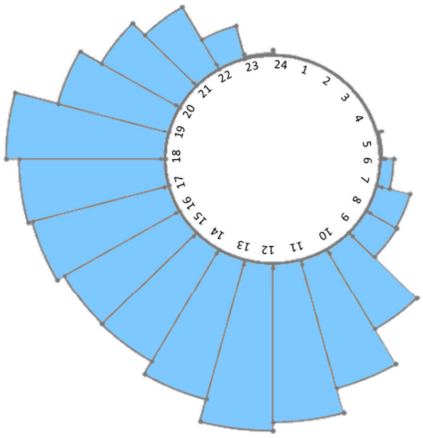

Figure 2: Daily Time Cycles

Contributions to the understanding of Venetian time cycles were made through this project. Using information collected by past teams through the Venice Project Center's 25 years, visual displays were created for both daily store hour cycles and yearly cycles. These cycles play an integral role in the perceptions of time in Venice.

This project also focused on measuring the pace of life for Venice based on a 1999 study conducted by Robert Levine.

Advancements in the standard methodology allowed for calculation of a more accurate pace of life for Venice. This study involved collecting walking speed, working speed, and clock accuracy data in the city. The figure below provides a visual representation of walking speeds and the effect the speeds would have when walking the length of a marathon- 26 miles. As one can see, Venice's walking speed differs whether looking at tourist, Venetian, or overall pedestrian. The study found that, on average, native Venetians walk 3.3 miles per hour while tourists of Venice walk just 2.9 miles per hour.

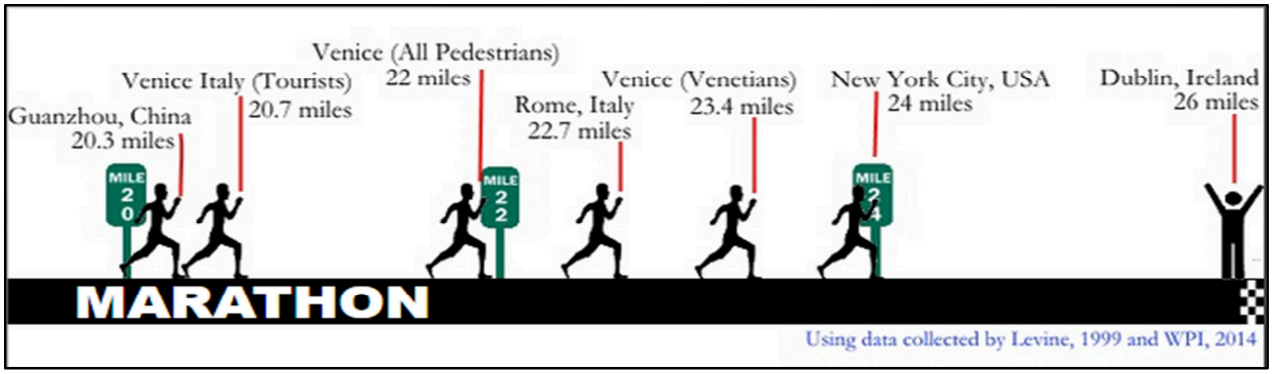

Figure 3: Walking Speeds in Distance of a Marathon

Another measurement in determining pace of life was collecting working speed data. This project involved collecting working speed data from post offices and tobacconist shops. In our experimentations, Venetian tobacconist shops worked 9.9% faster than Venetian post offices. These measurements were compared with other cities to view Venice on a global scale. Clock accuracy in Venice was the final measurement in the pace of life study. After a collection of randomly selected bank clocks were observed, the Venetian clock inaccuracy measurement was found to be 48 seconds.

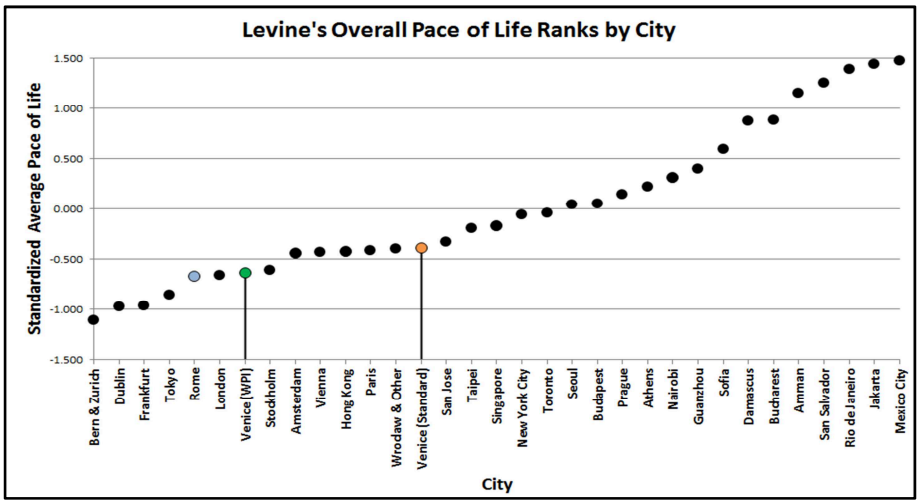

Figure 4: Overall Pace of Life Rankings

From these three measurements, the pace of life for Venice was determined and compared to that of other cities. Venice, through the standard methodology, ranks 14th. With our methodology, which better reflects unique Venetian lifestyles, Venice ranks 7th compared to other cities studied. The rankings are shown in the figure below.

The final portion of this project relates the travel times and walking times by creation of a map to display area of Venice covered in a given time frame. This also shows the impact of tourists on the travel times of Venetians. Overall, this map can be developed further and implemented in other cities to show percentages of area and population reached. The image below shows the maximum area reached by a Venetian using multiple transportation modes with and without influence of tourists.

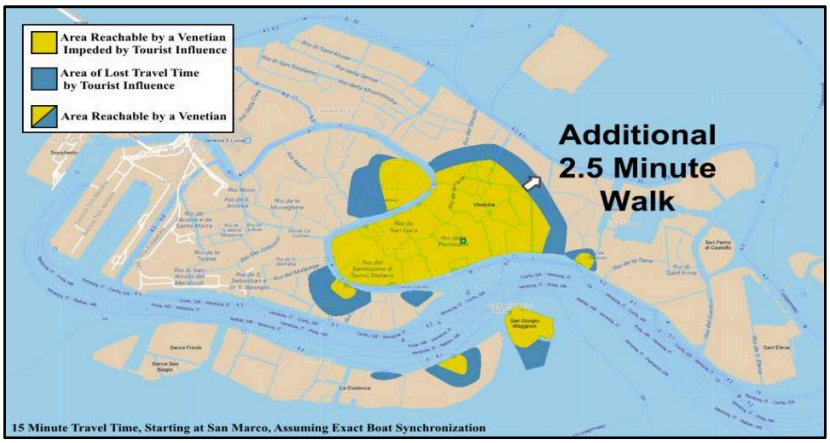

Figure 5: Tourist Impact on Travel Times

Overall, this project examined a variety of ways in which time affects the lives of those in Venice. Our team has gathered a significant amount of past data, as well as collected our own, in order to draw conclusions and comparisons with relation to time. Time in Venice moves differently than in other cities. The team defined multiple measurements to quantify perceptions of time in Venice. By looking at time keepers, characterizations of time, and travel times, our team has gained an appreciation for time in Venice. Through our findings, we hope others do the same.

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1. Introduction

24 hours to a day, 60 minutes to an hour, 60 seconds to a minute. A clock will always move at these constant rates. Different people and cultures perceive these movements differently. Venice is no exception. Each individual in Venice, whether they are tourist or native, lives by their own cycle. This intermingling of cultures, combined with that of Venice's unique mobility methods, creates a perception of time like no other, Venetian Time.

It is difficult to explain this phenomenon. In *Einstein's Dreams,* author and physicist Alan Lightman writes about a fictional but genuine relationship between clocks and humans. Here, mechanical time sets a defined pace for all.[1] In *What Time is This Place*, author David Lynch sees time as a human invention. Rhythms and events exist, but time itself is a mental idea, a kind of tool used to give order to events.[2] Even natural time cycles influence forms of time perception. Internal cycles such as breathing, growth, and hormone production shape our perceptions from the inside out.[3] Exploring Venetian Time is an insightful experience into yet another aspect that makes Venice such a unique city.

As David Lynch writes, "the time structure of a culture must be loose enough to tolerate a wide diversity of group time structures."[4] The goal of this project was to examine issues and experiences related to time by the people of Venice. Time is perceived and utilized differently between cultures. We utilized and expanded on studies associated with travel times and mobility. These studies were conducted through the Venice Project Center (VPC) and other outside groups. The VPC is a research facility founded by Fabio Carrera and operated by Worcester Polytechnic Institute (WPI). Over the past 25 years, data has been collected and stored in the VPC's online database, the CK Console. The specific objectives of our project were as follows:

1. To locate and examine time keepers of Venice
2. To characterize Venetian Time and create visuals
3. To explore various impacts on travel times

[1] Lightman, 1993
[2] Lynch, 1972
[3] Lynch, 1972
[4] Lynch, 1972

Our group gathered and consolidated information relating to Venetian Time. Our team viewed progression of time by observing time keepers. These included various types of clocks and bells. We also characterized Venetian Time both visually and numerically. This was done through investigating time cycles and uncovering the pace of life in Venice. Investigations into how individuals travel about Venice by foot and by boat were also conducted. In addition, our team looked at the influence of tourists on Venetian travel. Through our project, tourists and Venetians will gain a deeper understanding of just how much Venice can change their perception of time.

2. Time Keepers

This section explores various time keepers throughout the city of Venice including clocks and bells. This section explains each of the time keepers as well as our findings and recommendations for future teams.

2.1 Background

During the late middle ages and Renaissance, cities became more interested in the measurement of time.[5] In 1495 Venice's senate instructed that the *Torre dell'Orologio* be built. This clock tower would show the world Venice's interests in engineering and technology as well as its religious commitment. There are other time keepers besides clocks in Venice. Church bells are time keepers by chiming at regular intervals thereby making the flow of time more apparent. These bells set a rhythm for the city.

Figure 6: Torre dell'Orologio

2.1.1 Clocks

Figure 7: Minich Clock

The first purpose of clocks is to register time. They set a metronome for the pace. Located throughout Venice there are 21 clocks donated to the city by Angelo Minich.[6] Angelo Minich was a surgeon born in Venice. Upon his passing in 1893, Minich left the city money to build Ponte Minich, a bridge in Sestiere Cannaregio, and to fabricate these clocks to create a punctual city.[7] An example of a Minich clock can be seen in Figure 7. There are, however, other clocks including those on bell towers located throughout the city. Some of these bell tower clocks have been documented and recorded by past WPI teams. Of the 107 bell towers recorded, only 32 had been checked for whether they had a clock face before our team.[8]

[5] Muraro, 1984
[6] Carraro, 2014
[7] "Ponte Minich"
[8] Manor, Maitland, Kahn, Heinricher, & Hart, 2014

2.1.2 Bells

Bells that chime on a specific interval help people understand the flow of time. Once familiar with the chiming pattern of a bell, people will utilize this in their daily cycles. Previous groups have collected data for 7 of the 107 bell towers with bells that ring on an interval.[9]

2.2 Methodology

Time keepers in Venice play an important role in the perception of time. Through our team's work, we added to existing data collections within the Venice Project Center's online database, the CK Console. In addition, we created interactive maps containing time keeper data.

Our team produced the following deliverables for the time keepers section:

1. An interactive map containing the location and images of time keepers
2. Updated bell ringing times
3. Updated recordings of bells

2.2.1 Inventorying of Clocks

Our team traveled to the 21 Minich clocks. We took pictures for upload to the CK Console and recorded the following information:

1. Location of Clock
2. Date Visited
3. One or Two Faced
4. Working (Yes/No)
5. Accuracy (If applicable)
6. Number of Hands
7. Type of Clock (12/24 hour or other)
8. Description

Our team also visited bell towers to find which towers have clocks. While at the bell towers we collected the following information for purposes of updating information collected by past teams:

1. Bell tower Code
2. Date Visited
3. Does it have a Clock? (Yes/No) If so, answer the following questions:
4. One or Two Faced
5. Working (Yes/No)

[9] Manor et al., 2014

6. Accuracy (If applicable)
7. Number of Hands
8. Type of Clock (12/24 hour or other)
9. Description

The locations of bell towers in Venice, Giudecca, San Giorgio Maggiore, Murano, Burano, Mazzorbo, Torcello, and Sant' Erasmo were visited. The figure below shows visited bell towers in blue and bell towers which weren't visited in red.

Figure 8: Bell Tower Locations in Venice, Giudecca, and San Giorgio Maggiore

While our team collected data on Minich clocks and bell tower clocks, we also came across other public clocks. We documented these as public time keepers and included them in our research.

2.2.2 Recording Bell Ringing Times

To catalog bells, our group collected sound recordings and daily ringing times. We checked bells at common ringing times, including 9:00 AM and 12:00 PM. Our team decided that the best way to manage this was to assign each individual a group of bells. Each team member recorded using a smartphone with the same quality producing .m4a files.

2.3 Results and Analysis

Through analyzing results of the time keepers section, the team better understands time measurement in Venice. This has been completed through the study of different types of clocks and timekeeping by bells.

2.3.1 Interactive Clocks Map

The map of clocks in Venice can be accessed directly from veniceprojectcenter.org by hovering over Data, Infrastructure, Clocks, and clicking on each of the three categories. The color coded map shows locations of the 21 Minich clocks, 9 bell tower clocks, and 4 other notable public clocks throughout the city of Venice.

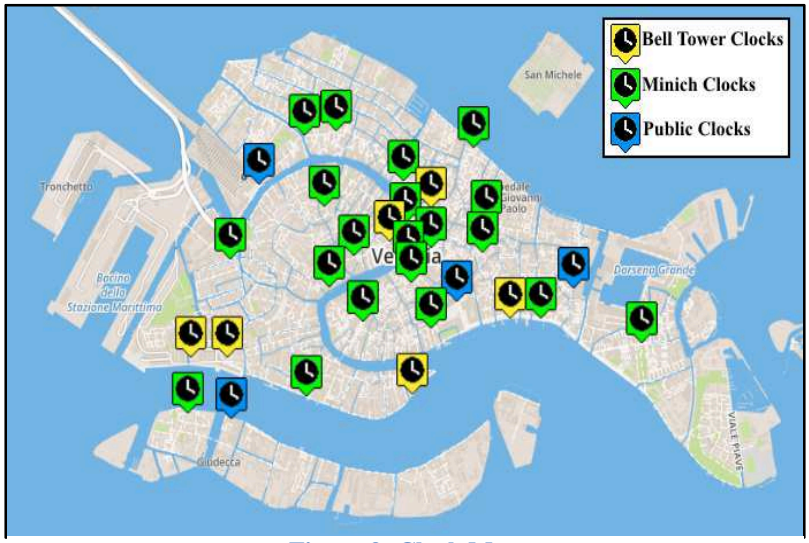

Figure 9: Clock Map

When a user selects a clock icon from the map, they are shown an image of the clock and other relevant information. The overall map can be seen in Figure 10.

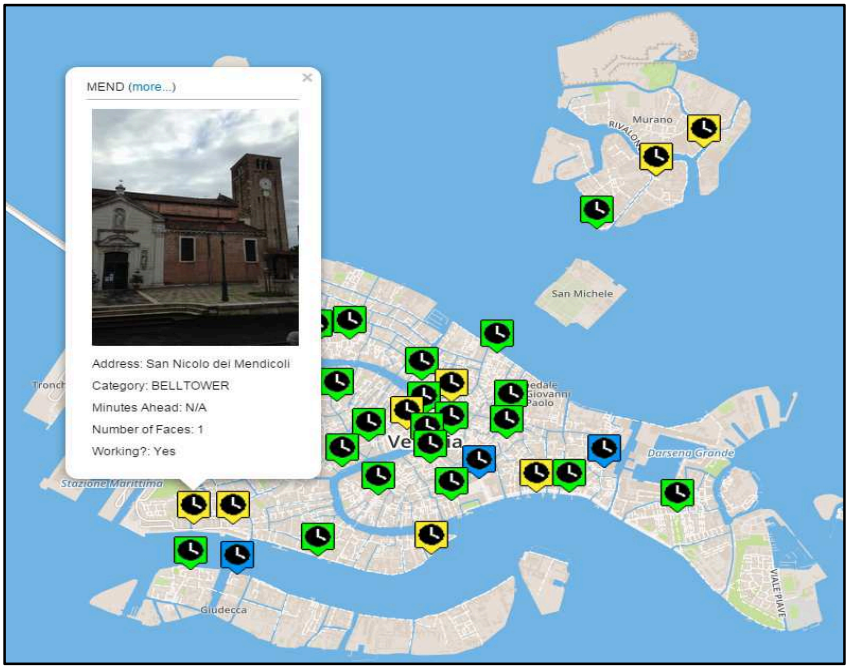

Figure 10: Features of Clock Map

Once a clock is selected, the user can click on more info to expand the information box to include additional data collected on the clocks. If the user wishes to view all known information of a clock, including pictures, they can click on the "more…" tab to go to the individual clock's Venipedia page.

Overall, the exploration of clocks in Venice led us to understand time perception. Beginning with the 21 Minich clocks, we noticed the clocks rarely synced to the time provided by the telephone company. The mean time of inaccuracy for the clocks is 8.81 minutes with a median time of 0 minutes. The greatest inaccuracy was recorded as 320 minutes ahead in Santa Croce at Campazzo tre Ponti 460. An image and further statistical analysis can be seen in the figure below.

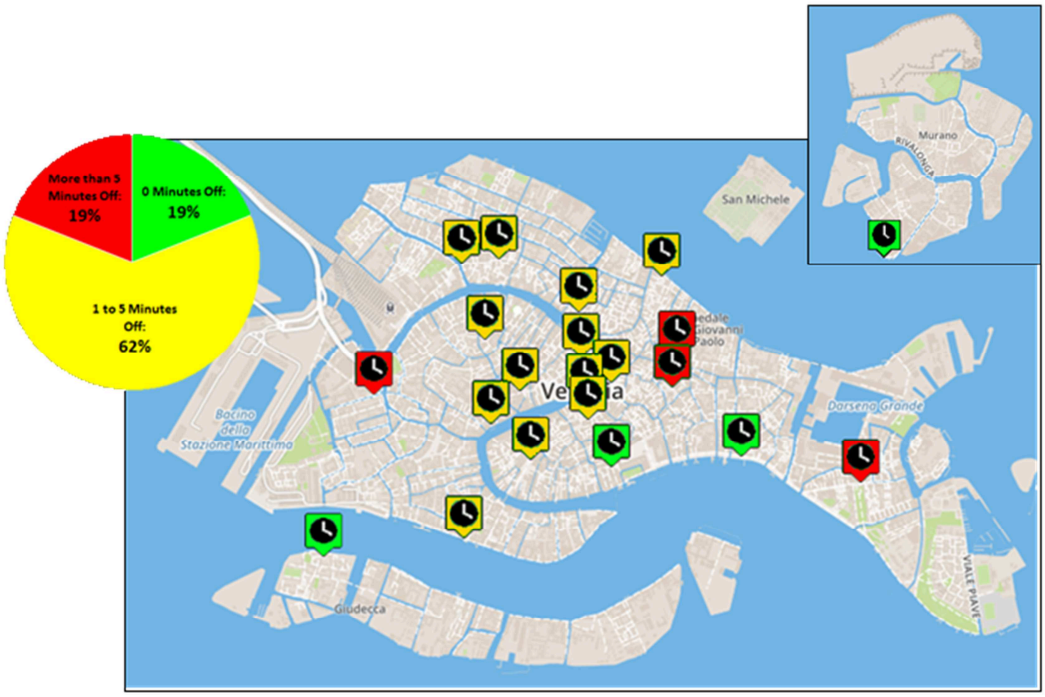

Figure 11: Minich Clock Accuracy

Structured by the boat schedule, each minute is important to the Venetian. Because of this observation and the inconvenient heights of the clocks, our team has concluded that these Minich clocks are not used as primary time keepers of the city. With the clocks at very high spots on the outside of buildings, we understand that Venetians are very unlikely to utilize these clocks to measure time accurately. It would rather seem that these clocks provide landmarks for common meeting places and general time understanding.

The clocks on the bell towers play important roles in Venetian culture. Of the 102 bell towers visited, 9 of them had clocks on them. This low percentage, 8.8%, is not surprising. Many of the bell towers are too high to have clocks on them. These clocks would not be visible nor accurately readable

by most. An interesting observation is that of the 9 bell towers with clocks, 2 were 24 hour clocks and 7 were 12 hour clocks.

2.3.2 Bell Recordings

A map seen in Figure 12 shows the locations of added bell recordings to the project center website.

The ringing times have been added to collections set up by previous teams. Venice is regulated in part by bells. The bells influence Venetian Time and thus by recording the sounds of these bells others can experience a small portion of this unique sense of time.

Figure 12: Bell Recording Locations

The feature to listen to bell recordings on bells.veniceprojectcenter.org is useful as it helps to orient the user to the layout and sounds of Venice. By recording additional bell ringing, our team was able to contribute to the collections started by past teams.

Our team understands that perceptions of time are influenced by bell ringing times in Venice. With knowledge of the ringing times, a person will regulate their day around them. As more data is collected, this website becomes more relevant to the user. For example, the ringing times are useful for orientation purposes. In conclusion, although our team did record many bells, there is always room for growth within this data collection.

2.4 Recommendations

Through recording data for use on bells.veniceprojectcenter.org, our group came to the conclusion that the website has potential for updates. First and foremost, our new recordings must be added to the website by a future team. The website currently does not allow for automatic audio updates through the CK Console. Also, by implementing a slider feature, similar to venicebells.com, the website can display information on ringing times. Each bell tower marker could be made to glow

during the times they ring when the slider is active. Additional ringing time information for a specific bell can be stored in that bell tower's "more info" selector page. We recommend a future team combine this function in order to benefit both future teams and users. If one looks for information specific to a bell tower on bells.veniceprojectcenter.org, it would seem logical to provide the ringing times too. All of the bell data collected by past WPI teams should be made available to the public in one place with this application. In addition to website functionality improvements, there is still more data to be collected regarding ringing times of the bells.

3. Characterizations of Time

Along with clock and bell time, there is experienced time. This time is discussed in the pace of life, stressed and unstressed time that moves slowly or quickly. In cities, the hustle and bustle of the day plays a role. Various factors contribute to this dense traffic, noise and people density. This section explores quantifying that feeling for Venetians.

3.1 Background

Time cycles revolve heavily around using past research and outside knowledge. In order to conduct a Pace of Life methodology for Venice, it is important that past methodologies are first understood.

3.1.1 Time Cycles

Venice's typical daily cycle influences the community's perception of time. Most stores open at 9:00 AM and close at 7:30 PM. Generally, stores close between the hours of 1:00 PM and 4:00 PM for lunch.[10] Stores and restaurants that cater to tourists follow "*Orario Continuato*," or continued schedule and do not close in the middle of the day. Many of the stores in Venice are closed on Sunday.[11] These contrasting daily cycles experienced by tourists and Venetians contribute to the concept of Venetian Time.

[10] Srl, 2014
[11] Srl, 2014

Venice's yearly cycles also influence the perception of time. Italy traditionally has three special seasons in the span of a year: *Carnevale* (Carnival), Holy Week, and *Ferragosto* (August's Holiday). *Carnevale*, the largest celebration of the year, marks the last few days before the season of Lent begins.[12] *Carnevale* is known to last up to two weeks, with nightly festivities throughout the city. Holy week is celebrated during the week beginning on Palm Sunday and ending on Easter Sunday. [13] *Ferragosto* is rooted in Roman Emperor Augustus' proclamation of August as a full month of feasts and worship of gods and goddesses.[14] Many business owners close their doors for an extended part of August and go on vacation. Venetians also celebrate many other holidays throughout the year, both national and local. Venice's yearly time cycle is rooted in religion and tradition influencing broader perceptions of time.

3.1.2 Pace of Life

"The Pace of Life" study by Robert Levine compared average walking speed, working speed, and public clock accuracy in major cities in 31 countries.[15] The premise of this study is to quantify the pace at which a city moves. Naturally, the Pace of Life of a city goes hand in hand with perceptions of time. Levine's methodology served as a starting point to gain insight into Venice's Pace of Life.

The first indicator of the pace of life is the average walking speed. A minimum of 35 male and 35 female pedestrians were observed walking a distance of 60 feet.[16] The pedestrians were randomly selected and only those walking alone were chosen. The measurements were made on clear summer days during main business hours in at least two locations on main downtown streets. All locations were flat and unobstructed. In 2006, Richard Wiseman conducted the same methodology as Robert Levine in order to find updated walking speed rankings for countries.[17] A criticism of Levine's methodology includes the relatively small sample size for this experiment. The distance of 60 feet traveled may also be too small and be more prone to measurement error. In addition, most measurements were taken in one city from each country and were said to reflect the pace of life of the entire country.

[12] World, 2014
[13] World, 2014
[14] World, 2014
[15] R. Levine & Norenzayan, 1999
[16] R. Levine & Norenzayan, 1999
[17] Wiseman

Speed in the workplace is another indicator of the pace of life. Levine focused on the time it took postal clerks to fulfill a standard request for stamps. A researcher presented a postal clerk with cash and a note in the local language asking to purchase one stamp.[18] The elapsed time between the passing of the note and the completion of the request was recorded. The post offices selected were randomly chosen. Also, a minimum of eight postal clerks were approached in each city. The work speed of a postal clerk may not be reflective of the entire range of working environments in a city, but it provides a standardized starting point. This experiment also does not factor in waiting time at the post office. The small sample size of this experiment is another point of concern when considering this measurement.

Public clock accuracy is the last indicator of pace of life. Clock accuracy can provide insight into how much a community needs to be oriented to the exact time. A total of 15 bank clocks were randomly chosen and the observed time was compared to that of the telephone company. The net difference in seconds between these two times were recorded. A larger variety of clocks utilized by the public could have been observed to better capture the clock accuracy of a city.

3.2 Methodology

Time can be characterized in many ways, but each requires a different method of measurement. Characterizing time by day and by year require cyclical measurements. The Pace of Life also characterizes time and requires concrete calculations and comparisons.

Our team produced the following deliverables for characterizing time in Venice:

1. Infographics of daily and yearly time cycles in Venice
2. Calculation of the Pace of Life in Venice
3. Comparisons of Venice's Pace of Life to that of other major cities

3.2.1 Visualizing Daily Cycles

Our team has created a mockup of an interactive infographic depicting the daily time cycles of Venice. All of the data used in this infographic was extracted from the Venice Project Center's online database, the CK Console. The CK Console contains a data set called MERGE Current Stores, a compilation of all store data collected throughout the entire history of the VPC. The data was difficult

[18] R. Levine & Norenzayan, 1999

to sort through due to time inaccuracies and missing data fields. Existing data used by our team included opening times, closing times, and types of stores. This data was combined into an infographic reflecting a potential store application to be made by future teams.

3.2.2 Visualizing Yearly Cycles

A mockup of an interactive yearly time cycle infographic of Venice was produced by our team. The infographic was made with the intention for a future team to create an interactive online application. The mockup was made using information based on the celebrations in Venice and tourism data. One of the sources our team gathered holiday information from was A to Z the World Country Guides.[19]

3.2.3 Measuring the Pace of Life

We conducted Levine's Pace of Life Study in Venice in order to compare the city to others previously studied.[20] Our team also implemented additional methods in order to correct some criticisms with the original methodology.

The overall pace of life of Venice is comprised of both the Venetian and tourist individual Paces of Life. Each of these individual paces was examined to understand the whole they form. Our team has calculated the average walking speeds for both Venetians and tourists individually. We timed 70 Venetians and 70 tourists, half of each group being from each gender, walking 60 feet over a flat and unobstructed street.

Levine's study included using two locations over 60 feet. We measured walking speeds at four locations in order to see if there was a location bias in Levine's methodology. These locations were Strada Nuova in Cannaregio, Riva degli Schiavoni in San Marco, Rio Tera Lista di Spagna in Cannaregio, and Via Giuseppe Garibaldi in Castello. At Rio Tera Lista di Spagna we also measured walking speeds over 120 feet. Our team hypothesized that a longer walking distance would decrease the effect of measurement error. Levine made his measurements once for each of two downtown locations. Our measurements were taken at three different times of day for each of our four locations. This change was made in order for our group to observe changes in walking speed based on the time of day.

[19] World, 2014
[20] R. Levine & Norenzayan, 1999

The second part of Levine's experiment was to calculate the average working speed. We performed the same experiment of purchasing a stamp at a randomly selected post office. In our experiment, we used a tender of ten euros to buy a two euro stamp. This amount allowed the cashier to provide us change in bills and coins. Levine's study took a minimum of 8 samples, and we have conducted this methodology in eight post offices. Our team compared these measurements to other cities around the world as measured by Levine.

In Venice there is another source more commonly used to buy stamps. Our team explored working speeds in tobacconist shops in addition to the post offices. This gave us a better understanding of working speed in Venice as well as a broad understanding of public versus private employee speeds. Venetians typically use tobacconist shops in order to purchase stamps because of long lines in post offices. We collected measurements in the same way as done for the post offices in eight tobacconist shops throughout Venice. One difference that we did make involved the note written in Italian asking to buy a stamp. We chose not to use the note for the tobacconist shops because we felt confident enough to overcome the language barrier in order to ask for a stamp.

The third and final part of the Pace of Life experiment determined the accuracy of bank clocks throughout Venice. The study observed the accuracy of bank clocks compared to the actual time provided by the local phone company in each city. We have conducted this same procedure although feel it is outdated. Some of the banks we entered had digital clocks rather than analog. We recorded these digital values as if they were analog because of the nature of the study. Due to increased cell phone usage, we feel that bank clocks are used less as an indicator than they may have been when the study was first conducted.

By compiling the data collected from each of these experiments, we have calculated the pace of life of Venice according to Levine. Although this calculation is not exact, the comparisons that can be made with other countries are of great interest. In addition to comparing Levine's measurements, we were able to compute a more accurate pace of life according to our methodologies which are more reflective of the Venetian way of life.

3.3 Results and Analysis

Overall, each of these aspects which characterize time had results worth noting. The daily cycles, as noted by store hours, shows the day as one might expect of Venice. Yearly cycles are also of interesting note. With regard to the Pace of Life, intriguing comparisons can be made between Venice and other cities.

3.3.1 Daily Time Cycle Infographic

Our team viewed time cycles as a way to characterize time by day and by year. Beginning with daily cycles, we extracted data from previous WPI teams research. The heights of each hourly section are reflective of the number of stores open during that hour. Our team has designed this infographic to be interactive and have drafted a version. The features of the infographic are as follow. When a user hovers over an individual

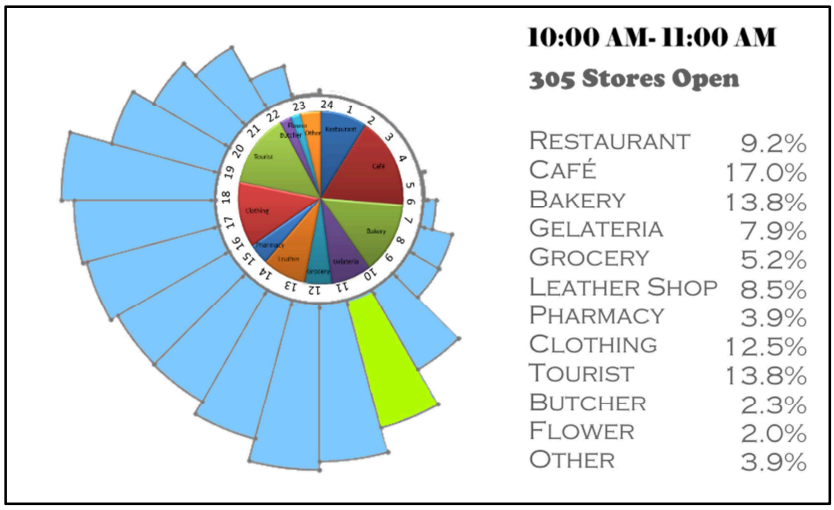

Figure 13: Stores Open 10:00 AM to 11:00 AM

area of the stores diagram, they are provided more information on which stores are open during this time. In this figure, one can see the effect on hovering over 10:00 am to 11:00 am.

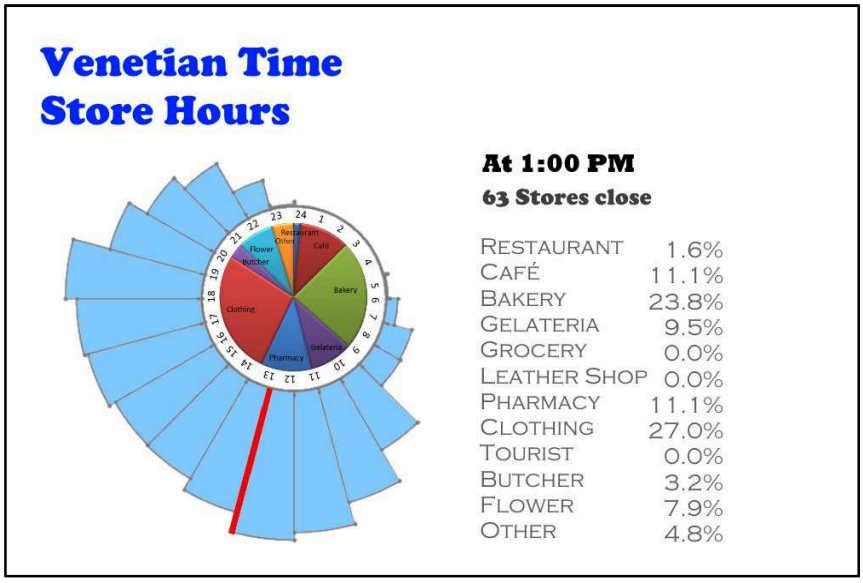

Figure 14: Store Closings Between 1:00 PM and 2:00 PM

It should be noted that the percentage breakdown of the stores open are estimated using data from past WPI teams. Figure 14 shows the effect of hovering between hours. The visual allows a user to observe the percentages of stores that have opened or closed over this time.

3.3.2 Yearly Time Cycle Infographic

In addition to looking at daily time cycles, our team considered yearly time cycles in Venice. The infographic can be viewed in Appendix B showing comparisons of the yearly holiday cycles for Venice to those of the United States.

The yearly time cycles can be viewed in a more interactive format as well. We have created a mockup of such visualizations which show tourist data for days throughout the year. This uses a spiral calendar but gives additional historical tourist data as seen in Figure 15. When a user hovers over a specific month on the calendar, they are provided with tourist information.

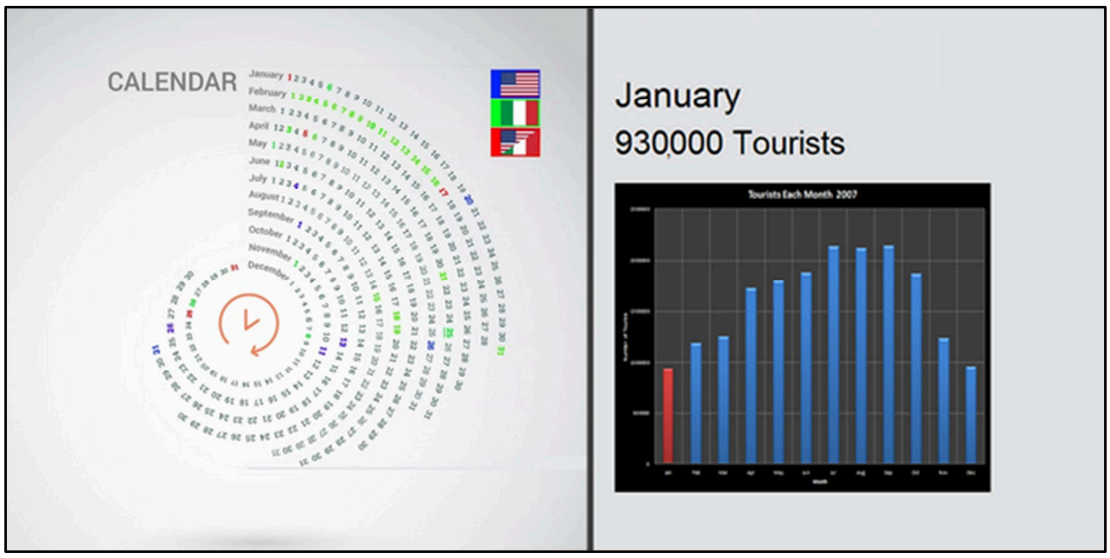

Figure 15: Yearly Cycle Interactive Tool

3.3.2 Pace of Life Study

Our team conducted Robert Levine's Pace of Life Study for Venice, Italy. We also edited Levine's methodology and conducted the measurements in a way which we felt would best provide a more accurate Pace of Life for Venice.

3.3.2.1 Average Walking Speed Levine Method

To mimic Levine's Pace of Life Study, we gathered walking speeds in 2 locations during peak business hours. For Venice, we used the data collected at 12:00 PM. The street locations we used were Strada Nuova in Cannaregio and Riva degli Schiavoni in San Marco. The average pedestrian in Venice walks 60 feet in 13.05 seconds. This compares to the cities found by Levine in 1999 as follow in the following Figure 16.

Levine's Walking Speed Ranks (All Pedestrians)

Rank	Country	City	Time (sec)
1	Ireland	Dublin	11.13
2	Netherlands	Amsterdam	11.45
3	Switzerland	Bern & Zurich	11.8
4	England	London	12
5	Germany	Frankfurt	12.01
6	United States	New York City	12.03
7	Japan	Tokyo	12.11
8	France	Paris	12.34
9	Kenya	Nairobi	12.58
10	**Italy**	**Rome**	**12.75**
11	Canada	Toronto	12.86
12	Poland	Wroclaw, Lodz & Other	12.9
13	Sweden	Stockholm	12.92
14	Hong Kong	Hong Kong	13.1
15	Greece	Athens	13.1
16	**Italy**	**Venice (All Pedestrians)**	**13.18**
17	Costa Rica	San Jose	13.33
18	Mexico	Mexico City	13.56
19	Taiwan	Taipei	13.58
20	Hungary	Budapest	13.75
21	S.Korea	Seoul	13.76
22	Czech Republic	Prague	13.8
23	El Salvador	San Salvador	14.04
24	Austria	Vienna	14.08
25	China	Guanzhou	14.26
26	Singapore	Singapore	14.75
27	Indonesia	Jakarta	14.82
28	Bulgaria	Sofia	15.57
29	Jordan	Damascus	15.79
30	Syria	Amman	15.95
31	Romania	Bucharest	16.72
32	Brazil	Rio de Janeiro	16.76

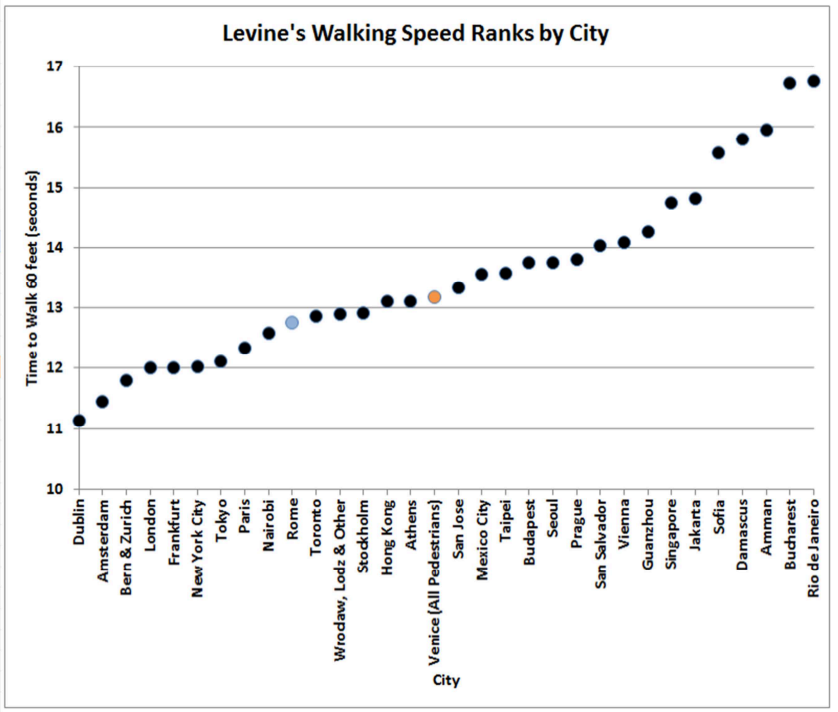

Figure 16: Levine's Walking Speed Rankings (All Pedestrians)

From this image we see that the pedestrian walking speed calculated by our group is fairly close to Levine's calculated speed for Italy, 13.18 seconds to 12.75 seconds respectively. It is interesting to see that the walking speed for Rome and Venice are not too far from one another. The two measurements were not expected to be exactly the same due to the small sample sizes of 35 individuals. Levine's data is relatively outdated, and as such it is difficult to come to substantial conclusions using only Levine's walking speed data set.

In 2006, the average walking speed portion of Levine's study was conducted again by Richard Wiseman. Comparing our results to those, we find that Venice has significantly increased in rank. Figure 17 reflects this data.

Wiseman's Walking Speed Ranks (All Pedestrians)

Rank	Country	City	Time (sec)
1	Singapore	Singapore	10.55
2	Denmark	Copenhagen	10.82
3	Spain	Madrid	10.89
4	China	Guangzhou	10.94
5	Ireland	Dublin	11.03
6	Brazil	Curitiba	11.13
7	Germany	Berlin	11.16
8	United States	New York	12
9	Netherlands	Utrecht	12.04
10	Austria	Vienna	12.06
11	Poland	Warsaw	12.07
12	United Kingdom	London	12.17
13	Croatia	Zagreb	12.2
14	Czech Republic	Prague	12.35
15	New Zealand	Wellington	12.62
16	France	Paris	12.65
17	Sweden	Stockholm	12.75
18	Slovenia	Ljubljana	12.76
19	Japan	Tokyo	12.83
20	Italy	Venice (All Pedestrians)	13.18
21	Canada	Ottawa	13.72
22	Zimbabwe	Harare	13.92
23	Bulgaria	Sofia	13.96
24	Taiwan	Taipei	14
25	Egypt	Cairo	14.18
26	Yemen	Sana'a	14.29
27	Romania	Bucharest	14.36
28	United Arab Emirates	Dubai	14.64
29	Syria	Damascus	14.94
30	Jordan	Amman	15.95
31	Switzerland	Bern	17.37
32	Baharain	Manama	17.69
33	Malawi	Blantyre	31.6

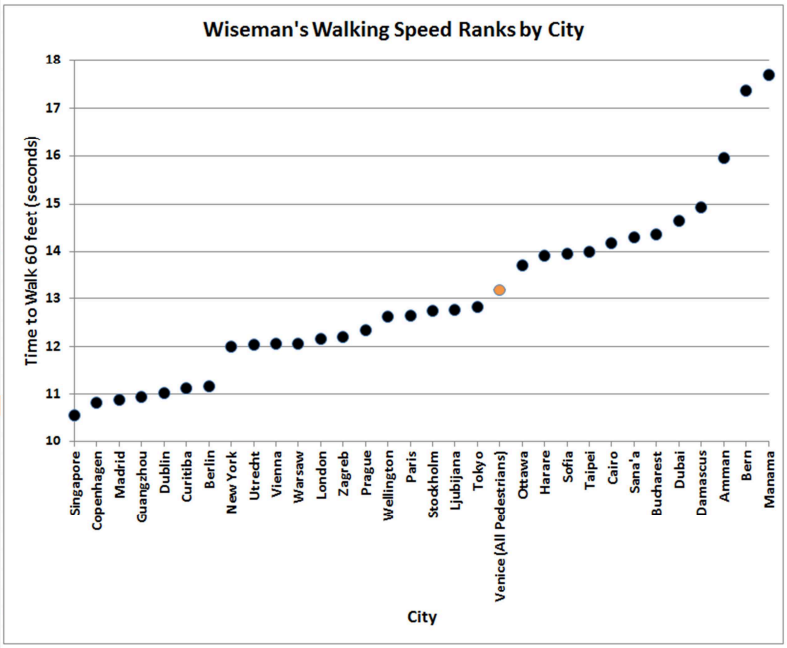

Figure 17: Wiseman's Walking Speed Rankings (All Pedestrians)

It should first be noted that the locations where measurements were made changed from Levine's original study. Most notably data on Italy was not taken in Wiseman's study. From this figure we see that the overall walking speeds of the countries have gotten faster over the seven years between experiments. This data is more reflective of the current walking speeds in various cities around the world. As such, comparisons made to this more up to date data are more reflective of Venice's pace of life compared to the rest of the world. We see that Venice is ranked twentieth, slower than more than half of all cities studied. This may come as a surprise to some, however, there are large factors that play a role in such a slow walking speed. Venice, for the most part, is a city populated by a large number of tourists. Tourists are not familiar with the layout of the city and take time to enjoy the various attractions. Due to these two factors, the overall walking speed of Venice is slower than would be predicted if we were to focus only on the Venetian population. Our team anticipated these and other factors of variability and modified Levine's methodology to reflect them.

3.3.2.2 Average Walking Speed Results

In addition to ranking Venice's overall average walking speed, our team ranked individual averages of Venetian walking speeds and Tourist walking speeds as seen in Table 1.

Levine's Walking Speed Ranks			
Rank	Country	City	Time (sec)
1	Ireland	Dublin	11.13
2	Netherlands	Amsterdam	11.45
3	Switzerland	Bern & Zurich	11.8
4	England	London	12
5	Germany	Frankfurt	12.01
6	United States	New York City	12.03
7	Japan	Tokyo	12.11
8	France	Paris	12.34
9	**Italy**	**Venice (Venetians)**	**12.38**
10	Kenya	Nairobi	12.58
11	**Italy**	**Rome**	**12.75**
12	Canada	Toronto	12.86
13	Poland	Wroclaw, Lodz, & Other	12.9
14	Sweden	Stockholm	12.92
15	Hong Kong	Hong Kong	13.1
16	Greece	Athens	13.1
17	**Italy**	**Venice (All Pedestrians**	**13.18**
18	Costa Rica	San Jose	13.33
19	Mexico	Mexico City	13.56
20	Taiwan	Taipei	13.58
21	Hungary	Budapest	13.75
22	S.Korea	Seoul	13.76
23	Czech Republic	Prague	13.8
24	**Italy**	**Venice (Tourists)**	**13.97**
25	El Salvador	San Salvador	14.04
26	Austria	Vienna	14.08
27	China	Guanzhou	14.26
28	Singapore	Singapore	14.75
29	Indonesia	Jakarta	14.82
30	Bulgaria	Sofia	15.57
31	Jordan	Damascus	15.79
32	Syria	Amman	15.95
33	Romania	Bucharest	16.72
34	Brazil	Rio de Janeiro	16.76

Table 1: Levine Method Walking Speed Ranks

Our team decided to directly compare with Levine's rankings as Italy was not measured in Wiseman's study. We found that the average Venetian walks 60 feet in 12.38 seconds and the average tourist walks the same distance in 13.97 seconds. In addition we see that the Venetian walking speed has the 9th fastest walking speed amongst all the cities studied. Notable cities which Venice walks slower than include New York City and Paris, France, although the city walks faster than Rome,

Italy. The tourists of Venice reflect a speed more leisurely pace akin to cities like Prague, Czech Republic and San Salvador, El Salvador. The figure below provides a graph for visual comparison of the data.

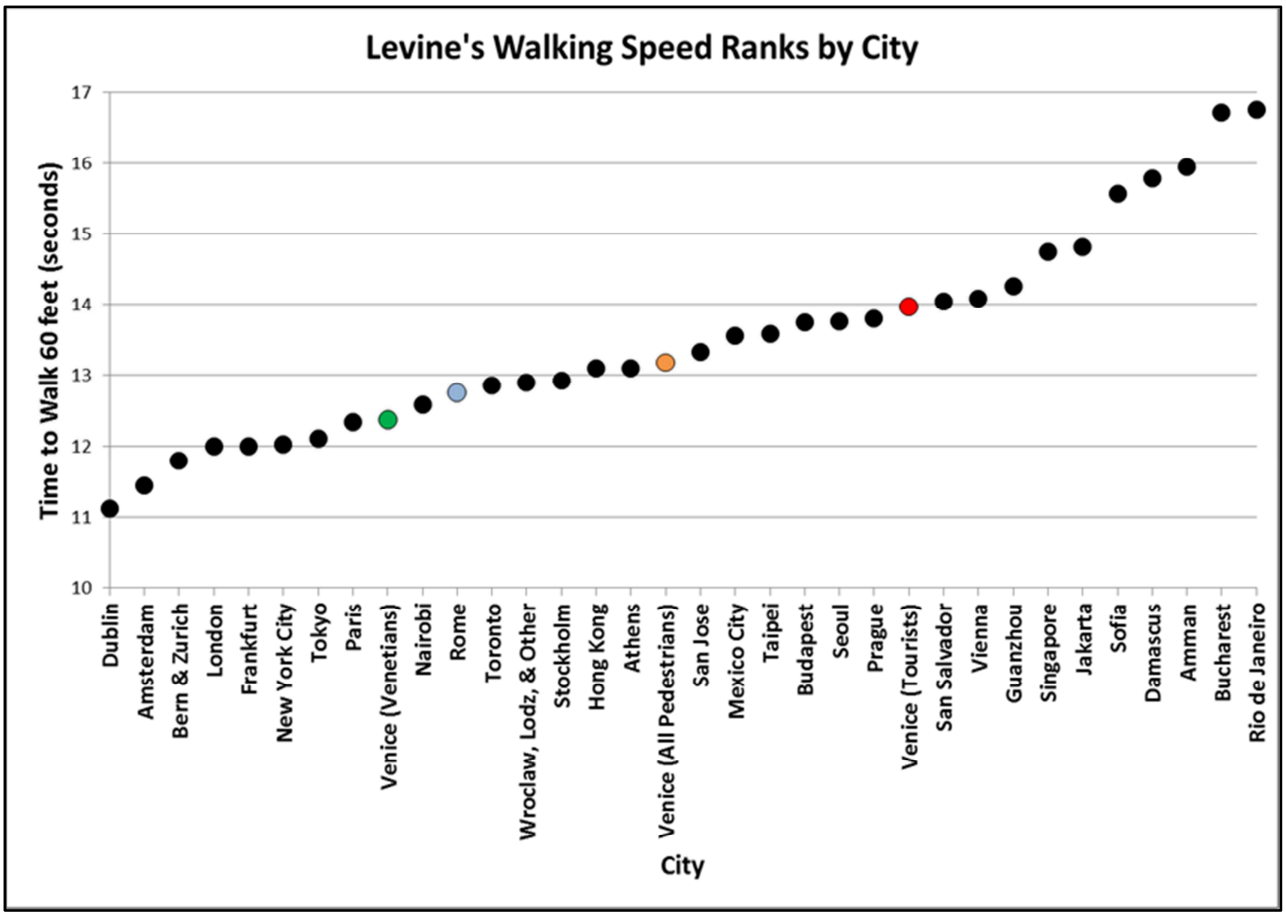

Figure 18: Levine Walking Speed Rankings (Venetians and Tourists)

Although the possibility of a coincidence cannot be ruled out, we conclude that our combined walking speed of Venice fits well with Levine's collected data. We also can conclude that Venetians, by themselves, are among the fastest walkers in the world. Due to the fact that Levine's data is considered outdated these conclusions cannot be made with high precision, and are made for relative comparisons.

We examined this data on a scale of 26 miles, in order to compare cities in a way more applicable. We were interested to see the effects the differences in walking speeds make on a larger scale. Using walking speeds, the visual in the following figure shows placement as if each country were to walk the length of a marathon.

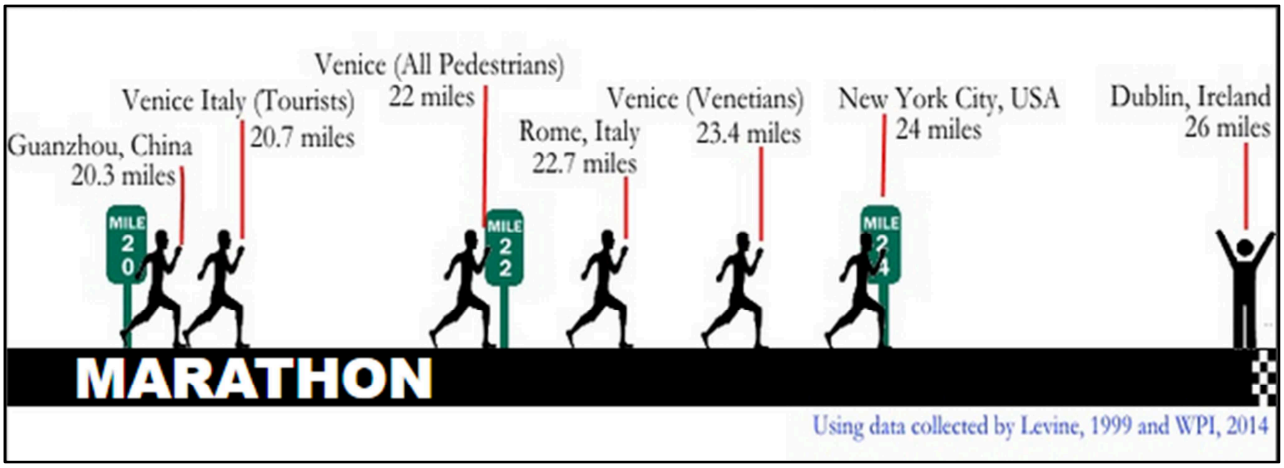

Figure 19: Comparing City Walking Speeds

Although we conducted the study identically to Levine's, we also wanted to explore variables we thought were overlooked. After reading through Levine's procedure, we tested a few of his variables for accuracy. The three different variables we tested were walking distance, time of day, and location. Other variables were thought to exist such as age and cultural background, but these variables were deemed too time consuming to study given our short stay in Venice.

One of the methods we wanted to test was the predefined walking distance of 60 feet. Our team measured walking speeds over a distance of 120 feet to study if 60 feet was an accurate sampling range. It was hypothesized that with a longer distance, measurement error would be further reduced. We measured people walking at both distances in Rio Tera Lista di Spagna. We concluded that a distance of 120 feet was too long of a distance to measure over. The average pedestrian tended to either stray from a straight path or become distracted over the longer distance, making them ineligible for observation. A cause of this was thought to be the multiple flows of traffic and various attractions that exist on most popular streets in Venice. On average measuring over a distance of 120 feet rather than 60 would only increase our overall walking speed averages by 0.15 seconds. Overall, we concluded that Levine's range of 60 feet was acceptable.

In addition to testing the distances as determined by Levine, our team wanted to understand the different paces of life as measured at different times of day. We took speed measurements at 8:30 AM, 12:00 PM, and 8:30 PM. Our team wanted to identify whether this Pace of Life Study would accurately reflect Venice if taken at different times of day. Through our understanding of the Pace of Life, the walking speed was hypothesized to change based on the time of day the measurements were

taken. We observed that walking speeds changed drastically during each time of day and for each location.

Our team also wanted to better understand if location was a variable that Levine had overlooked. We hypothesized that the location of where the walking speed observations took place would influence the results. As such, we followed Levine's method of calculating the average walking speed in four different locations in Venice. These locations were Strada Nuova in Cannaregio, Riva degli Schiavoni in San Marco, Rio Tera Lista di Spagna in Cannaregio, and Via Giuseppe Garibaldi in Castello. We observed that there was a statistically significant difference.

The figure below shows walking speeds for Venetians given different locations and times of the day. We expected different speeds based on time of day because of lifestyle and motivation for walking.

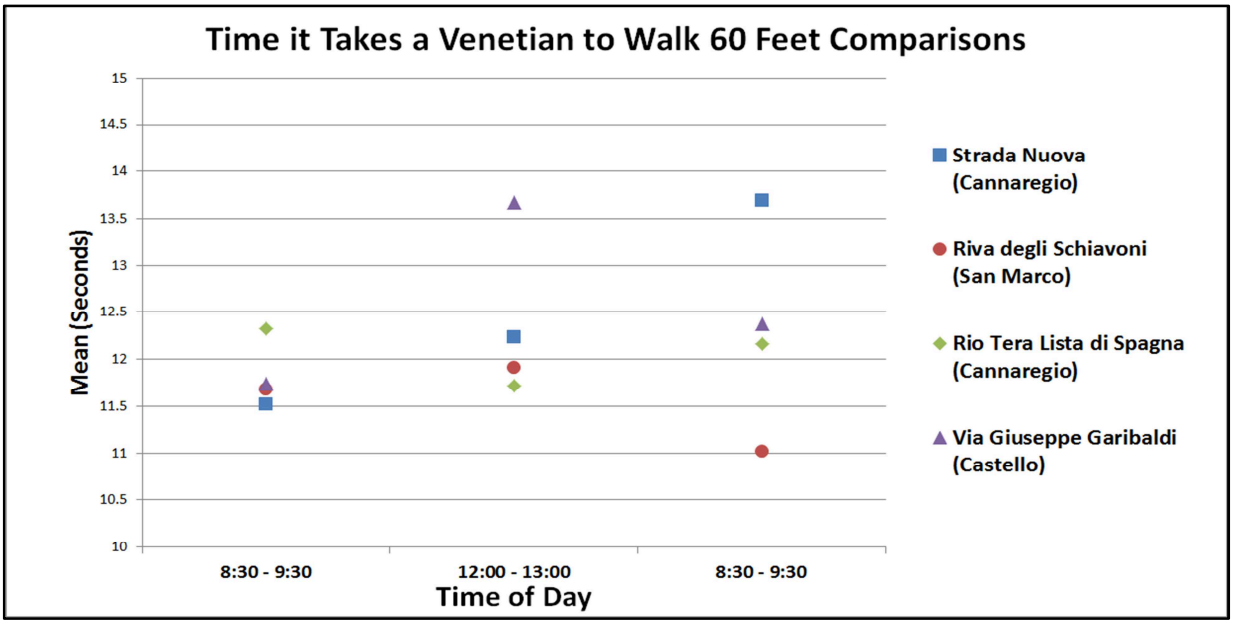

Figure 20: Walking Speed Location and Time Comparison

3.3.2.3 Average Working Speed Results

In addition to computing Venice's ranking from postal service employees, our team collected data and ranked working speed of Venice based on tobacconist shops. The rankings are shown in Table 2.

Levine's Working Speed Ranks (Post Offices)			
Rank	Country	City	Postal Speed (sec)
1	Germany	Frankfurt	13.46
2	Switzerland	Bern & Zurich	16.91
3	Ireland	Dublin	17.49
4	Japan	Tokyo	18.61
5	Sweden	Stockholm	19.1
6	Hong Kong	Hong Kong	20.1
7	Taiwan	Taipei	20.22
8	**Italy**	**Venice (Tobacconist)**	**20.22**
9	Austria	Vienna	20.6
10	England	London	20.78
11	Costa Rica	San Jose	21.13
12	Singapore	Singapore	22.42
13	**Italy**	**Venice (Post Offices)**	**22.45**
14	**Italy**	**Rome**	**23**
15	Greece	Athens	24.33
16	Netherlands	Amsterdam	24.42
17	Poland	Wroclaw, Lodz, & Other	25.83
18	El Salvador	San Salvador	25.88
19	Czech Republic	Prague	27.73
20	France	Paris	27.84
21	Hungary	Budapest	28.45
22	S.Korea	Seoul	29.75
23	Canada	Toronto	30.5
24	Bulgaria	Sofia	33.67
25	United States	New York City	36.99
26	Brazil	Rio de Janeiro	38.17
27	China	Guanzhou	39.63
28	Indonesia	Jakarta	39.64
29	Jordan	Damascus	39.92
30	Syria	Amman	40.02
31	Romania	Bucharest	42.25
32	Kenya	Nairobi	42.5
33	Mexico	Mexico City	70

Table 2: WPI Method Working Speed Ranks

Levine's study used 8 post offices in major cities to compare working speeds. Our team observed the working speed for 8 post offices in Venice and found an average of 22.45 seconds. Levine initially generalized Italy's measurement of working speed by measuring in Rome. He obtained a value of 23 seconds which isn't far off from the measurement obtained for Venice.

After completing measurements at post offices, our team compared these to the measurements taken at 8 tobacconist shops throughout Venice. We expected the tobacconist shops to show faster times than post offices because this is a common request at these shops. We also wanted to see if there were differences in speed with public versus private workers. We found the average working speed of the 8 tobacconist shops to be 20.22 seconds. This compares to a speed of 22.45 seconds for the post offices.We believe the tobacconist shops to be more reflective of the working speed in Venice. Stamps are more frequently purchased at tobacconist shops than at the post office due to high wait times. Taking working measurements for the tobacconist shops reflects culture in Venice more

properly than post offices would. It is understood that Levine used post offices as a constant for comparison purposes, however, this location isn't the most practical.

3.3.2.5 Clock Accuracy

The clock accuracy rankings are shown in Table 3, Venice ranks 10th among the cities studied.

Levine's Clock Accuracy Ranks (Banks)			
Rank	Country	City	Seconds Off
1	Switzerland	Bern & Zurich	19.29
2	**Italy**	**Rome**	**24.17**
3	Austria	Vienna	25
4	Singapore	Singapore	32
5	Romania	Bucharest	32.46
6	Japan	Tokyo	35
7	Sweden	Stockholm	40.2
8	Germany	Frankfurt	43
9	Poland	Wroclaw, Lodz, & Other	43
10	**Italy**	**Venice**	**48**
11	France	Paris	49
12	Ireland	Dublin	51.42
13	China	Guanzhou	51.82
14	England	London	53.72
15	Hong Kong	Hong Kong	54.83
16	Costa Rica	San Jose	55.38
17	S.Korea	Seoul	58
18	Bulgaria	Sofia	60
19	Hungary	Budapest	64.17
20	Jordan	Damascus	66.16
21	United States	New York City	67.87
22	Taiwan	Taipei	68
23	Canada	Toronto	70
24	Czech Republic	Prague	76.07
25	Kenya	Nairobi	77.14
26	Netherlands	Amsterdam	82.33
27	Mexico	Mexico City	92.31
28	Syria	Amman	94.52
29	Brazil	Rio de Janeiro	108
30	Greece	Athens	117
31	Indonesia	Jakarta	161.5
32	El Salvador	San Salvador	210

Table 3: Clock Accuracy Results

The final portion of Levine's Pace of Life study is comparing clock accuracy in randomly chosen downtown banks. We conducted this portion of the experiment identically to Levine however it is worth noting that this was not an easy measurement to take. Many of the banks we visited did not have clocks inside. We found it difficult to enter banks solely with the purpose of checking the clock

because of security precautions in Venetian banks. This measurement may also be out of date because of increased technology since the 1999 study. Many people rely on cell phones to provide the accurate time.

Our team developed a visual representation to show clock accuracy in a few key cities. The image below uses an actual time of 12:00:00 to show what would be read on an average bank clock for each city.

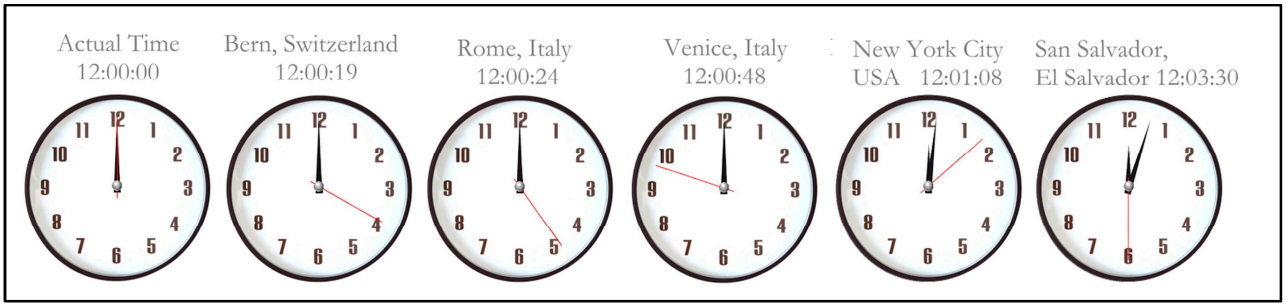

Figure 21: Clock Accuracy Visualization

The statistics of clock accuracy are interesting to compare, especially the difference between Rome and Venice. When considering the rankings of clock accuracy results, Venice's inaccuracy was not surprising. Based on observation, bank clocks overall are not the best form of public timekeeping. Pedestrians only enter banks for business purposes and other clocks could have been used in this study in order to better understand time accuracy. Although bank clocks appear inaccurate from this study, many Venetians rely on clocks at boat stops in order to obtain accurate time. Each of the boat clocks observed by our team are accurate.

3.3.2.6 Comparing Venice to Other Cities

Combining all of our data from each of the sections, we find that Venice's overall Pace of Life ranks 7th with the methodology created by our team. Venice has an overall Z Score of -0.64092. If using the methodology by Levine, Venice would rank 14th with a Z-Score of -0.39181. Venice ranks among other cities according to the following table.

Levine's Overall Pace of Life Ranks by City			
Rank	Country	City	Z-Score
1	Switzerland	Bern & Zurich	-1.11054
2	Ireland	Dublin	-0.97929
3	Germany	Frankfurt	-0.96805
4	Japan	Tokyo	-0.85856
5	**Italy**	**Rome**	**-0.67181**
6	England	London	-0.66354
7	**Italy**	**Venice (WPI Method)**	**-0.64092**
8	Sweden	Stockholm	-0.61568
9	Netherlands	Amsterdam	-0.44313
10	Austria	Vienna	-0.43238
11	Hong Kong	Hong Kong	-0.42319
12	France	Paris	-0.41515
13	Poland	Wroclaw, Lodz, & Other	-0.39684
14	**Italy**	**Venice (Standard Method)**	**-0.39181**
15	Costa Rica	San Jose	-0.33544
16	Taiwan	Taipei	-0.20047
17	Singapore	Singapore	-0.16698
18	United States	New York City	-0.05702
19	Canada	Toronto	-0.04266
20	S.Korea	Seoul	0.040927
21	Hungary	Budapest	0.051276
22	Czech Republic	Prague	0.140215
23	Greece	Athens	0.219419
24	Kenya	Nairobi	0.309569
25	China	Guanzhou	0.397602
26	Bulgaria	Sofia	0.587694
27	Jordan	Damascus	0.875029
28	Romania	Bucharest	0.876663
29	Syria	Amman	1.15032
30	El Salvador	San Salvador	1.253412
31	Brazil	Rio de Janeiro	1.392445
32	Indonesia	Jakarta	1.437635
33	Mexico	Mexico City	1.477374

Table 4: Levine Rankings by City

These rankings can also be viewed in a graph as shown in Figure 22.

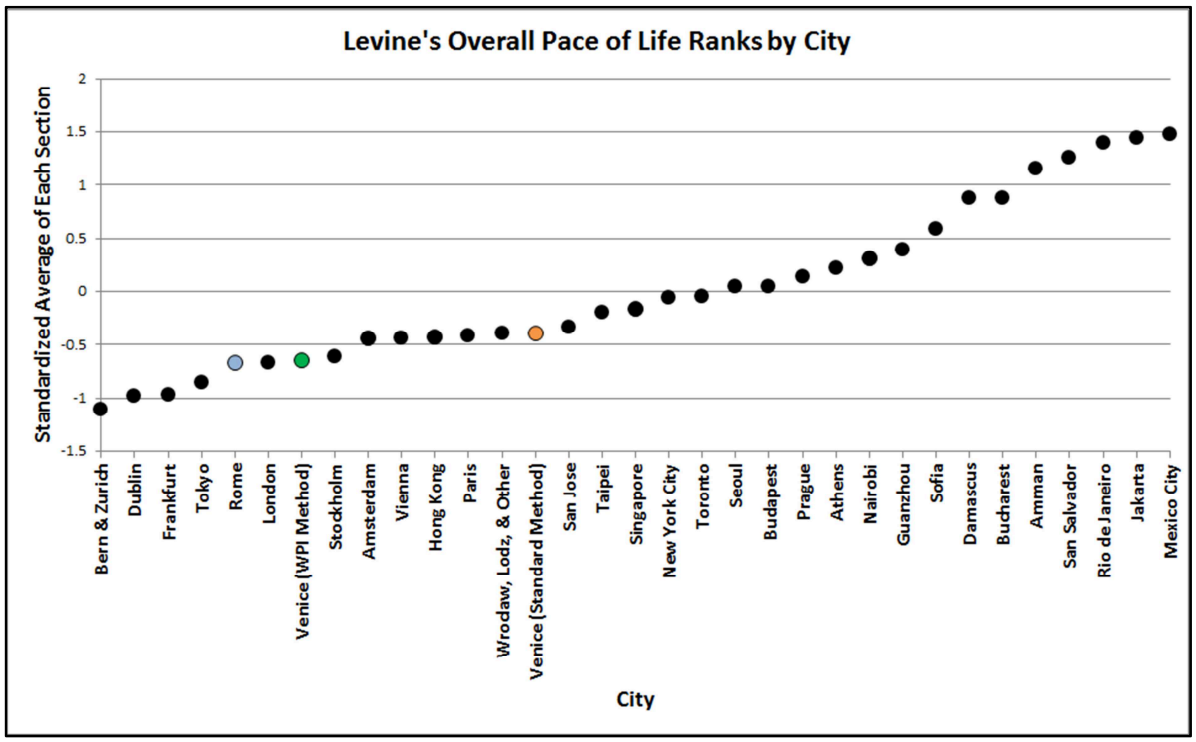

Figure 22: Overall Pace of Life

Looking at Venice's overall Pace of Life in comparison to other cities is intriguing. Venice has a higher pace of life than notable cities such as Amsterdam, Hong Kong, and New York City. Bern and Zurich have the highest Pace of Life and Rome still ranks higher than Venice. The difference in Venice's ranking with the two different methodologies is very large. The improved methodology by the 2014 team shows a higher Pace of Life than the methodology created by Levine. The updated methodology is significant because it reflects life in Venice much better than a standardized test would.

Our team explored using these Pace of Life measurements in order to see correlations between other community variables. We looked at a happiness index created by the United Nations. In 2013, the United Nations used surveys, reports, and other means to calculate the happiness of many cities throughout the world. The happiness index was compared with Pace of Life and GDP as shown in the following image.[21] The chart shows Pace of Life decreasing from left to right and happiness increasing as the marker gets higher on the chart. The size of the marker shows GDP per capita of the country which the city is located in.

[21] "World Happiness Report," 2013

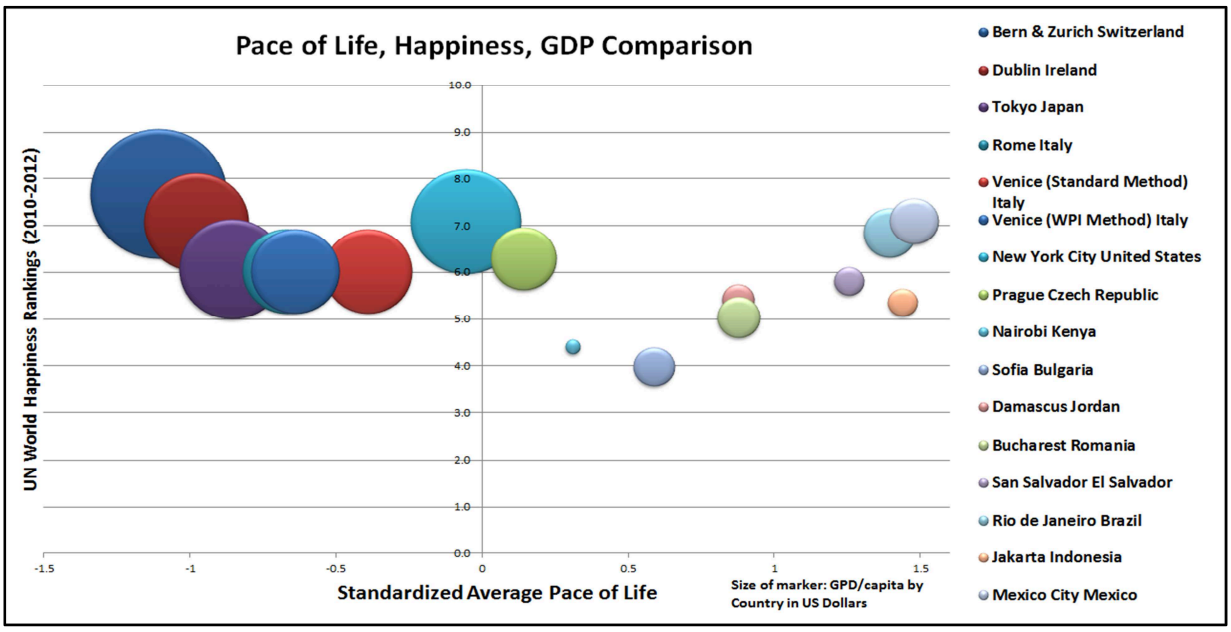

Figure 23: Comparing Pace of Life, Happiness, and GDP

Looking at the graph it can be seen that Pace of Life and GDP per capita have a negative correlation. It is harder to deduce a strong correlation between happiness and Pace of Life however. It is interesting to see that countries that are on both ends of the Pace of Life spectrum tend to have relatively high happiness scores. Those that are within 0.5 and 1 standard deviations above the average Pace of Life z-score tend to have relatively low happiness scores. as well as GDPs per capita.

3.4 Recommendations

After completing this section of our project, the team has come up with the following recommendations to expand the collections of the project center.

3.4.1 Daily Cycles Infographic

Our team created mockups for interactive daily cycle visualizations. Due to our team's capabilities, we were not able to program the full functionality. This can be done by a future team using our outlines and data gathered by past teams. Our daily cycle visualization can be completed based on the MERGE store data from past years. In order to create an accurate visualization, the stores data would need to be combed through and updated. Many stores collected by past groups have incomplete hours and record of store types. Visualizations for store hours could be created as could visualizations in a similar style for tourist, boat times, and other statistics of interest to the VPC.

3.4.2 Yearly Cycles Visualization

In addition to the daily cycle infographic and visualization, we created a mockup design for an interactive yearly cycle visualization. The yearly cycles visualization will use data relating to visiting tourists for different seasons and holidays. Additions to our interactive application will be created by future teams using our outlines from sections above and data collected by teams from WPI. This application will show holiday and tourist information with the goal of comparing holidays with other days throughout the year.

3.4.3 Pace of Life

Our team calculated an accurate Pace of Life in Venice for comparisons to be made with other cities around the world. As our methodology improved upon Levine's, we would recommend future teams improve upon ours. Improvements to recording accurate walking speed measurements should be developed to bring human error to a minimum. We also hope teams create a replacement methodology for calculating the clock accuracy of a city.

Once a new standard methodology is created, the study should be re-done in Venice. By utilizing students at various WPI Project Centers, the study can be conducted around the world in a relatively short period of time. Data collected would be much more reliable than Levine's measurements and stronger comparisons to other cities could be made.

Although our team has hypothesized about the correlations between the Pace of Life and other community variables, they are difficult to prove. Once more accurate and precise data is collected, the Pace of Life could be used as a tool to define different aspects of Venice and other cities. We recommend teams compare variables that may be influenced by the Pace of Life. Variables our team found notable were: happiness, economic vitality, climate, population size, and health.

4. Travel Times

Walking directly from point to point is not always the best option in Venice. Street traffic and congestion can impede a Venetian's trip. The water based public transportation system takes pressure off the main street arteries of Venice, allowing better pedestrian traffic flow. Studying the ways in which walking and the boat system function together helped us to understand Venetian Time.

4.1 Background

Studying impacts to travel time in Venice allows us to analyze how Venetians are willing to use their time in relation to travel. This includes measurements such as walkscore and an analysis of the ACTV Boat Application.

4.1.1 Walkscore

Pedestrian activity in an area can be described by a value known as a walkscore. A walkscore from 0 to 100 is given to a location based on the distance to a variety of nearby facilities. [22] These facilities are divided into five categories: educational, retail, food, recreational, and entertainment. A walkscore of 90-100 means that daily errands don't require a car. A walkscore of 0-24 means that almost all errands require a car and the location is car dependent. Venice's neighborhoods are defined as a "walker's paradise" by having scores in the high 90s.[23] Venice's walkscore reflects the experience of how one is willing to use their time.

4.1.2 ACTV Boat Application

The two primary types of public water transportation used in Venice today are *traghetti* and *vaporetti* (water buses). *Traghetti* are small commuter boats that serve as an alternative to a bridge. *Vaporetti* in contrast, circulate around the city, making stops analogous to typical city bus routes. The *Azienda del Consorzio Trasporti Veneziano* (ACTV) is Venice's primary provider of these public transportation services.[24] The company focuses on providing efficient boat transportation in the city through managing, monitoring, and planning public transport needs.[25]

A past WPI team designed a mobile application to study mobility in Venice, the ACTV Boats VAPP.[26] The app uses ACTV boat traffic schedules and provides navigation routes to the nearest ACTV boat stops. From the GPS of the user's mobile device, the closest boat stops are calculated. The user can select a stop and a series of boat departure times will be generated. A suggested departure time from origin is then displayed. With modifications, this application could be used to generate isochrone maps providing pedestrians with another tool to better traverse the city.

[22] WalkScore, 2014
[23] WalkScore, 2014
[24] ACTV, 2014a
[25] Venipedia, 2014
[26] Shea, Pernia-Rovayo, Larkins, Brofford, & Carrera, 2014

4.1.3 Isochrones

Isochrones are lines of equal travel times. They serve to connect points on a map when something occurs or arrives at the same time. Isochrones have been utilized in mobility studies to better understand an area's network structure. For example, journey time isochrones to airports in Finland have been well documented for use in urban planning.[27] First an initial airport location and a pre-defined time interval are given. A map is then generated depicting all locations that can reach the initial point within the predefined time interval. Shown is an example of an isochrone map centered from Worcester Polytechnic Institute with a six minute travel time interval outlined in white.[28]

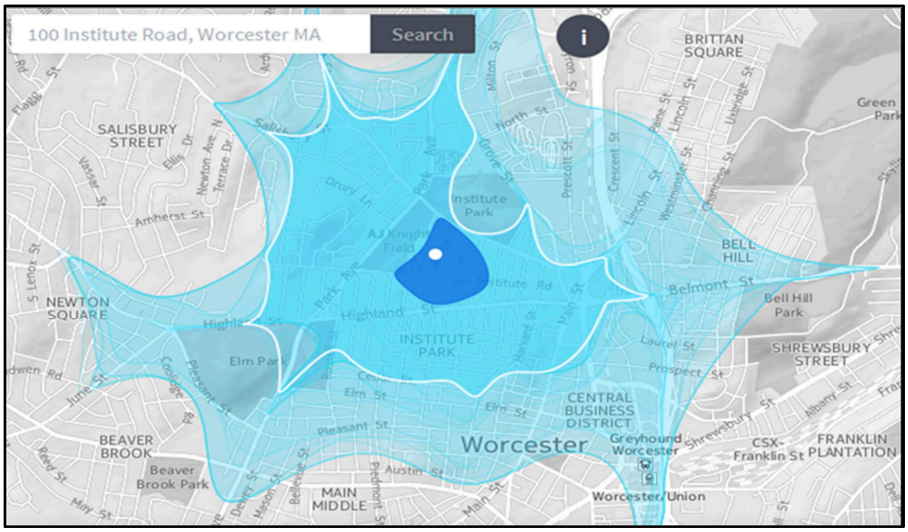

Figure 24: Six Minute Isochrone Map

In the same way, it is possible to examine isochrones utilizing both public transport and walking options. This can be done both mathematically and visually. Basic isochrone creating algorithms are accessible for public use in the various Application Program Interface (API) systems. Visual representations of these isochrones have been produced through Geographic Information Systems (GIS).

4.2 Methodology

Our team studied travel times and its impacts in order to better grasp how mobility in Venice is affected. We analyzed travel methods through conducting a feasibility study. This study centers on extension of applications created by past teams to incorporate travel times from one point to another.

[27] Graser, 2014
[28] "Isoscope," 2014

Our team produced the following deliverables:

1. Collection of data outlining feasibility and research for transportation mode smartphone application
2. Creation of isochrone maps utilizing various transportation modes

4.2.1 Analyzing Transportation Modes

Deciding whether to travel by foot or by boat is commonly learned while living in Venice. Venetians naturally hone their skills by taking public transportation or walking to their destinations every day. This has been quantified through the collection of mobility and pedestrian data by past teams. Our team has consolidated this information into a template for future teams to create an application providing the best route of travel.

The feasibility study was conducted at a popular tourist attraction, the Rialto Bridge. This increases the likelihood a pedestrian would consider using this methodology. With information from Google Maps and the ACTV website, we added wait time and walking time to obtain the overall travel time.

We used the most efficient walking path and ACTV boating routes from the top of the Rialto to the *Piazza San Marco.* In addition to this path, we also computed walking times from the Rialto to the entrance of La Biennale di Venezia – Giardini, a popular tourist attraction. A map indicating these points is shown in Figure 25.

Figure 25: Start and End Locations for Walking Versus Boating

The ACTV app also provides the travel time, walking distance, boat departure time, and directions for each route. Once the initial calculations were produced, our team traveled these exact paths while in Venice. These times reflect data collected for pedestrian street counts compiled by past WPI teams.[29]

[29] Shea et al., 2014

4.2.2 Visualizing Travel Distances

Paradoxically, the time-restricted travel options a Venetian possesses is enormous yet limited. On one hand, in only a few minutes a Venetian can board the closest *vaporetto* (water bus) and travel to within a short walking distance of their destination. On the other hand, if a Venetian just missed their *vaporetto*, the final destination may no longer be reachable within a set time-restriction. Our team studied these time-restricted travel areas through the implementation of isochrone maps.

Our team created two visuals depicting the isochrone maps in Venice. To create these maps we utilized a program called isoscope.[30] This program creates pedestrian isochrone maps for locations all around the world.

Our group wanted to create a map reflecting the increased travel options a Venetian gains through utilization of the public ACTV boat lines. Through isoscope, an isochrone map was first created using the initial starting position, Piazza San Marco, and a time span of 15 minutes. This served as the first layer of our visual. We then used the ACTV Boat VAPP to calculate the times it takes a Venetian to reach the closest boat stops from the starting location. All ACTV public boat line data was then used to find all reachable *vaporetto* stops on each line within the rest of the 15 minute span.[31] Isochrone maps were then generated starting at each new boat stop location with time-intervals equal to the 15 minute span minus the travel time of the *vaporetto*. These isochrones starting at the new boat stops served as the second layer of this visual. We then overlaid both layers of maps to compare travel times with and without public boat transportation.

Our second visual was to reflect the impact tourists have on Venetian travel times. We followed a similar method to create our second visual, however the time span was shortened. Through our findings in the Pace of Life of Venice our team found that Venetians, on average, walk 16 percent faster when unimpeded by tourists. Thus we used a total time span of 13 minutes. These new isochrone maps were then overlaid with the entirety of our first visual.

4.3 Results and Analysis

Relationships between different impacts of travel time in Venice can be observed through infographics showing walkability and walkscores. Travel times have been analyzed with transportation modes and through isochrones.

[30] "Isoscope," 2014
[31] ACTV, 2014b

4.3.1 Walkability Infographics

The research collected for the infographic represents different factors contributing to walkability in a city. We compared New York City to Venice because of their similar walkscores. This infographic can be seen in Appendix F.

We also created an interactive visual tool to explore walkscores of many cities around the world. The following images show the functionality of the mock-up created. When the user hovers over a city, the walk score and city name appears.

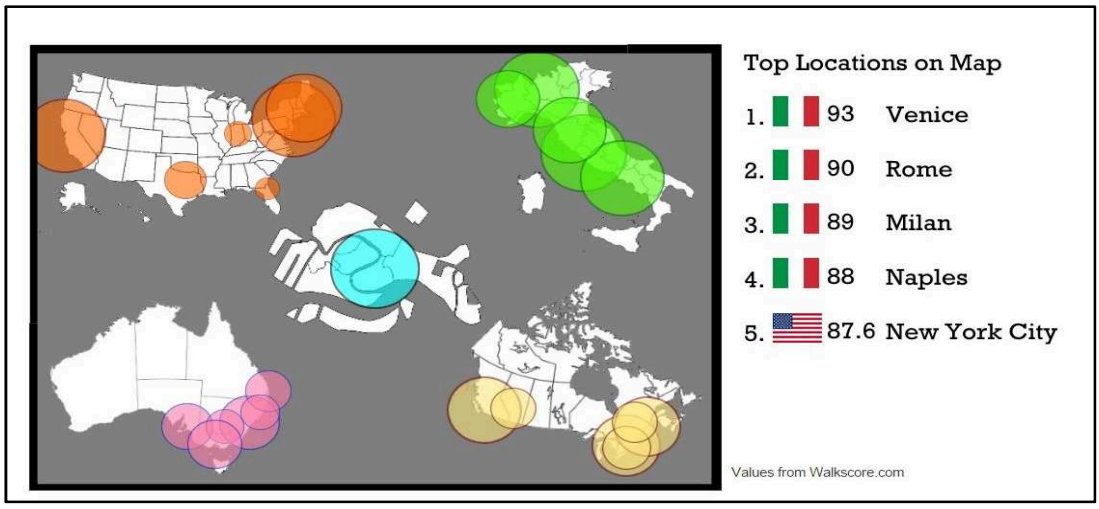

Figure 26: Interactive WalkScore Application

4.3.2 Transportation Mode Visualization

The visualization for transportation times shown in Figure 27 represents a mock-up version of an application created to outline different travel routes and times.

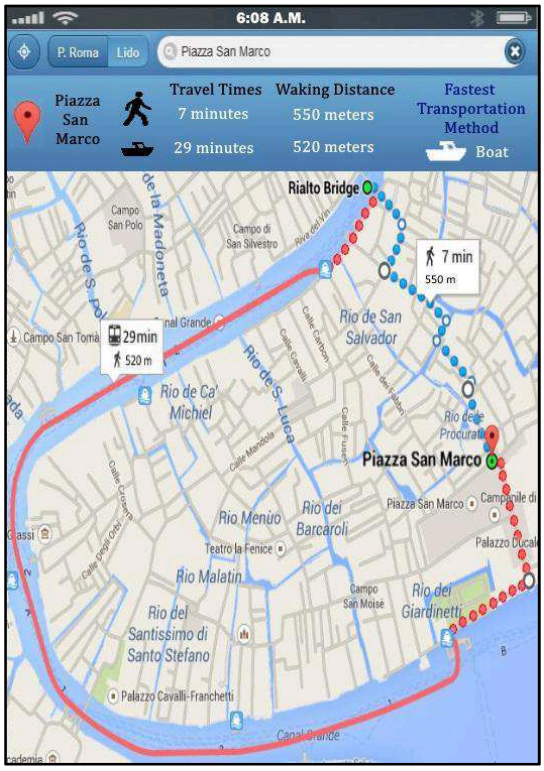

Figure 27: Transportation Mode Visual

Our team found that the travel times provided by Google Maps were accurate to within two minutes during different times of day, for locations near the Rialto. The ACTV boat lines were also on time, in most cases almost to the minute. This showed that the calculations used to create this mock up where accurate and a future application is possible. During our stay in Venice, it came to our attention that Google is currently in the process of adding the ACTV boat lines to their map applications. When implemented, Google Maps will have the same functionality as our team's vision for the future ACTV Boat VAPP. For this reason we will not be recommending future development of this application.

4.3.3 Travel Time Visualization

Data collected on the impact to Venetian travel times were to be created by our team. Two map visuals were made through the use of isochrone mapping in Venice. The first visual shows the impact of the ACTV public boat lines, and can be seen in Figure 28 below.

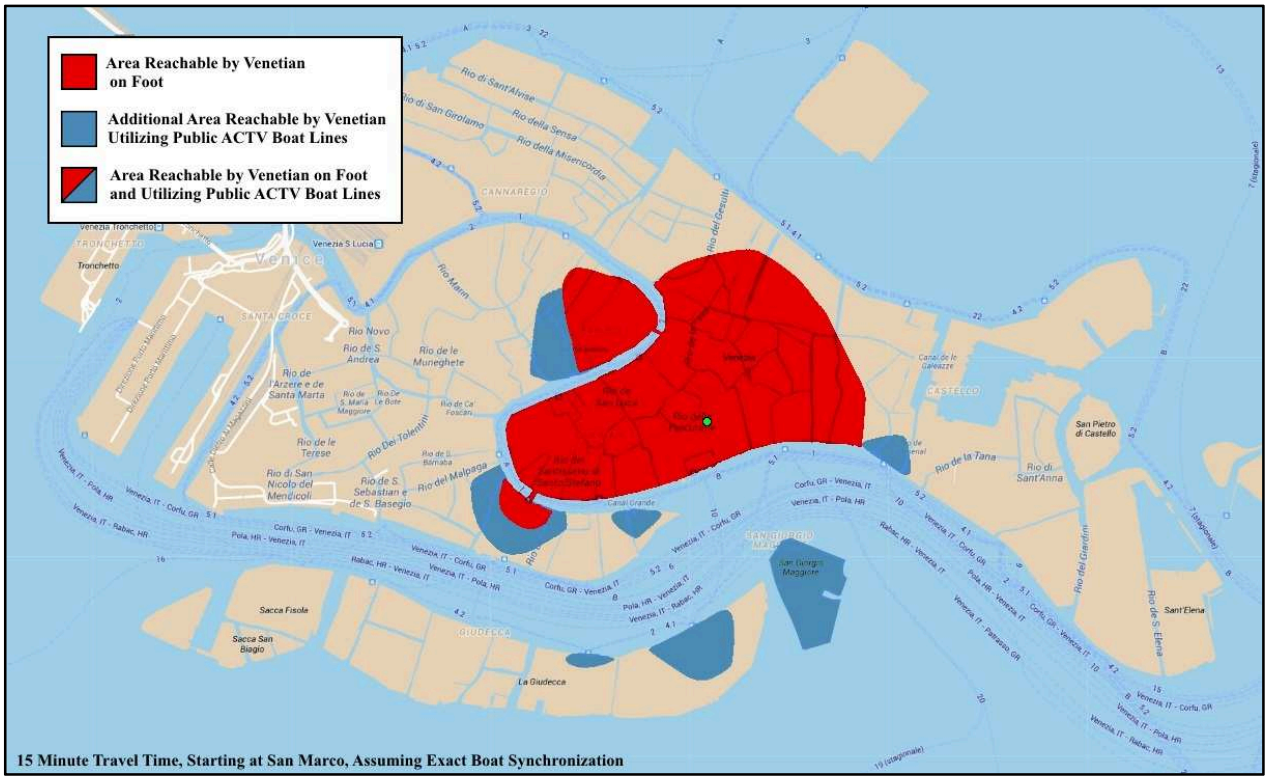

Figure 28: Walking Versus Public Boat Transportation Travel Time Map

Although it is simple to understand that public boat lines would increase Venetian travel time options, it is difficult to quantify this increase. Our visual quantifies this difference in options in a small section of Venice. Additional areas become accessible on the islands of Guidecca and San Giorgio Maggiore. As one can see, the public ACTV boats allow the average Venetian to access a greater amount of area in Venice within the same amount of time.

Our second visual was to quantify the impact on travel options tourists have on Venetians. This impact can be seen in Figure 29.

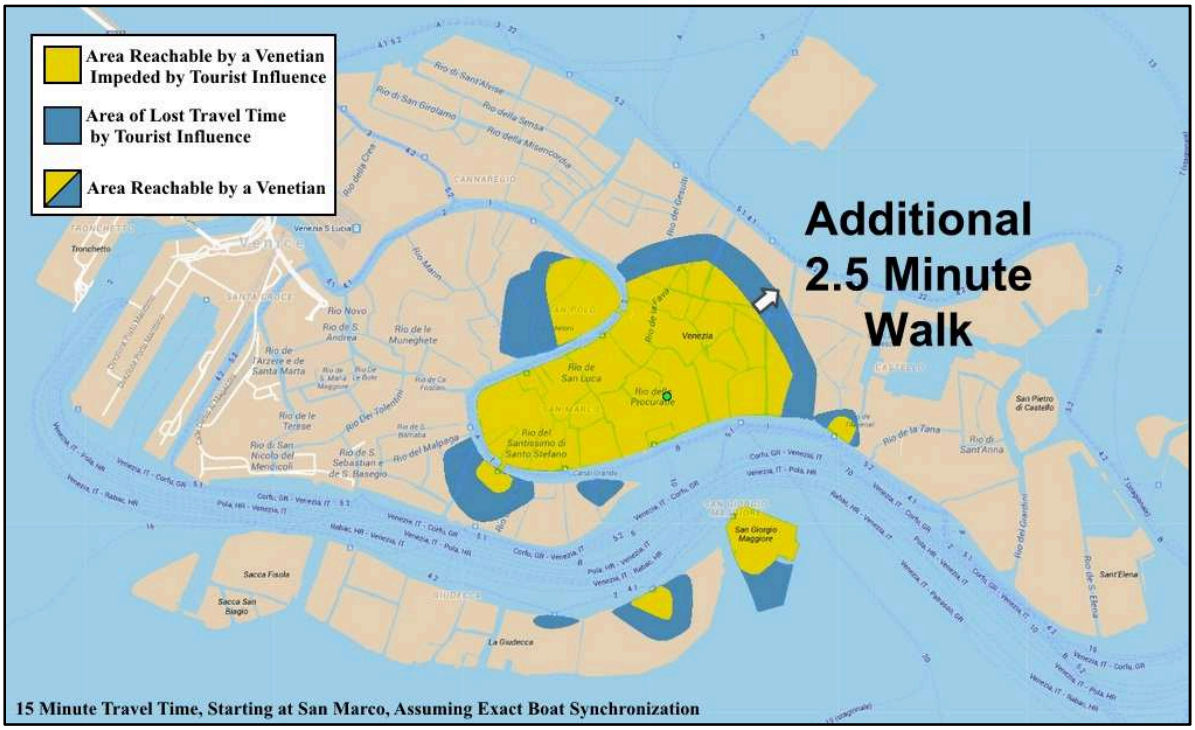

Figure 29: Venetian Versus Tourist Impeded Venetian Travel Time Map

Our team was able to create this visual with the data we collected through calculating average walking speeds. Tourists impede Venetian travel as depicted the by contrasting yellow and blue isochrone maps. We found that this difference in walking speed would force the average Venetian to walk an extra 2.5 minutes if they were to maximize their travel distance over the 15 minute interval. Even with exact boat synchronization assumed, impeded Venetians will be unable to make most of the boat lines on time. In our visual, three boat stops are inaccessible and as such travel times on other islands are greatly diminished.

4.4 Recommendations

Recommendations for future teams and projects have been compiled to advance studies involving travel in Venice. The following recommendation includes advancement of the isochrone applications both for Venice and potentially other cities.

4.1 Isochrone Application Development

Our team created a visual representation for isochrones originating at one location in Venice for a set time frame. Through programming an interactive application, it would be possible to create

this for purposes of comparing many cities around the world. By taking the area covered in a set amount of time, the program could also obtain statistics for the percent of population reached. Given these parameters, the isochrone application would help to show relationships between time and space for many different cities. With a program to compute these isochrones, a future team would be able to more easily compare many different locations and statistics. Because of our limited programming capabilities and time constraint, we were not able to create this application. The future team could develop this using open source code and should include multiple transportation options.

5. Final Conclusions

The goal of this project, to come to better understand perceptions of time in Venice, has been accomplished. Our team looked at a variety of ways to quantify this abstract feeling. Through observing time keepers of the city we gathered information on how time is measured in Venice. By characterizing time in Venice, our team noted how cycles impact the day and year. The team also conducted Levine's Pace of Life Study for Venice, and made modifications in order to better capture the unique qualities that make up the city. Finally, the team looked at travel times with special interest in mobility. We observed the quantification of Walkscores, as well as looking at future enhancements of previous project work through an upgrade to a mobile application. The team concluded the study through creating a visual representation of travel areas in Venice given a specific interval of time.

Overall, each of these pieces came to show a different side of the city. Venice is known for its canal structure and massive tourist population. Many people who travel to the city notice something different about the structures of time, and yet have a difficult time quantifying the feeling. By observing the city during our seven weeks here and by collecting a large variety of data, we have concluded some aspects about time in Venice.

Overall, with the observations of time keepers, we note the rarity in using Minich clocks, bell tower clocks and other public clocks for precise time measurement. The schedule of a Venetian is dictated by the boat schedule and therefore those clocks are most often used for time keeping. Minich clocks and bell tower clocks serve commonly as a meeting place rather than something referenced for time. However, bells do commonly dictate schedules. People use bells in their daily schedules as an indicator of time because of their loud presence. Each of the bells, as observed by our team and past teams, are set to ring at an exact time. These times differ however from the subtle differences in clock accuracy.

While characterizing time in Venice, our team drew conclusions based on time cycles and Pace of Life. Time cycles dictate time in Venice more heavily than one might think. Festivals and seasons are common indicators of the time of year. Daily cycles are of interest in Venice because of the unique store hours. The Pace of Life is reflective of this characterization as well. With the calculation of Pace of Life in Venice, we hoped to compare Venice to other cities in a quantifiable manner. Although it's easy to say "time is different in Venice," we showed this difference through our rankings.

Finally, through the study of travel times, we note the high walkability, indicating a willingness to walk. This shows one of the many unique aspects of Venice because Venetians are more willing to spend their time walking than using other means of transportation. We have also concluded through this section that Venetians are impacted by tourists when considering travel times. By using measurements taken of walking speed for each type of pedestrian, our group has added solid research to this problem.

Overall, our team feels confident that we have captured many aspects which can be used to quantify time. Our contributions to the Venice Project Center are important in aiding future research and understanding with regard to the unique aspects of time in Venice.

Bibliography

ACTV. (2014). Actv - impresa e territorio, il valore dei fatti. Retrieved 9/28/14, 2014, from http://www.actv.it/

Carraro, S. (2014). [Censimento Orologi e tesi WPI].

Carrera, F., Guerin, S., Smith, C., Fogarty, C., Folinas, G., Greco, S., & Stacy, C. (2014). 2011 Mobility Model. Retrieved October 1, 2014, from http://venice2point0.org/mobility_model/

Graser, A. (2014). Drive Time Isochrones - An Example Using Finnish Airports. Retrieved September 29, 2014, from http://anitagraser.com/2011/02/12/drive-time-isochrones/

Isoscope. (2014). Retrieved 10/2, 2014, from http://www.flaviogortana.com/isoscope/

Levine, R. V. (1999). The Pace of Life in 31 Countries. In A. Norenzayan (Ed.): Sage Publications.

Lightman, A. P. (1993). *Einstein's dreams*. New York: Pantheon Books.

Luca, D. (2014). The Store Hours in Venice Italy Visit-Venice-Italy.com. Retrieved October 6, 2014, from http://www.visit-venice-italy.com/shopping-opening-hours-venice-italy.htm

Lynch, K. (1972). *What time is this place?* Cambridge: MIT Press.

Manor, N. P. S. a. R. B. E., Maitland, I. M. S. a. B. E., Kahn, L. M. S. a. C. S., Heinricher, D. J. S. a. C. E., & Hart, F. L. F. a. C. E. (2014). *Ecclesiastical Architecture -- Preserving Convents, Churches, Bells and Bell Towers*. Worcester, MA: Worcester Polytechnic Institute.

Muraro, M. (1984). The Moors of the Clock Tower of Venice and Their Sculptor. *The Art Bulletin, 66*(4), 603-609. doi: 10.2307/3050475

Ponte Minich. Retrieved 1 December, 2014, from https://www.triposo.com/poi/W__157598602

Shea, A. E. S. a. B. E., Pernia-Rovayo, L. J. S. a. I. E., Larkins, R. D. S. a. R. B. E., Brofford, K. M. S. a. I. E., & Carrera, F. F. a. I. D. (2014). *Boats and Bottlenecks -- Improving Mobility in Venice*. Worcester, MA: Worcester Polytechnic Institute.

Statistica, I.-I. N. d. (2014). Censuses. Retrieved 10/2, 2014, from http://www.istat.it/en/censuses

Venipedia. (2014). ACTV - Venipedia. Retrieved 9/28/14, 2014, from http://www.venipedia.org/wiki/index.php?title=ACTV

WalkScore. (2014). Walk Score. Retrieved 9/23, 2014, from http://www.walkscore.com

Wiseman, R. Pace of Life Project: Method. Retrieved 1 December, 2014, from http://www.richardwiseman.com/quirkology/pace_method.htm

World, A. t. (2014). AtoZ the World Country Guides. Retrieved 9/29, 2014, from http://www.atoztheworld.com/

World Happiness Report. (2013). In J. Helliwell, R. Layard, & J. Sachs (Eds.). New York: UN Sustainable Development Solutions Network.

Appendix A: Clock Data

Category	Name	Address	Latitude	Longitude	# of Faces	Type	Working?	Minutes Ahead
MINICH	CLOCK1	Cannaregio-Calle de la Colombina 5091	45.443056	12.340417	1	12-Hour	Yes	-2
MINICH	CLOCK2	Cannaregio-Calle Ca D'Oro 3929	45.441222	12.334269	1	12-Hour	Yes	1
MINICH	CLOCK3	Cannaregio-Fondmenta de Cannaregio 1297	45.443722	12.325722	2	12-Hour	Yes	-1
MINICH	CLOCK4	S.Croce - Campazzo tre Ponti 460	45.437028	12.319281	1	12-Hour	Yes	320
MINICH	CLOCK5	S. Croce-Campo S. Giacomo dell'Orio 1517	45.439861	12.327444	1	12-Hour	Yes	-1
MINICH	CLOCK6	S. Polo-Chiesa di S. Polo 2021	45.437194	12.330028	1	12-Hour	Yes	2
MINICH	CLOCK7	S. Polo-Calle Scimia o delle Spade 231	45.438917	12.334486	1	12-Hour	Yes	2
MINICH	CLOCK8	S.Marco - Campo S.Bartolomeo 5380	45.437639	12.336722	2	12-Hour	Yes	1
MINICH	CLOCK9	S. Marco-Riva del Carbon	45.436889	12.334728	2	12-Hour	Yes	1
MINICH	CLOCK10	S.Marco - Rio Terrà S.Paternian 4267	45.43575	12.335011	1	12-Hour	Yes	-1
MINICH	CLOCK11	S.Marco - Campo S.Stefano - angolo chiesa	45.433656	12.330778	2	12-Hour	Yes	-3
MINICH	CLOCK12	Dorsoduro-Fond ta Zattere 925	45.429611	12.325917	1	12-Hour	Yes	-1
MINICH	CLOCK13	S. Marco-Calle de l'Ascension 1343/B	45.433278	12.336722	1	12-Hour	Yes	0
MINICH	CLOCK14	Castello - Calle del Doge 3733 A	45.433842	12.346222	1	12-Hour	Yes	0
MINICH	CLOCK15	Castello-Via Garibaldi 1810	45.4325	12.354972	1	12-Hour	Yes	21
MINICH	CLOCK16	Castello-Campo SS. Giovanni e Paolo 6808	45.439083	12.341472	1	12-Hour	Yes	-211
MINICH	CLOCK17	Castello-Campo S.M. Formosa 6129	45.437389	12.341167	1	12-Hour	Yes	57
MINICH	CLOCK18	S.Polo - Calle del Traghetto Vecchio 2882	45.4355	12.327889	2	12-Hour	Yes	-1
MINICH	CLOCK19	Cannaregio-Rio Terra S. Leonardo 1411	45.443944	12.3285	1	12-Hour	Yes	1
MINICH	CLOCK20	Isola di Sacca Fisola-Cpl. Del Vaporetto	45.428694	12.315556	1	12-Hour	Yes	0
MINICH	CLOCK21	Murano-Piazzale Colonna 1-1/A	45.451249	12.348504	1	12-Hour	Yes	0
PUBLIC	TORO	Torre dell'Orologio	45.43471	12.338912		24-Hour	Yes	0
PUBLIC	STUC	Molino Stucky Giudecca	45.42837858	12.31937377	1	12-Hour	Yes	-2

PUBLIC	ARSE	Venetian Arsenal	45.4354255	12.3490193	1	12-Hour	No	Broken
BELLTOWER	APON	Sant'Aponallinare	45.437382	12.332519	1			Construction
BELLTOWER	ELEM	San Giovanni di Rialto	45.4380002	12.3330977	1	24-Hour	Yes	0
BELLTOWER	APOS	S. Apostoli	45.439752	12.336737	1	24-Hour	Yes	0
BELLTOWER	DONA	S. Maria e Donati	45.456576	12.357145	1	12-Hour	No	Broken
BELLTOWER	FORM	Santa Maria Formosa	45.436505	12.340979	2	12-Hour	Yes	0
BELLTOWER	RAFF1	San Angelo Raffaele	45.431694	12.319028	1	12-Hour	Yes	0
BELLTOWER	SALU2	Santa Maria della Salute	45.429712	12.335056	1	12-Hour	Yes	0
BELLTOWER	STEM	Santo Stefano di Murano	45.45469	12.35328	2	12-Hour	No	Broken
BELLTOWER	ZACC	San Zaccaria	45.43381	12.34356	1	12-Hour	Yes	0
BELLTOWER	MEND	San Nicolo dei Mendicoli	45.431714	12.315872	1	12-Hour	Yes	2 hours off

Appendix B: Yearly Time Cycles Infographic

Appendix C: Walking Speed Data

Strada Nuova (8:30-9:45) Sunny 48 degrees			
Venetian		Tourist	
Male	Female	Male	Female
8.23	9.39	10.1	10.9
9.35	9.49	10.71	11.36
9.51	9.63	11.4	11.39
10.03	10.02	11.86	11.51
10.16	10.23	12.01	11.56
10.18	10.25	12.4	12.01
10.4	10.37	12.43	12.03
10.43	10.6	12.45	12.06
10.43	10.62	12.58	12.46
10.61	10.8	12.81	12.58
10.66	10.83	13.13	12.72
10.71	10.84	13.14	12.76
10.95	10.88	13.23	12.92
11.13	10.92	13.41	13.21
11.18	10.97	13.5	13.21
11.25	11	13.53	13.38
11.28	11.09	13.76	13.41
11.3	11.25	13.93	13.54
11.43	11.26	14.03	13.73
11.46	11.57	14.13	13.76
11.63	11.69	14.31	13.82
12.11	11.76	14.43	13.89
12.33	11.86	14.48	13.92
12.56	11.9	14.55	13.95
12.86	12.06	14.8	13.97
13.1	12.12	14.83	14.03
13.3	12.18	15.03	14.27
13.3	12.23	15.21	14.28
13.35	12.23	15.23	14.3
13.35	12.57	15.28	14.31
13.43	12.6	15.8	14.43
13.81	12.62	15.9	14.67
13.93	12.92	16.36	15.23
14.18	13.24	17.08	16.27
14.86	13.39	17.3	16.62

Strada Nuova (11:20 AM-12:20PM) Sunny 61 degrees			
Venetian		Tourist	
Male	Female	Male	Female
8.83	10.2	10.46	9
9.43	10.5	10.6	10.5
9.55	10.7	11.5	10.7
10	10.7	11.81	10.8
10.36	10.7	11.81	11.4
10.46	10.8	11.88	11.5
10.57	11.1	12	11.6
10.75	11.2	12.05	11.8
10.85	11.3	12.75	12.3
11.13	11.4	12.85	12.5
11.23	11.4	12.98	12.7
11.25	11.5	13	12.8
11.45	11.6	13.01	12.9
11.45	11.6	13.31	13.1
11.58	11.7	13.56	13.3
11.6	11.8	13.6	13.5
11.66	11.9	13.65	13.6
11.73	12	13.98	13.7
11.9	12.3	14.05	14.4
12.11	12.4	14.4	14.4
12.18	12.5	14.45	14.5
12.41	12.6	14.68	14.5
12.46	13.1	14.78	14.5
12.53	13.2	15	14.6
12.58	13.5	15.11	14.8
12.68	13.9	15.13	15.1
12.85	14	15.68	15.3
12.93	14.2	15.7	15.3
12.95	14.2	15.8	15.3
12.95	14.5	16.18	15.3
13.5	14.8	16.23	15.4
13.51	14.9	16.31	15.4
13.76	15.1	16.53	15.7
14.45	16.6	17.71	15.8
15.25	17.4	19.46	16.5

Strada Nuova (8:30 PM - 9:10) Clear 46 degrees			
Venetian		Tourist	
Male	Female	Male	Female
8.83	9.73	7.89	9.55
9.6	10.65	10.87	10.87
10.5	10.75	11.5	11.88
10.75	10.83	12.37	12.14
11.4	10.83	12.7	12.29
11.55	11.09	12.74	12.37
11.58	11.25	13.08	12.48
11.9	11.55	13.26	12.7
12.06	11.68	13.45	13.24
12.18	11.91	13.48	13.45
12.18	12.03	13.56	13.48
12.21	12.17	13.76	13.8
12.32	12.31	13.8	13.84
12.46	12.42	13.84	14.34
12.54	12.5	14.15	14.4
12.88	12.54	14.34	14.6
12.96	12.62	14.61	14.61
13.21	12.88	14.67	14.64
13.31	13.09	14.72	14.66
14	13.26	15.22	14.72
14.02	13.84	15.29	14.72
14.11	14.11	15.33	14.98
14.27	14.27	15.55	15.22
14.5	14.43	15.83	15.29
14.66	14.45	16.21	15.55
14.91	14.56	16.24	15.83
14.91	14.6	16.48	16.27
15.08	14.7	16.84	16.48
15.35	14.91	16.88	16.84
16.37	15.35	16.94	16.88
16.43	15.77	17	16.94
16.6	17.64	17.36	17.06
17.64	17.96	18.8	17.36
17.96	19.63	18.85	18.71
30.55	19.99	19.53	19.72

San Marco (8:30 AM- 9:40 AM) Sunny 46 degrees			
Venetians		Tourists	
Male	Female	Male	Female
8.9	9.77	10.91	11.23
9	10.06	11.4	11.35
10.3	10.17	11.6	11.52
10.4	10.17	11.6	11.67
10.5	10.2	11.8	11.72
10.6	10.53	12.1	11.84
10.6	10.64	12.4	11.91
10.7	10.65	12.4	12.4
10.8	10.77	12.4	12.53
10.9	10.86	12.51	12.57
11	10.97	12.8	13.1
11	10.98	12.8	13.13
11.3	11.06	12.9	13.2
11.4	11.12	13	13.26
11.4	11.45	13.1	13.27
11.5	11.51	13.3	13.31
11.6	11.57	13.5	13.53
11.6	11.62	13.5	13.57
11.6	11.87	13.6	13.62
11.6	11.87	13.6	13.81
11.8	12.07	13.7	14.21
11.8	12.08	13.7	14.24
12	12.13	13.7	14.27
12	12.25	13.8	14.5
12.1	12.37	14.5	14.9
12.3	12.56	14.7	15.3
12.4	12.61	15	15.34
12.4	12.65	15.6	15.37
12.7	12.66	15.8	15.7
13.2	12.77	15.9	16.08
13.4	12.8	15.98	16.1
13.7	12.97	16.5	16.34
13.7	13.74	17	16.35
13.8	13.97	17.3	16.47
13.8	14.67	21.15	17.03

San Marco (11:30 AM- 12:45 PM) Sunny 57 degrees			
Venetians		Tourists	
Male	Female	Male	Female
7.56	9.37	10.61	11.53
8.6	9.81	11.11	11.66
8.68	10.39	11.23	11.68
9.11	10.61	11.46	12.01
9.73	10.69	11.48	12.07
9.76	10.73	11.48	12.19
9.81	10.81	11.53	12.31
9.83	10.82	11.7	13.05
10.58	11.32	11.91	13.14
10.66	11.43	11.93	13.19
10.68	11.56	12.41	13.58
10.81	11.64	12.53	13.78
10.98	11.8	12.58	13.86
11.05	11.81	12.86	14.07
11.35	11.98	13	14.13
11.41	12.11	13.01	14.26
11.51	12.17	13.05	14.29
11.51	12.18	13.53	14.41
11.59	12.29	13.58	14.65
11.63	12.51	13.78	15.35
12.51	12.56	13.86	15.37
12.51	12.56	14	15.56
12.65	12.75	14.08	15.85
12.71	12.79	14.13	16.26
12.91	12.79	15.08	16.43
12.95	12.81	15.16	16.86
12.96	12.99	15.16	16.95
13.13	13.01	15.31	17.05
13.38	13.41	15.46	17.12
13.85	13.59	16.21	17.41
13.88	13.76	16.3	17.79
14	13.85	16.41	18.21
14	14.33	16.86	18.68
14.03	14.42	17.79	19.05
14.43	15.09	18.68	14.88

San Marco (8:20 PM -9:40 PM) Partly Cloudy 50 degrees			
Venetians		Tourists	
Male	Female	Male	Female
3.83	9.38	9.11	9.21
4.18	9.38	9.21	9.57
4.53	9.83	9.26	10.04
4.56	9.96	9.57	10.48
8.36	9.98	10.48	10.59
8.45	10.01	10.66	11.11
8.48	10.08	11.01	11.13
8.91	10.16	11.11	11.16
9.21	10.36	11.13	11.43
9.43	10.51	11.7	11.55
9.86	10.51	11.89	11.89
9.98	10.66	11.9	11.9
10.05	10.68	12.03	12.05
10.11	10.76	12.05	12.15
10.7	10.79	12.15	12.31
10.8	10.85	12.31	12.38
11.01	10.87	12.42	12.42
11.16	11.03	12.55	12.83
11.28	11.09	13.13	12.84
11.38	11.2	13.25	13.01
11.66	11.36	13.25	13.25
11.7	11.71	13.36	13.5
11.75	11.73	13.5	13.58
11.82	11.73	13.83	13.77
11.86	11.82	14.02	14.02
11.95	12	14.04	14.02
12	12.68	14.21	14.04
12.05	13.11	14.36	14.21
12.2	13.24	14.53	14.36
12.86	13.25	14.53	14.41
13.24	13.56	16.11	14.51
14.38	13.9	16.11	14.53
14.53	13.91	16.18	15.06
14.66	14.38	16.86	16.86
16.85	15.12	18.05	18.05

Train Station (Rio Tera Lista di Spagna) (8:30am - 10:00am) Sunny 41 degrees			
Venetian		Tourist	
Male	Female	Male	Female
6.68	9.48	9.56	9.31
9.8	9.71	10.11	11.74
10.4	9.93	10.25	11.88
10.43	9.98	10.7	12.01
10.56	10.57	11.35	12.09
10.66	10.6	11.74	12.09
10.75	10.67	11.8	12.11
10.83	10.68	11.91	12.15
11.08	10.95	12.11	12.37
11.25	11.4	12.31	12.54
11.41	11.42	12.35	12.57
11.58	11.43	12.8	12.7
11.58	11.55	13.06	12.8
11.63	11.55	13.11	12.93
11.81	11.87	13.38	13.02
11.93	11.96	13.64	13.06
11.95	11.98	13.71	13.25
12.01	12.14	13.86	13.64
12.03	12.18	14.17	13.65
12.2	12.3	14.18	13.76
12.23	12.56	14.28	14.01
12.45	12.75	14.31	14.14
12.51	12.86	14.51	14.17
12.6	12.87	14.53	14.31
12.83	13.35	14.7	14.53
12.87	13.45	14.75	14.7
13.03	13.77	14.76	14.75
13.7	14.55	14.91	14.78
14	14.55	15.53	15.19
14.06	14.6	15.6	15.41
14.16	14.71	15.91	15.6
14.55	14.92	16.21	15.9
15.05	15.02	17.1	16.19
15.35	16.41	17.3	18.48
15.99	18.28	18.75	20.75

Train Station (Rio Tera Lista di Spagna) (11:50am - 12:25pm) Cloudy 50 degrees			
Venetian		Tourist	
Male	Female	Male	Female
9.31	8.9	9.48	10.4
9.35	9.53	9.65	10.88
9.38	10.3	10.1	11.05
9.51	10.3	10.11	11.06
9.6	10.63	10.4	11.6
9.7	10.7	10.8	11.6
9.9	10.94	10.93	11.7
10.03	11.1	11.06	11.7
10.13	11.2	11.5	11.76
10.16	11.3	11.6	11.8
10.41	11.4	11.7	11.9
10.48	11.4	11.76	12.11
10.5	11.5	11.9	12.15
10.53	11.6	11.96	12.3
9.78	11.9	12.5	12.4
10.8	12.1	12	12.4
10.98	12.3	12.25	12.5
11.03	12.5	12.4	12.7
11.11	12.6	12.53	12.8
11.15	12.7	12.8	12.8
11.15	12.8	12.8	13.1
11.34	12.8	13	13.3
11.36	12.9	13.25	13.4
11.46	12.9	13.25	13.4
11.55	13.2	13.4	13.7
11.77	13.4	13.4	13.88
11.8	13.4	13.61	14.1
11.86	13.4	13.7	14.25
12.01	13.4	13.9	14.26
12.21	13.66	13.9	14.7
12.3	14	14.26	14.7
13.06	14.2	14.3	14.76
13.66	14.9	14.36	15.1
14.51	15.6	14.7	15.2
14.53	16.2	15.8	15.8

Train Station (Rio Tera Lista di Spagna) (8:30pm - 9:15pm) Clear 40 degrees			
Venetian		Tourist	
Male	Female	Male	Female
8.7	9.1	10.3	9.9
9.2	9.3	10.6	10.1
9.3	9.4	11	10.9
9.3	10.2	11.1	11.2
9.5	10.3	11.3	11.4
9.6	10.7	11.4	11.4
10.3	11.3	11.7	11.9
11	11.4	11.7	12.1
11.1	11.5	11.9	12.3
11.3	11.5	12.1	12.6
11.4	11.6	12.1	12.8
11.4	11.7	12.2	12.8
11.4	11.8	12.3	12.8
11.5	11.8	12.8	13.1
11.6	11.9	12.9	13.1
11.7	12	13	13.2
11.8	12.1	13.3	13.2
11.9	12.2	13.3	13.4
12	12.2	13.4	13.6
12.2	12.4	13.5	13.6
12.5	12.4	13.6	13.6
12.7	12.5	13.7	13.9
12.9	12.7	14.1	14.3
13.1	12.9	14.2	14.3
13.1	13.1	14.2	14.4
13.2	13.3	14.3	14.4
13.3	13.4	14.3	14.7
13.3	13.7	14.4	14.7
14.1	13.7	14.4	14.8
14.1	13.8	14.7	14.8
14.2	14.1	14.7	14.9
14.3	14.1	14.8	15.6
14.5	14.2	15.2	15.7
14.8	14.5	15.6	15.8
14.9	17.1	15.7	16.3

Via Giuseppe Garibaldi (8:30am - 9:30am) Clear 45 degrees	
Venetians	
Male	Female
8.26	8.99
8.3	9
8.5	9.15
8.53	9.17
8.61	9.4
9.05	9.52
9.46	9.6
9.83	9.66
9.93	10.33
10	10.34
10.11	10.63
10.35	10.75
10.86	10.81
10.88	11.06
11.06	11.2
11.4	11.2
11.55	11.41
11.66	11.7
11.75	11.92
11.9	11.93
12	12.02
12.2	12.11
12.28	12.21
12.4	12.29
12.7	12.31
12.78	12.37
12.88	12.94
12.95	13.12
13.65	13.43
13.88	13.51
14.23	13.84
14.35	15.59
14.5	15.62
14.76	17.52
18.45	19.29

Via Giuseppe Garibaldi (12:30pm - 1:00pm) Sunny 41 degrees			
Venetians		Tourists	
Male	Female	Male	Female
9.5	9.1	12.11	12.11
9.6	10.8	12.7	12.23
9.83	10.9	12.8	12.34
10.4	11.06	12.81	12.49
10.5	11.4	13.08	12.92
10.64	11.61	13.1	13.1
10.8	11.8	13.26	13.24
11.05	11.8	13.4	13.48
11.7	12.08	13.4	13.82
11.93	12.6	13.41	13.9
11.95	12.7	13.81	14.1
12.1	12.7	14.1	14.33
12.16	12.9	14.4	14.44
12.3	13.2	14.5	14.68
12.3	13.3	14.7	14.78
12.5	13.4	15.08	15.08
13.01	13.42	15.08	15.2
13.03	13.5	15.11	15.24
13.42	13.58	15.2	15.3
13.5	13.6	15.32	15.4
13.8	13.7	15.35	15.43
15.38	13.71	15.4	15.44
15.51	13.9	15.8	15.51
15.9	13.9	16.15	16.15
16.4	14.06	16.38	16.42
16.41	14.2	16.6	16.6
16.41	14.78	16.73	16.73
17.2	15.1	16.8	17.1
17.2	15.23	17.1	17.1
17.24	15.5	17.1	17.2
17.56	15.8	17.2	17.73
17.6	15.81	17.24	17.77
17.73	15.9	17.73	18.11
18.26	17.6	18.3	18.3
19.53	18.3	18.31	18.57

Via Giuseppe Garibaldi (8:30pm - 9:20pm) Clear 41 degrees	
Venetians	
Male	Female
4.98	9.62
8.86	10.3
8.97	10.4
8.98	10.45
9.39	10.78
9.4	10.78
10.2	10.94
10.21	11
10.8	11.49
11.4	11.5
11.58	11.5
11.63	11.5
11.8	11.7
12.2	11.7
12.3	11.8
12.4	12.1
12.4	12.2
12.5	12.39
12.6	12.4
12.65	12.4
12.7	12.82
12.7	12.9
12.8	12.96
12.9	13.04
12.9	13.2
13.04	13.5
13.1	13.65
13.1	13.8
13.2	14.4
13.4	15.4
13.42	15.6
14.1	15.8
15.4	15.9
16.19	16.19
19.3	16.7

Rio Tera Lista di Spagna December 8, 2014 8:30am - 10:00am, 41 degrees							
Venetian				Tourist			
Male		Female		Male		Female	
Male-60 ft	Male-120 ft	Female-60 ft	Female-120 ft	Male-60 ft	Male-120 ft	Female-60 ft	Female-120 ft
6.68	12.95	9.48	18.66	9.56	19.8	9.31	20.71
9.8	19.06	9.71	20.95	10.11	22.3	11.74	23.14
10.4	22.1	9.93	20.51	10.25	20.75	11.88	22.98
10.43	20.93	9.98	20.5	10.7	22.03	12.01	24.89
10.56	22.08	10.57	20.8	11.35	23.16	12.09	24.54
10.66	21.15	10.6	22.77	11.74	23.14	12.09	25.14
10.75	20.51	10.67	20.71	11.8	23.88	12.11	25.11
10.83	22.85	10.68	22.07	11.91	23.28	12.15	25.4
11.08	23.21	10.95	20.66	12.11	25.13	12.37	23.73
11.25	23.75	11.4	23.67	12.31	25.9	12.54	25.36
11.41	22.48	11.42	23.47	12.35	24.88	12.57	26.01
11.58	24.38	11.43	24.45	12.8	26.6	12.7	27.49
11.58	23.88	11.55	24.59	13.06	25.81	12.8	24.97
11.63	23.7	11.55	23.03	13.11	27.76	12.93	25.09
11.81	23.83	11.87	24.38	13.38	30.01	13.02	26.77
11.93	24.58	11.96	23.87	13.64	27.77	13.06	25.81
11.95	23.66	11.98	24.68	13.71	29.55	13.25	26.16
12.01	23.46	12.14	24.52	13.86	28.33	13.64	27.77
12.03	24.46	12.18	24.9	14.17	27.85	13.65	28.1
12.2	25.55	12.3	23.32	14.18	26.86	13.76	26.88
12.23	25.33	12.56	25.55	14.28	28.46	14.01	28.43
12.45	24.4	12.75	25.83	14.31	28.89	14.14	28.51
12.51	25.68	12.86	27.02	14.51	29.6	14.17	27.85
12.6	24.66	12.87	26.11	14.53	30.32	14.31	28.89
12.83	24.8	13.35	27.44	14.7	29.49	14.53	30.32
12.87	26.11	13.45	26.41	14.75	27.89	14.7	29.49
13.03	26.7	13.77	31.41	14.76	28.81	14.75	27.89
13.7	28.51	14.55	28.55	14.91	27.05	14.78	29.88
14	29.01	14.55	27.31	15.53	32.18	15.19	31.04
14.06	26.76	14.6	30.58	15.6	31.3	15.41	30.34
14.16	28.02	14.71	27.88	15.91	30.63	15.6	31.3
14.55	27.31	14.92	30.23	16.21	34.2	15.9	30.43
15.05	31.2	15.02	29.62	17.1	34.55	16.19	32.97
15.35	31.85	16.41	32.92	17.3	35.91	18.48	38.07
15.99	31.5	18.28	32.99	18.75	36.93	20.75	46.16

Appendix D: Working Speed Data

Post Office Code	Location	Latitude	Longitude	Date	Measured Time (seconds)
POST1	Calle Larga Ascensione	45.433626	12.336893	11/3/2014	21.06
POST2	Via Garibaldi	45.43209	12.35127	11/3/2014	23.43
POST3	Viale IV, Sant' Elena	45.427704	12.360139	11/19/2014	24.07
POST4	Fondamenta Ponte Lungo, Giudecca	45.426046	12.328101	11/19/2014	25.16
POST5	Fondamenta Santa Chiara	45.438773	12.318826	12/7/2014	26.2
POST6	Fondamenta Andrea Navagero, Murano	45.455472	12.356677	11/21/2014	17.1
POST7	Calle Larga Brusa	45.4386116	12.3434212	11/24/2014	20.14
POST8	Fondamenta Zattere Al Ponte Lungo	45.430714	12.32113	12/7/2014	22.45

Tobacconist Shop Code	Date	Measured Time (seconds)
TOB1	11/24/2014	23.13
TOB2	11/24/2014	19.57
TOB3	11/24/2014	21.29
TOB4	11/24/2014	20.89
TOB5	11/24/2014	18.94
TOB6	12/3/2014	28.5
TOB7	12/3/2014	13.81
TOB8	12/3/2014	15.6

Appendix E: Bank Clock Accuracy Data

Bank Code	Bank Name	Latitude	Longitude	Date	Recorded Time Off (Minutes)
BANK1	Banco San Marco	45.433	12.336889	11/3/2014	-1
BANK2	Cassa di Risparmio di Venezia	45.440877	12.334801	11/7/2014	-2
BANK3	Banco San Marco	45.443324	12.331142	11/7/2014	0
BANK4	Banca Carige Italia	45.44054	12.326507	11/11/2014	0
BANK5	Cassa Di Risparmio Di Venezia	45.439184	12.334117	11/21/2014	2
BANK6	Banca Monte Dei Paschi Di Siena	45.440496	12.322462	12/2/2014	-1
BANK7	Allianz Bank	45.437966	12.318042	12/2/2014	0
BANK8	Cassa Di Risparmio Di Venezia	45.434232	12.323278	12/2/2014	2
BANK9	Veneto Banca Holding	45.429886	12.324596	12/2/2014	0
BANK10	Banca Nazionale	45.43098	12.328642	12/3/2014	0
BANK11	Banco Di Brescia Spa	45.436974	12.329707	12/5/2014	0
BANK12	Deutsche Bank	45.432004	12.353018	12/8/2014	2
BANK13	Deutsche Bank	45.432822	12.334672	12/8/2014	1
BANK14	Banca Popolare di Vicenza	45.43484	12.335831	12/9/2014	1
BANK15	Veneto Banca	45.435055	12.334184	12/10/2014	0

Appendix F: Walkability Infographic