PROMOTING BIKING AMONG LOW-INCOME CHINESE IMMIGRANTS IN SAN FRANCISCO

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In partial fulfillment of The Requirements for The Degree

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BACKGROUND 》

1 Introduction

Immigrants in the United States have less access to automobiles than native-born Americans, and therefore travel more frequently using alternative modes, such as carpool, public transit and non-motorized modes (Smart, 2010). According to the report *Pedaling to Prosperity by the Sierra Club*, transportation expense accounts for as much as 55 percent of the budget in low-income families (2012). Although evidence of income level for Chinese immigrants is limited, the statistical analysis of the data from American Community Survey (ACS) 2007–2011 (Figure1) finds that the Chinese population with language barriers is likely to be classified as "poor" in San Francisco.

This Creative Work is intended to support low-income Chinese immigrants by promoting lower cost transportation alternatives. For this purpose, the bicycle holds great potential to save transportation cost, and still provide efficient mobility.

The outreach effort to immigrants regarding the bike planning is as yet insufficient in major cities throughout the United States (Smart, 2010). Migration Information Source (MPI) shows nearly 50 percent of Chinese immigrants live in only three metropolitan areas. Following New York–Northern New Jersey–Long Island, San Francisco–Oakland–Fremont has the second largest population in the United States; and this region accounts for 12.9 percent (202,248 people) in a total population of 1.6 million as of 2008. Los Angeles–Long Beach–Santa Ana follows in third. (Terrazas & Batalova, 2010). Despite the large population of Chinese immigrants in these three metropolitan areas, a 2007 citywide bicycle survey in New York City was conducted only in English online; and a draft Bicycle Master Plan Update, which was released in 2009 in Los Angeles, didn't include any consideration of immigrant communities (Smart, 2010). In San Francisco as well, outreach to Chinese immigrants regarding bike planning has been limited as research shows fewer bike networks in Chinese immigrant neighborhoods. The survey that this research is based on found

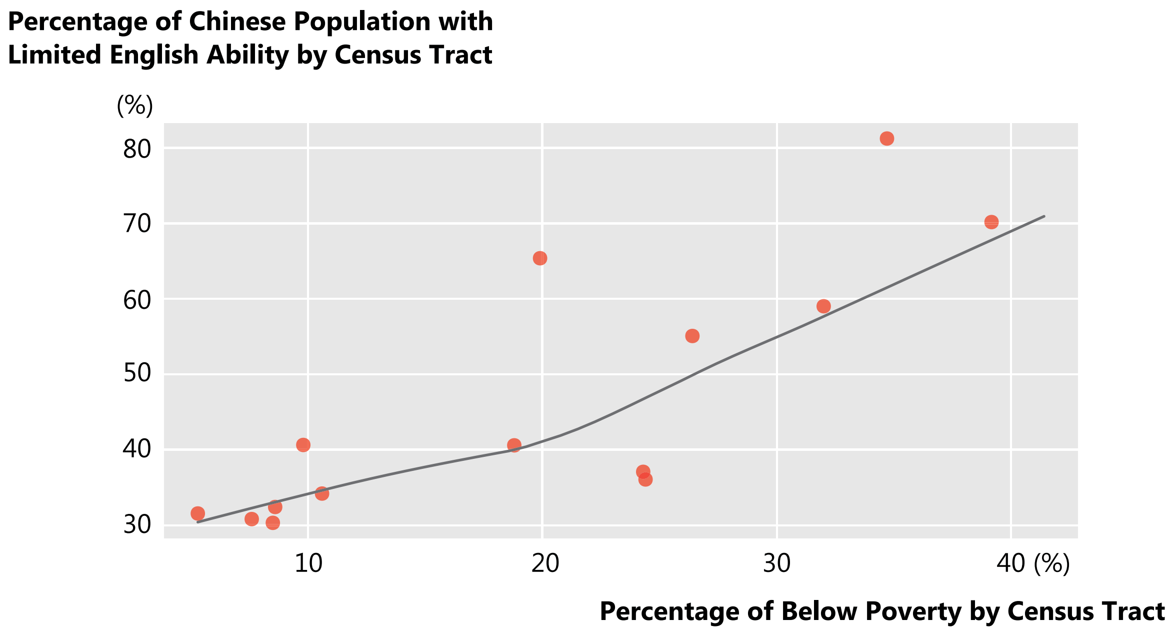

Figure 1. Correlation between Chinese population—limited English ability and poverty

over 70 percent of survey respondents (N=28) who have a language barrier, answered “they didn’t receive enough information regarding community issues,” 86 percent of respondents (N=28) answered this is “because all information was relayed in English” and 54 percent of respondents (N=28) answered this is “because all information was relayed exclusively online.“

As the survey of this research found, auto traffic and safety concerns are the two biggest barriers to biking for the Chinese immigrants in San Francisco. Therefore, promotion of a safe bike lane is the primary solution in the Creative Work. To support the process of making the bike lane, this Creative Work is also focusing on outreach methods, which uses visual communication to fill the gap caused by the language barrier and digital divide.

This Creative Work is intended to use visual communication to fill the gap caused by the language barrier and digital divide. Since the survey showed that most of the target audiences, Chinese low-income immigrants, prefer more traditional outreach methods, such as newspaper and phone call, the Creative Work chooses the media of newspaper to reach the target audiences. However, they are intended to guide the target audiences online application “Bikeability Reporting System” with accessible instruction as well as an optional paper based reporting form. The survey found the majority of the target audiences use public transit. Therefore it is proposed that the application is accessible at the major bus stops using digital screens, which connect to the internet. The Creative Work also proposes a system to have the target audiences participate in the process of improving bikeability in their neighborhoods with collaboration from local media and community organizations.

2 Problem Statement

There are some bike related projects intended to reach out to Chinese communities using multi-language in San Francisco, such as the Green Infrastructure Projects—managing watershed and improving other infrastructures on streets, like public space, bike lanes and vegetation (PUC, 2013) by Public Utility Commission (PUC). However, the author suggests that the underlying problem for the low bicycle participation among Chinese immigrants is the language barrier. Although the study focuses on Chinese immigrant youths, Yeh, C., Kim, A., Pituc, S., and Atkins state, “the loss of opportunities to communicate in one’s native language contributes to feelings of insecurity and fear when interacting with the majority culture or engaging in daily living activities” (2008). SFMTA is in the process of expanding biking’s share in commuting from 8 to 10 percent by 2018, which is two to three times the 2010 figure of 3.5 percent (SFMTA, 2013). Regardless of SFMTA’s effort, language barriers contribute greatly to the low participation in biking by Chinese immigrants, since most of SFMTA’s outreach is exclusively in English. ACS 2007–2011 census data showed 65 perent of the Chinese population in San Francisco had language barriers. This accounts for 14 percent (110,900 Chinese people) of the total population of San Francisco—797,983 (ACS 2007–2011), may have problems receiving or accessing helpful information about biking.

“The loss of opportunities to communicate in one’s native language contributes to feelings of insecurity and fear when interacting with the majority culture or engaging in daily living activities”

3 Benefits of Biking

A bicycle is an inexpensive transportation mode and it also provides a great amount of mobility (Tumlin, 2010). Tumlin calls the bicycle the "most-efficient form of transportation ever invented" in his book, *Sustainable Transportation Planning* (2010). Although the benefits of biking are many, the research primarily focuses on its possibility of economic status improvement in low-income populations.

Increase Mobility in the Poor

The improvement of the urban environment in Bogotá, Colombia has received wide attention. Although TransMilenio—total 87 km (54 mi) Bus Rapid Transit (BRT) (Bogotá.gov.co, 2012), was the primary focus of Bogota's transportation improvement, another huge improvement was bikeways and pedestrians. Importantly, these implementations were prioritized over automobile infrastructures (Hustwit, 2011). This characteristic cycle-way, called Ciclovia is 376 km (about 234 mi) in total length (Bogotá.gov.co); it is more than two times longer than the bike network in San Francisco if sharrow—a shared marking lane, and other bike networks without separation from automobile travel lanes are excluded (SFMTA, 2013). In the documentary, *Bogotá: Building a Sustainable City*, Enrique Peñalosa, who contributed greatly to the revitalization of Bogotá through massive change in the urban environment, commented how he had the option to build a massive highway system in Bogotá with support from Japan International Cooperation Agency (JICA)—but, he turned down their proposal, since he knew it would help only the 15 percent of rich people who could afford automobiles and would not solve the underlying problems in Bogotá. Although this is an advantageous effect especially for TransMilenio, Peñalosa notes that people who use TransMilenio save 800 hours in transportation time per year and 300, 000 people save more than 10 percent of their income by reducing transfers and travel time (Albers & Fettig, 2007). These numbers prove that improving mobility helps to develop individual economies. Li, Campbell and Fernandez cite accessibility to jobs and other public services influence people's quality of life and economic development (2013). Residential location is also an important factor to improving the economic status by increasing accessibility. Likewise, improving the transportation network to provide mobility to access jobs and other public services also greatly helps in economic status improvement.

Transportation Cost

Bikes are an inexpensive means of transportation, but they are not completely free. There are the initial costs to purchase a bike, running costs and maintenance fees. However, a bicycle's operating costs are much cheaper than owning a car; its annual average cost is $308 (Sierra Club, 2012). This figure is one-seventeenth the annual average cost of a car, $5,109 (Bureau of Transportation Statistics, 2013). Comparing this bicycle cost to public transit, this research uses the example of the transit expense in San Francisco. The main public transit services in San Francisco are San Francisco Municipal Railways (MUNI) and Bay Area Rapid Transit District (BART). This research restricts its travel range within San Francisco to ease the fare calculation. San Francisco's monthly transit pass is $76 per a month (SFMTA, 2013), which allows one to take MUNI and BART within San Francisco limitlessly. If one purchases this monthly pass and minimizes the travel range within San Francisco, it costs $912 per a year, which is still three times higher than the operating cost of a bicycle. Since the travel ranges of the three different modes are not taken into account, the validity of this comparison is limited. However, it is very clear that the bicycle is the best mode to minimize expenses for transportation other than walking (if the travel distance is short).

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Effective Speed of Bicycles

It is important to note that the cost of public transit may be competitive with the cost of bicycles in certain conditions. SFMTA offers discounts on the monthly pass for people whose status are low-income, senior, disability and/or youth. In the case of low-income, the MUNI monthly pass is 50 percent off from the original price of $66, although this discount is restricted only to MUNI, and not including BART within San Francisco (SFMTA, 2014). In this case, the annual cost for transportation is $396, which doesn't show a huge difference from the operating cost of a bicycle, $308. However, a bicycle can be the fastest mode of transportation in certain conditions as was shown with the Seventh Annual New York Commuter Challenge by Transportation Alternative in 2008. In this event, a bicycle commuter won most efficient commuting time against a bus/subway and private auto commuters (Pucher & Buehler, 2012).

Additionally, there is a concept of "effective speed," which takes a holistic view of speed. The formula of the effective speed is distance divided by all the time costs, which includes all the time relating usage of each mode of transportation. In the case of automobiles, all the time costs include items such as idling in traffic jams, time for finding parking and routine maintenance. Furthermore, effective speed includes the time to earn money to pay off the cost of driving, such as vehicle costs, registration fees, insurance, parking fees and maintenance fees. Applying this concept, a cheaper mode of transportation is also more effective in speed (Pucher et al., 2012).

Although public transit is less expensive compared to owning and driving an automobile, also to be considered the actual time for waiting on services. Regarding the case of MUNI in San Francisco, the service is not very reliable as shown by the data, *Transit Performance Report Q4 FY2013*. The data in August 2013 shows the percentage of on-time performance is only 60.1 percent (SFMTA, 2013). In the article, *Neglecting MUNI Costs the Economy at Least $50 Million Per Year*, published on www.streetsblog.com, Bialick points out MUNI's unreliability in that MUNI trains oftentimes breakdown and MUNI bus is frequently stuck in traffic jam. In the same article, the author cites MUNI passengers were delayed 86,000 cumulative hours in April 2013, which is a total of 19 years and 8 months (2013). Compared to these figures, it is obvious that bicycling is much more efficient with total travel time—especially if the travel distance is relatively short distance, compared to using MUNI public transit in San Francisco.

Physical and Mental Health Benefits of Biking

Bicycling contributes to improve people's health, especially if it is introduced as a daily activity. According to the 2*008 Physical Activity Guidelines for Americans* by U.S. Department of Health and Human Service, it is recommended that adults do a minimum of 30 minutes of moderate-intensity physical activity per day (2008). If one uses a bicycle to commute or other daily activities, it likely covers this minimum exercise requirement to maintain one's health.

Benefits are not only restricted to physical health, but bicycling is also able to contribute to one's mental health. Pucher et al. cite that a recent systematic review that shows physical activity is able to solve depressive symptoms. As well as possibly easing depression, bicycling provides relaxation, enjoyment and social interaction, which are the some of the key motivations for people who do bicycle.

When the health benefits of biking are seeen holistically, there are more factors, such as reducing air and noise pollution from motorized vehicles, which are argued by Pucher et al. (2012). However, the research focuses on the direct health effect of bicycles, which improve people's physical and mental health.

It is not necessary to argue that driving harms one's mental health. However, it is likely true that driving doesn't contribute to people's physical health. Todd Alexander Litman's *Transportation Cost and Benefit Analysis* shows that active transportation, like walking and cycling, greatly contribute to reducing obesity. Not surprisingly, the U.S. shows the highest obesity ratio and lowest active transportation ratio among Western industrialized countries (2009).

Driving could be harmful to the mind too. Tumlin states, "too much driving will cause the effect of anxiousness, anger and stupid behavior, which are publicly recognized as 'road rage,' a type of IDE (Intermittent Explosive Disorder) (2011)."

Compared to driving, using public transit is considered active transportation since any active transportation planning tends to take public transit consideration into their planning (Active Transportation Alliance, 2014), although active transportation is defined as "human-powered transportation, such as biking and walking" by the U.S. Department of Energy (2014). However, public transit provides less exercise than bicycle. Plus, there is a study, which argues that public transit increases psychological stress when it is crowded and its service is not reliable (Wener & Evans, 2010).

For some, bicycling could be the best mode of transportation (excluding walking) in terms of improving physical and mental health; however, it is not always the case that bicycling helps improve them. A 2012 San Francisco State of Cycling Report shows, safety concerns (e.g., bicycling in automobile travel lanes) as the biggest barrier for infrequent bicyclists (SFMTA, 2012). Bicycling is not an inherently dangerous activity. However, it could happen in a dangerous environment, such as insufficient road infrastructure. If this is so, the activity of cycling may provide negative mental stress on bicyclists instead of improving mental health. (Pucher et, al., 2012). If one is injured while cycling in an unsafe environment, it may harm one's physical health too. To maximize the benefit of biking, appropriate bike infrastructures to make cycling safer are essential.

Bicycling is not an inherently dangerous activity. However, it could happen in a dangerous environment, such as insufficient road infrastructure

4 Anticipated Sub Problem

Four anticipated sub problems are considered: 1) Safety, 2) Unsafe Bicyclists' Riding Behaviors, 3) Impact on Existing Neighborhoods and Businesses, 4) Stigma for Bicycling.

Safety

As discussed in the previous segment, *Benefits of Biking*, without safe environment, bicycling can be a dangerous activity. News channel, NBC Bay Area reported in the article, *San Francisco: Deadly Collisions Spark Bicyclists Concerns*, four bicyclists died in SoMa (South of Market) or near SoMa area in 2013 one year alone (2013). One of them was Cheng Jin Lai, a Chinese immigrant, who represents the target audience highlighted in this research. Cheng Jin Lai immigrated to the United States in 1996. He was 78 years old when he was hit and killed by a MUNI bus while riding his bicycle. Despite his age, he was a very healthy person keeping up his health with Chinese exercise and biking. He was an avid cyclist and biking was everyday transportation for him between Chinatown and SoMa, where he lived. This accident was preventable if the road infrastructure was designed for safe biking (Tamaki, 2013).

Theoretically, when more cyclists appear on streets, bicycle related collisions by automobiles are decreased in that area, a phenomenon called "safety in number (Tumlin, 2011)." However, this is not the case in San Francisco. The report, *SFMTA Bicycle Strategy*, April 2013 states that growth of bicycle counts and frequency of bicycle crashes are correlated over this half-decade, 2006-2011. The report argues that the main reason of this is a lack of bicycle facilities, and not because of unsafe bicyclists' riding behaviors (SFMTA, 2013).

Unsafe Bicyclists' Riding Behaviors

SFMTA's *2011 Bicycle Count Report* found there was 6 percent of unsafe behaviors (94 percent legal riding) by biking, which were Sidewalk Riding (2 percent), Wrong-way Sidewalk Riding (1 pecent) and Wrong-way Riding (3 percent) (SFMTA, 2011). This report didn't count the unsafe behaviors of ignoring stop signs and red lights.

Even though the case is very rare—there were 220 pedestrian deaths in San Francisco from 2000-2009, and the vast majority of these deaths were caused by motorized vehicles—there were two pedestrian deaths caused by bicyclists in San Francisco in the same time span (Jones,T., 2012). Bicyclists at large tend to avoid stopping to conserve their stamina. Re-pedaling from stops takes much energy, especially, if it happens before an uphill. For this reason, bicyclists tend to only slow down at stop signs instead of completely stop (Fajans & Curry, 2001). Considering Fajans and Curry's argument, it could be physiologically natural for bicyclists to not stop, which may cause collisions.

Impact on Existing Neighborhoods and Businesses

As discussed earlier, to promote biking, cities need to build a safe environment for biking. The *2012 San Francisco State of Cycling Report* shows, 94 percent of survey respondents feel comfortable riding on physically separated bike lanes from automobile travel lanes, and 89 percent of survey respondents feel comfortable riding on the standard bike lane, which is a bike lane without physical separation (SFMTA, 2012). Unlike "sharrows"—marked bike route sharing lanes with automobiles, these bike lanes are dedicated to only bicyclists. Physically separated and standard bike lanes take additional space on streets, which can be a hindrance to implementation.

This is an issue for most bicycle planning in San Francisco, because it would change the configuration of streets in many neighborhoods. As is often the case, adding bike lanes causes removal of on-street parking or road diet—the removal of automobile travel lanes. For instance, the Polk Street Improvement Project in San Francisco by the SFMTA plans for the removal of 10 percent of parking space on the middle part of the Polk Street, and 50 percent of parking space on the lower part of the street (SFMTA, 2013). Valencia Street in San Francisco is a good example of road diet in the United States. There were four automobile travel lanes until March 1999, when two of four lanes were taken and the city implemented bike lanes on both sides of the street (Roth, 2010).

These changes most likely encourage traffic calming and reduce automobile access, which may bring a negative impact for residents and businesses in the area, although this is not always the case such as 9th Avenue (between 23rd to 31st)

Peñalosa stated that prioritizing improvement for pedestrians and bikeways so that citizens came to think of a $30 bicycle as equal to a $30,000 car

in New York that bike infrastructure improvements successfully vitalized the streets and improved retailers' sales (New York City DOT, 2012).

The website "Save Polk Street," savepolkstreet.com, which opposes the Polk Street Improvement Project, provides an opposition letter template to send to the SFMTA. Their arguments state that the improvement project will: 1) threaten the economic viability of Polk Street businesses, 2) threaten the jobs of hundreds of employees of Polk Street businesses, 3) increase traffic and emissions and create further parking shortages on the residential streets adjacent to Polk Street with people looking for already scarce parking in the neighborhood, 4) impair access of the elderly and mobility-challenged to health care services and businesses on Polk Street, 5) make daily errands like picking up laundry and dry cleaning, groceries, large and heavy items from the book, pet and hardware stores far more difficult and inconvenient, 6) increase traffic congestion on Polk Street with delivery trucks that cannot park (Save Polk Street, 2014). These statements summarize what some believe to be the pitfalls of implementing safe bicycle infrastructure on roadways.

In addition tovehicle access by merchants and residents, there is research on how bicycle and pedestrian safety improvements with bike lanes, corner-bulb outs and medians make emergency vehicles difficult to drive, which cause delay of response time (Rasmussen, 2013). This is an unintended downside of traffic calming, which may ironically in turn endanger people's lives.

Stigma for Biking

Even though Smart's study finds that immigrants tend to bike more than native-born Americans (2010), they nevertheless harbor stigmas for biking. As an example of this, Wray J. Harry describes the condition of biking in Amsterdam, the Netherlands in his book, *Pedal Power*, as more participation from middle to upper class citizens, but not many participants from the lower income populations. Many immigrants living in Amsterdam are from countries where wealthier people drive automobiles and poor people ride bicycles. Therefore, the immigrant populations have a stereotype of the bicycle for only poor people (2008). In the documentary, *Urbanized*, Peñalosa stated that prioritizing improvement for pedestrians and bikeways so that citizens came to think of a $30 bicycle as equal to a $30,000 car (Hustwit, 2011). Paradoxically, if bicycle infrastructures are lacking, potential bicycle participants may not be able to think of bikes as a worthwhile mode of transportation.

5 Scope and Limitations

The purpose of this Creative Work is to promote biking among Chinese low-income immigrants in San Francisco who have language barriers. However, it is not expected that this Creative Work will persuade them to start biking immediately, because the barriers for biking are varied and complicated. The report from the SFMTA, *2012 San Francisco State of Cycling Report*, shows the lack of bike infrastructure, topography, distance, baggage, and travel with children as barriers to biking (2012). Other factors, such as bicycle infrastructure, are very difficult to solve directly from the Creative Work. Therefore, the Creative Work will focus on determining barriers for biking specifically among Chinese low-income immigrants and strive to reduce their barriers. This Creative Work is also intended to educate and to encourage this population to have their opinions about bike planning in the city. As an anticipated result, they will begin to participate in the city's bike planning; attending community meetings and open houses that are related to biking.

6 Significance of Chinese Migration

According to data from The World Bank, the United States is the second highest country in number to accept Chinese immigration in 2000, following Hong Kong. The numbers of Chinese immigrants in the United States grew 10 times from 1950 to 2000; 105,384 to 1,016,412 (2013). Yeh et al. cite in their study that Asia accounts for 35 percent of the total immigrants in 2003; and the percentage of Asian immigrants is projected to increase 213 percent by 2050 in the United States. Up to 21 percent of Asian immigrants in 2003 were from the Chinese mainland, Hong Kong and Taiwan (2008). The ACS 2007–2011 shows that the Chinese population, including American Born Chinese (ABC), accounts for over 20 percent of San Francisco's total population. This is the second highest ethnicity in San Francisco following the white population of 45 percent.

50 percent of all Chinese immigrants in the United States are concentrated in the three metropolitan areas of New York, San Francisco and Los Angeles (Terrazas & Batalova, 2010). Therefore, the two other cities may have the same or similar Chinese immigrant related problems when compared to San Francisco. For this reason, the outcome of this Creative Work could be transferable and useful in those two cities, and potentially other United States cities that expect growth in the number of Chinese immigrants.

7 Chinese Immigrants in San Francisco

Using ArcGIS—a software used to analyze and visualize geographic information by ESRI, and R—an open source program enables conducting statistical analysis and visualizing data, this research discovered there is greatly little interest in biking among Chinese immigrants in San Francisco. To explain this result, this research shows the census tract where Chinese immigrants are most concentrated; and compares that information with the membership of the San Francisco Bicycle Coalition—a non-profit organization that advocates promoting bicycles for everyday transportation.

Chinese Immigrant Neighborhoods in San Francisco

There is no exact data to show the spatial distribution of Chinese immigrants specifically in San Francisco. Hence, the research assumes Chinese people who answered "less than very well" in English proficiency in the census survey are most likely Chinese immigrants. The ASC 2007–2011 census data surveyed English proficiency in the Asian populations, both native and foreign-born in San Francisco. Among a total population of 257,781 Asians, 123,935 answered "less than very well" in their ability to speak English. Because foreign-born accounts for 92 percent in this figure—123,935 people (only 8 percent of native-born), this research defines that about 90 percent of Chinese population who answered "less than very well" in their ability to speak English are immigrants. Figure 2 shows the distribution of Chinese population whose English ability is less than very well—Chinese immigrants, as defined by this research.

As shown in the map, except for Chinatown and surrounding areas, the Chinese population with limited English ability is distributed far away from downtown, which is located in northeast area of San Francisco. Figure 3 shows the change in population from 2000 to 2010 among all Chinese (not restricted to Chinese population with limited English ability) in San Francisco.

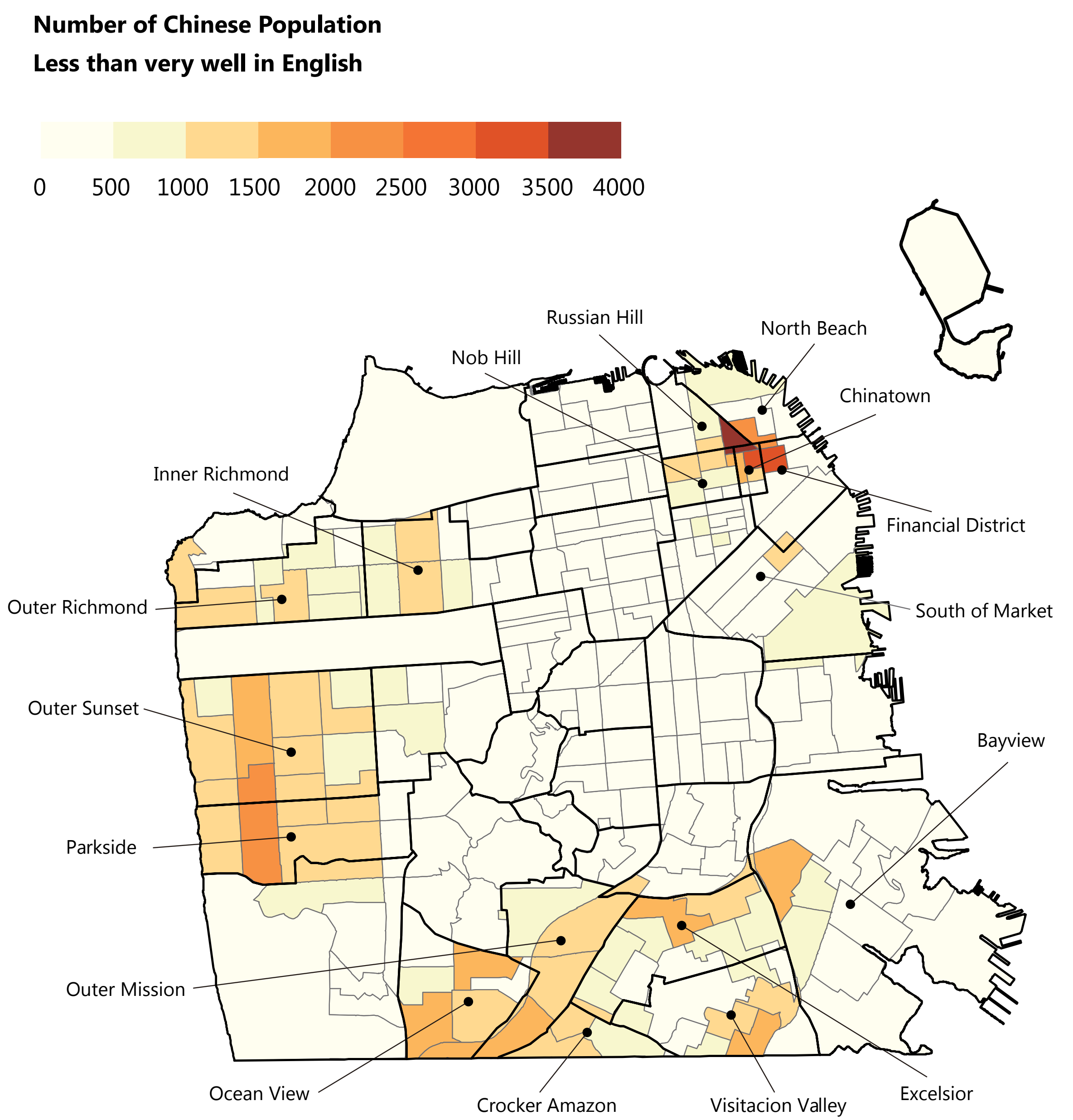


Figure 2. Number of Chinese population less than very well in English (ACS 2007–2011)

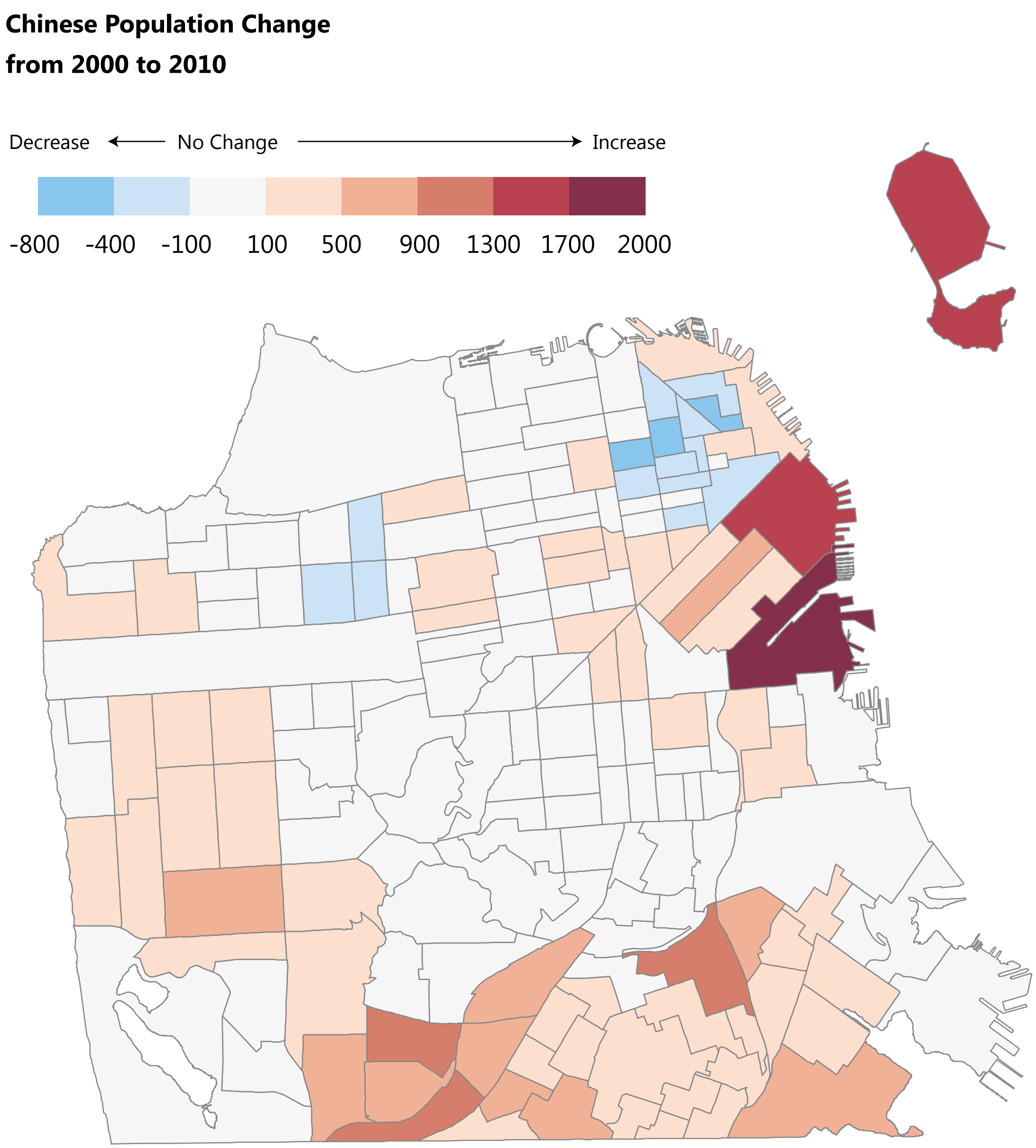


Figure 3. Change in Chinese population from 2000 to 2010 (U.S. Census 2000, 2010)

A comparison of these two maps provides information that more Chinese immigrants have moved to the southeast to southern part of San Francisco in the last 10 years. Although Figure 3 shows strong growth in South of Market (SoMa) and Mission Bay, which are located northeast, the research excludes these neighborhoods due to the relatively higher median income there, which is shown in Figure 4. These neighborhoods were developed rapidly as residential neighborhoods in this decade according to the comparison of U.S. Census 2000 and 2010. The population of SoMa increased from 19,812 to 31,368, and of Mission Bay from 676 to 9,083. The total population in these neighborhoods dramatically changed, which in turn increased Chinese population in this analysis. The research determines Parkside, Ocean View, Outer Mission, Crocker Amazon, Excelsior, Visitation Valley and Bayview as primary study areas. For convenience, this research refers to these neighborhoods as Chinese Immigrant Neighborhoods (CINs).

Income Level among Chinese Immigrants

Figure 4 shows the median annual income in San Francisco by ASC 2007–2011. The map shows distinct low median income around Chinatown. However, the research excludes Chinatown because it is located in the center of the city and is fairly close to downtown. It is considered that the population in this neighborhood has better accessibility to job opportunities and other services the population needs because a great number of these opportunities are concentrated downtown or near downtown.

The CINs also show lower income than the other neighborhoods, which are closer to downtown. The research especially focuses on the Excelsior, Visitation Valley and parts of Bayview in CINs considering their population density among CINs, which is defined by the smaller size of census tracts.

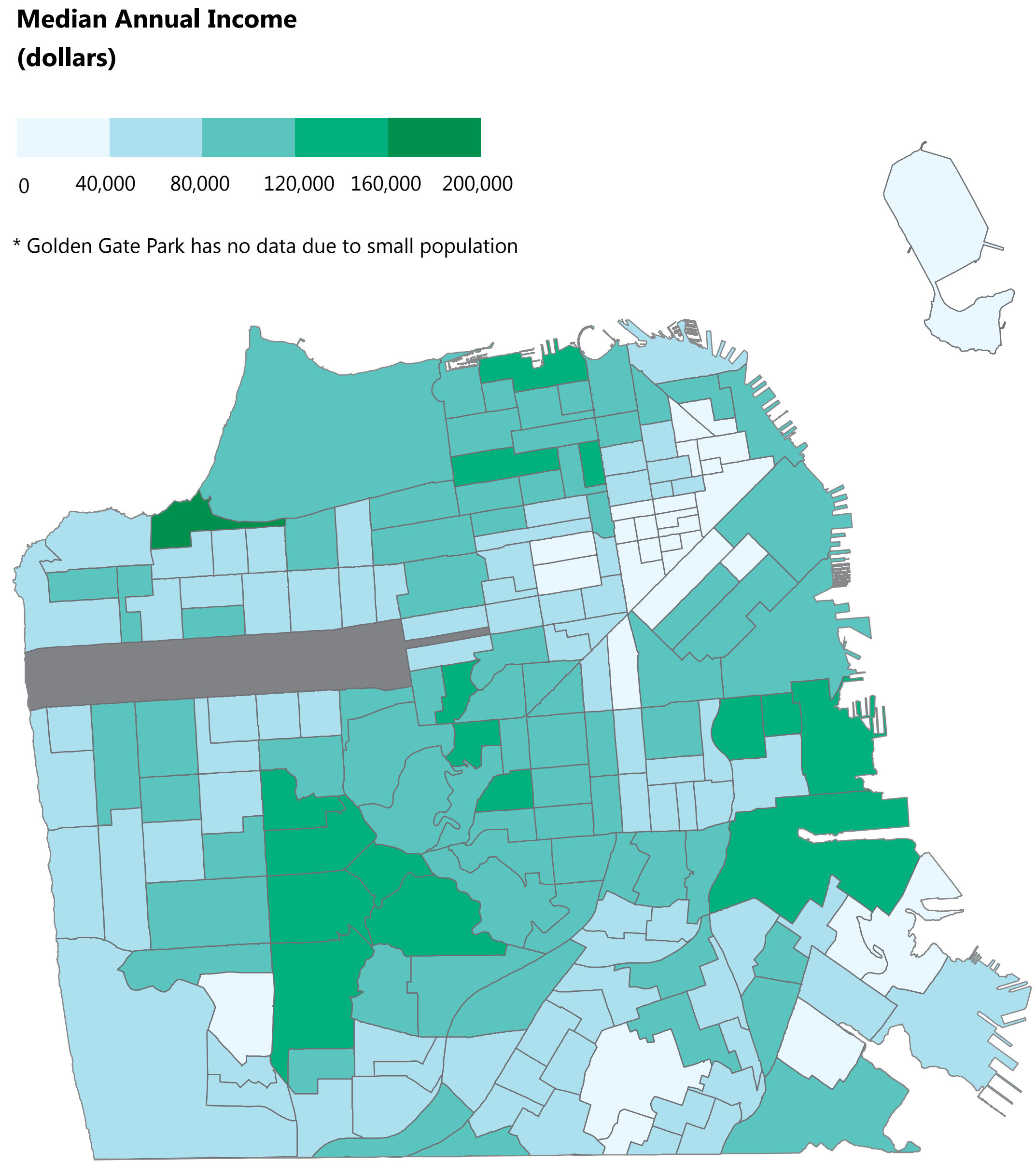


Figure 4. Median annual income in San Francisco (ACS 2007–2011)

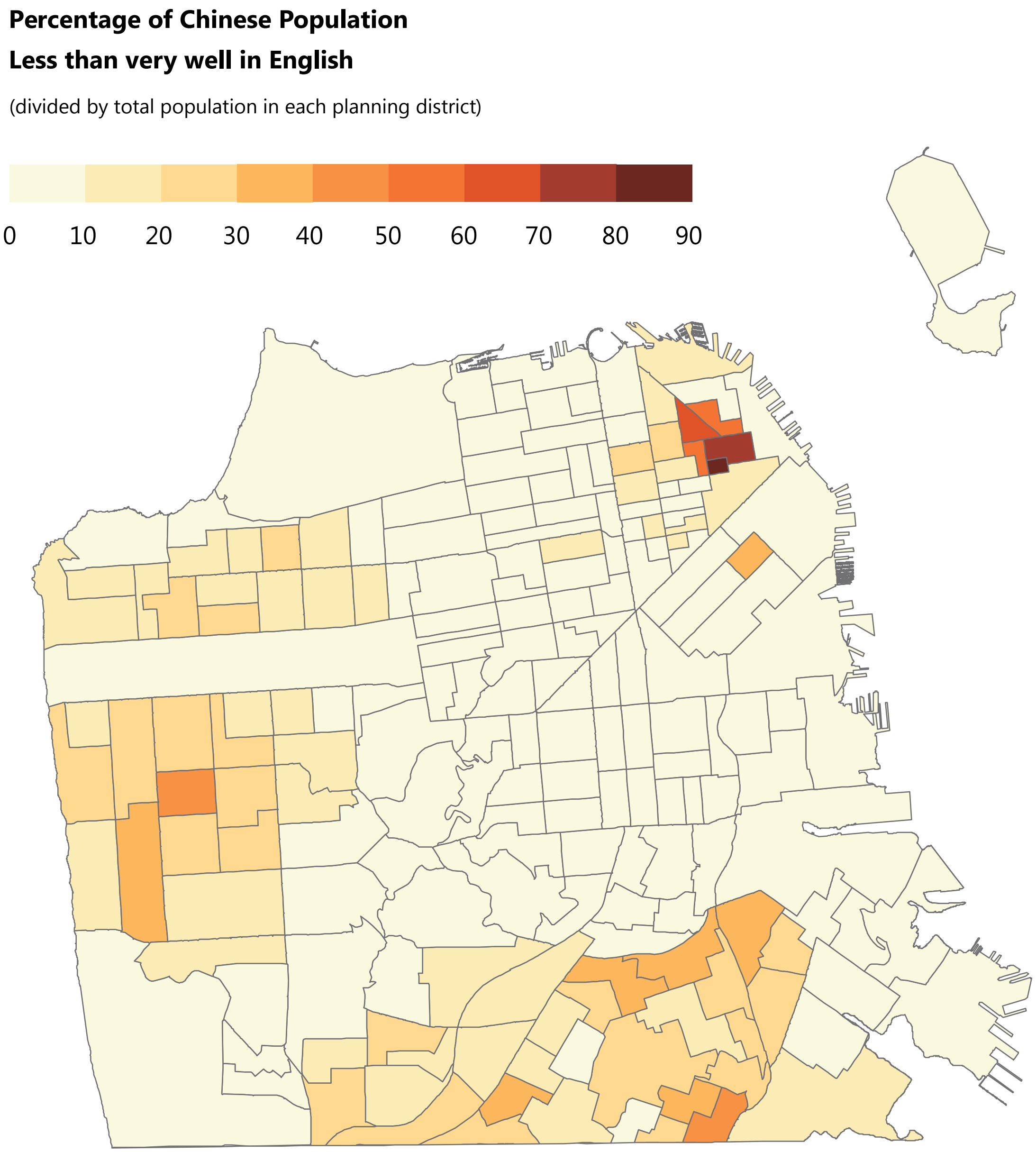


Figure 5. Percentage of Chinese population less than very well in English (ACS 2007–2011)

Figure 5 shows the same Chinese population with limited English ability, but this data is calculated by percentage of the population in each census tract divided by the total population in each census tract. Not surprisingly, Chinatown has a very high percentage of non-English speaking Chinese population.There are also high percentages in CINs, but most areas are less than 50 percent. Again, the Excelsior, Visitation Valley and West part of Bayview shows higher percentage of Chinese population with limited English ability, compared to the other CINs.

Means of Transportation among Chinese Immigrants

According to the article, *US Immigrants and Bicycling: Two-Wheeled in Utopia*, immigrants have less access to automobiles than the native-born, and they use alternative transportation modes more frequently—like carpools, public transit and non-motorized modes. Smart's study shows the income level of immigrants is one factor why immigrants tend to have lower access to automobiles, in addition to other barriers, such as dense living conditions, legal barriers, and past travel behavior. The author cites the report from National Household Travel Survey (NHTS) 2001 that shows "native-born Americans have, on average 0.76 cars per adult household member, while foreign born Americans have far fewer cars, 0.45 cars per adult"(Smart, 2010). Since this data is based on a survey og the United States in general, it is not hundred percent comparable to the condition in San Francisco. Based on data from the Metropolitan Transportation Commission (MTC) and The World Bank, the vehicle ownership per 1000 persons is 478.2 (data in 2000) (MTC, 2005) in San Francisco and 797 (The World Bank, 2010) in the United States. From these data, it can be considered that Chinese low-income immigrants in San Francisco have less car ownership compared to the data from NHTS (0.45 cars per adult). It is important to note, however, the percentage of car ownership within

Immigrants have less access to automobiles than the native-born, and they use alternative transportation modes more frequently—like carpools, public transit and non-motorized modes.

a region does not necessarily dictate percentage of drivers. For instance, San Francisco has mode split—the percentage of each mode of transportation, 37.5 percent of commute (data in 2011)(SFMTA, 2012) and 62 percent (data in 2010) for all trips by private automobiles (SFMTA, 2012). Compared to San Francisco, the United States has much higher private auto commute rate of 91.2 percent and 86.6 percent for all trips (NHTS, 2001).

Data led to the idea that Chinese immigrants in San Francisco use more public transit than automobiles, although travel behavior may vary depending on their income levels and where they live. Evidence is limited on how frequently Chinese immigrants in San Francisco use pubic transit. However, in a study in New Jersey for immigrants with limited English proficiency, Liu and Schacher targeted an audience of English-as-Second Language students. The authors had 575 responses; and found more than half of the respondents used public transit, which is significantly higher than the average public transit usage of 6 percent in New Jersey (2007).

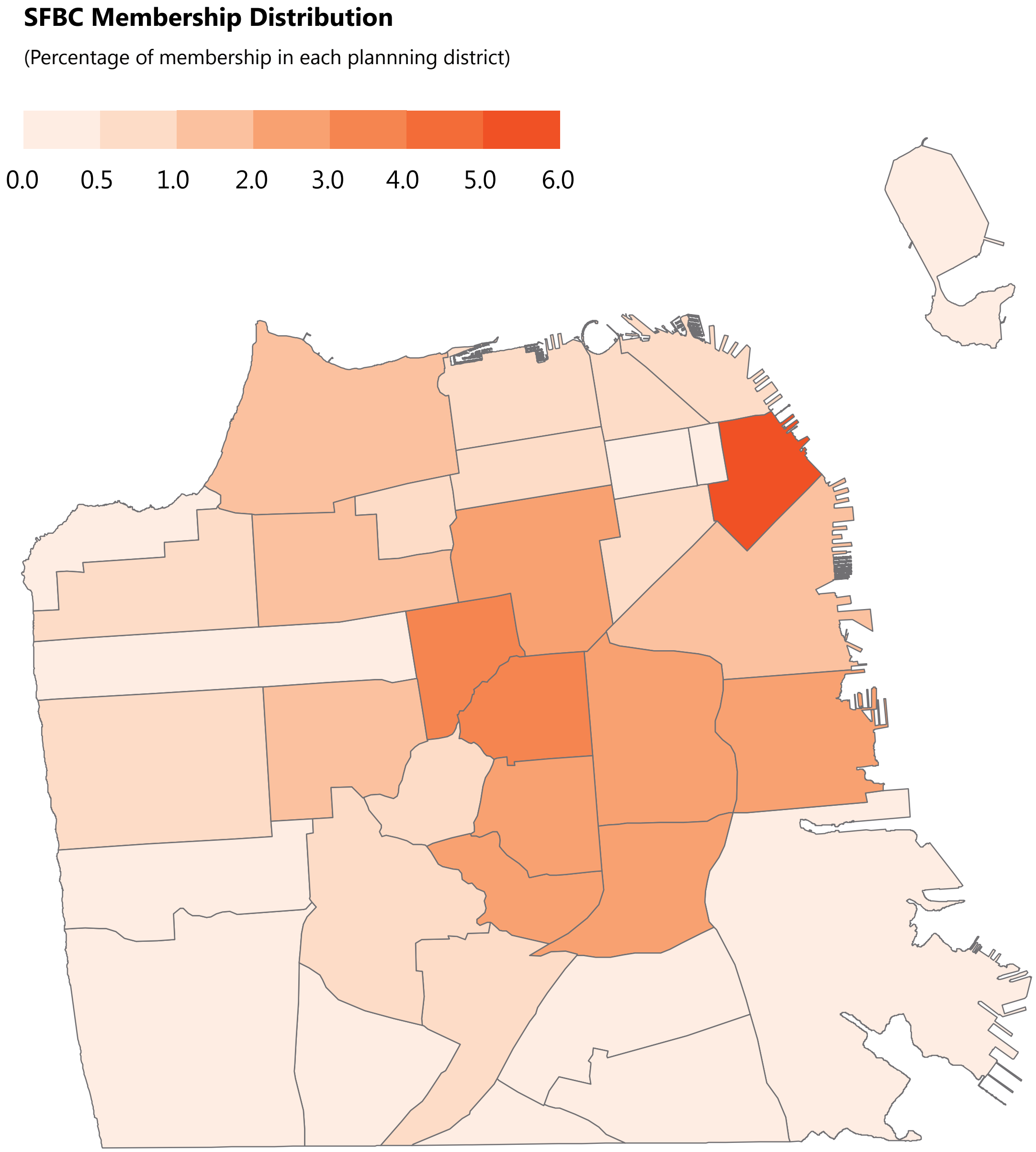


Figure 6. Percentage of SFBC membership by planning district

Biking among Chinese Immigrants

The hypothesis of this research is that Chinese immigrants in San Francisco have lower income and use public transit more frequently than native-born Americans, including American Born chinese. Furthermore, it is hypothesized recent Chinese immigrants have less participation in terms of bicycle usage as shown in Figure 6.

Although, membership in SFBC is not exactly correspond to participation in biking, it is generally true that SFBC members are more positively participating in biking and show more interested in bike planning throughout the city than non-members. A few disclaimers regarding the source of the data is necessary. 1) Due to privacy issues, SFBC is not able to provide the exact number of members in each planning neighborhood, but rather a percentage. Therefore, the numbers have been calculated based on an estimated total number of members of 12,000 (SFBC); 2) The research uses the total population data in each planning district from the

According to the 2012 San Francisco State of Cycling Report, 94 percent of survey respondents show comfort on physically separated bikeways, and 89 percent showed comfort on standard bike lanes (visually separated by lines)

report of the San Francisco Planning Department, *San Francisco Neighborhoods Socio-Economic Profiles*, which uses ACS 2005–2009 as the source of data; 3) There are some gaps in neighborhood divisions among three data sources—data from SFBC, *San Francisco Neighborhoods Socio-Economic Profiles* and shapefile, which is a file format specifically designed for ArcGIS to visualize data, to show planning district boundaries in San Francisco. Therefore, some districts have been integrated for the convenience of this analysis. (For instance, Diamond Heights and Glen Park have been combined, which are separate planning districts currently.)

The data clearly shows that SFBC members are concentrated in adjacent planning districts downtown. Even though some activity can be seen in the Richmond and Sunset districts, which are located in the northwest and midwest part of San Francisco—the southeast has very little membership participation. Many factors contribute to lower SFBC membership among these neighborhoods. Availability of bike networks may be one of the most significant factors. Figure 7 shows two graphs comparing (a) all of San Francisco's bike networks—bike paths (exclusive bicycle ways, which are completely separated from motor vehicle ways with no automobile travel lanes adjacent), bike lanes (physically or visually separated from vehicle travel lanes) and bike routes (travel lanes shared with automobiles with/without marking), with (b) selected bike networks—bike paths and lanes (San Francisco Data, 2013).

San Francisco appears to be well connected throughout in the top map, which includes bike routes. However, when the bike routes are excluded, there are distinct gaps in each planning district, especially, in the northeast, southwest, southeast and right middle parts of San Francisco. As discussed earlier, according to the 2012 San Francisco State of Cycling Report, 94 percent of survey respondents show comfort on physically separated bikeways, and 89 percent showed comfort on standard bike lanes (visually separated by lines) (SFMTA, 2012). From this aspect, a lack of bike paths and lanes most likely results in smaller number of member participation.

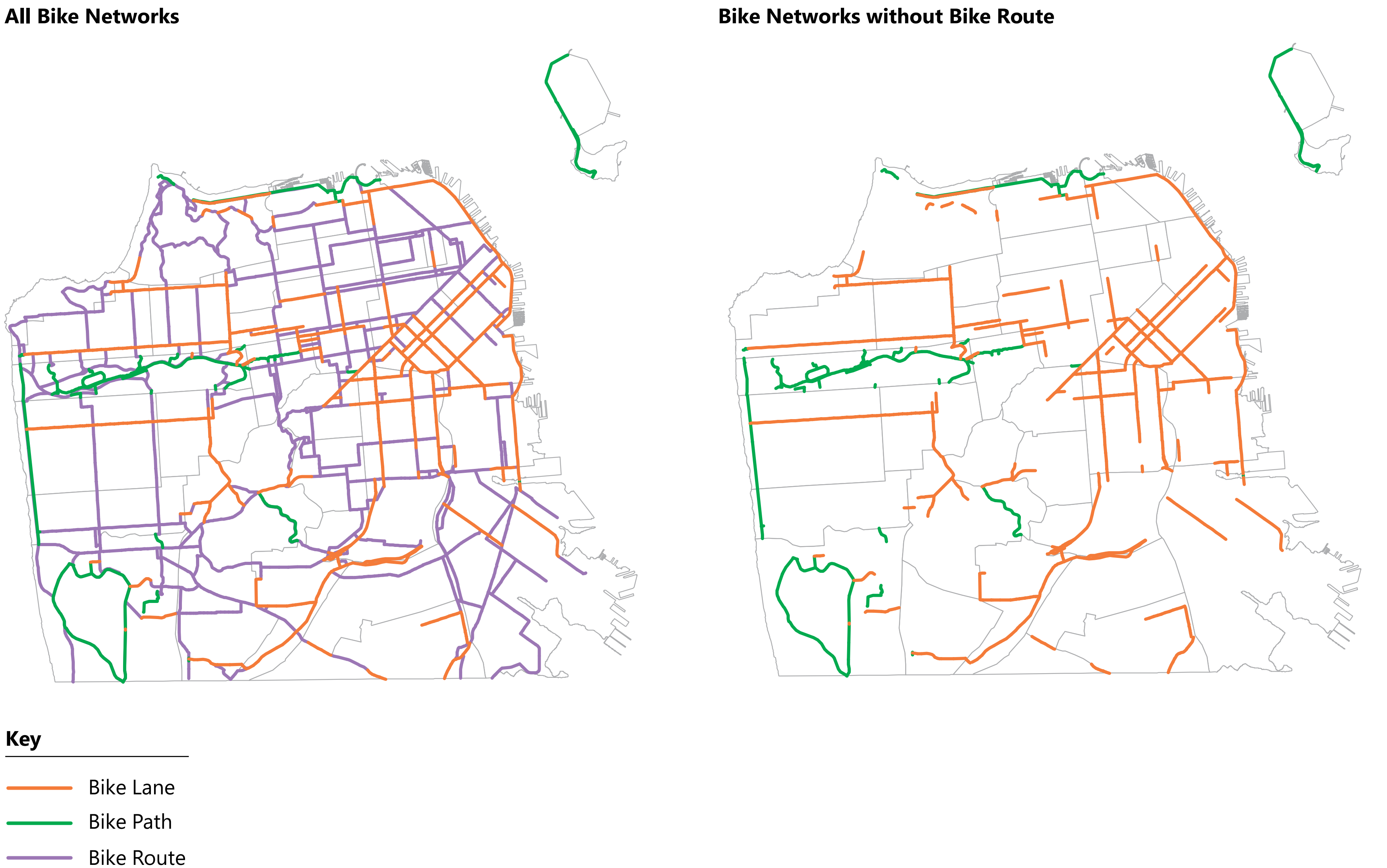


Figure 7. Comparison of bike network with and without bike route in San Francisco

RESEARCH »

8 Tools and Methods for Gathering and Analyzing Data

As it was conducted earlier, the initial approach of this research is to analyze the most recent U.S. Census ACS, 2007–2011, and U.S. Census 2010 in San Francisco. As a necessity, the recent data compared previous data from the 2000 U.S. Census. Data provided by the City of San Francisco is also used for the quantitative research. To enable spatial analysis using census data, the research uses ArcGIS. Additionally, this research uses R for statistical analysis.

The primary research consists of three parts —statistical analysis, ethnographic research and survey. The statistical analysis is conducted by R using the spatial data manipulated by ArcGIS. The ethnographic research (includes observation and participation) is conducted to better understand current situations in the determined study areas, southeast part of San Francisco. Lastly, the survey is administered to understand the overall status of Chinese immigrants and barriers to biking in San Francisco.

8 Statistical Analysis—Correlation and Regression Coefficient

To understand what factors encourage and discourage SFBC member participation, "R" is used for correlation and regression coefficient analysis for this research. For data collection, ArcGIS is used mainly for extracting geographical data. Table 1 shows the data table, which is used for the regression coefficient analysis.

In summary, this statistical analysis shows the physical bicycle infrastructure of all bike network (model 1 in Figure 8 on page 38) and bike racks (model 5 in Figure 8 on page 38) greatly contribute higher percentage of SFBC membership. Average slope and median annual household income didn't show any strong relationships with the percentage of people with a SFBC membership. Bike lane/path show a stronger relationship than bike route, but its p-value is slightly higher than 0.05, deeming it statistically insignificant.

There are six variables other than percentage of SFBC membership. These include: 1) all bike networks miles (per sq.mi), 2) bike route miles (per sq.mi), 3) bike lane/path miles (per sq.mi), 4) average slope grade, 5) number of bicycle racks (per sq.mi), and 6) median annual household income. Each value in the variables is divided by each San Francisco's planning district, as shown in the row of Table 1.

Neighborhood	SFBC Membership (%)	All Bike Networks per sq.mi (mi)	Bike Route per sq.mi (mi)	Bike Lane/Path per sq.mi (mi)	Average Slope (grade, %)	Bicycle Racks per sq.mi (mi)	Median Annual Household Income (dollars)
Bayview	0.26	3.04	2.52	0.52	13.52	13	43,155
Bernal Heights	2.8	4.34	2.02	2.32	27.28	85	85,607
Castro/Upper Market	3.32	4.64	3.12	1.51	25.77	178	92,237
Chinatown	0.07	4.68	3.16	1.52	25.24	177	17,630
Crocker Amazon	0.15	1.46	1.03	0.43	18.31	17	68,705
Diamond Heights	2.33	5.25	2.95	2.31	25.79	13	90,510
Downtown/Civic Center	0.53	7.09	5.51	1.58	9.72	406	24,491
Excelsior	0.25	2.03	1.33	0.71	18.22	16	67,398
Financial District	5.95	8.4	5.83	2.57	6.26	443	45,221
Haight Ashbury	3.3	6.7	4.45	2.24	18.31	188	85,539
Inner Richmond	1.21	4.37	1.61	2.76	8.68	82	69,861
Inner Sunset	1.53	2.18	0.91	1.26	27.38	80	85,696
Lakeshore	0.23	3.45	2.95	1.73	8.64	7	62,904
Marina	0.51	5.61	3.4	2.31	7.65	148	102,442
Mission	2.81	5.51	1.94	3.56	7.92	383	63,627
Nob Hill	0.45	7.16	7.15	N/A	26.68	159	53,283
Noe Valley	2.18	4.79	4.12	0.68	29.42	102	105,807
North Beach	0.82	3.35	1.13	2.22	26.66	87	70,067
Ocean View	0.19	3.45	2.84	0.61	21.15	46	67,475
Outer Mission	0.57	4.49	1.92	2.57	18.74	31	79,477
Outer Richmond	0.88	3.76	1.95	1.81	13.47	35	72,459
Outer Sunset	0.59	2.94	1.67	1.27	9.28	31	73,728
Pacific Heights	0.53	3.27	3.27	N/A	24.26	55	109,307
Parkside	0.42	3.69	3.17	0.51	12.86	31	83,131
Potrero Hill	2.86	3.61	1.94	1.67	21.81	54	98,182
Presidio	1.84	4.7	3.28	1.42	17.8	0	116,807
Presidio Heights	0.55	4.08	2.84	1.24	14.57	73	96,542
Russian Hill	0.88	5.33	2.54	2.78	30.81	104	84,537
Seacliff	0.1	4.69	4.27	0.42	16.16	3	162,903
South of Market	1.06	6.33	1.47	4.87	5.24	202	85,757
Treasure Island/YBI	0.11	3.08	N/A	3.08	22.13	0	55,676
Twin Peaks	0.68	2.29	1.35	0.46	32.56	5	99,449
Visitacion Valley	0.05	1.94	0.72	1.22	22.48	18	44,373
West of Twin Peaks	0.59	3.79	2.65	1.14	23.42	38	125,027
Western Addition	2.22	6.55	4.64	1.91	14.67	184	53,990

Table 1. Data table for correlation and regression coefficient analysis

Data Sources and Manipulations

The SFBC membership ratio uses the same data, which was used for Figure 6. 1) All bike networks miles (per sq.mi), 2) bike route miles (per sq.mi) and 3) bike lane/path miles (per sq.mi) are the same data with Figure 7 with additional manipulations by ArcGIS. The original data is provided by the SFMTA through San Francisco Data, which is named "SFMTA Bikeway Network" with the data format of shapefile. The original shapefile contains other minor bike networks, in addition to major bike networks of bike route, bike lane and bike path, so the research extracted these three major bike networks data using SQL—Structured Query Language, which is used to communicate with a database to update or retrieve data. 1) All bike networks miles (per sq.mi) hold all three types of major bike networks. First, the process uses a "dissolve" tool to merge all of them in ArcGIS. After merging, it uses an "intersect" tool to clip these combined networks by the area of each planning district shapefile. Planning district shapefile is also provided through San Francisco Data, created by the Department of City Planning. After that, ArcGIS automatically returns the total length of all bike network in each planning district. The same method is used for data manipulation of 2) bike route miles (per sq.mi) and 3) bike lane/path miles (per sq.mi). Instead of using all bike network, these data are extracted appropriately from the all bike network shapefile (before merging all types of networks). Then, they are merged each type of network respectively, which are bike route, and bike lane/path. After that, they are processed using a "intersect" tool to calculate the total bike route and bike lane/path miles in each planning district.

Average slope is calculated by using street shapefile and DEM (Digital Elevation Model). This data is provided by USGS (United States Geological Survey). Streets shapefile is also available through San Francisco Data, collected by the SFMTA. DEM is raster-based data that it is made of pixels. Each pixel represents each elevation value. The first step is layering DEM under the streets shapefile. ArcGIS has a tool called "add surface information," which adds maximum slope, minimum slope and average slope to selected lines or areas based on elevation data in the DEM. In this analysis, it uses the streets shapefile as the location (street segments) to add average slope information. This shapefile is divided by the area of each planning district using a "intersect" tool first. Later, each street shpefile is merged using a "dissolve" tool, because the streets shapefile is not one single line, but a combination of many lines. If the analysis uses "add surface information" to this type of data, the tool returns slope information on all single lines individually, which makes the analysis confusing and difficult. Therefore, the streets in each planning district have to be a single line by merging them together. Afterwards, "add surface information" is used to calculate the average slope of the entire street in each planning district using DEM layer as a source of elevation information. 5) Number of bicycle racks (per sq.mi) uses the data from the San Francisco Data, "Bicycle Parking (Public)" and a shapefile of the planning district. Bicycle Parking (Public) was not a shapefile, but a data table with location attributes of each bike rack's longitude and latitude. Therefore, the analysis is needed to convert the data table into the shapefile to enable ArcGIS visualizing the data. The location attribute of longitude and latitude enable ArcGIS geocoding—the process takes location attributes and lays them onto a map. The result shows each bike rack in the city shown by points on a map. Afterwards, the same process (using a "intersect" tool) was used to divide the points into each planning district. Finally, the analysis shows how many bike racks fall into each planning district. 6) median annual household income in each planning district is found in the report, *San Francisco Neighborhoods Socio-Economic Profiles*, and there was no data manipulation on it.

It is important to note that the data on length of bike networks and the number of bike racks in each planning district is normalized, which means divided by the total area of each planning district (square miles) for accuracy of the comparison. All data shows the length and the numbers per square mile in each neighborhood.

Statistical Analysis Using R

Statistical Analysis Using R

R conducts statistical analysis using these data manipulated by ArcGIS. First of all, read the data table with the name "BI" into R and use a "describe" function, which shows the summary of the data, which is shown in Table 2.

For the convenience and prevent long variable names, each variable name was changed as follows in this analysis.

1) All Bike Networks Miles (per sq.mi)
-> all_bySqmi
2) Bike Route Miles (per sq.mi)-> br_bySqmi

3) Bike Lane and Path Miles (per sq.mi)

-> li_bySqmi

4) Average Slope -> Avg_Slope

5) Number of Bicycle Racks per sq.mi

-> racks_bySqmi

6) Median Annual Household Income -> income

The next step, the analysis outputs correlation each valuable at once, using a "cor" function. Table 3 shows this result.

The analysis needs to examine the correlation between SFBC membership and other variables. Because some neighborhoods didn't have a bike route or bike lane/path, the analysis didn't return the correlation between the SFBC membership ratio, and br_bySqmi and li_bySqmi. Positive 1 shows positive correlation and by contrast, if the number towards negative 1, it means there is negative correlation. If the number is close to 0, it means there is no correlation. From these criteria, it is found that all bike network and number of bike racks show relatively strong correlation with the SFBC membership ratios.

	var	n	mean	sd	median	trimmed	mad	min	max	range	skew	kurtosis	se
sfbc	1	35	1.22	1.3	0.59	1.04	0.65	0.05	5.95	5.9	1.61	2.69	0.22
all_bySqmi	2	35	4.34	1.63	4.34	4.27	1.47	1.46	8.4	6.94	0.43	-0.39	0.28
br_bySqmi	3	34	2.81	1.49	2.75	2.66	1.21	0.72	7.15	6.43	0.92	0.52	0.26
li_bySqmi	4	33	1.73	1.02	1.58	1.64	1.08	0.42	4.87	4.45	0.84	0.76	0.18
Avg_Slope	5	35	18.65	7.75	18.31	18.65	10.27	5.24	32.56	27.32	-0.09	-1.24	1.31
racks_bySqmi	6	35	99.83	114.86	55	77.9	62.27	0	443	443	1.62	1.96	19.41
income	7	35	78371	28534.1	79477	77689.2	24571.1	17630	162903	145273	0.37	0.78	4823

Table 2. Result of the "describe" function

	sfbc	all_bySqmi	br_bySqmi	li_bySqmi	Avg_Slope	racks_bySqmi	income
sfbc	1	0.5392901	NA	NA	-0.06683899	0.5643005	0.02875888
all_bySqmi	0.53929008	1	NA	NA	-0.30724555	0.7579628	-0.12329208
br_bySqmi	NA	NA	1	NA	NA	NA	NA
li_bySqmi	NA	NA	NA	1	NA	NA	NA
Avg_Slope	-0.066839	-0.307246	NA	N	1	-0.3660769	0.19524789
racks_bySqmi	0.56430054	0.7579628	NA	NA	-0.36607685	1	-0.4051418
income	0.02875888	-0.123292	NA	NA	0.19524789	-0.4051418	1

Table 3. Result of the "cor" function

There is one more correlation analysis that takes a look at the detailed correlation between the SFBC membership ratios and the other values. This uses a "cor.test" function, which enables to select two valuables to see their correlation. In addition to the benefit as returning details of correlation, cor.test takes off NA value to conduct analysis. Therefore, making it possible to see the correlation between the SFBC membership ratio, and the bike route and bike lane/path, which couldn't be calculated by "cor" function. When typing "cor.test(BI$sfbc, BI$all_bySqmi)" in R, it returns the following.

Pearson's product-moment correlation

data: BI$sfbc and BI$all_bySqmi
t = 3.6788, df = 33, p-value = 0.0008289
alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: 0.2511858 0.7396155
sample estimates: cor 0.5392901

Although there are more factors to certify the significance of each correlation through this cor.test function, the analysis only takes the output of p-value, sample estimates, and 95 percent confidence interval. The p-value shows 0.0008289, which rejects null-hypothesis. The rule of Null Hypothesis Significance Testing is that any numbers below 0.05 means statistically significant. 95 percent confidence interval shows 0.2511858, 0.7396155, which is good, because 0 is not in between these tow numbers. (In a correlation analysis, the number closest to 0 means no correlation.) Lastly, sample estimates shows cor 0.5392901, which is the exact same number by using the "cor" function from the previous analysis. The analysis conducted the same process on the other valuables. Table 4 is the result of the analysis by cor.test function.

	Correlation	P-Value	95 percent Confidence Interval
All Bike Networks Miles	0.5392901	0.0008289	0.2511858 0.7396155
Bike Route Miles	0.2851544	0.1021	-0.05866864 0.56849999
Bike Lane/Path Miles	0.3236626	0.06615	-0.02210234 0.60027164
Average Slope	-0.06683899	0.7028	-0.3913682 0.2724767
Number of Bike Racks	0.5643005	0.0004142	0.2845672 0.7554784
Median Annual Household Income	0.02875888	0.8697	-0.3074341 0.3585690

Table 4. Result of the "cor.test" function

All bike networks and number of bike racks show a strong correlation with the SFBC membership ratios. Taking a look at their p-values and 95 percent Confidence Intervals, these are statistically significant. Although it was expected that bike lane/path shows strong correlation with the SFBC membership ratios compared to the bike route, this analysis didn't show statistically significant results because of its high p-value. Interestingly, average slopes didn't show any correlations. And there was also no correlation with median annual household income.

The analysis uses a regression coefficient for visualizing data as well as showing some of the key information from it. The formula for the regression coefficient analysis in R is— lm (BI$sfbc ~ BI$all_bySqmi). The analysis named each 6 models accordingly (e.g., model1 <- lm(BI$sfbc ~ BI$all_bySqmi)). Afterwards, the summary function is used to see the summary of the regression coefficient, "summary (model1)," which result in the following.

```
Call: lm (formula = BI$sfbc ~ BI$all_bySqmi)

Residuals:
Min       1Q        Median    3Q       Max
-1.9848   -0.6288   -0.0922   0.5901   2.9817

Coefficients:
Estimate        Std. Error  t value   Pr(>|t|)
(Intercept)     -0.6453     0.5417  -1.191 0.242098
BI$all_bySqmi  0.4302      0.1169   3.679 0.000829

Signif. codes:
0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error:
1.114 on 33 degrees of freedom

Multiple R-squared:
0.2908,  Adjusted R-squared: 0.2693

F-statistic:
13.53 on 1 and 33 D, p-value: 0.0008289
```

	Estimate	P-Value
All Bike Networks Miles	0.4302	0.0008289
Bike Route Miles	0.2508	0.1021
Bike Lane/Path Miles	0.4237	0.06615
Average Slope	-0.01124	0.7028
Number of Bike Racks	0.006403	0.0004142
Median Annual Household Income	0.000001313	0.8697

Table 5. Key figures from "lm" function

The key parts to look at are "estimate" and "p-value," underlined above. The p-value shows the exact same value as the previous analysis. The estimate shows that if "All Bike Networks" increases 1 mile, SFBC membership ratios increase 0.4302 percent. Table 5 shows the summary of each regression coefficient analysis.

It needs to be clarified that bike racks show very low "estimate," because this reflects how much a SFBC membership ratio raises when adding 1 bike rack per square mile. The impact is a quite low when it is compared to add 1 mile of bike network in a square mile. Finally, the analysis visualizes the data as a summary. To visualize, a "plot" function is used as well as adding a regression line with a "abline" function.

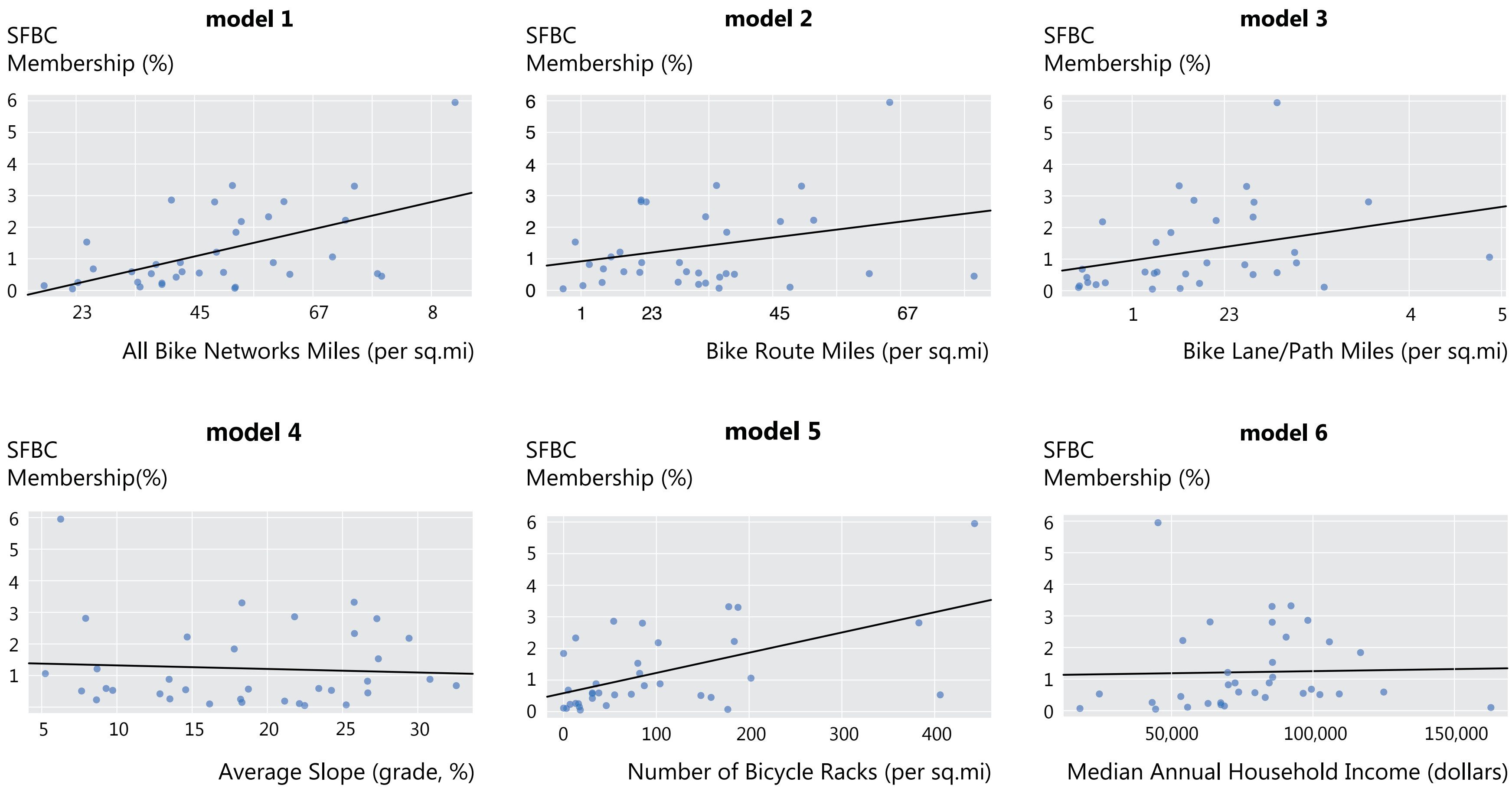


Figure 8. Visualization of the regression coefficient analysis

8 Ethnographic Research

Ethnographic research was designed in two ways —observation and participation. Observation was conducted at the intersection of Arleta Avenue, San Bruno Avenue and Bayshore Boulevard in Visitation Valley, and multiple locations on San Bruno Avenue between Bacon Street and Silver Street. Participation had two parts—taking a bus and riding a bicycle from the observed neighborhoods to Chinatown and downtown, which are the common destinations for the target audiences in Southeast San Francisco. Key findings from the observation were 1) a heavy traffic during peak hours in the morning slowed down public transit and made it difficult to bike on the streets and 2) very low bike usage. Key findings from the participation were 1) a number of seniors who used the bus, 2) a long travel distance, 3) over capacity on the 8X Bayshore Express line, 4) Bikability of the Bayview-Downtown San Francisco except SoMa. Figure 9 indicates the research area in San Francisco.

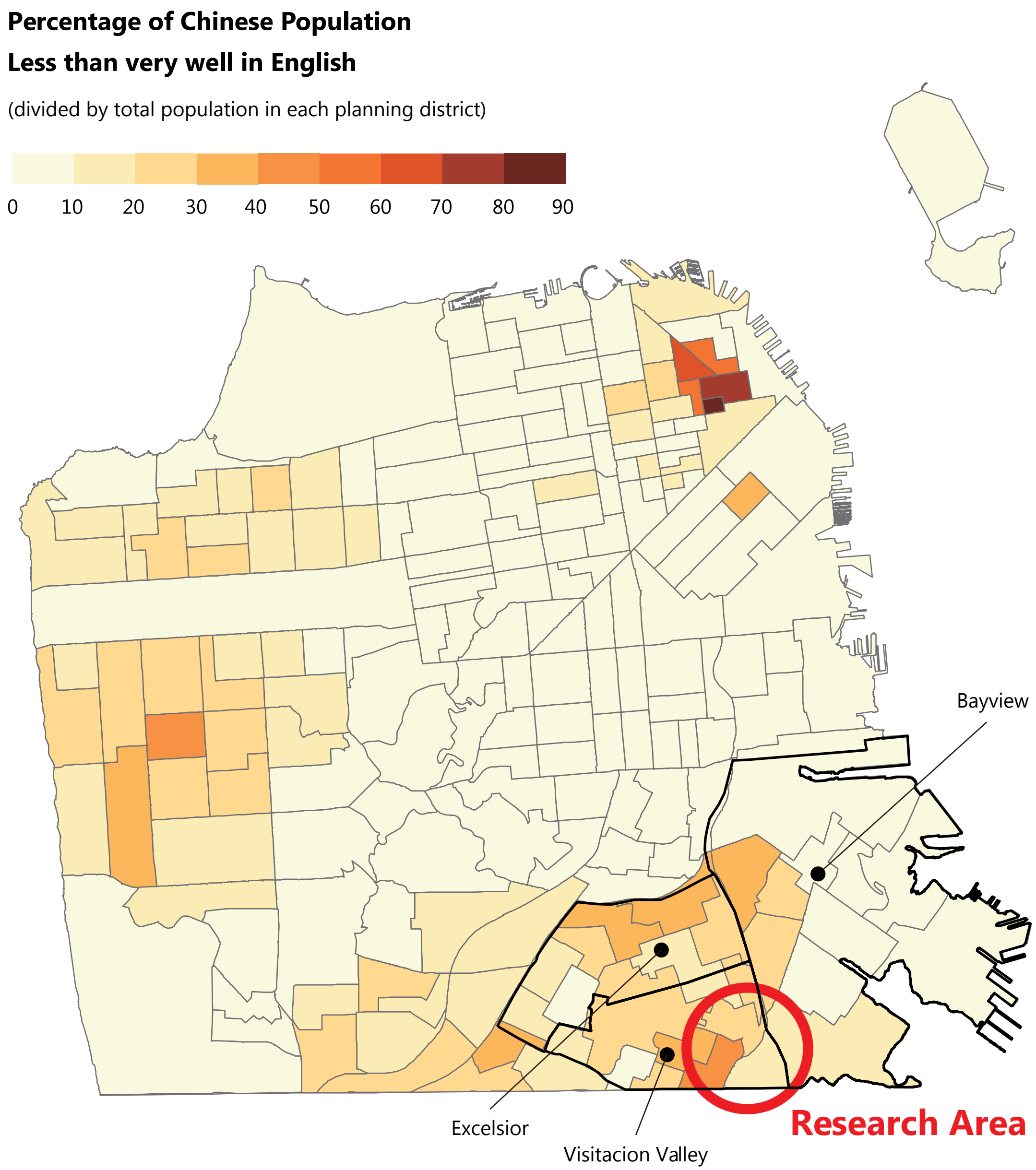


Figure 9. Indication of the observed area

Figure 10. Traffic jam at the intersection of Bayshore Boulevard, Arleta and San Bruno Avenue

Observation

The observation was held 7:30 am to 10:30 am, on November 28, 2013. Compared to the public transit usage, the primary mode of transportation was a private automobile at the intersection of Arleta Avenue, San Bruno Avenue and Bayshore Boulevard. The traffic jam on Bayshore Boulevard started around 8:30 am during the observation as shown in Figure 10.

Although there is a bike lane on Bayshore Boulevard, a very few bicyclists used the bike lane, instead riding on sidewalks. This seems very natural behavior for bicyclists, because of the traffic volume of Bayshore Boulevard. Especially, the automobiles joining to Bayshore Boulevard from Arleta Avenue often drove into the bike lane on Bayshore Boulevard. This was extremely dangerous for bicyclists—regular bicycle commuters may know this dangerous intersection from their daily experience.

Figure 11. Biking on sidewalks on Bayshore Boulevard

Although there is a bike lane on Bayshore Boulevard, a very few bicyclists used the bike lane instead riding on sidewalks. This seems very natural behavior for bicyclists, because of the traffic volume of Bayshore Boulvard. Especially, the automobiles joining to Bayshore Boulvard from Arleta Avenue often drove into the bike lane on Bayshore Boulvard. This was extremely dangerous for bicyclists—regular bicycle commuters may know this dangerous intersection from their daily experience.

Figure 12 shows the configuration of the observed intersection. This intersection was very busy by the traffic and concentration of public transit stops. 8X Bayshore Express is a very frequent bus line with service between San Francisco City College and Fisherman's Wharf in San Francisco. During morning commute hours, observation found there was a bus every 2 to 3 minutes. Since this line goes through Chinatown, there is usually high volume ridership.

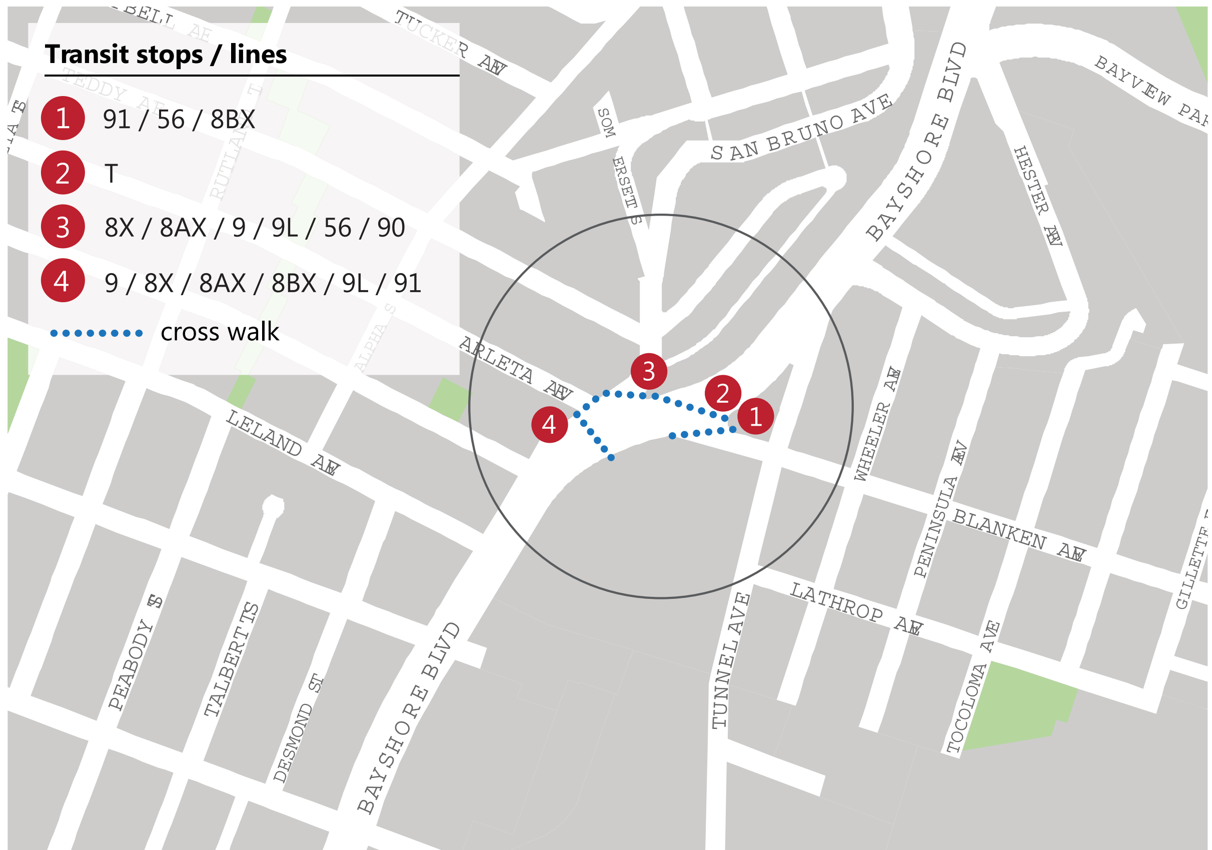


Figure 12. Street configuration of the first observation area

The second part of the observation was conducted at several locations on San Bruno Avenue. San Bruno Avenue was busy with automobile traffic in the morning commute hours as well. The entrance/exit of the Highway 101 was extremely busy, making it difficult for people to cross the crosswalk. A senior crossed the crosswalk with fear and raised her hand as shown by Figure 15. In the case of the senior, the observation on San Bruno Avenue found an unfavorable streetscape for pedestrians, mostly due to poor infrastructure and private vehicle volumes.

Figure 13. Busy traffic at the entrance/exit of Highway 101 on San Bruno Avenue

Figure 14. Poor pedestrian infrastructures on San Bruno Avenue

Figure 15. Unsafe crosswalk on San Bruno Avenue

Regarding the public transit, there was relatively frequent bus service in the observed area. However, the volume of private automobiles and the traffic caused by them greatly contributed to slow public transit services. According to the SFMTA, *8X Bayshore Express Travel Time Reduction Proposal*, this line has 23,000 daily ridership (out of total MUNI ridership of 700, 000) on an average weekday. During peak periods, the 8X Bayshore Express operates at an average speed of only 7.7 miles per hour (SFMTA, 2013).

Figure 16. Bus stop on San Bruno Avenue

Figure 17. Crowded bus on San Bruno Avenue

Participation—Public Transit

The research conducted participation—taking the 8X Bayshore Express with daily passengers. This was conducted on the morning of January 3, 2014. The author took this line from the bus stop at San Bruno Avenue and Mansell Street, which is about a half way from the intersection of Bayshore Boulevard, Arleta Avenue and San Bruno Avenue, and San Bruno Avenue and Silver Street. While the bus drove along San Bruno Avenue, it filled very quickly with passengers—the majority Asian seniors (50 percent to 60 percent). As a result, about 20 percent to 30 percent of Asian seniors had no seats. Not surprisingly, the great number of passenger debussed near Chinatown. This was quite far trip San Bruno Avenue, which was about 5 miles. According to Tumlin, bikeable distance is a range of 3 miles (2010). Therefore, their travel range is farther than this average bikeable distance.

Participation—Bicycle

The research also uses the participation of bike rides from Bayview to downtown San Francisco. This was done by participating in the Bike Bayview, organized by Chris Waddling—the District 10 member of the San Francisco County Transportation Authority (SFCTA) Citizens Advisory Committee, on January 18, 2014. There were about 10 participants in the bike ride. The main conclusion from this participation was a possibility of biking from the Bayview to the downtown because of relatively flat route and easy traffic.

Figure 18. Departure of the Bike Bayview

Bike Bayview Routes

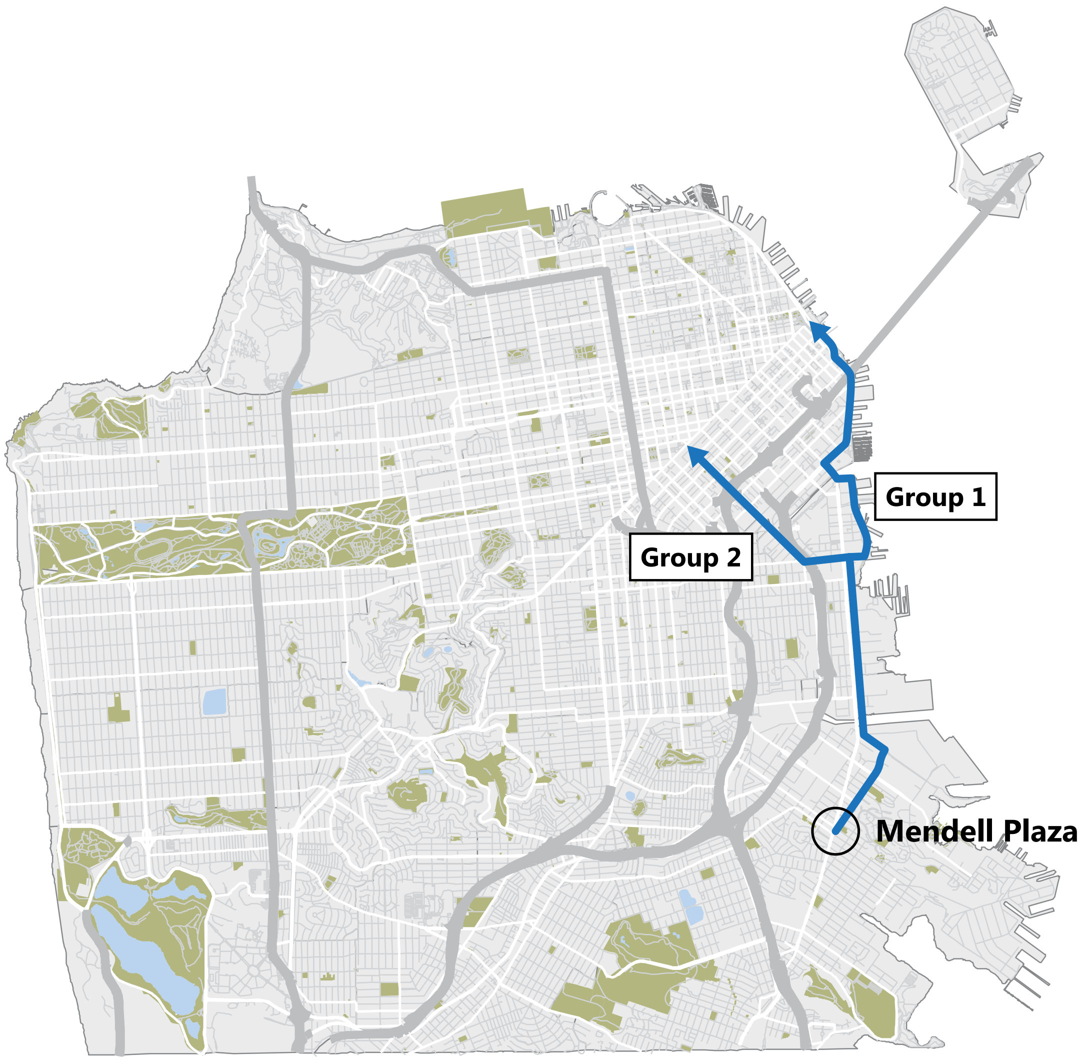


Figure 19. Two designed routes on the Bike Bayview bike rides

The Bike Bayview participants met at the Mendell Plaza (Palou and 3rd Street) at 8 am and started biking toward downtown. Two routes were designed for this bike ride. Both routes headed north along Mendell Street, left at Cargo Way, then north on the Illinois Street. Afterwards, the group split 16th Street and Route 1 took the Terry A. Francois Boulevard to the Financial District via the Embarcadero, and route 2 turned left at the Illinois Street /16th Street and made a right on 7th Street toward the Civic Center (see Figure 19).

The author took the second route, which went through SoMa. Although some streets didn't have bike lanes on the route, it was relatively easy to ride bicycles due to slower and easy traffic. Also, there were significant bike infrastructures, such as physically separated bike lanes, bike signals and bike paths, which may be hidden from non-bicyclist or the people who don't usually bike.

Figure 20. Easy traffic on the route of the Bike Bayview

Figure 21. Fully separated contra flow bike lane

Figure 22. Exclusive bike way on the route

Figure 23. Bike signal on the route

Figure 24. Large vehicles passing by on the route

Although, the traffic condition is relatively better than riding on 3rd Street, the parallel street of Illinois Street from 3rd Street had huge trucks to pass by. This may scare bicyclists, especially if they are beginners and/or not familiar with biking in San Francisco.

SoMa was the most dangerous area on this bike ride. As discussed earlier, four bicyclists died in SoMa and near SoMa in 2013. According to the article, *Central Corridor Plan Envisions Transitways and Safer Streets for SoMa*, SoMa streets were designed for automobiles. This was appropriate decades ago because the SoMa was a more industrial area, but now, more people reside and work in this area, so that the street configuration has to be changed to more transit and pedestrian/bicyclist oriented (Bialick, 2013). As this participation demonstrated, SoMa is also an important area to connect southeast San Francisco to downtown, so bike safety in this area is necessary to encourage commute by bicycle.

Figure 25. Bicyclists on SoMa streets

9 Survey

A survey was conducted to understand the target audiences' transportation behaviors, barriers to biking, familiarity with community issues, and preference of outreach methods. The survey was also intended to examine their ability to understand graphs and pictograms because the Creative Work plans to use them for communication purposes.

Overview

The survey was distributed by local organizations reach out to Chinese immigrants in San Francisco —Asian Law Caucus, CCDC (Chinatown Community Development Center), CPA (Chinese Progressive Association), ECC (Excelsior Community Center), Portola Family Connections, and NEMS (North East Medical Service). In addition to these organizations, Astor Lee, a senior student of the Taichi class organized by the Asian Pacific American Community Center in Visitation Valley, and Yiting Deng, a Master student in the Asian American Studies Department at San Francisco State University, volunteered to distribute the surveys to Chinese immigrants in San Francisco. There were a total of 103 survey respondents. 87 survey respondents identified their nationality as Chinese. This survey analysis excludes survey respondents whose nationalities are not Chinese. Figure 26 shows demographic information of the Chinese respondents.

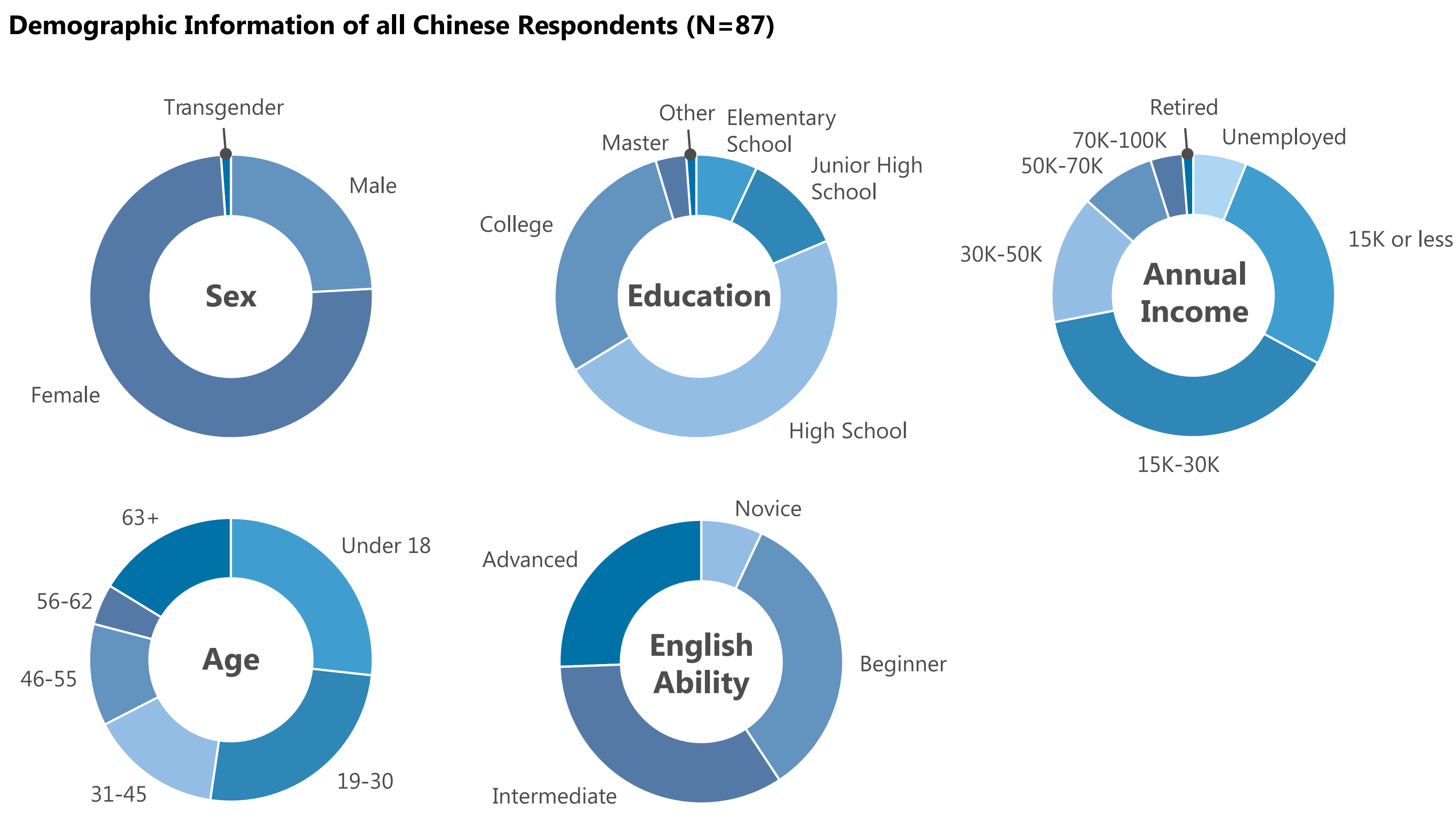


Figure 26. Demographic information of all Chinese respondents

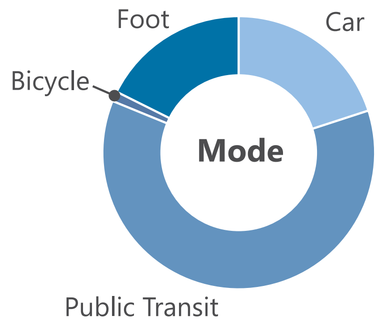
Results from All Chinese Survey Respondents

As shown in Figure 26, the ages of Chinese survey respondents were relatively well distributed. The majority of Chinese survey respondents were women, who accounted for 75 percent. 72 percent of Chinese survey respondents were classified as low-income using the criteria (annual income below $30,000 as low-income) defined by Local Spokes in their report, *Neighborhood Action Plan*. Local Spokes is a corroboration of nine community-based organizations to educate and motivate local residents to participate in bike planning in Lower East Side and Chinatown in New York (2012).

As hypothesized in the research, very few respondents (1%) indicated bicycling as their main mode of transportation. Their mode split is 61 percent for public transit, 20 percent for car and 18 percent for foot. The average monthly transportation cost was $62. Most respondents were satisfied with the quality of public transit. Relative proximity to transit stops (average 2.7 blocks) from where they live may have contributed greatly to this result.

Only 15 percent of the respondents currently own a bicycle. In contrast to this lower figure of current bicycle ownership, 62 percent owned a bike in the past and 56 percent want to own bicycle, which shows their familiarity with bicycling and the potential to promote biking among them. However, the survey found motor vehicle traffic, safety concerns, topographic difficulty, lack of understanding of the traffic laws and a shortage of storage space as the top five barriers to biking from the people answered this section (N=61). These barriers likely discourage Chinese immigrants from owning and using bicycles. Figure 27 shows the summary of transportation behavior among the Chinese survey respondents.

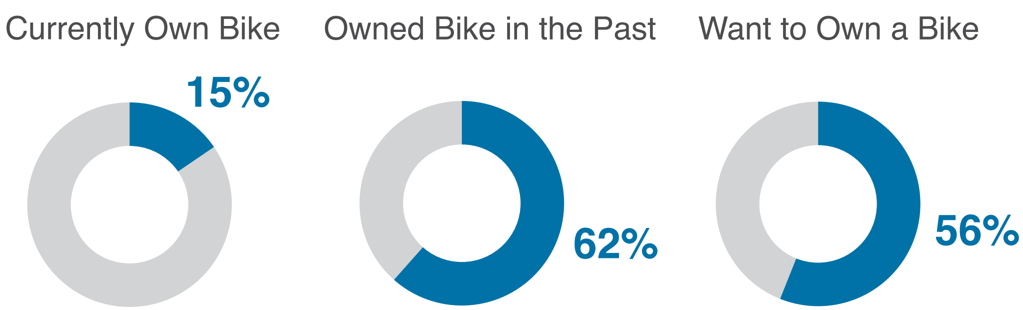
Transportation Behavior of All Chinese Respondents (N=87)



Monthly Transit Cost
$62 (average)

Closest Transit Stop
2.7 blocks (average)

Bicycle Ownership



Barriers to biking

Top Five Barriers for Biking 61 responses out of 87 Chinese respondents

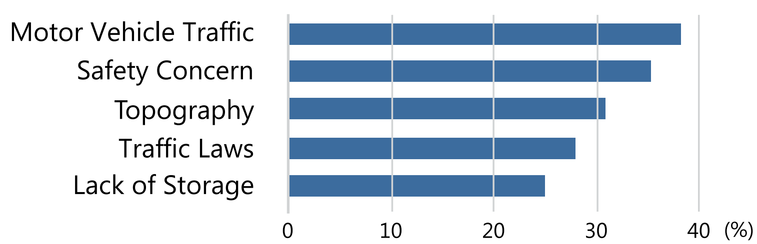


Figure 27. Transportation behavior of all Chinese respondents

Preferable Outreach Methods and Familiarity with Graphs/Pictograms

64 percent of Chinese respondents answered that they were not well-informed about community issues. For people who agreed with the statement that "Community issues are not well informed," the survey had additional questions to regarding their reasons. The survey was intended to identify language barrier and/or digital divide among Chinese immigrants regarding community issues. Therefore, these questions only focused on asking if their reasons were based on the fact that relevant information is available exclusively through online and/or in English. 58 percent of the respondents agreed that availability exclusively in English, and 41 percent of the respondents agreed that availability exclusively, were reason for lack of familiarity. Compared to the language barrier, the digital divide is less problematic among the respondents. In fact, the survey found 80 percent of the respondents have some experience with a computer and 66 percent of them own smart phones.

One question related to ask familiarity with graphs and pictograms as a form of communication among target audiences. Regarding the question about graphs, the survey presented three common types of graphs, a pie chart, a bar graph, and a line graph. In this question, 24 percent of the respondents show no understanding of them (37 percent answered understood very well.). Compared to the understanding of graphs, a relatively higher percentage of the respondents show understanding of pictograms. Only 11 percent of the respondents understood less than 40 percent of the pictograms in the question (48 percent understood 80 to 100 percent). Figure 28 shows the pictograms that were used in the survey.

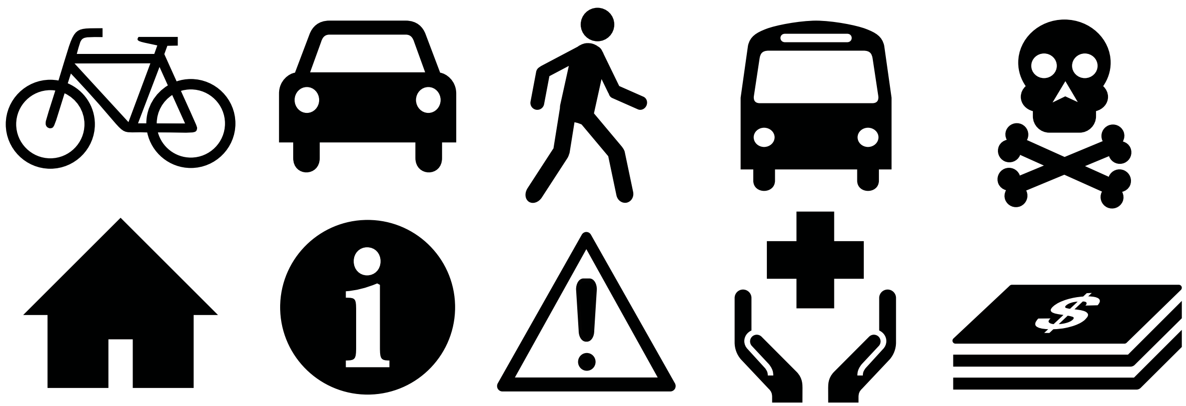


Figure 28. Pictograms used in the survey question

According to Tijus, Barcenilla, Cambon de Lavalette and Meunier, there are three types of pictogram, "figurative," "abstract" and "arbitrary" (2007). Figurative pictograms are most likely understood in spite of cultural backgrounds, educational attachment or the context of the pictograms' usage, because their forms directly represent the objects. In the survey, six out of ten pictograms were classified as figurative pictograms; bicycle, car, people/walk, bus/train, bone/death and house.

Considering that the figurative pictograms are the easiest pictograms to understand, since 70 percent of the respondents showed understanding of at least 60 percent of the pictograms in Figure 28, the research understands that two-thirds of Chinese immigrants do not have problems understanding at least figurative pictograms. 19 percent of them showed 40 to 59 percent understanding. This population may understand the majority of figurative pictograms. Only 11 percent of them have significant problems understanding pictograms.

Transportation Behavior Difference by Income Level

To understand how income level affects transportation behavior, in the survey, the additional analysis separates Chinese survey respondents (N=87) by income level—low-income (annual household income below $30,000) (N=59), moderate-income ($30,000-$70,000) (N=19) and high-income (above $70,000) (N=3). Income levels are classified using the criteria defined in Local Spokes's *Neighborhood Action Plan*. Figure 29 shows the summary of the analysis.

Transportation by Income Level

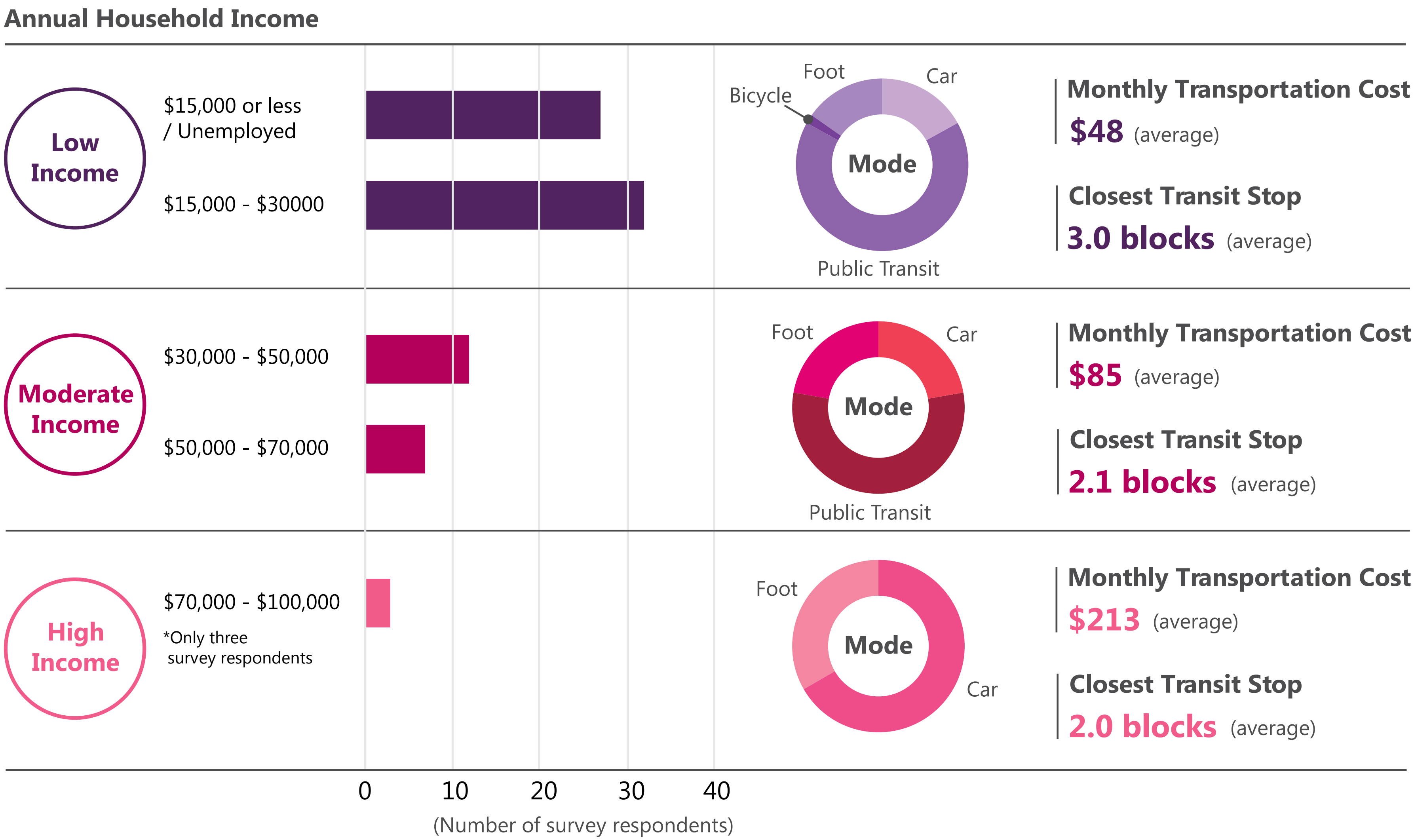


Figure 29. Transportation behavior difference by income level

As hypothesized in this research, the survey also found very few Chinese immigrants (3 survey respondents) who were classified as high-income. Although this result affects the accuracy of the analysis, it shows the tendency that as income levels become higher, monthly transportation costs also becomes higher. Use of public transit, which is an inexpensive means of transportation (excluding foot and bicycle), decreases as income increase. It proves people with low-income need affordable means of transportation.

Familiarity of Community Issues and Computer Usage among Chinese Immigrants

Lastly, the survey analysis compares three types of Chinese survey respondents— all respondents, low-income respondents, and respondents with language barriers, to understand how their familiarity with community issues and computer usage are different. This analysis is also intended to determine the best media to reach out those target populations. The respondents with low-income have annual household incomes of less than $30,000, using the classification used earlier. Regarding, the respondents with language barriers are defined by the question to ask English proficiency in the survey. In this analysis, people who answered “novice” or “beginner” (total 35 respondents) are considered people with language barriers. Figure 30 shows the summary of the comparison of these three types of respondents.

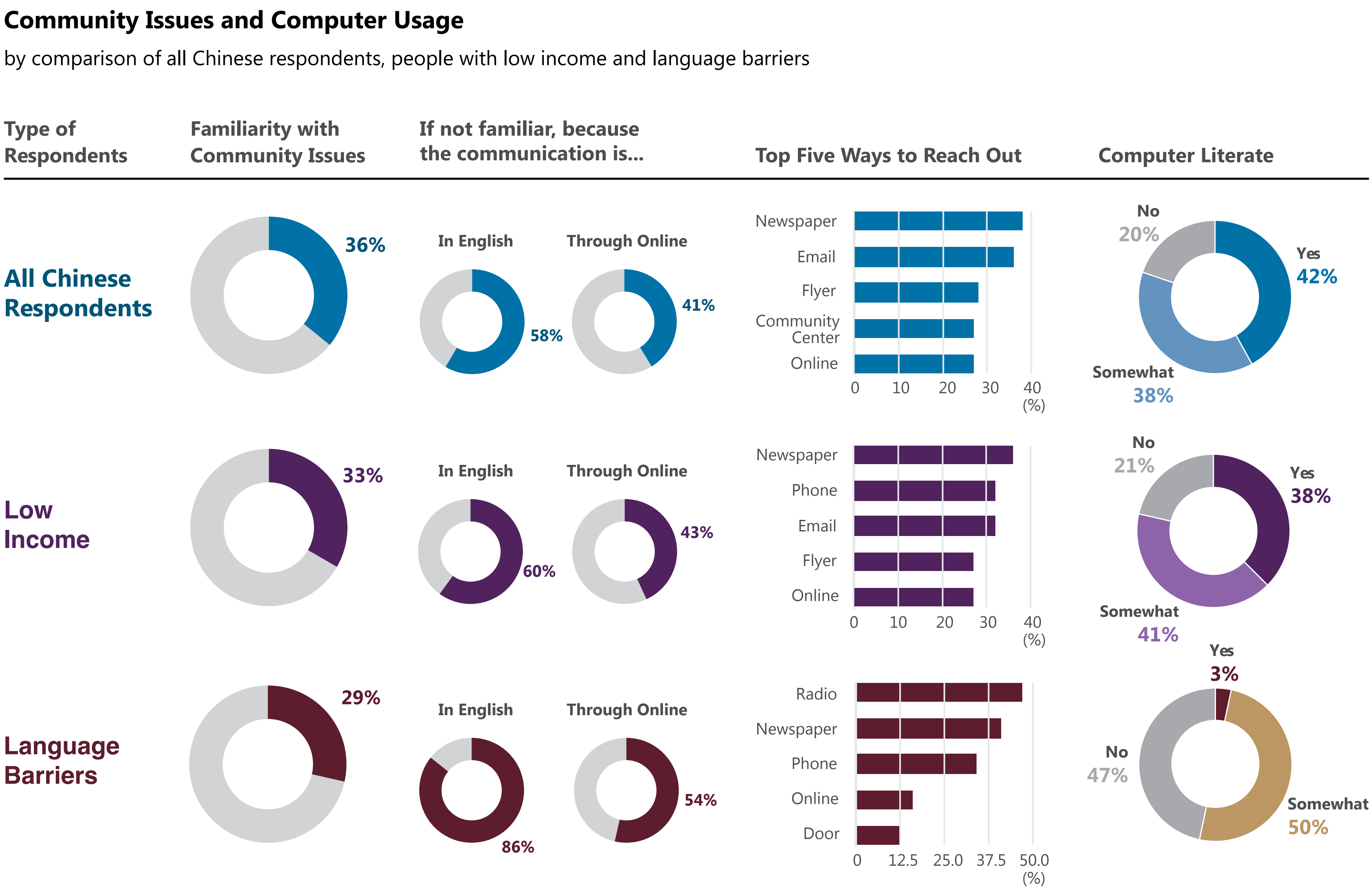


Figure 30. Familiarity with community issues and computer usage by comparison

All types of survey respondents show lower familiarity with community issues. Since people with low-income account for the majority of all Chinese immigrant respondents (72 percent), there is no significant difference between these two types of survey respondents. However, low-income respondents tend to prefer more traditional methods for outreach, such as newspaper and phone, rather than email and online communication. This tendency is remarkable for the respondents with language barriers. Aside from online communication, the top four ways to reach out to this population are radio, newspaper, phone call and door to door.

Needless to say, difficulty in communication in English is a huge barrier to familiarity with community issues, as 86 percent respondents indicated in their answers. The survey also found that respondents with language barriers have significantly lower familiarity with computers. Only 3 percent of the respondents answered "yes" to the question whether they are computer literate, compared to 42 percent of all respondents and 38 percent of the low-income respondents.

The survey found Chinese immigrants in general have problems receiving information on community issues. Communication in English is a major issue of this problem, as 60 percent of all Chinese survey respondents agreed with it. The survey didn't find a significant problem with a digital divide. Importantly, 65 percent of the low-income respondents and 53 percent of the respondents with language barriers answered that they own smart phones. This proves the potential of outreach through online and digital devices to target Chinese immigrants in San Francisco. However, use of traditional media also needs to be considered to cover the target audiences who are not familiar with computers and audiences who are beginners with computers.

CREATIVE WORK 》

12 Creative Work

The primary research found the importance of bike infrastructures and the safety improvements to promote biking. The Creative Work focuses on proposing a bike lane specifically targeting to Chinese immigrants in San Francisco. It also seeks to establish a system using visual materials and tools to enhance community participation, thereby promoting safe bike lanes in Chinese immigrant neighborhoods. The Creative Work consists of four parts—1) propose a desirable bicycle lane design for Chinese immigrants, 2) creating the system to reach out the target audiences by collaboration with local medias and advocates 2) making the traditional print visual materials communicating to the target audiences directly to navigate them to use an online application, 3) developing the online application, which enables them to participate bike planning.

13 Bike Lanes

The ethnographic research found streets' configurations and traffic volumes were not favorable for people who bike in the observed area. As the survey found, excess auto traffic and safety concerns are the top two barriers to biking for Chinese immigrants in San Francisco. To reduce these barriers, the Creative Work proposes the installation of a separated bike lane. The Creative Work suggests a visually and physically separated bike lane, especially on streets with busy traffic, since the ethnographic research on Bayshore Boulevard found that bicyclists used sidewalks for biking instead of the bike lane due to high volume automobile traffic in the morning commute hours. Bayshore Boulevard needs a physically separated bike lane as shown in Figure 31, which is widely considered the minimum requirement to encourage people to bike on this street safely.

Existing Bicycle Lane on Bayshore Boulevard

Minimum Requirement for Bicycle Lane on Bayshore Boulevard

Figure 31. Minimum Requirement for bike lane on Bayshore Boulevard

Social Marketing for Transportation Behavior Change

To target certain audiences and encourage them participating in biking more, the Creative Work uses a theory of social marketing. Social marketing for transportation planning and travel behavior change is not a new idea. McGovern points out that social marketing is paying attention to transport behavior change (2007). Smith describes five key elements of social marketing— 1) a program management process (sequenced action steps), 2) designed to influence human behavior on a large scale, 3) by creating benefits and reducing barriers that matter to specific audiences, 4) through consumer oriented decision making (audience behavior is key), 5) leading to increased societal benefit (as defined by somebody)" (2006). Although all five elements are relevant to the Creative Work, the Creative Work focuses especially on the 3) and 5), key words of "specific audience," "reduced barriers" and "increased societal benefit." Pucher et al. state the importance of focusing on a particular group to promote biking due to its efficiency in advising based on the specific situation and preference rather than communicating to a wide range of audience broadly (2012).

Proposed bike lane and route to Chinatown for Chinese Immigrants

Using the idea of social marketing, the Creative Work proposes the bike lane, which is specifically targeted to Chinese immigrants, and which is still open to the general public since bike lanes shouldn't be exclusive for certain populations. Figure 32 shows the bike lane, which is designed to target Chinese immigrants in San Francisco. There are four significant features shown here. First, for people who are not familiar with a bicycle icon (pictogram) on a bike lane, additional signage, which indicates "bicycle lane" in Chinese,

Proposed Bike Lane targeted to Chinese Immigrants

Figure 32. Proposed bike lane to target Chinese immigrants

Figure 33. “Look” sign in Chinese in San Francisco’s Chinatown

is painted on the surface of the bike lane. Importantly, the survey found about 10 percent of Chinese respondents indicated a problem with understanding pictograms. Therefore, the design should take this population into consideration. Additionally, usage of Chinese language is effective as targeting specific audiences like the “look” sign in San Francisco’s Chinatown (see Figure 33), which was discussed earlier as social marketing theory. Second, the bike lane uses plants as a buffer from automobile travel lanes. PUC’s survey at the community meeting of their project, “Chinatown Green Alley” found “Green Wall,” had the biggest polling compared to the other elements, such as lightning and cultural objects for making their neighborhood pleasant (2013). The plant buffer is also considered to look at some of bike lanes in China as Figure 34. Third, a wayfinding will be provided to assure bicyclists of the route for major destinations. The proposed wayfinding models the one used in Portland—the city selected in 2012 as the best bike-friendly city in the United States by Bicycling magazine. Portland’s wayfinding shows the cyclists the way to popular destinations using arrows, miles to destinations and estimate time to arrive at destinations. According to the National Association of City Transportation Officials (NACTO), the estimate time is considered bicycle travel time as 10 miles per hour. NACTO states the benefits of bicycle wayfinding as 1) overcomes a “barrier to entry” for infrequent users, 2)signage that includes mileage and travel time to destinations may help minimize the tendency to overestimate the amountof time it takes to travel by bicycle or on foot, 3) visually indicates to motorists that they are driving along a bicycle route and should use caution, 4) Passively markets the bicycle network by providing unique and consistent imagery throughout the jurisdiction (2014). Although the survey found there were few Chinese people in San Francisco who own bikes, only 13 people out of 87 respondents, the biggest reason for them to bike is exercise and fun. As the U.S. Department of Health and Human Service indicats that adults need minimum 30 minutes of moderate-intensity physical activity per day (2008), making time factors the most likely target for exercise goals. Considering this, estimate travel time to destinations on wayfinding potentially work for Chinese immigrants to consider traveling by bike as exercise. Lastly, an orange line is painted on the edge of the bike lane to indicate that the bike lane is specially designed for Chinese immigrants, and navigate them to the major destinations, such as Chinatown, where 45 percent of Chinese survey respondents indicated that they travel often. The design doesn't use the orange paint on the entire surface of the bike lane because of two reasons, 1) the use of a different color bike lane may deter the non-Chinese population in San Francisco, and 2) SFMTA is currently expanding red paint as a transit only lane (2014), so a similar color may cause confusion. Needless to say, it is more advantageous to have visually and physically separated bike lanes on all the streets where Chinese immigrants travel. However, this is not feasible considering existing

Figure 34. Plant buffered bike lane in China, Beijing (Photo credit: Jason Henderson)

streets' configuration. Some streets may be too narrow to put separated bike lanes. Other streets already have appropriate bike infrastructures. Therefore, the Creative Work suggests integration of the Chinese immigrants bicycle network to existing street conditions and bicycle infrastructures as necessary. Figure 35 shows the potential bike route from Visitation Valley, Southeast San Francisco, to Chinatown, which is located in the Northeast, with potential bike infrastructures dedicated to Chinese immigrants

As shown in Figure 35, the orange line is proposed based on the research, which the PUC has done for their Chinatown Green Alley project. They researched the existing site color and Chinese traditional garden color palette, and proposed orange color for pavements on some alleys in Chinatown (2013). To keep consistency and build strong image color for Chinese immigrants in San Francisco, the Creative Work also uses orange for their bike network. There is one concern to use orange colors on the streets. Yellow line, such as double yellow lines, which indicate not crossing, already exists in streets in the United States. To prevent confusion, the orange color has to be distinctly different from yellow, such as reddish-orange, rather than yellowish-orange.

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Possible Route to Chinatown from Visitation Valley in San Francisco

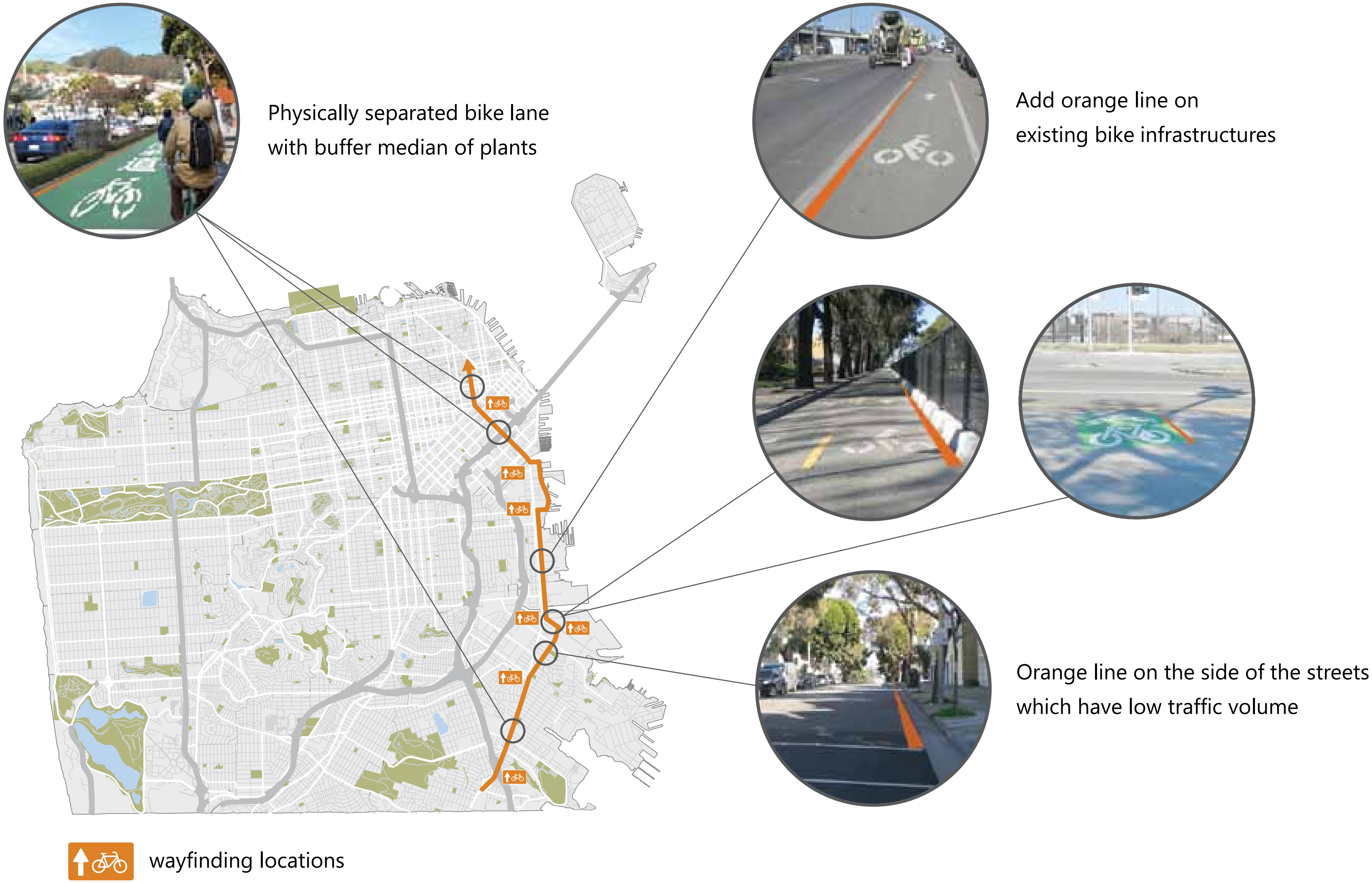

Figure 35. Bicycle route to Chinatown from Southeast San Francisco with key infrastructures

14 Voice from Communities

The Creative Work proposes an extension of a safer bicycle network in southeast neighborhoods in San Francisco, as well as the route to Chinatown starting from southeast neighborhoods. Currently these neighborhoods (indicated in red on Figure 36 and 37) have fewer bike infrastructures compared to the other neighborhoods in San Francisco (see Figure 36 and 37). This leads to the smaller percentage of participation in biking.

All Bike Networks Miles (per sq.mi) by Planning District

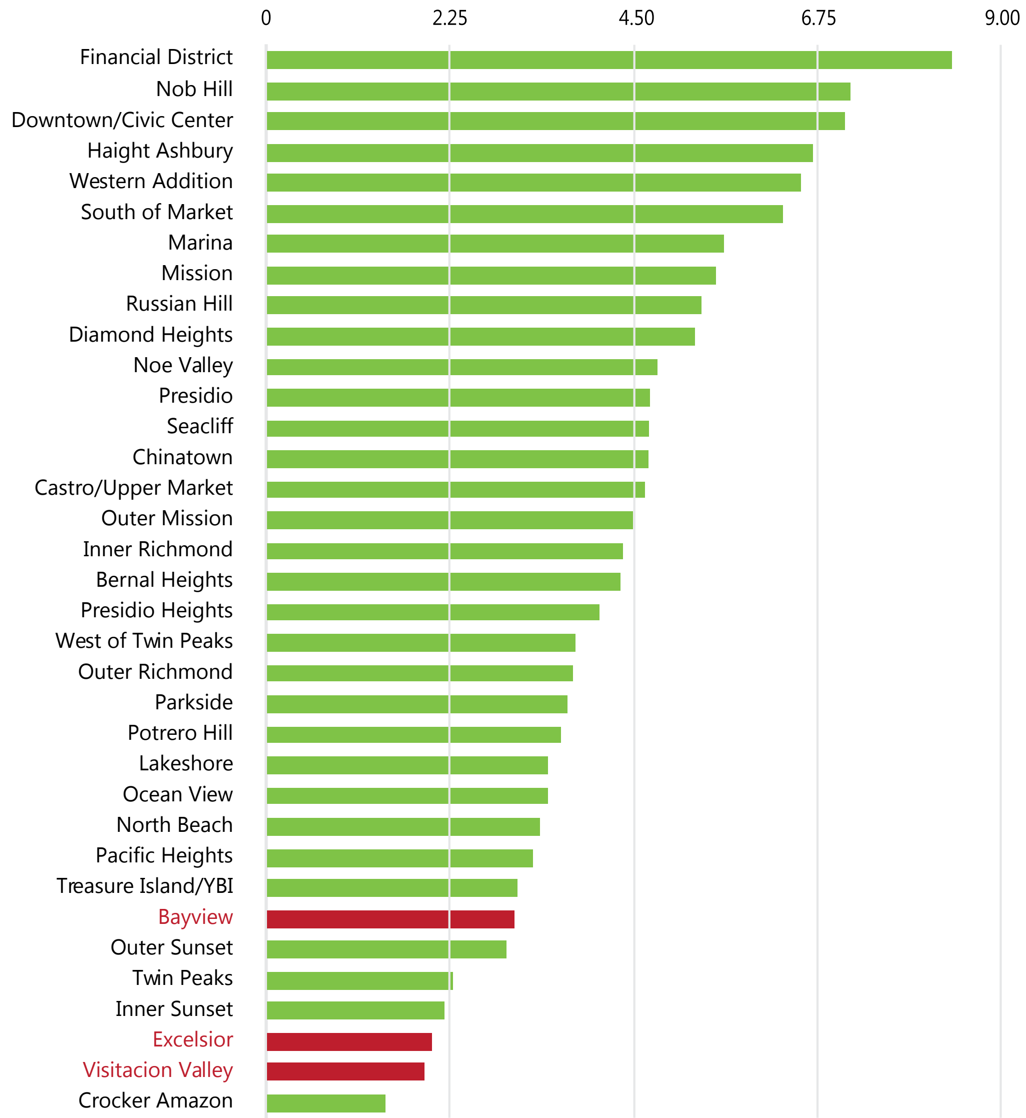

Figure 36. All bike networks miles per sq.mi by planning district

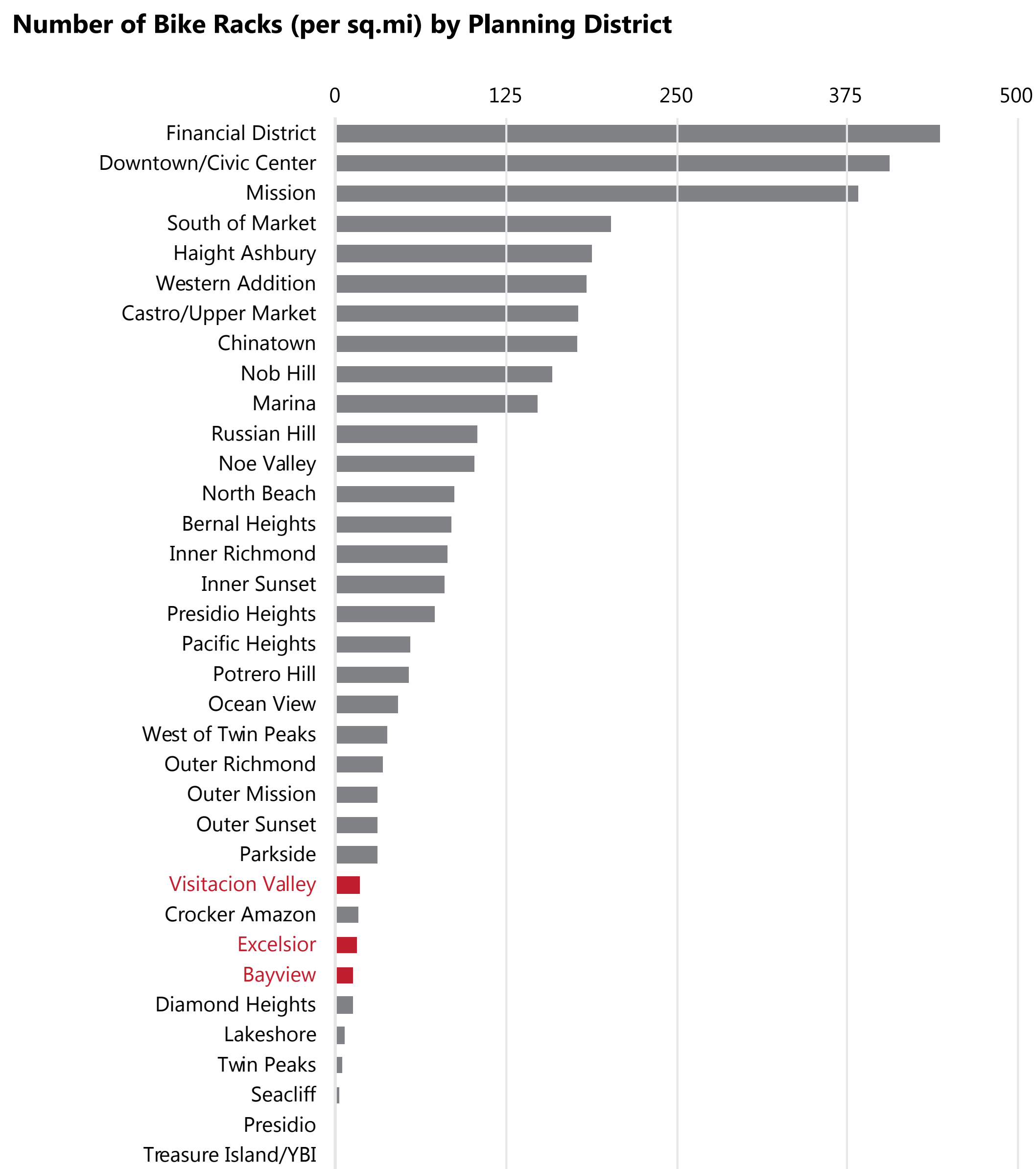

Figure 37. Number of bike racks per sq.mi by planning district

Need for Collaboration in Communities for Change

There are many considerable reasons for the gap between neighborhoods that have more bike infrastructures and neighborhoods that have less bike infrastructures. Some neighborhoods may have topographical difficulty to implement bike infrastructures. Other cases, like the Polk Street Improvement Project, which was discussed earlier, it often happens that residents or merchants strongly oppose implementing bike infrastructures that would result in the removal of parking space. However, for Chinese immigrants in San Francisco, the survey found they are not receiving sufficient information regarding community issues, which include transportation planning, because the most of the communication is done through online and/or in English.

If the majority of the population in some neighborhoods need bike infrastructures—but no bike infrastructures are available, this becomes an issue of transportation inequity. However, this problem is hard to solve if these neighborhoods do not collaborate closely with each other. A great example that demonstrates how a neighborhood made progress to improve on bike networks and sidewalks—San Francisco County Transportation Authority approved the Masonic Avenue Safety Improvements on June 25, 2013. This outcome was not because of the improvement plan that was originally decided by the authorities; instead, it was the grassroots outreach effort by San Francisco Bicycle Coalition and collaboration with other local neighborhood association, such as Fix Masonic and the North Panhandle Neighborhood Association (SFBC, 2013).

Not all neighborhood planning is started by local communities. However, although authorities take the lead on projects, neighborhood participation is still necessary to shape what the community wants. Whenever the authorities plan projects in certain neighborhoods, they prepare a term of outreach to conduct hearings and ask desirable designs/design options. As mentioned earlier in this paper, the PUC is currently implementing various Green Infrastructure Projects (PUC, 2013) including the Chinatown Green Alley. It is noteworthy that they conducted this first community open house, which occurred on August 20, 2013 in two languages—English and Cantonese.

If the majority of the population in some neighborhoods need bike infrastructures—but no bike infrastructures are available, this becomes an issue of transportation inequity.

Although there are outreach efforts to diverse communities by authorities in San Francisco, such as the one from PUC in Chinatown, the author argues that there is still distinct isolation between Southeast neighborhoods and the city. It is still hard to find street improvement projects in southeast neighborhoods, except for the Green Infrastructure Projects by PUC. PUC selected Visitation Valley and Yosemite Creek as parts of their project neighborhoods (PUC, 2013). Needless to say, outreach efforts by authorities to Southeast neighborhoods are necessary. However, in addition to this, the author still insists that communities in southeast neighborhoods have to have their own opinions to shape their neighborhoods and become more active in planning issues.

Visual Communications for Those with Language Barriers

This Creative Work suggests visual communications as an inclusive way to communicate with different cultures that speak different languages. The study by Buyayisqui et al. in Argentina shows that graphical explanation (specifically, illustration in their study) in health educational materials help communicate successfully to communities with language barriers. They conducted interviews with 96 families who have language barriers; and 64 (66.7 percent) families showed understanding of the material with visual explanations (2013). Although the result of this study couldn't show complete success with visual communication to diverse communities, it is noteworthy that if they had used only linguistic communication to the communities with language barriers, the comprehension rate for the material could have been close to zero.

In visual communication, the Creative Work project uses pictograms and cartographies to communicate to the target audiences. According to the article, *The Design, Understanding and Usage of Pictograms*, a pictogram is defined as "a stylized figurative drawing that is used to convey information of an analogical or figurative nature directly to indicate an object or to express an idea." Pictograms are often used in conditions where the message has to be understood quickly, communicated in diverse communities and communicated to the people who have visual problems, such as seniors (Tijus et al., 2007). There is the ANSI standard—ANSI Z535.2-2002 and Z535.4, Annex B, which defines safety signs. The standards say "the use of symbol is strongly encouraged in order to better communicate the sign's hazard information across language barriers (SAFETY HEALTH, 2005)". The survey conducted in the research also found that a higher percentage of survey respondents understood pictograms if they are limited to figurative ones.

The survey was also intended to understand their ability to understand geographical information asking where they live and travel to by choosing them from the map numbering each neighborhood, and the route they take. Regarding the route they take, it was limited to 67 percent people to understand. However, only 2 percent people didn't know where they live and travel to. Therefore, the research recognizes the target audiences likely have some basic knowledge to understand geographic information in San Francisco.

15 Bikeability Reporting System

Development of Online GIS-Based Web Application

Maps have been used for over 3000 years. Understanding of spatial information is important because it has huge impacts to design our lives (Bolstad, 2012). From these aspects, it is considered Chinese immigrants in San Francisco naturally know the geographic information for their lives. Because geographic information is important, GIS (Geographic Information System) was created to help with providing spatial information. The key concept of GIS are "where" and "what (Bolstad, 2012)." There are the cases, which GIS helped in improving neighborhood safeties. As an example, Comstat was started by the Police Department in the New York City for decreasing crimes by tracking them and mapping them using GIS in 1990s. The program greatly helped with analyzing and visualizing data to see certain trend on crimes. As a result, the Police Department succeeded in reducing crimes dramatically. In addition to that, Comstat has been recognized as efficient tool to collect and manage crime data. It supported decision-making process and even foresees some crimes to see the frequent patterns (Gullino, 2008).

Using the concept of Comstat, the Creative Work will create the GIS-based online application —web cartography, which allows users to report directly the problems that are related to biking in their neighborhoods. The application aims to encourage more participation by low-income Chinese immigrants by reporting problems and need for bike infrastructure improvements in their neighborhood. Therefore, the interface and the process of reporting should be simple enough with step-by-step instructions on the right column. Since the survey found the majority of survey respondents had smart phones, the application should be responsive, with adjustable interface design depending on the screen sizes. Figure 38 shows the main interface of the application.

Since the application is designed to target the Chinese population in San Francisco. The

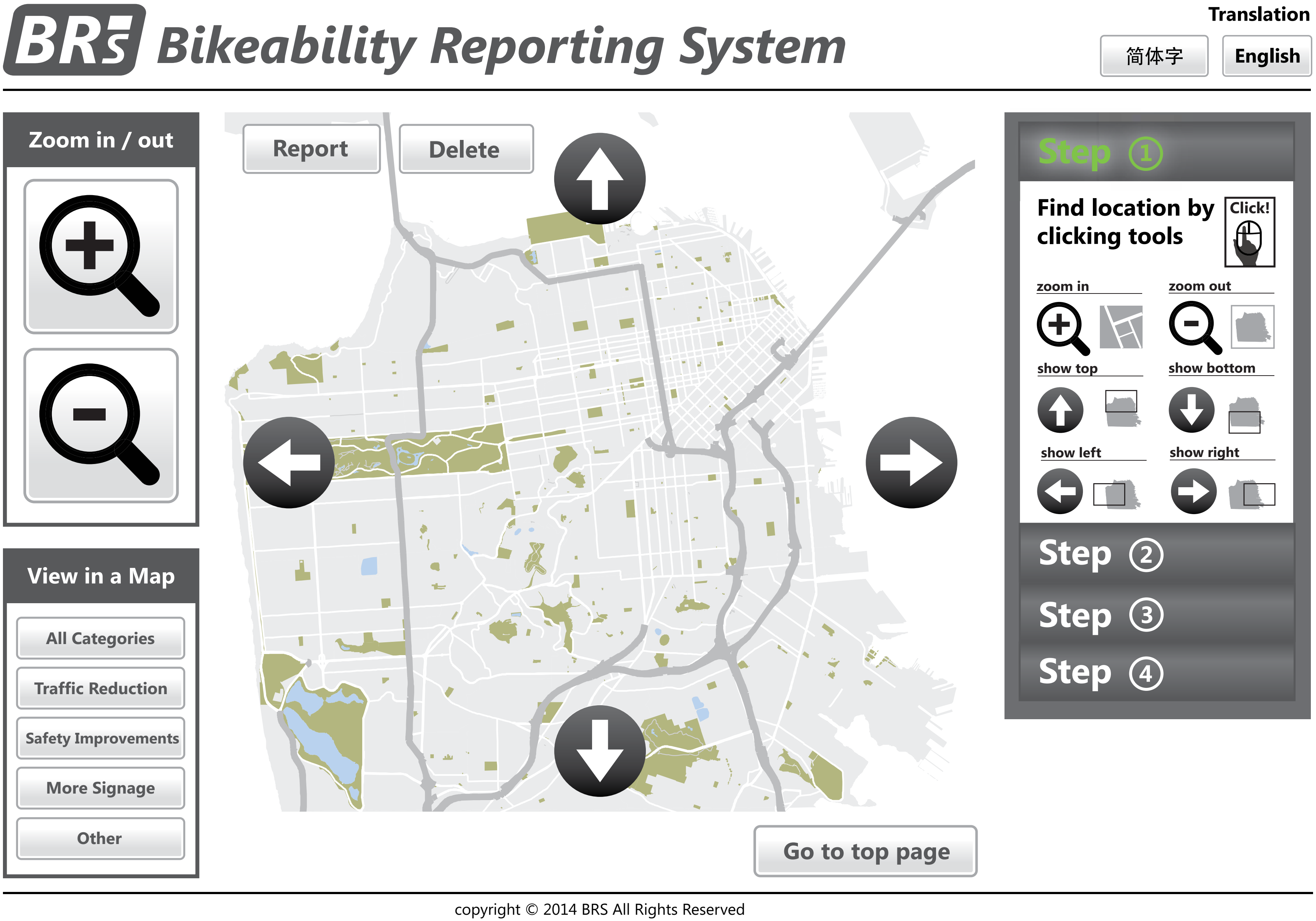

Figure 38: Online GIS based application top page

Figure 39: Online GIS based application top page in Cantonese

application must be in Chinese. As the survey found, the majority of the Chinese population in San Francisco speaks Cantonese (60 out of 87 Chinese respondents chose Cantonese survey form rather than Mandarin and English ones), so that the application 's primary language is Cantonese with translation options for Mandarin and English (see Figure 39).

The application is called "Bikeability Reporting System." As the right column indicates, reporting can be completed in four steps. This guide is based on the concept of "Mental Aids," which is discussed in the book, *The Psychology of Everyday Things* by Donald A. Norman. This concept is exactly the same idea as taking notes to remind users. This may not be necessary if the process is standardized—for example, most people are able to tell the time from analog clocks, and/or target audiences know how to use them from their experience as a conceptual model (Norman, 1988). However, since this application is intended to target people who are not familiar with using computers and online applications, the application needs instructions on use even though they may be redundant for users who are familiar with the interface of web map applications. In addition, web map application interfaces are not standardized yet (You, Chen, Liu & Lin, 2007). Some users who are familiar with web map applications at some levels may be confused when they encounter the interface of the Bikeability Reporting System. Therefore, this map application has to include instructions on how to use the program.

Furthermore, this guide is also used to let users know what they can do next by highlighting the steps. This idea is based on the concept of "bridge the gulfs of execution and evaluation" by Norman (1988).

Usability of web map applications relies on their interfaces because the screen size to represent geographic information is limited. To enable showing geographic information in the computer's graphical user interface (GUI), zoom and pan are the key functions to be considered in web map applications. Although zoom tools have no significant differences among existing web map applications, pan has two distinct ways—moving maps by dragging with the mouse, and using pan buttons that are spatially related positions. Using time and distance factors, which are proposed by Paul M. Fitts, the second type of pan function is not well suited for efficiency, since it requires the user to move the mouse to each pan to achieve the locations he/she is looking for. However, from the aspect of learnability, the second type of pan would be a better design, because the location pan is also indicates the direction where the map moves. This concept, which is referred to as "natural mapping, is proposed by Norman as well (You et al., 2007).

Finally, the buttons in the interface are used embossment, which resemble push buttons in the real world. This web map application uses a mix of two styles, flat and skeuomorphism design. Flat design, which takes away the third dimension from objects in the interface, such as shadow and embossment on the objects, is becoming popular due to loading size and simplicity of appearance. In contrast, skeuomorphism design, which applies the third dimension, makes objects in the interface more realistic (Bilton, 2013). One of the advantages of skeuomorphism design is its affordance, a term originally defined by James J. Gibson. The embossed buttons afford users to push, and are reminiscent of buttons in the real world, which often have a bump. (Takahashi, 2012). The application uses skeuomorphism design on buttons which need to afford users to push, and flat design concept for the sake of simplicity, where users are not required to take any action to eliminate any extra decorations. and pursuits of simplicity.

To use the application, users find the street segment(s) where they need bike infrastructure improvements using plus magnify button located in top-left to zoom in, and pans located in each frame to move the map. After the user finds the street segment(s), click on it (them). After selecting the street segment(s), the submit buttons in the bottom of map is highlighted. Once the user clicks the button, a pop up shows up with a multiple choice. The multiple choice contains the item called “other,” so that the user can enter the types of problems by itself, which are not listed in the options. At the initial stage to promote the application, this multiple choice should be optional because the main purpose of the application is to encourage the target audience in participating reporting biking issues in their neighborhood. So that the possible barriers need to be gotten rid of from the task.

Figure 40 shows the snapshot of the pop up that users can choose or enter desirable improvements they have on the particular street segment(s).

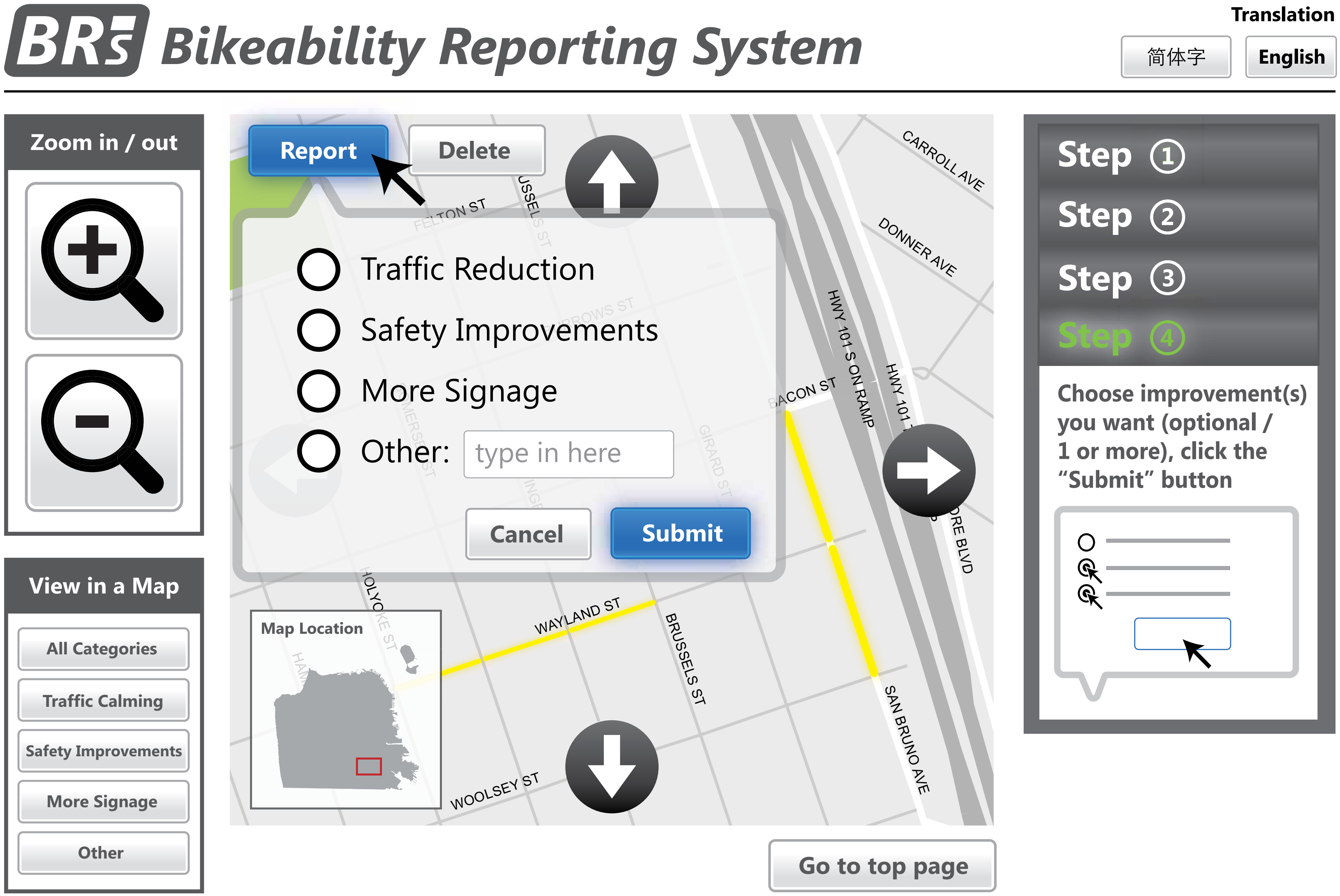

Figure 40. Pop up window to choose necessarily improvements for biking

After entering the necessary improvements for biking, users need to hit the submit button. The screen responds with a "thank you" and a summary of the street segment(s) data that the users chose in the map along with instructions in the right column (see Figure 41).

Lastly, the application has visualization tool, so that users are able to learn what improvement requirements they have in their neighborhoods, not only just reporting. This could be an advanced feature for users although the tool is very simple to use. However, in the initial approach, the Creative Work does not promote this feature in order to prevent confusion among users who are not familiar with computers (see Figure 42).

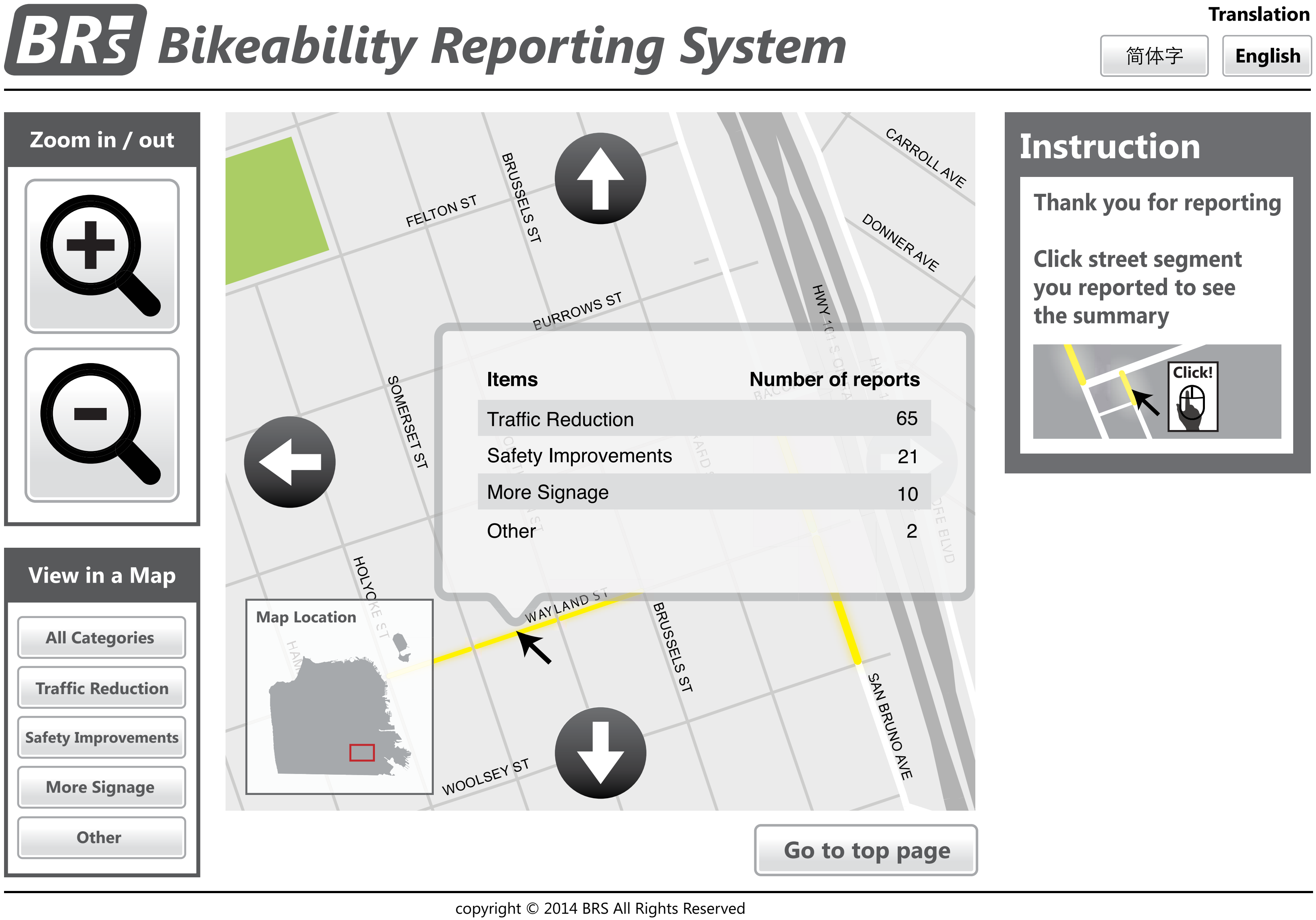

Figure 41: Window after completing submission

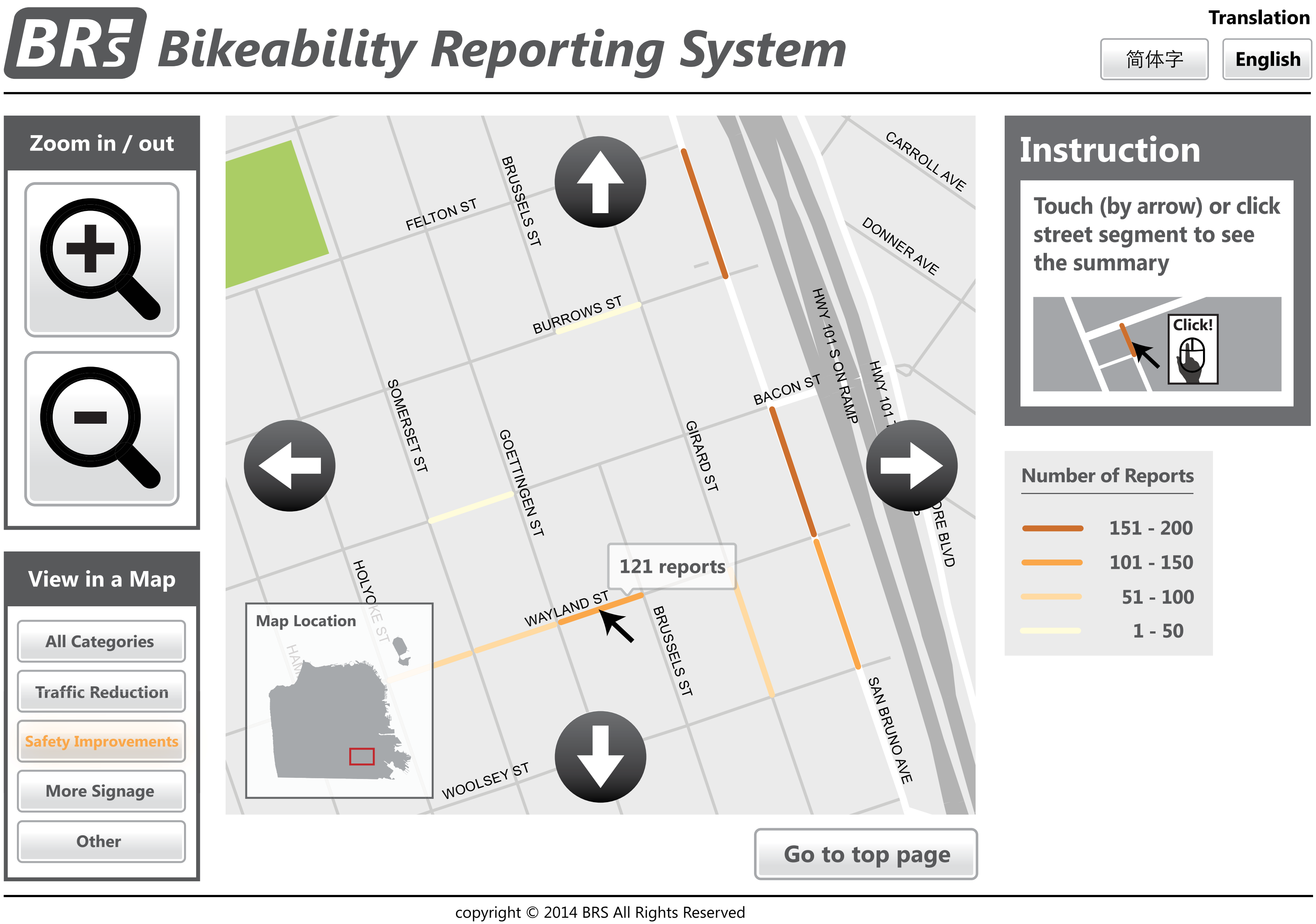

Figure 42. Visualization function

Other Media to Promote Usage of the Application and to Encourage Reporting

Although GIS-based technologies have great potential that it enables wider varieties of people understand compared to the other information and communication technologies, Gullino's study about the CitiStat in Baltimore, Maryland, which is based on GIS, for urban regeneration found certain people wouldn't be engaged in Citistat because of lack of internet access and informatic skills (2008). The survey discovered 47 percent of the Chinese immigrants in San Francisco who have language barriers have no experience with computers. Therefore, these populations will be excluded from the solution of online application to report problems. This is defined as the digital divide—the further isolation of the people who are already segregated from society caused by lower education or less affordability of electronic devices to receive the information conveyed electrically, which is defined by Gullino. There is a study by Dick, Manson, S., Hansen, A., Huggins & Trullinger, *The Native Telehealth Outreach and Technical Assistance Program: A Community-Based Approach to The Development of Multimedia-Focused Health Care Information*, uses multimedia-based products as a solution of a digital divide (2007). The Creative Work project uses the same approach to consider the some portion of the target population who are not accessiblze to any online sources.

To promote the web map application, a public digital touch screen board connected to the internet is considered for people who have no access with electronic devices. The Creative Work proposes to use the board in MUNI bus stops used for advertisements. As posted on GIZMODO, Yahoo has installed a touch screen game panel which allows users to play games with people who are waiting at other MUNI bus stops (VanHemert, 2011). Therefore, technologically, it is possible to install the web map application on MUNI bus stops, although not all MUNI bus stops have the space to install this, because some MUNI stops are market on electronic poles or have simplified structures without huge panels. Importantly, this has a potential not only to reach the target audiences without digital devices, but also to promote the application to the majority of the target audiences, since the survey in this research showed over 60 percent of them use public transit as their main mode of transportation. Figure 43 shows the installation image of the web map application on MUNI stops.

Because the survey found the newspaper and phone call are the most popular channels to reach the target audience, the research uses newspaper as the media to reach out. Figure 44 shows the print based information, which encourages the target audiences to participate in reporting their improvement needs in the neighborhoods.

Figure 43. Bikeability Reporting System installation on MUNI bus stops

A System to Navigate the Target Audiences Accessing Online

This Creative Work is not intended to just use traditional print media to reach out the target audiences who have no experience with computers, but, it is intended to guide and educate them to participate in online access. Because using online applications have great benefits, especially for data collection and processing. Chema Hernández Gil, Community Organizer at SFBC who has Java and C development experience in the past, showed the diagram (Figure 45) of online applications' benefit, particularly for data visualization in geographic contexts.

Although the goal is the same as data visualization, which will be shared with decision makers, there is way more processes on a traditional method. Additionally, each process may need each specialist, which increases many types of cost, such as time and labor. Flexibility is the one of the benefits for online application. It can respond to

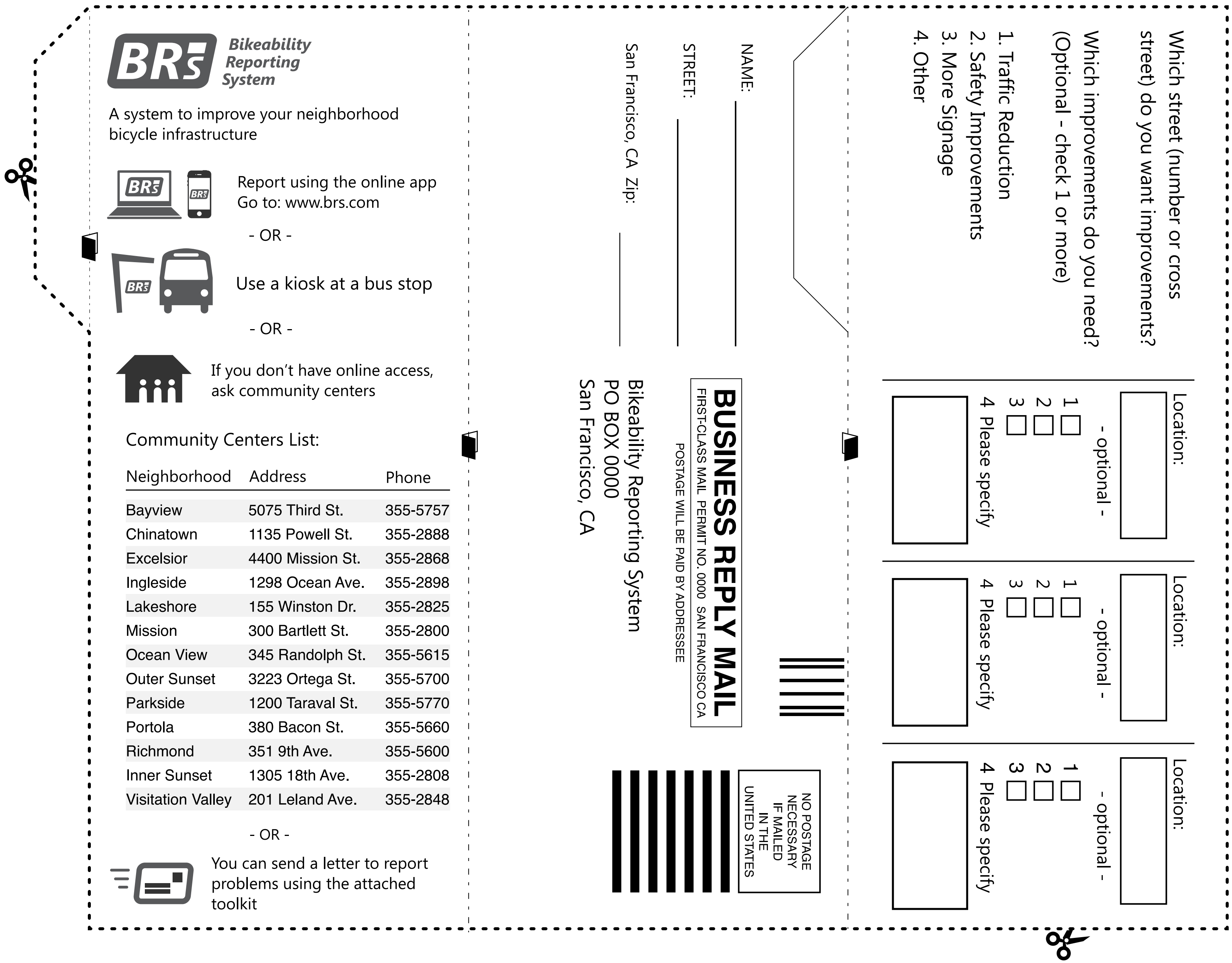

Figure 44. Newspaper advertisement of the Bikeability Reporting System

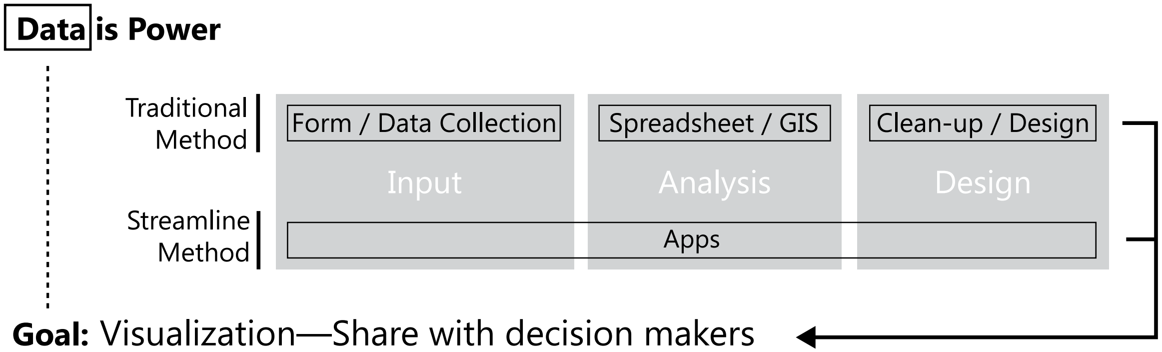

Figure 45. Benefit of online applications

the change of data input and reflect it to the output quickly. Compared to this, traditional methods need to repeat the entire process if the input data has been changed (personal communication, January 29, 2014).

As Figure 44, newspaper advertisement shows, the system recommends users to access the online application of the Bikeability Reporting System by themselves to report problems. However, as discussed earlier, not every user is familiar with accessing information online. Therefore, the Creative Work proposes the collaboration with local communities and providing support and education to the target audiences from them. Gullino cites a "three-way partnership," which are private sector, public bodies and local communities for urban regeneration. Among these three, local communities take the most important role since they are closer to the population who need to be reached out (2009). There is an example that focuses on collaboration with local communities for the solution of a digital divide. Dick et al.'s study conducted enhancing local community advocates to reach out and make resource available for American Indian and Alaska Native communities that are not able to receive health related information appropriately due to lack of technological knowledge (2007). Figure 46 shows the system needs to be created to reach out the target audiences as Chinese low-income immigrants in San Francisco.

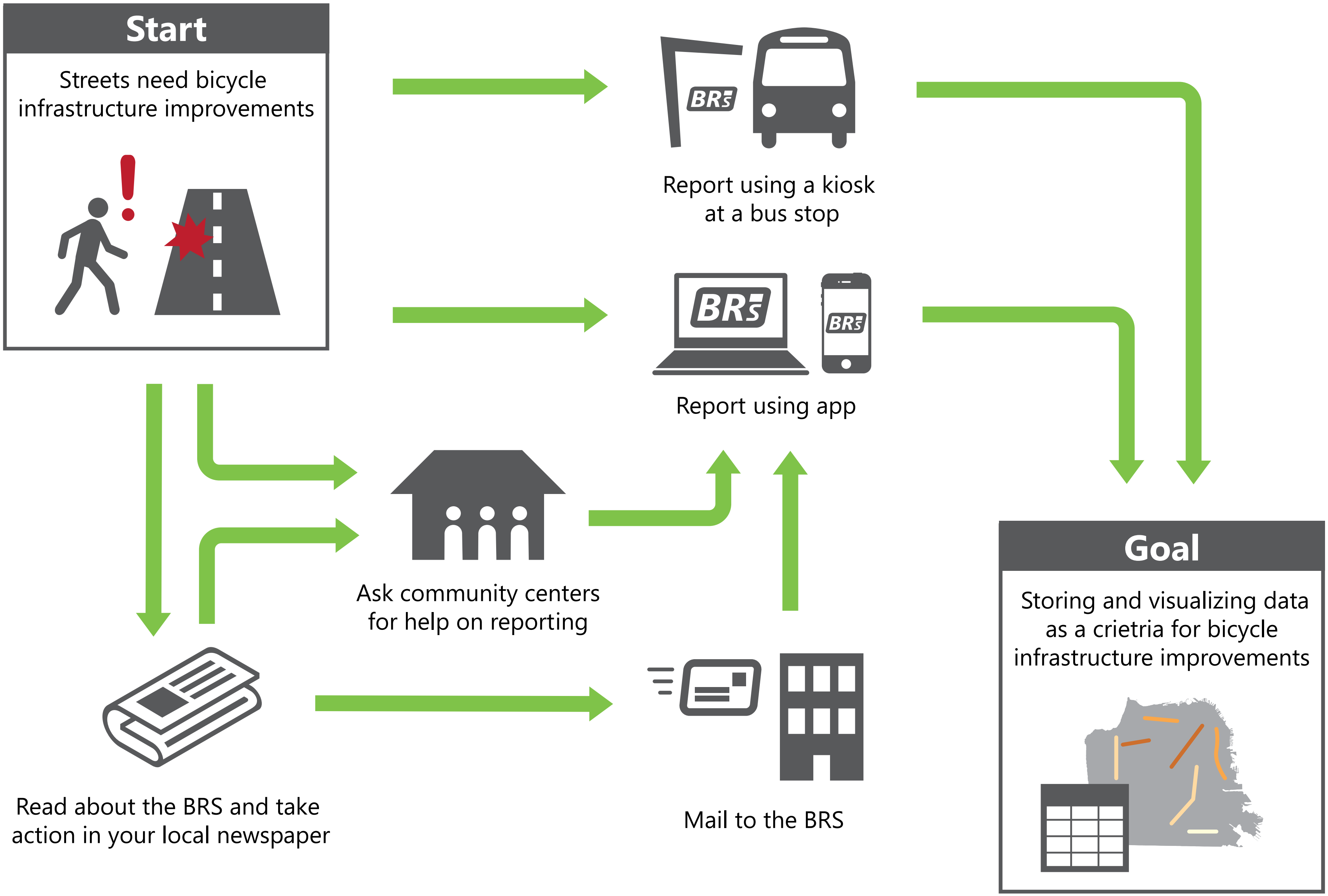

Figure 46. A system to cover the population who are not familiar with accessing online

The goal of the system is collecting/visualing data, which will be shown to decision makers, such as city authorities. This type of data driven solution is not a new idea in San Francisco. San Francisco Planning Department currently lead the project of "Walk First," which is intended to improve pedestriansafety in San Francisco using data collected from citizens directly (2014). However, the process of data input is complicated and this is only done through online. Marlene Tran, the spokes person at Visitation Valley Alliance responded to the project. Ms. Tran suggested that the survey format should be easier, so that the most important target audiences of vulnerable senior and children are able to contribute to data input. The online surveys restrict survey respondents to certain populations, which results in bias, and it is difficult to reach out diverse audiences (personal communication, November 13, 2014).

The significance of this Creative Work is simplicity of the online application, which has potential to enable non-computer users learn quickly and use. Plus, the Creative Work uses holistic approach of creating the system to include the target audiences who cannot access online by support from local communities. As a final resort, offline, traditional print media is used if the users are completely unfamiliar with accessing online and not able to learn it.

16 Conclusion

This research found segregation of Chinese immigrants in San Francisco geographically and linguistically. The city expects the Chinese population to increase in the future; therefore, certain measures to reach out to this population are necessary. In order to reach out to those populations with language barriers, visual communications, which minimize language usage, are proposed.

Although the ultimate goal of this research is promoting biking among Chinese low-income immigrants in San Francisco to provide them affordable means of transportation, the research found the improvement of bike infrastructures are necessary to reach this goal. Especially, based on the survey result, safety issues being the biggest barrier for the target audiences regarding biking. Thus, this Creative Work suggests safe bike networks, which specifically target to Chinese immigrants in San Francisco as well as developing a tool to create safe and bikeable neighborhoods. Online map application for data collection and visualization is designed to empower the target audiences reporting where they want to see bike infrastructure improvements in their neighborhoods. The application is designed simple enough by minimizing linguistic instructions, so that users are able to understand the logic of application intuitively.

The survey further shows, 20 percent of all Chinese survey respondents have no experience with computers. This Creative Work proposes the holistic approach to cover those people to create the system to navigate them online access by collaboration of local community centers. In addition to it, as a last measure, non-computer based communication—traditional print media is also used to reach out the rest of target audiences to cover.

Glossary of Terms

ACS (American Community Survey)
A census conducted annually by the U.S. Census Bureau with a small sample size to understand community changes.

Affordance
A term introduced by James J. Gibson, which means possible actions afforded by an object or environment.

ArcGIS
A software developed by ESRI, which is used to analyze and visualize geographic information.

Bike Lane
An bicycle way with a visual line or physical barrier to indicate a separation from vehicle travel lanes.

Bike Path
An exclusive bicycle way, which is completely separated from a motor vehicle way.

Bike Route
A shared travel lane with automobiles that may or may not be marked.

Comstat
Initiated by the Police Department in the New York City for decreasing crimes by tracking them and mapping them using GIS in 1990s.

DEM (Digital Elevation Model)

Raster-based data that uses pixels to represent each elevation value.

Flat Design

Remove the third dimension from objects in the interface, such as shadow and emboss on the objects.

Mode Split

The type of transportation used by the population based on percentage.

P-Value

The estimated probability to reject the null hypothesis, which indicates no significant difference.

R

An open source program, which one to enable conduct statistical analysis and data visualization.

Regression Coefficient

A statistical analysis used to estimate relationships among variables.

Responsive Design

An interface design capable of adjusting according to the screen size of a device.

Road Diet

The reduction of automobile travel lanes for the purpose of traffic efficiency.

Shapefile

A file format specifically designed for ArcGIS. It enables one to analyze and visualize data using ArcGIS.

Skeuomorphism Design

Applies the third dimension, which makes objects in the interface more realistic.

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