44-CXP-B175

Improving Transportation in Hangzhou, China Through Citizen Feedback

An Interactive Qualifying Project Report
Submitted to the Faculty of
WORCESTER POLYTECHNIC INSTITUTE
In partial fulfillment of the requirements for the
Degree of Bachelor of Science

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Date: December 13, 2017

Abstract

Hangzhou's transportation network fails to reach its full potential because transportation planners do not take into account citizen feedback through bottom-up planning. In order to determine major indicators of satisfaction, as advised by Hangzhou Dianzi University Dean of Sociology, Professor Wang Guofeng, our team conducted focus groups, interviews, and a survey with Hangzhou's residents and transportation operators and managers. We found that increasing network compatibility among different transportation systems will target indicators reflecting low satisfaction, thereby increasing overall transportation satisfaction.

Acknowledgments

Our group would like to graciously thank the following organizations and individuals for their assistance and support throughout our project:

- Hangzhou Dianzi University (HDU) for providing us with a comfortable living space and a beautiful work environment during our stay.

- HDU Sociology Department Head, Wang Guofeng for sponsoring our project and providing resources and contacts to conduct questionnaires, focus groups, and interviews.

- Creighton Peet, our project advisor who aided and encouraged us to reach our goal by offering his extensive knowledge of previous studies and occasional Chinese language skills.

- Katherine Foo, our project advisor who guided us to improve the focus of the project and gave us insight on the current data analysis software available.

- 刘露 (LiuLu), 石雨菲 (ShiYufe), 刘柳 (LiuLiu), and 许芷瑜 (XuZhiyu), HDU sociology students, for assisting us in translation, questionnaire distribution, and helping us with daily life in China.

- Annie Kids and Kid Castle English language companies, for their assistance in distributing questionnaires.

- Worcester Polytechnic Institute for making this experience possible.

- Sophomore HDU sociology students for participating in our focus groups and assisting us with translation during some interviews.

- All of the focus group and interview participants who graciously answered our questions.

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Executive Summary

Citizen satisfaction is integral to the successful planning and development of urban infrastructure. Gathered feedback helps city officials understand where improvements can be made, as well as where time and resources should be allocated. Transportation is an especially important area of development needing citizen feedback because of its prevalence in the daily lives of the populace. However, recent city planning by the Chinese Ministry of Transport has not adequately accounted for public opinion when developing and maintaining transportation infrastructure. Current systems have been designed for efficiency, but previous studies demonstrate that overlooking public opinion can be detrimental to city growth and development. It is essential for managers of transportation systems to receive and implement feedback from frequent users, as they may better understand where the system falls short of expected performance. In this project we applied social science research techniques to determine citizen satisfaction levels regarding Hangzhou's transportation network to make recommendations for improvements.

In order to complete our goal, we created three overarching objectives: 1) characterize Hangzhou's public transportation network, 2) determine the public's satisfaction level with the city's network, and 3) identify where improvements can be made. Before sampling, we determined a model of satisfaction based on a number of indicators gathered from both our literature review and experiential observation. These indicators formed the basis of our argument and allowed us to analyze both qualitative and quantitative data using the same criteria. We determined the public's satisfaction level primarily by conducting four focus groups, which was supplemented by a survey using convenience sampling. Finally, following data analysis we identified relationships among the various aspects of transportation satisfaction to determine one central argument to improve the entire network as supported by public opinion.

While Hangzhou's transportation systems may function adequately on their own, we have concluded that the biggest deficiency is a lack of overall network compatibility, or the cohesiveness and interconnectivity among these systems. Based on this, we have established a number of findings addressing areas of incompatibility and have made corresponding recommendations. The first of these findings is competition and redundancy between the metro and bus systems. Respondents were more satisfied with the metro's speed and reliability, but were less satisfied with crowdedness when compared to that of buses. Due to potential overcrowding, which both systems experience near in peak hours, we do not recommend a complete reliance on the metro for mass transit in Hangzhou. The most effective solution would be to design future bus lines with the planned expansions of the metro in mind. Integrating these systems will dramatically increase overall transportation satisfaction.

Through our study we discerned dissatisfaction resulting from an overabundance of shared bicycles blocking public sidewalks and bike lanes, particularly where they impede upon other methods of transport. While prioritizing quantity over quality allows the shared bike system to function smoothly, it only exacerbates the problematic number of bikes. In order to integrate bikes with the rest of the systems in a comprehensive way, parking for bikes should be regulated and unused bikes must be removed by the companies that own them. Bike zones should be strategically placed near stations of other modes of transport so that they may serve as the final leg of a trip. Public bikes, also referred to as government bikes, avoid the problems that shared bikes create, but restrictions created by their stations reduce convenience and public use. A new hybrid bike system that combines the desired qualities of government bikes and shared bikes would help solve the dissatisfaction with walkways being blocked. In this system, geofencing technology will prevent users from locking bikes outside of specified areas. This hybrid bike system would properly fulfill public demand for convenient, cheap travel for shorter distances. With or without the proposed hybrid system, greater regulation and more careful distribution of bikes is necessary to increase compatibility. Further research on locating

areas with more shared bicycle use would enable more efficient placement, particularly near crucial areas like metro and bus stations as the systems expand.

Our final primary finding states that parking and traffic problems are closely tied to a general disregard to traffic law, especially among pedestrians and smaller vehicle users. With the rapidly expanding metro, all nine districts will become more accessible, increasing both demand for public transportation and a need for a stricter enforcement of traffic laws. In order to decrease congestion, we recommend Hangzhou's city planners make its residents more aware of current traffic laws and enforce them more consistently. In areas of higher traffic, efficiency can be increased greatly by introducing pedestrian bridges or underpasses, as crosswalks filled with pedestrians dramatically slows travel time. Additional research may be beneficial in determining strategies to alleviate congestion as urban areas of Hangzhou become more accessible with the growing metro system.

In conclusion, using our indicator system that we developed from a combination of literature and experimental research, we determined that Hangzhou residents found cost, convenience, and travel time to be the most important factors of transportation satisfaction. In order to increase satisfaction, and in turn accommodate Hangzhou's rapid growth, the transportation network must be compatible. Incorporating the needs of the public into future design and management will make the network more efficient and increase citizen transportation satisfaction.

Chapter 1: Introduction

Incorporating public opinion into city growth is integral to identifying meaningful improvements in a city's infrastructure, environment, and livability. Consequently, failing to adequately address citizen satisfaction can hinder long-term city development (U.S. Department of Transportation, 2004). In particular, public transportation systems directly impact the public's well-being and perception of the city. The transportation network supports frequent use by all, as most people must travel daily. As such, it is important for city planners to create and maintain these systems in order to best serve their citizens and implement meaningful improvements. This can increase safety and security, provide an environment for businesses to thrive, and attract more tourists and residents.

Similar to many other Chinese cities, Hangzhou primarily pursues development in a top-down manner; whereby planning experts generate, develop, and implement their own ideas with minimal feedback from the local populace. Hangzhou is rapidly growing, as evidenced by its expanding metro system which plans to join all nine districts by 2022. The city's public transportation is at a pivotal stage of its development, with the recent introduction of new modes of public transportation and significant ongoing changes to infrastructure. Areas in need of improvement as observed by the public will not reach the city planners, and issues will often remain unresolved until public insight is gathered.

Prior studies focused on determining satisfaction have relied upon models of indicators in order to identify the wants and expectations of the public. Zenker, Peterson, and Aholt (2009) used a survey and focus groups in Germany to make a list of 21 overarching city satisfaction indicators. These indicators provide an excellent basis for city satisfaction research since understanding residential satisfaction is applicable to anywhere in the world. Other research demonstrates the importance of transportation satisfaction to Chinese cities in particular. A

study in Beijing tried to determine how satisfied the public is with various transportation methods by distributing questionnaires to residents of the city (Ji & Gao, 2009). It also identified two indicators, accessibility and stop distribution, which determined transportation satisfaction in that city. The nascent indicator model of these and other studies is a very useful basis for future studies.

Hangzhou has many means of public transportation including a metro system, bus lines, a bike share system, and taxis (Banister and Liu, 2013). However, current research on city satisfaction is insufficient and often unavailable to the public. The only relevant research that has addressed resident satisfaction was a survey conducted by the Hangzhou Metro Groups which also sought to determine public satisfaction. Other methods of transport, like the bus and bikes among others, have not incorporated or have sought to obtain public feedback, and solely relied upon a top-down approach. Comparable characteristics like quality, cost, location and accessibility that impact user satisfaction with all forms of transportation in Hangzhou have not yet been studied in any capacity. Without residential feedback, decisions made by city planners cannot be fully substantiated, even if they are grounded in their expertise. Hangzhou transportation planners' failure to incorporate the opinions of the very residents of the city they design results in a system that cannot fully accommodate the needs of the public.

The purpose of this project was thus to generate improvements within Hangzhou's transportation system to increase overall transportation satisfaction. In order to achieve this goal, we characterized Hangzhou's transportation, determined basic levels of transportation satisfaction in Hangzhou, and proposed concrete recommendations to enhance transportation satisfaction in Hangzhou. We completed these objectives by conducting a physical inspection, distributing questionnaires, organizing focus groups with residents of Hangzhou, and interviewing operators and managers of Hangzhou transportation systems. This multifaceted approach gave us insight into general satisfaction of the people, underlying problems in Hangzhou transportation, and potential solutions for city planners. Our findings of each

transportation type identified discrete factors that contribute to citizens' satisfaction, and contribute towards an overarching theme that sought to improve each of these indicators. We then made recommendations to HDU's Department of Sociology on processes to improve the public's satisfaction with the city's transportation system. Through these suggestions, we hope the city of Hangzhou will be able to improve transportation satisfaction by allocating resources to the areas where the public is most dissatisfied.

Chapter 2: Background

We begin this chapter with a brief overview of satisfaction and define models of satisfaction as a basis for research. Next we discuss several indicators of transportation satisfaction that have been the focus of other similar studies. We evaluate the current debates on incorporating public perception in previous studies and how it can be applied to generate solutions in urban planning. Finally we will describe the context and current conditions in Hangzhou focusing on transportation infrastructure and services.

2.1 Defining Models of Satisfaction

Many studies on satisfaction begin by defining a model of satisfaction to set the context for the topic of study. The following three studies provide examples of such models being defined. Deconstructing satisfaction into observable indicators is necessary for both qualitative and qualitative analysis. The process of choosing relevant indicators is dependent on understanding of the topic and location of study. In doing so, it is necessary to consider whether the indicators fully represent the scope of satisfaction.

One pertinent study conducted by Yiping Fang (2005) in Beijing sought to establish a relationship among resident satisfaction, moving intention, and moving behaviors. Their study provides excellent examples of how to establish a specific definition and model of satisfaction. Fang claims that understanding people's satisfaction can distinguish areas necessitating improvement. Using findings from Rosenberg and Hovland (1960), Fang defines satisfaction as a series of complicated relationships between interactions and reactions. With this model in mind, Fang relates high levels of satisfaction to successful systems. Despite this, satisfaction is a mere facet to understanding the effectiveness of a city's system. Residents' perceptions of, or satisfaction with systems are not necessarily reflective of actual quality; therefore, it is important to consider how to deconstruct it into observable and measurable components.

One such method of segmenting satisfaction is through declaring and classifying specific indicators. Potapov, Shafranskaya and Bozhya-Volya (2016) researched city satisfaction in Perm, Russia. They first determined a model of city satisfaction by breaking it down into a number of factors. The study analyzed the city's facilities in terms of component indicators so as to group them into social, demographic, and locational network indicators. Component indicators describe specific parts of the whole, and relationships between these factors contribute towards forming network indicators. The latter may provide insight into relationships among component indicators. However, in studies regarding satisfaction, it is more common to first identify the measurable components before generating connections within the system. This bottom-up approach provides a consistent, structured focus, which is common practice in satisfaction studies.

The creation of indicators is not a straightforward process and must incorporate many factors that vary among subjects and location. There is an abundance of city satisfaction and city ranking data on many topics, but the data is rarely comparable. In order to address this concern, Zenker, Peterson, and Aholt (2009) conducted a study in Germany to provide a standardized basis for analyzing satisfaction that can be universally applied despite these differences. They drew from eighteen pre-existing studies from various fields to assemble a large set of indicators, which they tested for importance to measuring satisfaction using focus groups and surveys in nine different cities.

Indicators are ideal for determining areas of focus for a study, but proper methods are integral to gathering useful data. The open-ended nature of focus groups can provide rich, meaningful data, but it will often not be comparable among cities. By contrast, a survey can focus too heavily on indicators alone and only provide statistical data. Zenker, Peterson, and Aholt (2009) determined that utilizing focus groups in conjunction with surveys was an ideal method of gathering more comprehensive data. Their team ordered each indicator by significance, and assembled them into four overarching categories: cost-efficiency of living,

nature and recreation, urbanity and diversity, and job opportunities. The results successfully highlighted underlying causes of satisfaction that can be applied regardless of location. Table 1, found in Zenker, Peterson, and Aholt (2009) on page six of the report, displays the 21 universally relevant factors (importance factor above 0.5), which may be relevant in developing an indicator system regardless of the field of study.

Table 1: 'Importance Factor' of Satisfaction Topics

Table 1: *Explorative Factor Analyses - Principal Component Analysis with Varimax-Rotation (Study 1)*

	Item	Urbanity & Diversity	Nature & Recreation	Job Chances	Cost-Efficiency
1	A wide range of cultural activities (theatre, nightlife, etc.)	.85			
2	A variety of shopping opportunities	.74			
3	Many different cultures and subcultures	.73			
4	The energy and atmosphere of the city	.70			
5	Availability of different services	.59			
6	The urban image of the city	.53			
7	Openness and tolerance of the city	.53			
8	A lot of nature and public green area		.83		
9	Environmental quality (low pollution)		.74		
10	A number of parks and open spaces		.74		
11	A wide range of outdoor-activities		.64		
12	Tranquility of the place		.63		
13	Cleanness of the city		.55		
14	Access to water		.50		
15	The general level of wages			.78	
16	Good job and promotion opportunities			.75	
17	General economic growth of the particular region			.64	
18	Professional networks in the city			.54	
19	Housing market / Cost of hiring				.90
20	The general price level in the city / Costs of living				.83
21	Availability of apartments and houses				.82

Note. $N = 611$; Only factor loads of .5 or more are shown

2.2 Indicators of Transportation Satisfaction

Transportation systems should be designed to improve residential quality of life, but may only adequately serve a portion of the city's population when planned without accounting for public opinion. Transportation satisfaction can be divided into separate factors, or indicators, to further define and compare findings. The following studies discuss their chosen indicators for researching satisfaction and explain the context in which they were used. Their findings provide valuable insight as to how future studies may want to proceed when defining their own indicators of satisfaction.

A study conducted by Bo Edvardsson in Göteborg, Sweden sought to determine the underlying causes behind dissatisfaction in public transportation (1998). He interviewed passengers and staff of public transportation using the critical-incident method, which focuses on problematic incidents that passengers had reported. Their team interviewed users who filed complaints as well as bus drivers for further investigation. They found that the primary source of passenger dissatisfaction was interaction with personnel, particularly the drivers. Conversely, the drivers believed that the most critical incidents were related to punctuality. The contrast of opinions between passengers and drivers highlights the importance of gathering multiple perspectives and should be studied closely to ensure satisfaction with the transportation system as a whole.

Jue Ji and Xiaolu Gao (2009) determined satisfaction regarding transportation in Beijing using a survey in order to identify meaningful improvements. Their questionnaire used a five-point Likert scale system that included rated categories from very unsatisfactory to very satisfactory. Specifically, they incorporated questions regarding distances between stops. They found that people in the inner city were more dissatisfied with transportation than those living in the outer city due to the road construction and distribution of bus stations. Based on these findings, Ji and Gao argued that the best way to improve Beijing's urban systems is to make public transportation more accessible. Transportation systems should consider population density and public demand to optimize accessibility and minimize redundancy.

Kostakis and Pandelis (2009) surveyed citizens in Larissa, Greece, on their degree of satisfaction with urban transportation, to reveal the underlying variables responsible for influencing customer satisfaction. They implemented a Multicriteria Satisfaction Analysis method; an ordinal regression involving eight different factors. They identified critical points that significantly affected customers' satisfaction including the overarching topics of time and availability, which were further defined as waiting time and route frequency. This subdivision allowed the researchers to identify specific areas of weakness within larger, broader topics.

They found that passenger satisfaction with different bus lines within Larissa varied significantly, and they were able to identify discrepancies in both wait time and availability at these locations. Kostakis and Pandelis' study further enforces the idea that broader topics should be subdivided into more discernable characteristics. Time and frequency of service are relevant aspects of transportation satisfaction and should be considered in future design.

Rather than base his recommendations purely on low satisfaction, Tor Wallin Andreassen (1995) also created an importance value from the input of survey respondents regarding public transportation in Oslo, Norway. He study supplemented a survey with interviews to gather more personalized feedback. Indicators needing the most attention were those that had low satisfaction scores and were both highly prioritized by frequent users. He determined three indicators from the survey responses that were 'critical with regard to change': travel time, cost, and station quality, each of which met the aforementioned criteria. Furthermore, he concluded from interviews that inadequacies of public transport compelled users to resort to private methods of transportation. Andreassen recommended privatization and deregulation of public transit; however, this conclusion only applies to the transportation system in Oslo. Andreassen conducted his study in response to a specific socio-political context; therefore, his conclusions may not apply to other cities.

The indicators mentioned previously in this section can be specific to one type of transportation, such as trains, buses, or boats. However, it is also important to consider how relationships between these network indicators can affect a city's transportation system in its entirety. One example of a city that struggled to consider the system as a whole is Cape Town, South Africa. Ferro, Behrens and Wilkinson (2013) sought to determine the underlying reasons and potential solutions for Cape Town's disjointed public transportation systems. Their team referenced case studies of similar cities in South America and Africa and evaluated those cities' success with transportation reform. They found that complications were rooted within Cape Town's transportation management systems. This included an imbalance of three different

transportation types: unregulated, regulated on a local scale, and regulated on a national scale. The Provincial Government managed 'formal' private bus services while the national government regulated the parastatal rail company's services through its Department of Transport (Ferro, Behrens, and Wilkinson, 2013). Consequently, passengers were forced to buy tickets for each type of transit separately. Wilkinson clearly states in a previous article that "a key problem with the situation in Cape Town...is the lack of integration between modes (Wilkinson, 2008)" (Ferro, Behrens, and Wilkinson, 2013). A lack of cooperation, or compatibility, among the multiple systems has prevented Cape Town from achieving an effective inner city transportation network. Ferro, Behrens, and Wilkinson's findings demonstrate that no single type of transportation can adequately satisfy the needs of everyone in a city. As such, compatibility should be considered when analyzing the effectiveness of any transportation system.

Transportation has a direct influence on social interactions and patterns of social health and well-being, and as such it is an integral part of everyone's lives (Geneva, 2009). Although it is usually road based, transportation can be designed for optimal accessibility and affordability for people of all demographics (Gwilliam, 2002). In order to account for as many people as possible, it is necessary to consider a broad range of indicators such as cost, treatment of staff, reliability, and location of service. The most relevant indicators as shown in previous research should be considered when designing new satisfaction studies. Indicator relevance is dependent on location of study, therefore it is necessary to consider the associated size, culture, and infrastructure.

2.3 Transportation Satisfaction in Hangzhou, China

China is currently a world power in technology, military strength, and exported goods. Despite its strong presence in the global economy, continued economic growth and exposure on an international scale will drive China's need for intense improvements of transportation and

infrastructure (Zhong, Jian, Qing, 2012). China's State Council sought to improve transportation to over twenty cities in the northwestern portion of the country by 2010 (Goh, 2010). These improvements included expressways, airports, seaports, and express transshipment centers. A similar five-year initiative to improve infrastructure was recently issued by the State Council of the PRC (2017). This plan includes improving transportation networks, enhancing smart transportation, increasing green transportation such as bikes, and developing new modes of transportation for businesses. The State Council acknowledges the need for improved pathways to encourage urbanization and balanced development among regions. The Council believes that improved green networks will reduce poverty in the long term, which will in turn improve the quality of life of citizens for years to come.

Despite this initiative, effective development is not assured. China has long been reliant on top-down development as a result of its strong central government and booming economy (Li, 2006). Rapid urbanization and population growth in such a large country has required the government to leverage this macro planning tool to help allocate population and industrial distribution across urban and rural lands. While Confucian roots lie at the center of Chinese planning, it is apparent that planning has been heavily shaped by Soviet influence (Curien, 2014). Its fundamental purpose as a tool to advance economic growth in the most efficient way possible leaves little room for incorporating public perspectives. This intense focus on pure economic development means China's urban planning fails in some areas by neglecting the opinions of the very people it is supposed to serve. This deeply rooted top-down approach in urban planning can be seen in many of China's mega-cities, like Hangzhou.

Hangzhou, the capital city of Zhejiang Province, is at the heart of its economic, cultural and political life (Banister and Liu, 2013). In 2017, Jones Lang LaSalle (JLL), a leading professional services firm specializing in real estate and investment management, ranked Hangzhou 26th of 134 cities globally, alongside other Tier One Chinese cities like Shanghai and Beijing. While Hangzhou's flourishing economy garners both international and domestic

attention, its public transportation is still in its infancy, leaving the city at a pivotal stage in its development. With a population of over nine million, the public transportation system receives heavy traffic daily. The main forms of transport include the metro, private vehicles, bicycles, buses, taxis, bus rapid transit (BRT), and waterway transit (Banister and Liu, 2013).

2.4 Summary

Satisfaction is an extremely broad topic and must be refined into a more approachable and measurable field of study. Urban areas in countries like China have an increased demand for transportation as rapid expansion and modernization take effect. Top-down planning, a practice common in China, may fail to meet public expectations due to a combination of their focus on maximizing system efficiencies and ignoring the public's opinions. While there is a broad range of transportation available to the residents of Hangzhou, little information is available regarding passenger perceptions. Understanding transportation satisfaction is especially pertinent to long-term city development, as the incorporation of bottom-up urban planning techniques may better bridge the gap presented by neglecting public opinion when using solely a top-down approach. This gap in knowledge was the focus of our project, where we determined current levels of transportation satisfaction and identified areas for improvement.

Chapter 3: Methodology

The goal of this project was to determine transportation satisfaction among residents of Hangzhou, China, in order to identify recommendations for future city development.

Our objectives were the following:

1. Identify the various transportation methods in Hangzhou and their characteristics, both physical and experiential, in terms of predefined indicators.
2. Determine baseline levels of satisfaction in Hangzhou for the city's transportation system in regard to specific public (metro, bus, ferry, taxi, shared bike, and public bike) and private sectors (car, moped and bike).
3. Identify concrete areas of strength and weakness in Hangzhou's transportation system using analysis performed on the data gathered in the second objective and generate recommendations based on our findings.

The following methods were chosen to help achieve each of our objectives. We explain their reasoning and limitations in this chapter.

3.1 Identifying Sectors of the Hangzhou Transportation System

Our first task in Hangzhou was to perform direct observation of the city's transportation systems by experiencing them ourselves. This preliminary work allowed us to identify the different types of transportation and how they functioned, as well as any unexpected important attributes of the transportation system. We performed this inspection by visiting and experiencing different types of transportation throughout Hangzhou. We worked in conjunction with four HDU students and one HDU professor who assisted us with each phase of our methods. We completed initial exploratory research primarily within the first week, with the assistance of our HDU colleagues.

3.1.1 Conducting a physical inspection

Our first objective was to identify the various public transportation types in Hangzhou and determine their characteristics using predefined indicators. We accomplished this by performing a structured physical inspection, which was based around determining indicators of interest (see Appendix B). The intention for this inspection was not only to gain a basic level of understanding, but also to identify present relevant indicators drawing from and expanding upon those in our literature review. While these previous studies provided context with which to structure a model of transportation satisfaction, not much was known about each transportation type. Our personal experiences with the transportation system gave us a direct reference with which to identify positive and negative attributes of each type of transportation. These discovered attributes influenced and further enhanced the design and relevance of the questionnaire, focus group protocol, and interview protocol.

Although this was an ongoing process occurring throughout the eight weeks spent in Hangzhou, we completed the most comprehensive physical inspection of the city's transportation system within the first week. Consequently, we were unable to inspect every part of the city as that was not realistic given the magnitude of Hangzhou, and our team's resources. Furthermore, as part of WPI's safety regulations, we were not allowed to use personal motorized vehicles, which includes mopeds and cars. Our HDU colleagues were especially helpful when dealing with the language barrier. Experiencing Hangzhou's transportation as foreign visitors provided a very different perspective from that of the average Chinese-speaking resident. Though we could take the water ferry, bus, and metro unaided, we required the assistance of the HDU colleagues to call a Didi and normal taxi as we did not have the accepted online method of payment.

We used the results of the physical inspection as a reference to provide context within Chapter 4, not as a basis for analysis. While most of the data gathered was highly subjective, it provides an excellent reference on several forms of transportation.

3.2 Determine Levels of Satisfaction in Hangzhou with Transportation

Our second objective was to gain a clearer understanding of the general opinions of residents in Hangzhou on each of the forms of transportation. After a thorough physical inspection, we began an iterative process of surveying and conducting focus groups with users of Hangzhou's transportation system. Zenker, Peterson, and Aholt's recommendations encourage this layered approach involved in gathering both objective and subjective data while refining our questionnaire to focus on the most relevant user concerns. The HDU students who assisted us provided enormous help with translations in all of our methods, as the language barrier prevented meaningful interaction. We conducted four focus groups and two iterations of the questionnaire after pilot testing with a preliminary version of the questionnaire. We adjusted new iterations of the questionnaire according to the feedback gathered from each layer of testing. We then conducted and completed the focus groups within two and a half weeks. We started surveying shortly after the first focus group and completed it mostly within four weeks, with questionnaires coming from outside sources in the fifth and sixth week. We finished our methods with a series of semi-structured interviews to confirm findings and general trends found from the questionnaire and focus groups.

3.2.1 Conducting the focus groups

We conducted focus groups with a range of participants comprised of HDU faculty, staff, and students as well as white collar workers in Hangzhou. These focus groups provided detailed insight behind general opinions of local residents. From this data, we were able to pinpoint the most important aspects of transportation as rated by participants. Data gathered

from these group discussions formed the basis of our analysis, used as direct and paraphrased quotes to support findings and recommendations. We adjusted the questionnaire according to the findings gathered from the first two focus groups.

The focus groups themselves were based on a guided question list designed to identify the participants' preferred methods of transportation, among other factors. We edited this protocol to focus on relevant indicators of interest based on findings gathered from our physical inspection. Follow up questions targeted the rationales behind their opinions, as well as their suggestions for future improvements. We conducted four focus groups with different demographics to obtain as wide a range of opinions as possible. We conducted the first two focus groups in a one week period, with qualitative data analysis and questionnaire adjustments layered in between. We based the discussion points for the first focus group, which included eight members of HDU faculty and staff, on a predefined structure, found in Appendix D1. One of the professors translated the conversation for us, leaving us to paraphrase a majority of the conversation. Because the second set of focus groups involved a total of 21 HDU Sociology students, we separated the students into two more manageable groups. Our HDU colleagues assisted translation of all dialogue. Prior to discussion, we distributed the second version of our questionnaire to both gauge its effectiveness and establish the topic. This is reflected in the protocol in Appendix D2. Our fourth and final focus group took place at a software company, with a total of five participants, and was also translated by our HDU colleagues. We took careful and thorough notes in each session. With the approval of participants, we also audio-recorded these sessions for further transcription and analysis post-discussion. As the conversations were primarily in Chinese, none of the audio recordings proved to be very useful.

Focus groups are an effective method of gathering general opinions and rich qualitative data. We analyzed the transcripts using qualitative analysis software, specifically NVivo, to organize comments by common themes, or indicator type. From sorting the data by expected and observed themes, we were able to generate supported findings and recommendations.

While we gathered plenty of detailed opinions, we still were only able to sample from a limited number of people. Our sponsor helped us organize last minute focus-groups through localized convenience, as they took place in Hangzhou's Xia Sha district. Consequently, other outside opinions were underrepresented in our gathered data. Despite this limitation, our data can be representative of at least a portion of the population, especially in the immediate Xia Sha district.

3.2.2 Surveying

In addition to conducting focus groups, we surveyed residents of Hangzhou in order to gather representative data from a portion of the population regarding transportation satisfaction. We chose questionnaires for their simplicity and ease of distribution. The target demographic for assessing transportation satisfaction included anyone who utilized transportation systems in Hangzhou. With Hangzhou's population of over nine million, our target sample of 400 was not representative of the total population and was based on practicality, given our limited timeframe of eight weeks. Ideally, we would have used simple random sampling (SRS), but this was impractical because SRS would require using a full list of every resident in the city, which would be unavailable to the public in China. In order to overcome this obstacle, we implemented convenience sampling at locations expected to have different demographics in an attempt to gather diverse responses. These locations included English Corner club at HDU, public areas in Jinshahu, a large mall in Hangzhou, and outside a Wumart grocery store. We did not survey near transportation stations themselves because we predicted that these people would be in a hurry and would thus be less receptive to answering survey questions.

We chose to use paper questionnaires printed at HDU because our Chinese colleagues informed us that Chinese residents did not respond well to online surveys. We gave participants the survey along with a clipboard and pen, which they returned after completing the questionnaire. In addition to convenience sampling, we also received assistance distributing

questionnaires from two English teaching centers, namely Annie Kids and Kid Castle. They distributed 100 and 60 questionnaires for us respectively, amongst their employees and customers. In return, we provided English lessons for their students.

We performed pilot testing of the questionnaire with HDU students and faculty arranged by our sponsor. This initial version can be found in Appendix E1: Initial Questionnaire, although it was never used for actual data collection. We noted a number of participants commented that the purpose of travel directly influenced the chosen transportation methods, so we added a series of questions asking what method the respondent prefers for certain distances and trips. Seventeen respondents answered the first questionnaire iteration, which can be found in Appendix E2: First Iteration. The format of this questionnaire confused a number of respondents, so with the help of our HDU colleagues we reformatted several of the questions. This version can be found in Appendix F3: Second Iteration. We then conducted the second and third focus groups, which began with distributing the second iteration of the questionnaire. Those focus groups confirmed that the updated layout was understandable and that the questions were all relevant. We used the second iteration of questionnaire for further surveying, resulting in almost 300 respondents.

Surveying the public was the longest phase of data collection; therefore, we allocated five weeks for this part of our research. With only a few weeks to complete this portion of the methods, we sampled from a limited number of districts. While statistical data is relatively simple to gather and analyze, by itself it is insufficient from which to draw meaningful conclusions. We gathered data from a concentrated region, so we cannot generalize our findings for all of Hangzhou, especially in areas without access to the metro. We therefore used the data gathered from these questionnaires to support and verify findings from focus groups. In the analysis phase of these questionnaires, we utilized a quantitative analysis software called SPSS, a statistical software that managed our data.

3.2.3 Semi-Structured Interviews

Along with our own views on transportation, as well as those of everyday users, we wanted to obtain the perspectives of those who operated and managed Hangzhou's transportation systems. Workers provide a different perspective from users of the system, an insight Edvardsson determined in his own study on dissatisfaction in public transportation. We interviewed two taxi drivers, a Didi driver, four bus drivers, a bus operator, and two OFO workers. These individuals, with their extensive experience, provided valuable insight on how Hangzhou's transportation system functions outside of public scrutiny. Each of these interviews targeted recent transportation improvements, and gave feedback on how they believed the public prioritized specific indicators when choosing a mode of transit. These interviews took place in the office or workplace of the interviewees to make the participant feel comfortable. Protocols for each of these interviews are available in Appendix F: Interview Protocol. While interviewees provided valuable information, we cannot take their opinions and ideas as fact. With the limited time constraints of our project, we were unable to schedule an interview with a metro worker or transportation designer. We used NVivo to analyze the translated transcripts of each of the interviewees to determine common themes in addition to data gathered from the focus groups.

3.3 Summary

The methods as described above assisted us in completing our goal: to determine levels of satisfaction of people in Hangzhou, China, to identify areas of strength and weakness of Hangzhou's public transportation system. We gauged the quality of Hangzhou's public transportation system by way of a thorough physical inspection. We determined the qualitative perception of satisfaction in Hangzhou through the use of focus groups, which provided us with preliminary data that refined and modified our questionnaire. Surveying residents in Hangzhou provided useful information on quantitative satisfaction levels for each form of transportation in

Hangzhou. Finally, interviews offered more specific views on particular transportation systems beyond focus groups. All together these methods allowed us to ascertain the state of the various transportation systems in Hangzhou.

Chapter 4: Results and Analysis

The purpose of this project was to determine a baseline of transportation satisfaction among Hangzhou's residents in order to create informed recommendations for improvement of the city's transportation system. The following objectives were completed to accomplish this goal: 1) characterize Hangzhou's transportation infrastructure, 2) determine basic levels of transportation satisfaction in Hangzhou, and 3) create concrete solutions to promote transportation satisfaction in Hangzhou. Detailed in this section are the results we gathered, arranged by the most significant indicators of satisfaction as determined through our research. We observed general incompatibility and a lack of accommodation among Hangzhou's various transportation systems, primarily as a result of the newly implemented metro. Specifically, our findings include incompatibilities with the city's conflicting metro-bus system, redundant government and shared bike programs, and messy, unregulated road traffic. Increasing the compatibility of Hangzhou's network of transportation systems would target and improve areas of weakness within the city's transportation satisfaction.

4.1 Incompatibility in Hangzhou's Transportation Systems

From our data, we determined that while many of the transportation systems are individually sufficient, transportation satisfaction is limited by incompatibility among different types of transportation. We primarily studied the interactions among the metro, bus, public and shared bikes, and taxis. After analyzing our data we found that predominant public opinion indicated a lack of compatibility as the limiting factor of satisfaction. Statistical data gathered from our survey supports the perception of an incompatible network of intra-city transportation systems, as shown in Appendix I. The newly constructed metro system has overwhelmed the older bus system, rendering it underutilized. Bicycles, mopeds, and other private vehicles can disrupt public walkways and bike lanes, furthering congestion and travel time. A lack of traffic

regulation and enforcement, in combination with limited public parking, can complicate normal traffic flow and decrease safety. In this section we present data to support these findings.

4.1.1 Metro System and Bus Line Competition

While both Hangzhou's metro and bus system were designed for mass intra-city travel, we found that the newly constructed metro overshadows the buses most notably in speed, reliability, and frequency. There are currently only three metro lines, as shown in Figure 1, a map of Hangzhou's current metro system. By 2022, there will be a total of ten lines, which are displayed in Figure 2. Even with a limited number of lines the metro is already a predominantly used system. As it expands further, other transportation systems must work to accommodate and reform to fit alongside the newly implemented metro . Twice as many people in our sample size favored the metro regardless of travel intention. As shown in Figure 3, 37.0% of questionnaire respondents said they used the metro "often" or "always," while only 16.1% said the same for buses. Passengers prefer the metro despite both forms of transportation fulfilling the same niche. Both the metro and bus systems were designed to fulfill the city's need for mass ground transit, yet our data supports the finding that they are unnecessarily competing for passengers. The city's newly implemented metro dominates, leaving the bus lacking in almost every aspect except overcrowding.

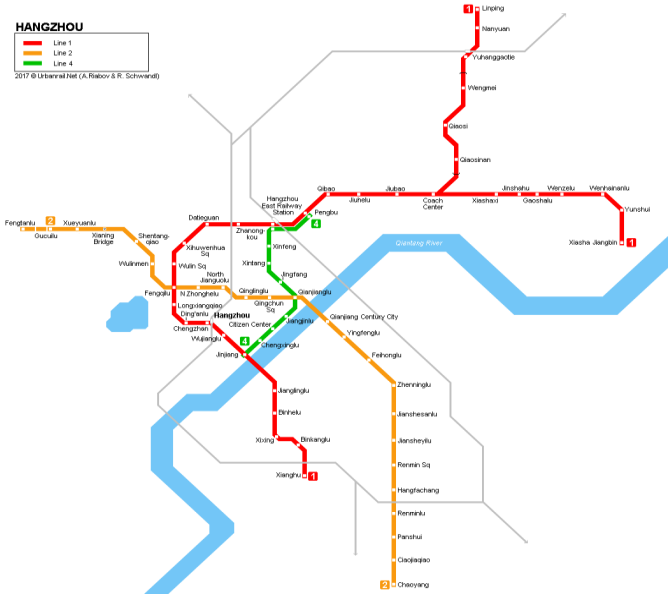

Figure 1: Hangzhou Current Metro Map

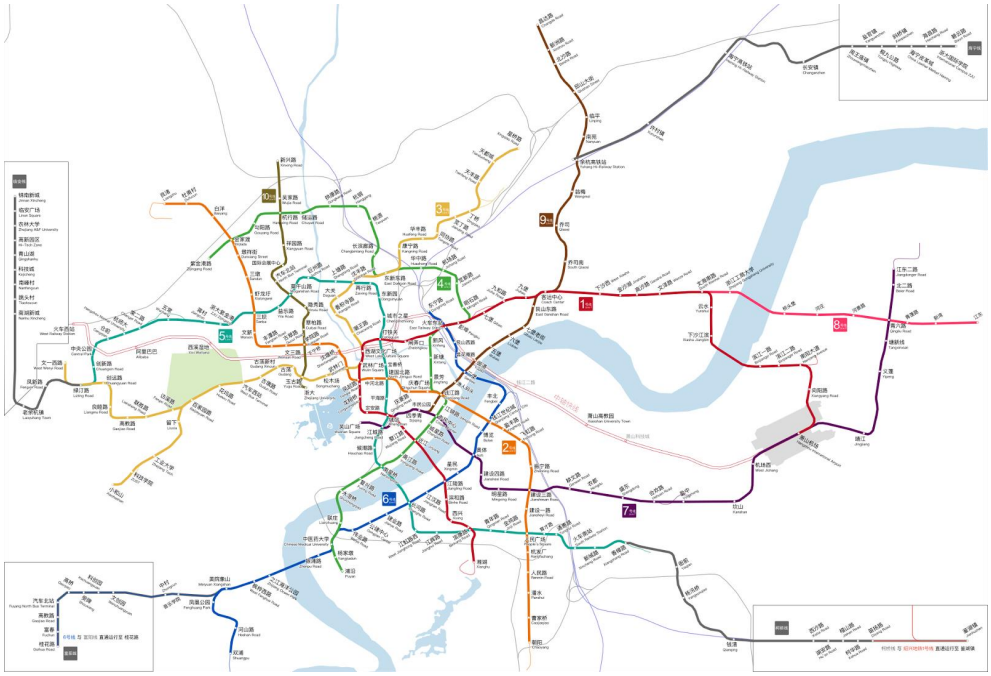

Figure 2: Hangzhou Planned Metro Map

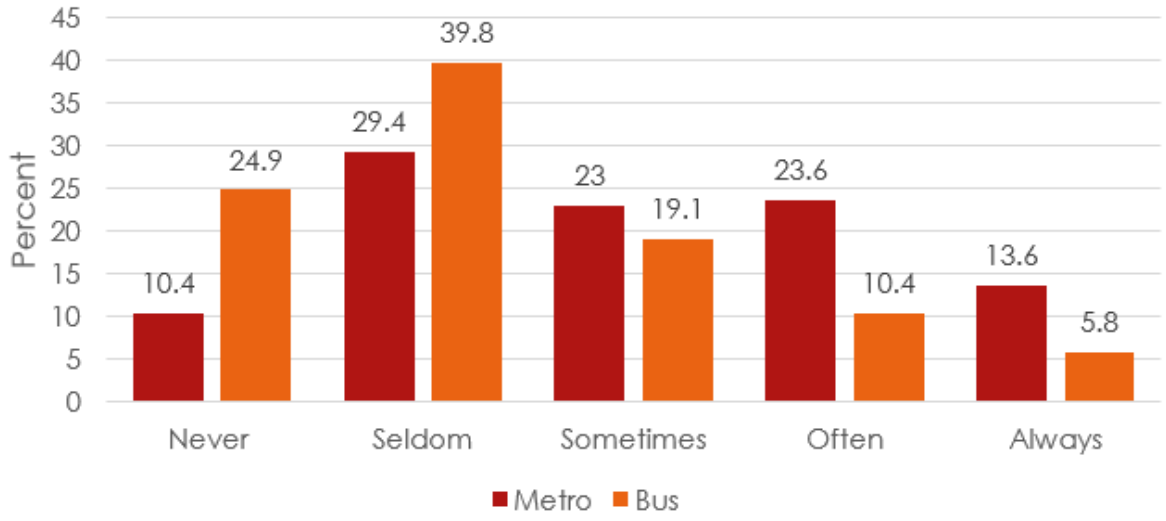

Figure 3: Metro vs Bus Weekly Use

Based on our own experiences, we observed that bus drivers minimized stop time and drove purposefully. In spite of this, bus drivers informed us that “not all buses follow a strict schedule, so people choose other methods of transportation whenever they have limited time.” While the metro’s direct underground routes are left unaffected by oncoming traffic, shorter stop distances and interference from other methods of transport can decrease bus travel time and traffic safety. Speed satisfaction results exemplify an overwhelming preference for the metro, with 81.9% of respondents answering they are “very satisfied” or “somewhat satisfied” with metro speed as shown in Figure 4, as compared to the low speed satisfaction of buses, with only 39.6% of respondents indicating positive satisfaction seen in Figure 5. Survey respondents highly preferred the metro and believed it to be much faster any other form of transport.

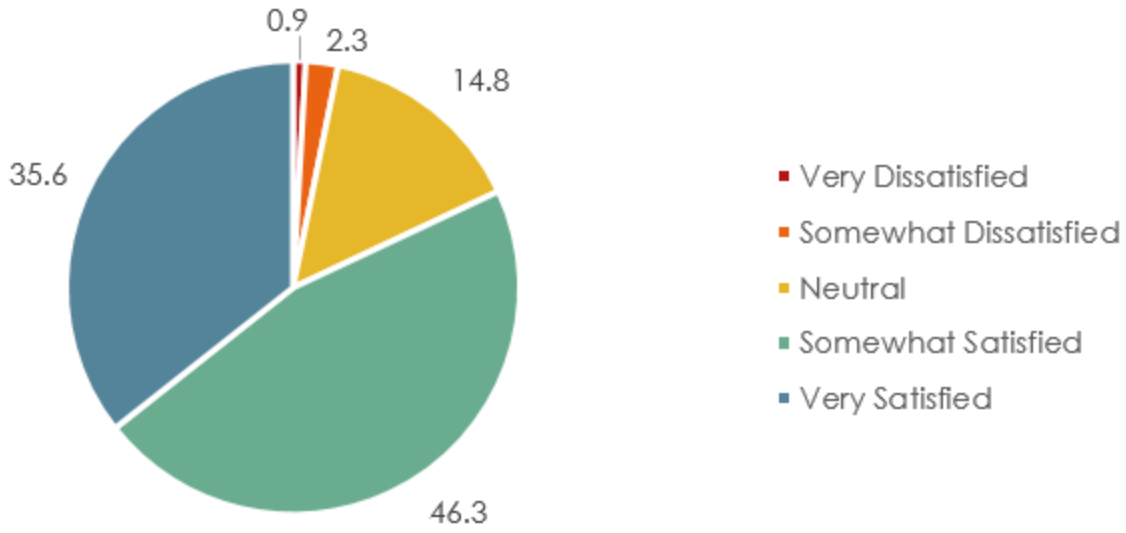

Figure 4: Metro Speed Satisfaction

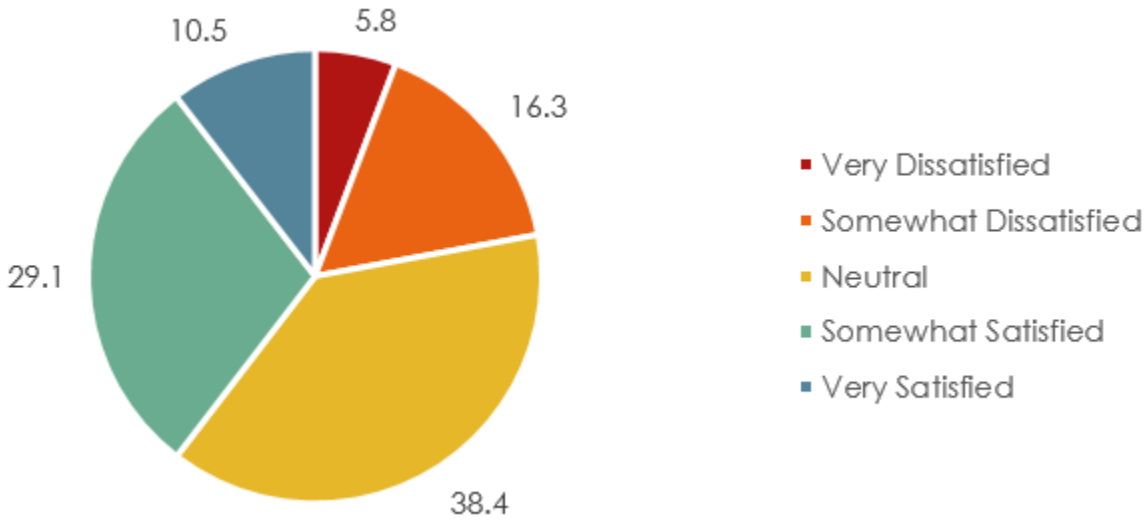

Figure 5: Bus Speed Satisfaction

Although the metro provides users a fast and reliable means of travel, overcrowding can often deter passengers from regular usage. Both survey results and focus group data show that while the public was generally satisfied with the metro, they were least satisfied with the metro's overcrowding. Only 16.8% of respondents indicated positive satisfaction ("very satisfied" or "somewhat satisfied") as shown in Figure 6. The student focus group stated that they "disliked the metro because it [was] crowded." With a steadily growing metro system to be completed

within the next decade, tripling its current size, expected overcrowding will likely increase. The metro alone will not be enough to support Hangzhou's transportation needs, even following construction of all ten lines. Fortunately, this is where buses may alleviate the overcrowding issue. Based on our survey, as reported in Figure 7, the metro receives far more use for longer distances than buses. Over 32% of respondents stated they consistently used the metro on these longer trips, with bus usage steadily declining from 11.9% to 6.9%.

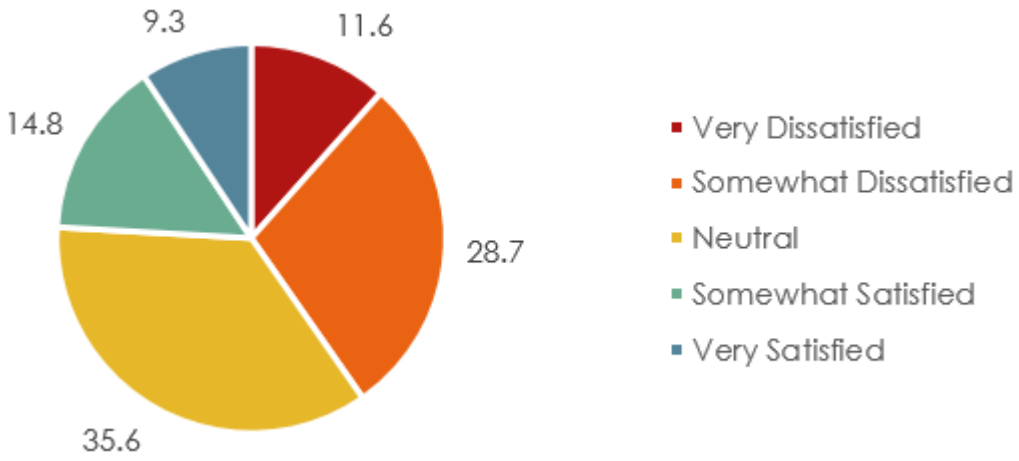

Figure 6: Metro Crowdedness Satisfaction

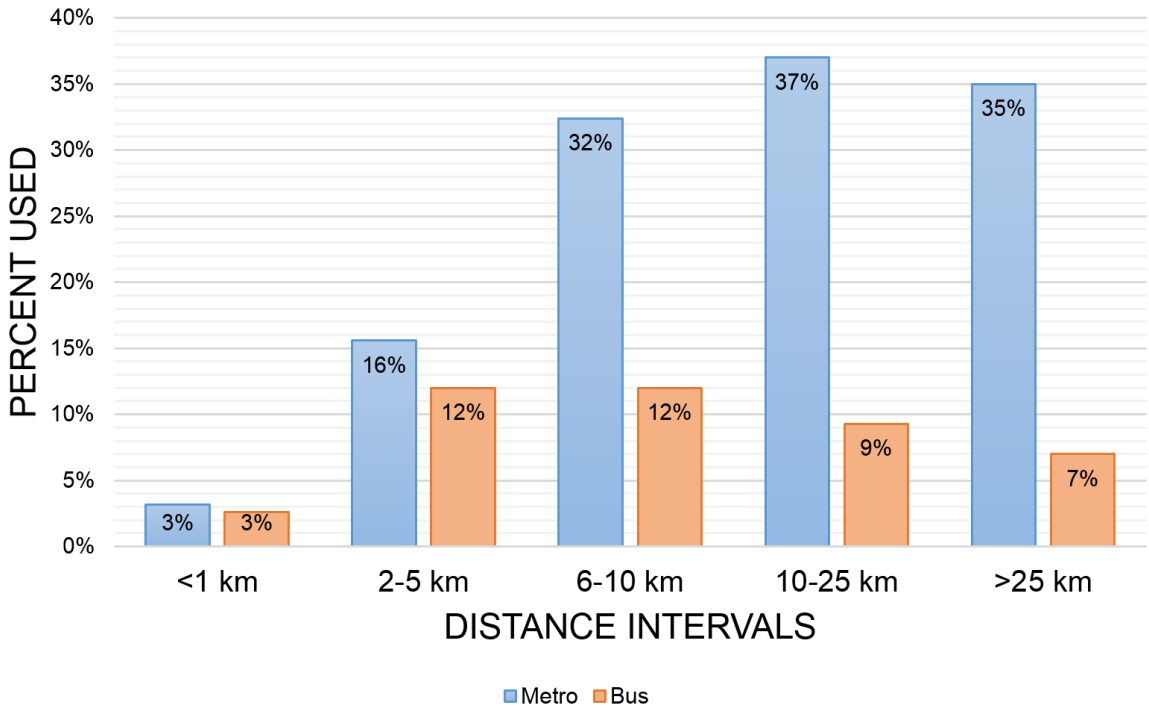

Figure 7: Metro Vs. Buses: Usage by Distance Traveled

In order for the less efficient buses to thrive, they will have to take opportunity in the gaps the metro presents. This was confirmed in an interview with a bus operator, who confirmed that “buses will have to take people places the metro can not go, and with more [metro] lines people will need buses at more locations.” Mini bus lines performing short neighborhood routes have already started to appear across the city for this very reason, although our study did not include them due to time constraints. Competition between the bus and metro on shorter travel distances, specifically less than 5 kilometers, may provide an area for which buses can be useful.

An integrated, compatible public transportation system may resolve public demand for more a convenient and reliably fast service. Instead of directly competing with the metro over all distances, the buses can instead take advantage of shorter circuits, especially in areas where the metro cannot go. The noticeably higher speed satisfaction with the metro, coupled with the

clear and abrupt drop-off in the bus system's usage over longer distances, signifies little need for the bus system for distances exceeding five kilometers. In order for these two systems to effectively complement each other, it is apparent that the metro system should be the primary type of travel for longer distances, while buses can cater to shorter trips within two to five kilometers or to places where the metro does not travel. Furthermore, both systems could benefit from a higher frequency of service, as overcrowding satisfaction for both is very low. Ultimately, the metro system and bus system should address different transportation needs in order to avoid redundancy.

Unfortunately, due to time limitations, we sampled mostly in the Xia Sha District. This district is one of the few with metro lines running throughout its entirety, which may have shifted our data to inaccurately favor metro usage. Furthermore, our survey did not take into account the metro card as a payment option, so the true usage of the card is unknown.

4.1.2 Shared Bike Incompatibilities

Shared bikes, despite being a fairly recent addition to the transportation system of Hangzhou, have rapidly grown into a widespread and heavily used mode of transport. For more information on shared bike systems, see Appendix C, Section 4. The government has left the quickly growing shared bike system generally unregulated, as exemplified by the incompatibilities of shared bikes with other methods of transit. As seen in Figure 8, shared bikes are frequently used, with 50% of our survey respondents using them "sometimes," "often," or "always" on a weekly basis. Three of the focus groups reported using shared bikes frequently because of the unparalleled convenience they offer for short trips, as they can be picked up and dropped off anywhere. Participants from the faculty focus group emphasized the importance of convenience and mentioned that shared bikes were a relied upon method of travel because of their abundance and extremely low cost. Students were similarly pleased with shared bikes for their low cost and abundance, but they also noted problems with distribution and poor bike

condition. Problems regarding quality and quantity of bikes may have deterred the other half of respondents who reportedly did not use the shared bike system.

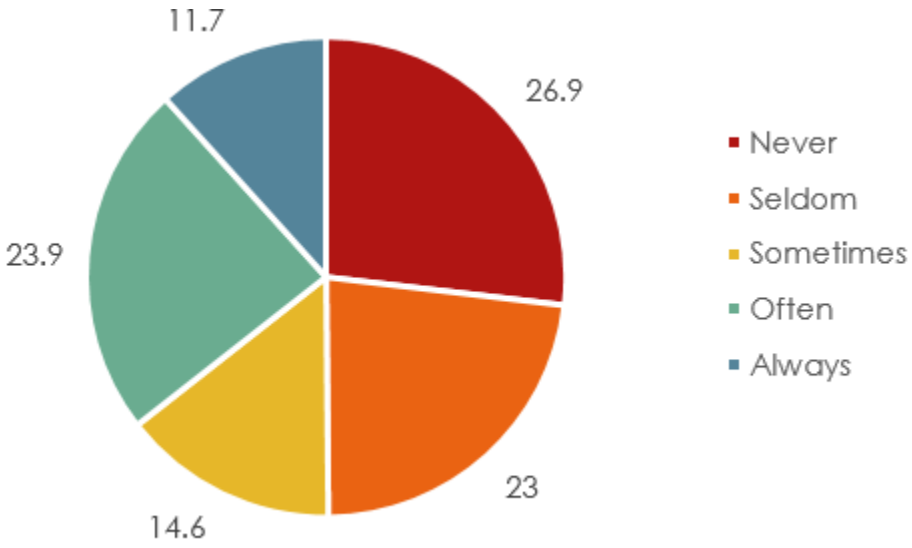

Figure 8: Shared Bike Weekly Use

While the system is self-sufficient, the sheer quantity of bikes around Hangzhou has become an issue for other transportation types by crowding walkways and even bus lanes. The lack of accountability and little regulation of these shared systems results in poor bike treatment, as demonstrated in Figure 9. This image (Figure 9) depicts a common scene of shared bikes completely blocking the public walkway. Cluttered areas of bikes force citizens to change regular walking patterns, and can often congest walkway traffic. Participants in the faculty focus group agreed with this point, expressing dissatisfaction with the great abundance and poor distribution of shared bikes. However, both faculty and students may have found bikes to be more of a problem than the average Hangzhou resident, as their area of work and residence is a known hotspot for shared bikes and their associated issues. That being said, the oversaturation of bikes is by no means limited to campuses, and was proven to be an issue discussed in all of our focus groups. Additionally, in our interviews, the bus drivers mentioned that bikers and moped users often blocked bus lanes, further congesting traffic and increasing

travel times for bus passengers. The overabundance of shared bikes clutters public areas and conflicts with other transportation systems.

Figure 9: Shared Bike Overcrowding

The condition and distribution of the bikes present the bulk of the issues found in the shared bike system. Satisfaction of shared bike condition, while not exceptionally poor, is notably lower than findings in other areas, as shown in Figure 10. This finding is supported by all four focus groups, as each of the discussions mentioned the inconsistent bike quality. However, due to the large number of bikes, quality is not the most pressing issue as another bike will likely be available. The quantity and quality of bikes suggest an overarching problem with the regulation of shared bikes. As an isolated system, this higher quantity of bikes resolves issues presented by inconsistent bike quality; however, the lack of regulation of bikes and bike use often interferes with other intra-city transportation, reducing the compatibility of bikes with other forms of transportation.

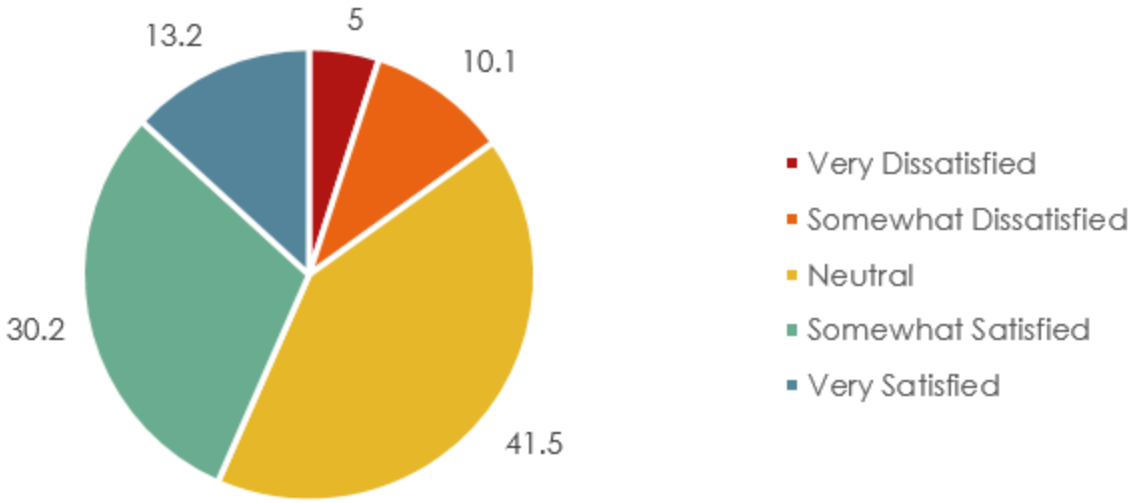

Figure 10: Shared Bike Condition Satisfaction

While problems persist with shared bikes, public bikes seem to have the opposite issues. Participants of both the faculty and Boye focus groups mentioned the lack of public bikes. Observations from physical inspection also substantiate this, as we found that public bike stations were sparse and provided fewer bikes, as compared to the shared bike system. For passengers without access to reliable mobile phone plans, a requirement to use shared bikes, public bikes present a more attractive option. However, the somewhat costly required deposit of CNY 200, designed to prevent theft and increase accountability, deters some users from regular usage. Unlike the shared bikes, which can be left anywhere, government bikes must be left at a physical station when not in use. The public bike system, while slightly higher in quality, also limits the number of bikes available as shown in Figure 11. These differing levels of satisfaction can be seen in the survey results, in which 51.9% of respondents were “somewhat” or “very” satisfied with public bike quality, while only 43.4% of respondents were similarly satisfied with shared bike quality, as shown in Figure 12.

Figure 11: Public Bike Station

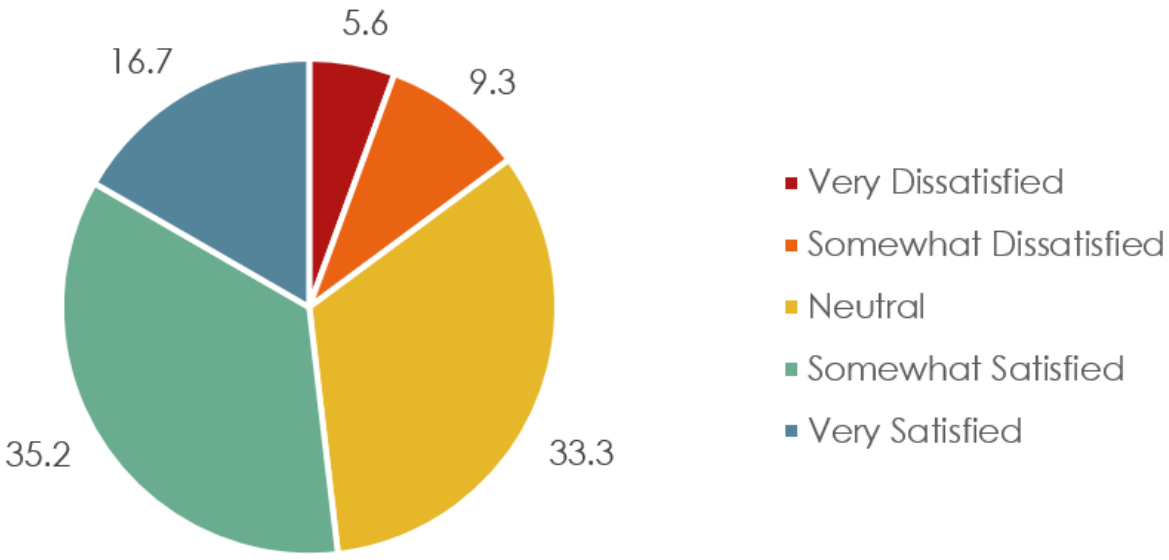

Figure 12: Public Bike Quality Satisfaction

4.1.3 Road Traffic Interactions

Traffic laws on roadways in Hangzhou seem to be followed inconsistently and rarely enforced, which will only worsen as the demand for public transportation increases from the

metro expanding. Our findings on traffic and congestion suggest that many relatively minor issues prevent existing systems from being more compatible. The bus drivers we spoke to were particularly annoyed over interference from private cars, bikes, and pedestrians, though they made no mention of mopeds or three-wheelers. Specifically, one driver said “private cars and OFO bikes often occupy the bus lanes, which disrupts everything.” Buses are forced to wait when cars and bikes block the bus lanes, resulting in slower service. Furthermore, another bus driver said “too many pedestrians are distracted and on their phones, they walk slowly.” Bus drivers are required to follow company rules and are forced to obey traffic laws as they are under real-time camera surveillance. They must wait for pedestrians to cross and clear out of the way or risk pay cuts, only cementing this issue. Careless pedestrians can delay traffic, decrease road safety, and slow travel time. The faculty focus group impressed that “buses are generally good about obeying traffic laws,” and stressed that buses consistently let pedestrians cross streets. While buses provide a measure of safety to pedestrians, the general lack of adherence to traffic laws endangers pedestrians and only exacerbates the incompatibilities among transportation types on the road.

Owners of private vehicles are often forced to park in illegal areas, further complicating traffic patterns. More private parking, as one participant of the Boye focus group said, is heavily needed in Hangzhou. General dissatisfaction with city parking is further supported by 57.2% of the respondents reporting being either “somewhat” or “very” dissatisfied with parking options, as seen in Figure 13. Student focus group participants remarked that private vehicles parked in the bike lanes can often complicate and congest pedestrian and vehicular traffic. Taxi drivers mentioned that the lack of parking in downtown Hangzhou can complicate passenger pickup and drop-off. The accumulation and prevalence of illegal parking of private vehicles in public areas, such that it has created incompatibilities between pedestrians, buses, bikes, mopeds and taxis indicates a need for additional traffic regulation.

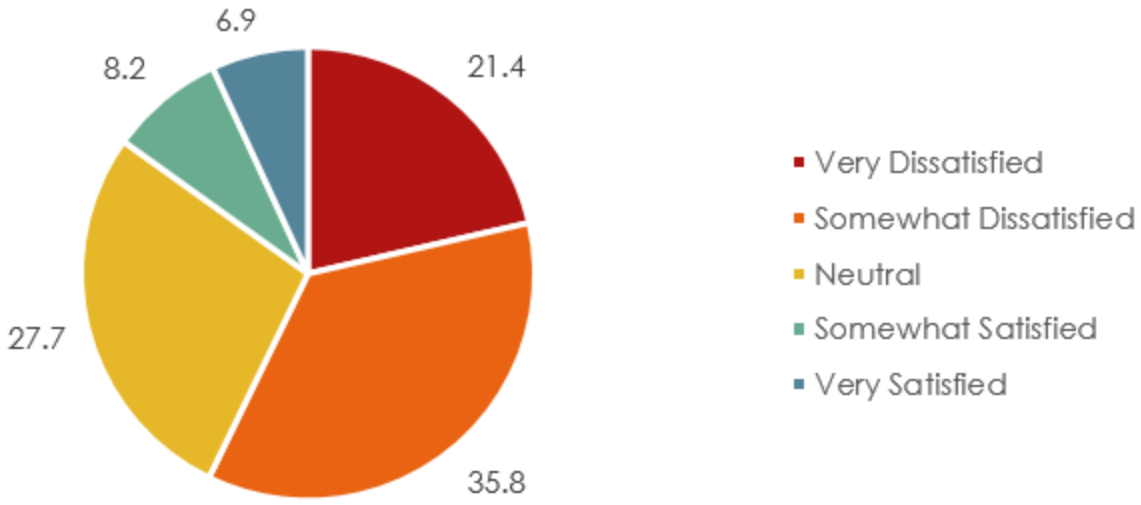

Figure 13: Car Parking Satisfaction

All of these minor incompatibilities aggregate and create traffic issues for all road based transportation. As seen in Figure 14, users of private cars are very dissatisfied with traffic, with 59.7% of respondents indicating dissatisfaction and only 11.9% indicating positive satisfaction. Unfortunately, we were unable to gather a comprehensive understanding of Hangzhou's traffic laws given our limited time frame of eight weeks. As such, these traffic issues may also be, in part, due to poor infrastructure of roads in Hangzhou. We interviewed two taxi drivers who both substantiated these claims that the city's poor infrastructure may contribute to unnecessary road congestion. One driver stated that Hangzhou's roads are not designed to handle heavy traffic. He specifically stated that turn lanes are often too narrow, or simply are not enough, to withstand high volumes of cars. A group of three bus drivers also mentioned that frequent crosswalks and stop lights often slow travel time. The large quantity of vehicles present throughout the city also contributes towards congestion, as normal traffic is comprised of a mix of publicly and privately owned vehicles. While many large cities in China, including Hangzhou, have implemented policies to limit the number of private cars, they are clearly not enough to solve these issues (Lu, 2016). Some of these strategies include implementing a capped annual number of licenses, restrictions based on the hukou system, and high registration fees. While

these solutions are a start, they do not completely resolve all traffic issues. Increasing network compatibility would target these issues by encouraging residents to rely more on public transportation. Greater regulation of all road vehicles would reinforce this new focus towards network compatibility.

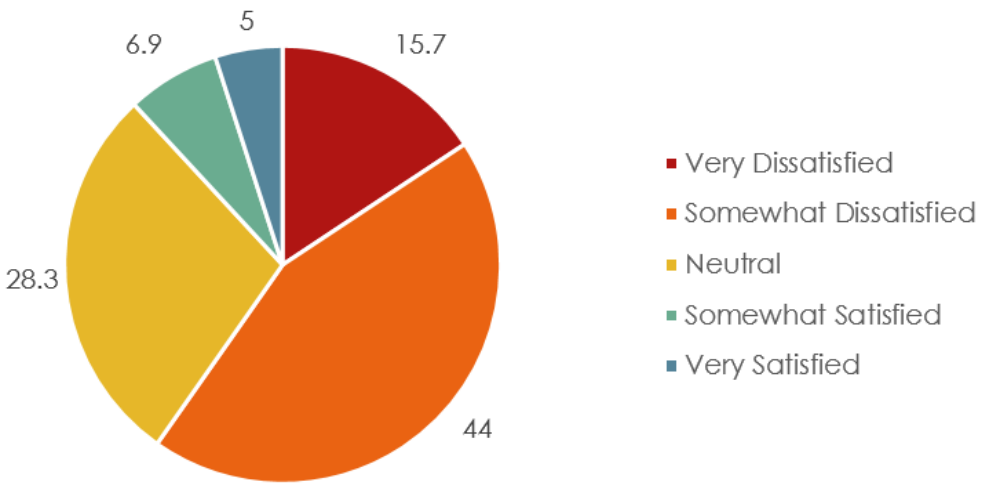

Figure 14: Car Traffic Satisfaction

4.1.4 Water Transit

Water transit was initially a target of our study, but we quickly found it to be a separate aspect of Hangzhou's overall transportation system. Within our initial faculty focus group, no one reported using water transit consistently. In fact, none of the participants had ever taken it before. Only 2% of survey respondents said that they used water transit on a weekly basis. Due to the limited usage, we have decided to exclude water transit as an applicable focus of transportation compatibility. While it is a functional method of travel, based on our physical inspection, it appears to be predominantly used by the elderly and tourists for relaxation rather than commuting. Since the line runs on the Grand Canal and stops at a number of tourist locations, it is more of an attraction than part of daily transit.

4.2 Compatibilities

An increase in network compatibility among different systems of transport within Hangzhou will positively affect transportation satisfaction. We analyzed the relationships among the metro, bus, public and shared bikes, and taxis to find areas of compatibility that already exist among them. Observations and statements from the focus groups and interviews regarding these transportation types indicate that increases in system compatibility would be welcomed by the public. Statistical data we gathered from our survey further supports this argument. These compatibilities include the transportation card, a reliance on both the metro and shared bikes to complete a journey, and the availability of a free bus ride after a qualifying metro trip. We found that these compatible aspects are positively received by the public, and may provide future insight into how to proceed.

4.2.1 Taxis and Didi Cars

Taxis represent a relatively unregulated aspect of Hangzhou's transportation system. Rather than being managed by a single entity, multiple companies or even individuals can operate as taxi drivers. Taxis are split into two roles, traditional taxis and app taxis, the latter of which are primarily through Didi. While app taxis are perceived as better in most aspects, both types of taxis tend to provide the same benefits to the transportation system and fill the same role.

Both taxis and app taxis fulfill the demand for fast, reliable service, particularly in the pockets of Hangzhou where the other systems, such as the metro, cannot go. Even as the metro expands and other systems conform around it, taxis will continue to fill in any gaps presented. Although taxis can be expensive, our results indicate that they have no other major drawbacks in regard to network compatibility. Most importantly, the constant availability of taxis helps to alleviate congestion and parking issues by reducing the need for private cars. As seen in Figure 15, users are satisfied with the reliable wait times for both types of taxis.

Approximately 69.6% of respondents indicated positive satisfaction with Didi wait time, with a mere 5.5% answering with negative satisfaction. Only 51.8% of respondents said the same for taxis, but less than 10% indicated negative satisfaction showing that it trends towards the positive. A member of our faculty focus group mentioned that “because not everyone has a private car, [taxis] fill an important gap when [they are] necessary,” suggesting that taxis also present an advantage for those who cannot or choose not to own a car for whatever reason. Taxis fulfill an important demand for citizens who do not own private cars. For example, faculty “used [taxis] often for trips where [they] need a lot of baggage, like to the airport” and a member of our company focus group mentioned “Didi is great for drunk people, it lets [them] get home safely.” The ride-sharing didi driver we interviewed said that Didi is sometimes used to fulfill the last-leg portion of the trip, especially in his area which extends past the last available metro stop. Both taxis and Didi cars fulfill the need for fast and reliable transportation, reduce the need for private vehicles, and can be used in conjunction with other transportation types. They both contribute towards compatibility among Hangzhou’s network of transportation systems, with their only drawback being their relatively high price.

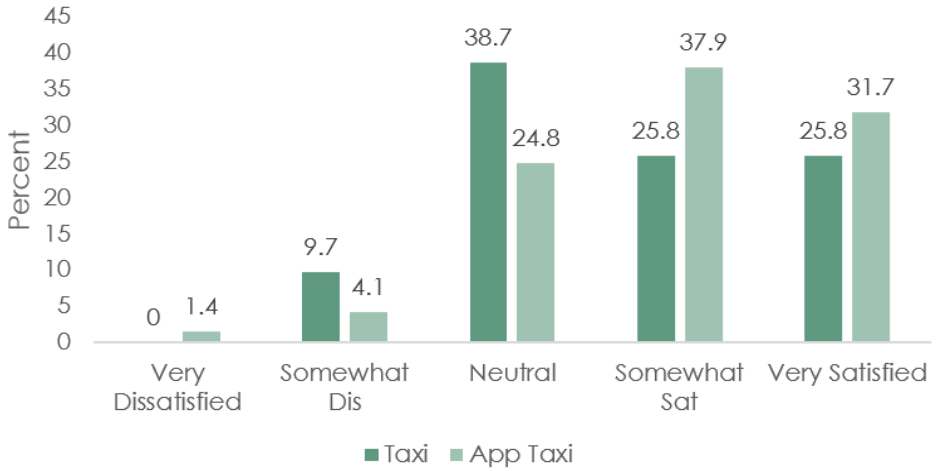

Figure 15: Taxi Wait Time Satisfaction

Traditional taxis and app taxis constantly compete with one another, but unlike the bus and metro, this competition does not contribute towards incompatibility with other transportation systems. Taxis can easily be used in conjunction with other systems, such as the metro. Taxis can easily be used in conjunction with other systems, such as the metro. When asked about the two different taxi types, one Didi driver mentioned in an interview that “[he does not] like Didi because there is too much competition. [He] had to join Didi to keep up with the rest of the drivers.” General preference between the two systems was in favor of Didi, but was not unanimous. Student focus group participants preferred Didi because “drivers are funny and nice” and “[they are given the] price and route before the car arrives.” They also noted that Didi’s cheaper ride-sharing option is great for those with lower income. Competition between both taxi types encourages each system to improve, but does not impede on other methods of transit. The privatized nature of these two systems separates them into their own niche within Hangzhou’s evolving transportation network, which allows them to contribute independently towards network compatibility.

4.2.2 Hangzhou Transportation Cards

The metro, buses, public bikes, water ferries, and even some taxis utilize an integrated transportation payment card. This multi-purpose card reduces the need for owning individual mobile apps, unlike the shared bikes, and is easy to refill. Providing users with a consistent and easy to use payment method accepted across multiple transportation types encourages the use of a variety of modes of transit. As the metro continues to add more lines, it is likely that more and more people will utilize this card. Unfortunately, users are limited by the methods of payment currently available for refilling their transportation cards. Approximately 55% of respondents preferred Alipay, as shown in Figure 16, followed by WeChat at 22%. Participants preferred mobile forms of payment due to their ease of use. Introducing Alipay to the transportation card refilling stations would be beneficial as it would increase ease of use and

potentially decrease travel time. Passengers wanted more incorporation of Alipay, as encouraged in our student focus group, due to its convenience and ease of use. Unfortunately, our questionnaire did not cover Hangzhou's transportation cards, so while we know convenient payment methods are welcomed, we do not know how frequently the transportation card is used.

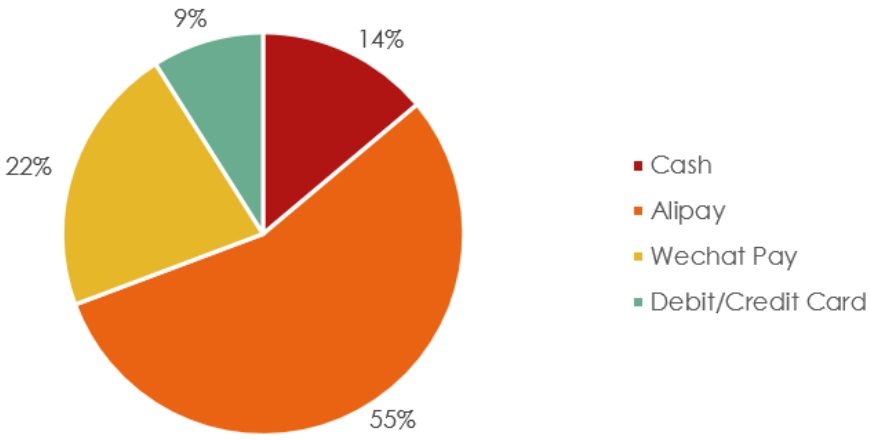

Figure 16: Payment Method Usage Frequencies

4.2.3 Bikes as Second Leg

We found that a majority of people rely upon the metro for the bulk of their trip and often finish the last part with shared bikes from our gathered focus groups and survey data. Both public and shared bikes are often located around transit nodes such as bus and metro stations. Faculty focus group members in particular supported this point by saying that bikes were used to finish the last kilometer of trips due to their convenience and low cost. These statements are further supported by Figure 17, which shows the percentage of respondents who reported using shared bikes, among other transportation methods, for trips of specific distances. 19.6% said they use bikes for trips under one kilometer, and 16.2% for trips between two and five kilometers. Shared bikes are seldom used for trips longer than this interval, instead mass-transit systems like the metro and bus are used. This compatibility and current reliance on a

combination of the shared bikes for shorter distances paired with the metro for longer distances within the same journey is an initial step towards a more cohesive system. This will be especially pertinent with the expanding metro system, as bikes will be relied upon as a secondary form of transit.

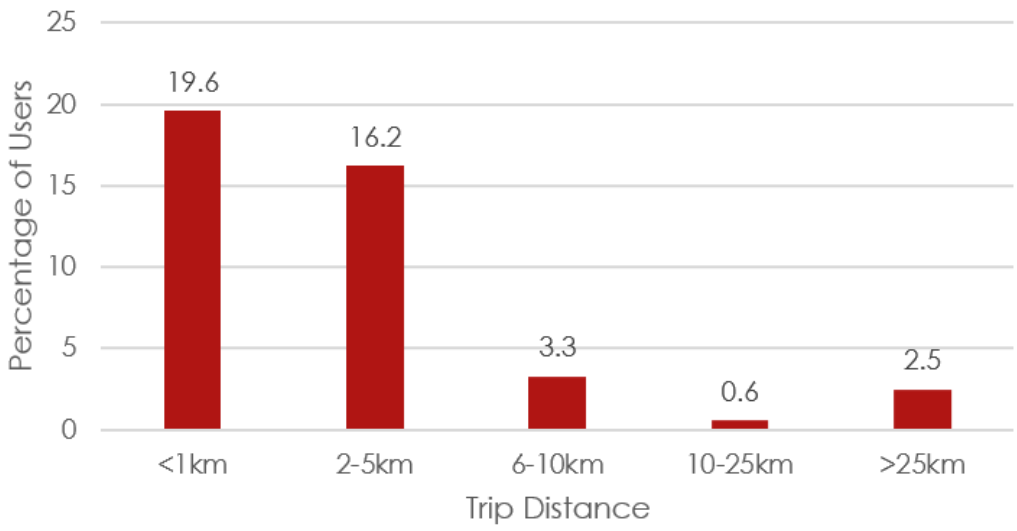

Figure 17: Shared Bike Trip Distance Frequencies

Unfortunately, not all transit nodes have bikes available for public use. Uneven distribution and allocation of bikes stifles compatibility with other systems. Additionally, access to shared bikes requires a reliable mobile phone. Public bikes, which are much less abundant than shared bikes, require an initial deposit of CNY 200 prior to use. Some participants from the faculty focus group noted that this deposit was costly, and warned that it may deter some from regular usage. Our research and observations only targeted a limited number of metro stations, where both shared and public bikes are more abundant. This concentrated sampling may have skewed our data in favor of these systems. We were not able to visit all of the stations, nor were we able to sample from all nine districts of Hangzhou; therefore, we do not know for certain that this is an accurate representation of the average Hangzhou resident's opinions.

4.2.4 Bus and Metro Compatibilities

While the metro and bus systems are generally not well integrated, our faculty focus group mentioned an area where the metro and buses are compatible. Metro users can qualify for a free bus ride following their trip, depending on the distance travelled. This integration of systems saves passengers time and money, and generally enhances user experience and willingness to use both kinds of transport. Unfortunately, it seems that this promotion is not well advertised, as it was only mentioned in one focus group; moreover, they did not know the exact details. Our survey did not ask questions about compatibility, so the specifics of the program are unknown. Nevertheless, we believe this is a good example of how the metro and bus systems can work together and should be expanded upon in future developments.

4.3 Overview of Limitations and Considerations

While the findings we have obtained from our focus groups, survey, and interviews are important, we must also consider the limitations of this study. Our methods were not perfectly able to capture every aspect of transportation satisfaction in Hangzhou. In particular, it is important to note that we cannot claim our survey results are representative of the entire urban populace of Hangzhou. The city has a population of over nine million people, so we were unable to properly randomly sample. Consequently, we elected to use convenience sampling instead. As a result, we conducted a majority of our sampling in the Xia Sha district. Participants consisted mainly of HDU students, faculty, and parents of the children who attended the English tutoring companies where we volunteered.

We were unable to directly communicate with our participants due to the language barrier. We required the assistance of a translator, as they were conducted in Chinese, creating a level of separation between us and our participants. Ideas may have been lost through translation, or specific thoughts may not have been significant enough to warrant a translation. We lost one of our student focus group transcripts from a hard drive failure, and it was thusly left

unrepresented in our findings. Additionally, communication errors between us and our HDU colleagues, resulted in initial confusion and a mix up of interview and focus group protocols for the Boye focus group and Rideshare Didi Driver interview. Due to our limited time and resources, we were also unable to schedule an interview with a representative from the Hangzhou Metro Group. We followed our protocols as best we could, and while the data gathered cannot be said to be universally relevant, we believe the data provide excellent insights into transportation satisfaction in Hangzhou, China.

Satisfaction is an inherently subjective topic that can be influenced by several internal or external factors. We observed throughout all four of our focus groups that while participants may have expressed dissatisfaction with specific aspects of the system, they seemed confident that these issues would eventually be resolved by the government. One of these instances occurred in the faculty focus group during a discussion on the overabundance of shared bikes in Hangzhou. One participant repeatedly assured us that “most issues will be resolved within two to three years from now.” Even though satisfaction should be lower, confidence in the city planner’s capabilities seems to have increased transportation satisfaction. Members in the same focus group, along with the Boye group, overlooked the less than ideal current state and were reportedly pleased with the metro’s planned construction. While we are confident that this observation had some effect on our results, there is no way to confirm this claim from our data alone. In conclusion, faith in the system can synthetically increase satisfaction even if current states are not perfectly satisfying.

Chapter 5: Conclusions and Recommendations

Our study identified Hangzhou's levels of transportation satisfaction and generated solutions targeting areas of weakness. We accomplished this by gathering both statistical and qualitative data through surveying and conducting focus groups and interviews. Our results show that a majority of users prioritized a subset of indicators including travel time, cost, and convenience as being most important when choosing public transportation. We found generally positive satisfaction with each form of transportation, but observed systemic issues when they interact. In order to address this, we recommend incorporating a focus on compatibility among each of Hangzhou's transportation systems as they continue to grow. This would not only increase current user satisfaction, but would also encourage more users to rely on public transportation. In this chapter we present recommendations to improve the city's transportation network compatibility, as well as provide suggestions for future study.

5.1 Compatible Metro and Bus System

Network compatibility, comprised of comprehensiveness and inter-connectivity among transportation systems, is the solution that Hangzhou's rapidly growing transportation network requires in order to increase and maintain citizen satisfaction. The developing metro system plans to connect all nine districts of Hangzhou, which will only raise the demand for public travel. We found that the metro was used much more frequently than the bus system for mass transit from both surveying and conducting focus groups. They have not yet shifted to accommodate one another as they directly compete since they fulfill the same role in Hangzhou's transportation network. The metro's numerous advantages over the bus systems, namely in speed and reliability, further promotes its stance as a main method of travel. Bus lines should support the metro system, particularly in less densely populated areas where the metro may not be available. Implementing shorter lines for buses will allow more reliable and frequent

service, as overcrowding was an issue observed in both transit types. Developing the two systems to complement one another will allow each to specialize, garnering their own target populace and functionality.

5.2 Walkways and Bikes

The quality and quantity issues surrounding both shared and public bikes can be solved with a hybrid system that adopts the strengths of each system. Shared bikes are a convenient, inexpensive and widely used method of transportation in Hangzhou, which are often used in conjunction with the metro to complete the last leg of a trip. However, their profusion often obstructs walkways and sometimes even bus lanes, endangering the safety and slowing commuters. Public bikes, on the other hand, are left underutilized because of their lack of consistent availability and relatively expensive deposit despite their current compatibility with the growing metro system. The purpose of the hybrid bike system is to incorporate accountability and network compatibility, exemplified in public bikes, while maintaining convenience and abundance, found in shared bikes. These improvements will allow the bike system in Hangzhou to be truly compatible and build upon other systems, rather than impeding them.

The hybrid system would be most easily implemented as a government owned and regulated program, replacing current public and shared systems. Government regulation would increase likelihood of compatibility among other similarly regulated systems, like the metro and bus. The bikes would be distributed to several destinations around Hangzhou, concentrated around transit nodes and areas of high demand. Hybrid bikes would adopt the deposit system of public bikes to maintain accountability. Additionally, we found that shared bikes required access to a mobile phone in order to scan QR codes to unlock and unlock the vehicle, which deterred some citizens from use. If this hybrid system adopted pre-existing payment methods like the transportation or citizen card, then those without access to a smartphone could also use the

bikes. Moreover, the hybrid system would avoid both the cumbersome stations of public bikes and the lawlessness of shared bikes while maintaining user freedom.

Geofencing can be accomplished using the current technology of shared bikes, as they already implement GPS software. This would prevent users from locking their bike outside of specified areas where they do not impede traffic. These geofenced parking zones would require no new infrastructure, making them far easier to implement in comparison to the stations of public bikes. Furthermore, if the user does not return the bike to the designated zone, they will not receive the deposit back; thus increasing accountability for returning bikes. We also recommend incorporating a visual indicator, such as a light, to notify workers which bikes need repair, as the current process is insufficient and not thorough enough. Regulation of this hybrid bike system would be best accomplished by the city government, with current bike systems being removed or forced to meet the same standards. A hybrid bike system would eliminate the issues present in both public and shared bikes and properly fulfill the public demand for convenient and cheap travel for shorter distances.

5.3 Road Travel and Traffic Laws

A lack of regulation and enforcement of among Hangzhou's transportation network has generated dissatisfaction and inhibited overall compatibility. This has resulted in obstructive traffic congestion throughout the city and impedes every mode of transit, excluding the metro. Addressing these issues is especially pertinent with Hangzhou's advancing metro system, as demand for all types of public transportation will only increase, worsening congestion. Excluding legislation and infrastructure, the simplest way to relieve traffic congestion is to reduce the number of cars on the road. An increased emphasis on public transit, especially compatible systems, can greatly reduce reliance on private vehicles for daily travel. Current government policies have attempted to regulate private vehicle demand, but this has not been sufficiently effective. The government must be sure to enforce parking and traffic laws in order for

recommendations to be fully effective, as all these smaller issues contribute to incompatibilities among systems. Several of these issues can be solved simply with infrastructural changes, like reducing interfering crosswalks with overhead or underground walkways. Limited public parking, which incites competition between public and private vehicles, could likewise be alleviated with a combination of increased law enforcement of and increased availability of parking. The number of pedestrians will only increase with the expansion of the metro, so it is imperative to address traffic-based complications among systems, especially on roadways. Addressing both safety and parking issues will contribute towards implementing network compatibility, which in turn will increase the appeal and usability of public transportation. Greater reliance on public transit will in turn decrease dependence on private vehicles such as cars.

5.4 Further Study

We recommend that further studies evaluate each type of transportation more thoroughly, examine the interactions among systems, and survey in all districts of Hangzhou. Location-specific questions will allow for an analysis on varying satisfaction throughout Hangzhou's bus, metro, and bike stations. Another important topic for future research is staff satisfaction, which is a critical indicator of transportation satisfaction that we did not account for in our study. Finally, while our results have established compatibility as a germane aspect of transportation development, it was not the sole focus. A complementary study specifically aimed at determining compatibility related indicators of satisfaction will substantiate our preliminary findings. Additional research focused on compatibility between intra-city travel and inter-city travel like high speed rail and planes will advance our results.

5.5 Summary

Our findings firmly establish network compatibility to be an integral part of improving satisfaction. Enhancing network compatibility will target many of the issues with interconnectivity

and cohesiveness present within Hangzhou's transportation systems. Integrating the bus, bike, taxi, and privately owned vehicles with the expanding metro system is necessary for sustained growth. Addressing concerns connecting these systems will allow for improvement within each individual system, naturally improving each indicator of transportation satisfaction and thereby overall transportation satisfaction. Identifying public perception has granted us and Hangzhou's city planners valuable insight with which to implement meaningful changes to Hangzhou's transportation network. Determining where a system fails to meet user expectations is essential to incorporating the wants and needs of the public rather than basing its effectiveness off of only efficiency. We sought to incorporate this bottom-up approach to improve Hangzhou's transportation network specifically; however, this model can be adapted to other aspects of city planning in China in order to maximize life satisfaction of its residents.

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Appendix A: Sponsor Description

Hangzhou Dianzi University (HDU) (2017) is a university in Hangzhou, China, known for its distinctive programs in electronic sciences and information technology, as well as management, economics, and accounting. Located in the Yang-tse River Delta area, HDU is at the center of China's history and culture. It was founded in 1956 as the Hangzhou Aviation Industrial Finance and Economics School, and in 1980 it added the Hangzhou Institute of Electronics and Engineering school. In 2004, the name was changed to Hangzhou Dianzi University.

HDU (2017) has four campuses, including Xiasha, Wenyi, Dongyue and Xiasha East. There are over 28,000 students in twenty different colleges, with 2,300 faculty and staff. HDU focuses on fostering practical skills and creative thinking amongst its students. The university has completed various high-tech research projects, in addition to state and provincial funded research projects across multiple disciplines. The successful alumni network at HDU spans hundreds of enterprises in China. HDU is currently aiming to expand its international reach and has partner relationships with institutions from more than twenty countries (HDU, 2017).

HDU has partnered with WPI for several years on facilitating the transition of WPI students to living in China. Therefore, we expect that we will be granted the resources necessary to accomplish our goal. These include access to the library, people to conduct focus groups and interviews with, printing services, and the support of HDU students.

While HDU has sponsored a number of IQP projects in the past, the School of Humanities and Law Sociology branch is a new addition to this partnership. This branch is one of twenty other colleges at HDU including Engineering, Computing, Automation, Management, Accounting, Foreign Languages, Digital Media and Art Design, International Education, Innovation and Entrepreneurship, etc. These are controlled by many upper management organizations including the Party Committee Organization Department, Development Planning

Office, Student Work Department of Undergraduate College and Party Committee, Academy of Science and Technology, Graduate School and Party Committee Graduate Work Department, Campus Construction and Management Office, etc. There are about 1,600 full time teachers and the Professor and Dean of Sociology, Guofeng Wang, hopes to determine factors that contribute to satisfaction (HDU, 2017).

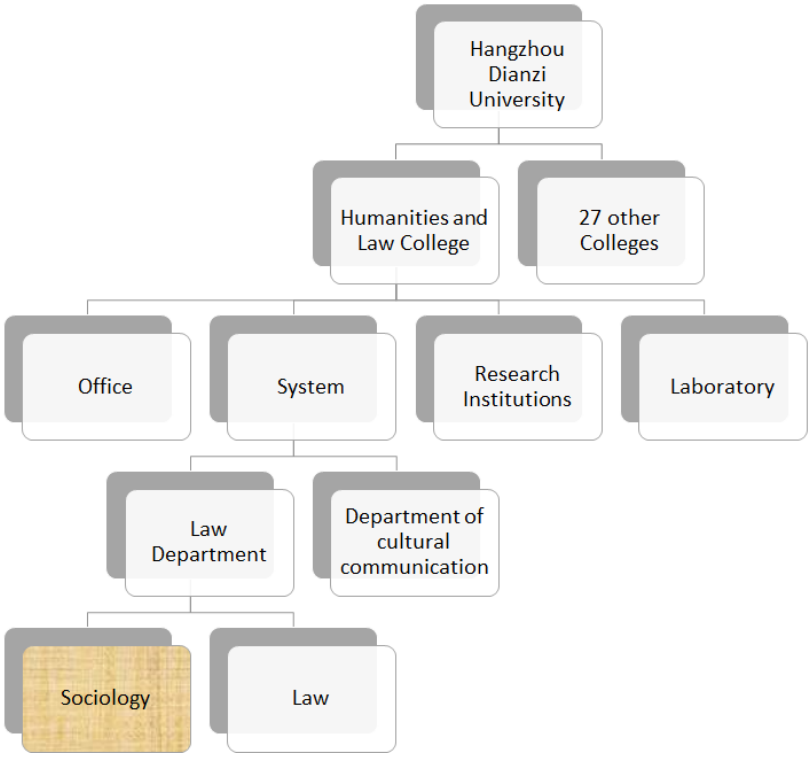

Figure 18: HDU Hierarchy (HDU 2017)

Appendix B: Physical Inspection Protocol

The physical inspection took place primarily during the first week in Hangzhou, but analysis continued throughout the project, as the team continued to use transportation in the city. This data was used to adjust focus group questions, and provided basic context for the WPI team members who previously had no experience with Hangzhou's transportation system. The team evaluated and documented the public metro, bus, mini bus, shared bikes, taxi, app taxi, and water ferry.

The team of four WPI students along with six partnering HDU students evaluated each of the given transportation types after their first-hand experiences. The team took pictures with their phones, some of which are provided in the report. Team members convened after each transportation trial to discuss the system regarding station/waiting area quality, cost, payment method, safety, frequency of service, crowdedness, sanitation, and timeliness.

Appendix C: Overview of Transportation in Hangzhou

1. Metro

The cost of the metro was the highest among types of group transportation but still inexpensive in comparison to our experiences in America. Hangzhou's metro will include ten different lines covering 375 kilometers by 2020, but are still undergoing construction. The only line operating under complete functionality is the red line, Line 1 which extends approximately fifty-three kilometers connecting Xianghu to Linping and Xiaxia Jiangbin. Line 2 and 4, orange and green, respectively, have been in service only partially and intersect Line 1. By end of construction, the orange line should connect Fengtan Road to Chaoyang, while the green line should connect Pengbu to Jinjiang. A map of the metro is included below.

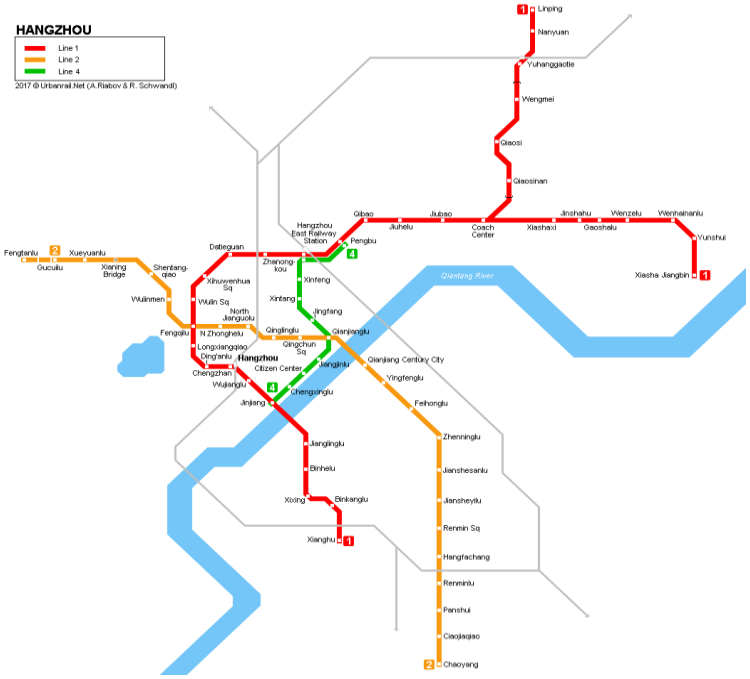

Figure 1: Hangzhou Current Metro Map

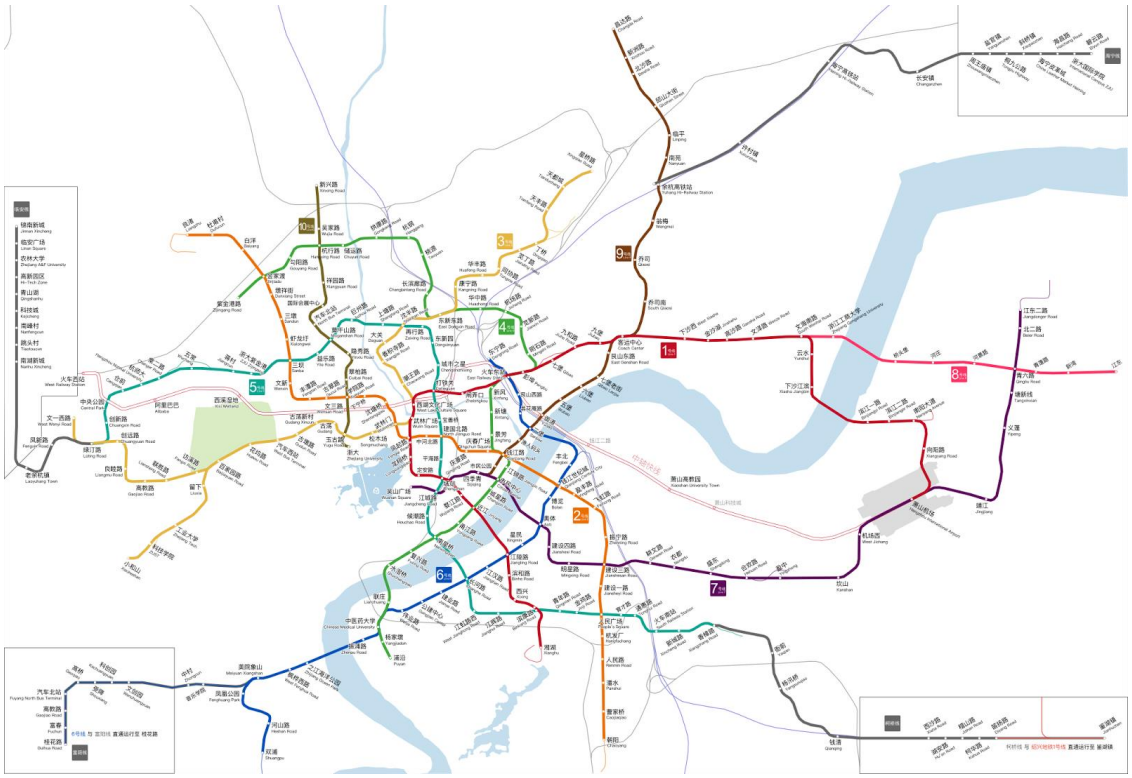

Figure 2: Hangzhou Planned Metro Map

Entrances and exits for the metro were clean and easy to navigate with basic signs and colors guiding passengers to the right direction. Ticket booths, computer and human operated, were available upon every entrance. Ticket fare varies by distance travelled. The first four kilometers cost CNY 2 and CNY 1 for every additional four kilometers for a total between 4-12 kilometers. Every additional six kilometers for a total distance of twelve to twenty-four kilometers costs an extra CNY 1, while every additional eight kilometers exceeding a total of twenty-four kilometers adds an extra CNY1. Children smaller than 1.3 meters can ride the metro for free, but cannot take the metro alone.

Five types of tickets (methods of payment) are available to passengers: single journey ticket, tourist metro pass, one-day pass, three-day pass, regular IC card or Hangzhou Multifunction Card. Single journey tickets are only valid for one person on the day of issue and are recyclable throughout the day. Tourist metro passes are valid for six months after day of

issue and can be loaded with a given amount of money. One-day passes, which cost CNY 15 each, are similar to the three-day passes, which cost CNY 40 each, in that they are valid for however long their name implies for an unlimited number of metro rides. IC Cards and Multifunction Cards can be preloaded with a given amount of money. All of these tickets can be paid for either through cash or Alipay. Our team used the Multifunction Card to pay for all metro rides and used cash to load our cards at the human-operated ticket booth with the help of our HDU colleagues. The multifunction card, as its name implies, can be used on other methods of transportation, such as the bus, which will be discussed in each applicable section.

Following ticket purchase, we then went through security checkpoints. This included an x-ray scanner to sift through larger belongings, and sometimes a metal detector scan and simple pat down. From station to station we observed that there were usually three to five guards at every entrance. Two sat behind the monitor observing the contents of the belongings, while one to three additional officers were there to guide and scan passengers. No food or drinks were allowed on the train, and any riders with visible drinkable liquids were required to sip to prove it is safe. We then scanned our multifunction card onto the digital reader. This displayed the current total for the riders to see, and flashed green allowing us to pass through an opened gate.

We then had to descend another floor in the metro to reach the waiting area. The tracks were blocked off with thick glass walls preventing passengers from jumping out in front of moving trains. The stations were all very clean, with usually one to two janitors cleaning the floor or emptying the trash at all times. Two safety officers roamed the track to ensure safety and wellbeing of passengers. Between each of the tracks were two benches for riders to sit on while waiting for their trains to arrive. Arrows on the floor, as well as colored posters clearly indicated the direction of each of the trains and following stations. Digital monitors hanging from the ceiling indicated when the next trains were arriving and the following stop. Trains arrived regularly, from every three to four minutes to ten to twelve minutes depending on time of day,

and ran from 6:00 AM to 12:00 AM. Rush hour times in the morning range from 7:00 – 9:00 AM and 4:00 PM – 7:00 PM in the evening. Upon train arrival, the glass doors opened, and we were allowed approximately 15 seconds to board the train.

The trains themselves were very clean, and included metal railways along the top and sides for standing passengers to secure themselves. LED displays ran along the top of the train car walls, indicating upcoming stops in green and departed stops in red. Televisions near doors advertised metro information, as well as other various corporations. The ride was relatively smooth and timely. One trip we took, from Wenze Road to Wulin Square, approximately twenty-three kilometers, only took a half hour, and cost CNY 5. We noticed that a majority of the metro riders were primarily workers and younger people. This made sense as the metro was the fastest and most crowded form of transportation, but also the most expensive. Exiting the station required one last Multifunction Card scan, outputting the current deducted total of our cards. Overall the metro was very easy to travel, and did not require too much prior knowledge for a successful trip. Metro security seemed to be a bit excessive, and was the most expensive form of transportation we took, approximately CNY 10 roundtrip.

2. Water Transit

Hangzhou offers two main types of water transit: a West Lake Cruise and a Grand Canal Cruise. The first is more for tourist pleasure trips in West Lake, while the latter is more for travel along the Grand Canal. We experienced both types of boat transportation, but we only experienced the second with our HDU colleagues. The West Lake Cruise navigated around attractions within the lake, and was a slow smooth ride perfect for pictures and sightseeing. Wharves for these cruises were distributed along the lake, about twelve total depending on the type and purpose of the boat. Wharves were clean, and there was no visible trash on any of the waiting areas. While the majority of the lake itself was clean the wharves were not as distinct from the surrounding areas. Organization was lacking, or at least signage of loading points was

lacking. Payment for this cruise was handled by our advisors and the tour guide. Loading the cruise ship was fairly easy, but the only platform to board was a thin wooden plank. This may be dangerous for older passengers, or small children. Each ride was approximately twenty minutes. Our class took the ferries available in the morning, regularly available from approximately 8:00 AM to 12:00 PM. Seats were available on the first floor and upper floor of the boat. Handrails and signs were abundant, preventing riders from jumping into the open water. The stairs and low ceilings leading up to the second floor the boat, however, were very narrow and were a potential safety hazard. These boats were relatively clean on the inside, but were clearly worn from long term use. The boat we were on was not too crowded in that everyone on it was able to sit down for the trip. Exiting the boat was same as boarding the boat. We left on the wooden platform, which was not securely fashioned to the boat.

The second form of transportation that we took was the Water Bus. This transportation is designed for viewing Hangzhou's scenery, and is mainly targeted at older people and tourists. Hangzhou's water bus system is one of the older forms of transportation and offers four different lines. Station locations vary by water bus line, from five stops to eleven. Operation time during weekdays are the same, and are slightly shorter on the weekends. The station we arrived at, Wulinmen, was very clean, with metal handrails, seats, and an abundance of police – we observed more than five total. One of the station walls included instructions on where the next stops were, but nothing was written in English. It would be difficult for us to ride the water transit again without the help of our HDU colleagues. While we planned on leaving approximately around 10:15 AM but due to the large amount of people, we had to wait an additional hour and a half to take the next available bus. The wait was long, and the station was very loud. Water transit fare is a flat rate of CNY3 for every ride, no matter the distance. Payment can be accomplished through the Hangzhou Multifunction Transportation Card. We paid with this card, which increased ease of use. The boats themselves were fairly clean, and offered two levels of seating with a layout similar to that of a restaurant with seats across from each other.

Figure 19: Grand Canal Cruise Boat

Figure 20: Inside Grand Canal Cruise Boat

The speed of water transit was fairly slow, perfect for taking pictures and sightseeing. Water transit was a nice tourist activity, but not a reliable form of transportation for day to day use, as we had to wait an extra hour to catch the next boat. We noticed there were mostly older

people and accompanying small children who rode the water transit. It also seemed like the passengers knew each other, meaning they were regular users of the water transit. This makes sense, as the ride was slow and relatively inexpensive. The ride itself was thirty minutes to get to the second stop, Beixinguan. The boat was clean, and had a bathroom for passengers to use. There were two security guards monitoring each level of the deck.

3. Buses

Hangzhou's bus system is perhaps one of the more complex systems currently in use for public transportation. There are seven different categories bus transit: 1) downtown, 2) night, 3) suburban, 4) micro bus, 5) mini bus, 6) bus rapid transit, 7) tourist. The bus station that we waited on included a board explaining the instructions on where each bus goes next. Unfortunately, there were no English translations so it would be difficult for us to use without the help of our HDU colleagues. There are two main bus companies in Hangzhou, one of which uses time schedules while the other does not. Each stop had a sign showing which buses stopped there and what their routes were, with or without timings respective to the company. However, the scheduled buses rarely arrived on time. As a result of this, it is impossible to pinpoint when any given bus will arrive, although the waiting times weren't unreasonably long. We were told buses arrived at a frequency of anywhere in between five to fifteen minutes. Bus fare charges CNY1 – CNY3 per person, but there is a discount on the normal ticket fare when paying with the Hangzhou Multifunction Transportation Card. Children shorter than 1.3 meters can ride for free, and passengers planning on paying in cash must give exact change or overpay without refund.

Figure 21: Hangzhou Bus Interior

We paid with the Multifunction card, which was very easy to use. Passengers could also use Alipay to pay for the bus. Either method was simply swiped at a terminal upon entering the bus. Neither the stops nor the buses themselves were very crowded. Speakers and LED signs on the bus indicated upcoming stops and warned passengers to prepare to exit before reaching the stop. The target audience was anyone who wanted to use inexpensive public travel and weren't on too tight a schedule. While the buses seem to be well used, they weren't very crowded at the times we have used them. The bus was moderately safe, it had handrails and seats but no seatbelts, and the drivers drove safely. Around every bus stop, a bus only lane of varying length started, sometimes extending all the way between stops. The buses were clean

and well kept. Overall the buses were a cheaper but somewhat less convenient alternative to the metro. The wait time and travel time were both moderately slower than the metro.

4. Shared Bikes

Hangzhou's shared bike system is corporately owned and is designed to supplement the public bike system operated by the government. The bikes require a phone application, so some people rely on taking bikes that people forget to lock. Shared bikes had no stations, but were readily available in most places in the city. In fact, there were sometimes hundreds of bikes together in lots near metro stations. In general, the distribution of bikes varied greatly from area to area and shifted throughout the week as people used them. We noticed workers using mopeds with trailers or trucks occasionally repositioning bikes a number of times. Unfortunately, not all bikes worked with all apps, so it could take time for a rider to find a bike they could actually use. We noticed that some areas of Hangzhou were cluttered with different types of shared bikes, occupying much of the public space.

Figure 22: Ofo bikes in walkway

Figure 23: Shared bikes in walkway

Each brand of bike is uniquely colored to assist this process. The cost of the bikes was CNY1 per hour or often free for short trips, although riders must put down a deposit to use them. Bike rides were fairly quick as the user could pick their own route and bike quickly. The target audience of shared bicycles was primarily younger people, but anyone physically able could be seen riding them. While there were distinct bike lanes alongside roads increasing safety, they were not strictly one way, so riders have to be careful of traffic passing both ways in the lane. Bikers also had to share these lanes with mopeds and sometimes other small vehicles. With the help of our HDU colleagues, we rode the yellow OFO bikes. The basket on the front of the vehicle was attached to the body of the bike, not the wheel like American bikes, and was more difficult to steer. One user who was carrying a larger bag struggled with operating the bike, proving that they are not ideal for heavy loads.

During the physical inspection one team member got into a minor accident, although there were no injuries. The bikes were operable, and generally clean, but some were damaged and did not ride straight. Many but not all of the bikes had baskets on them in varying shapes and forms. Overall they were easy to use and convenient for short distances, but not as safe as other forms of transit.

5. Hired Cars

Hangzhou has two main kinds of hired cars, taxis and Didi cars, which are nearly indistinguishable from each other. Taxis function as they do anywhere, pedestrians can wave down or call cars as needed. Didi, an app platform similar to Uber in the United States, can be used on a phone or through Wechat to call cars. Didi is used as much, if not more, than normal taxis, as we did not observe a large numbers of marked taxis. We eventually took both a Didi and regular taxi. Both vehicles were clearly worn but also clean and functional cars, and we did not have any safety issues while driving. Traffic can be a major issue for taxis, but we never experienced undue delays from it. Taxi fares start with a starting cost of CNY11 which then

increases by anywhere from CNY2 to CNY4 per kilometer. Didi cars, on the other hand, have a flat CNY2.5 rate per kilometer. With both methods, finding your car can be a challenge, even with the GPS locating of Didi. Streets are often crowded and there are very few places for taxis to stop, other than on the side of the road. In summary, taxis are a relatively fast but expensive method of travel. While they avoid the constant stopping of buses, traffic can still be a detriment.

Appendix D: Focus Group Protocols

Appendix D1: Focus Group Protocol Version 1

1. Begin with an introduction:
    a. Welcome and thank everyone for volunteering to participate in the focus group.
    b. Introduce the WPI moderators, HDU translator, and scribe(s).
2. Briefly review the purpose of the focus group in relation to the entire project.
    a. *The purpose of this focus group is to gauge transportation satisfaction in Hangzhou. We will ask you about different aspects of transportation. Please tell us how satisfied you are with each type of transportation you use for the given feature, and explain why you feel that way.*
3. Review guidelines and expectations for participants.
    a. There are no “right” or “wrong” answers, only different points of view. This is a safe zone, so feel free to speak your mind.
    b. Ask the participants if it is acceptable to tape record the session.
    c. If you do not understand a question, please stop one of the moderators and ask for further explanation.
    d. Please turn off any cell phones.
    e. One person will speak at a time.
    f. Listen respectfully to others when they are speaking.
    g. Please stay on topic.
4. Guided Discussion Points
    a. What types of transportation use for the following purposes:
        i. Work / Commute
        ii. Shopping / Leisure

b. What do you like and dislike about each of the different types of transportation?
c. Do you think the system could be improved? If so, how?
d. What categories are most important to you when choosing a type of transportation for the following purposes:
    i. Work / Commute
    ii. Shopping / Leisure

5. The moderator will restate the purpose of the study and then will ask the participants: "Have we missed anything?"
6. Thank everyone for participating.

Focus Group Set-up (day of):

Role assignments should be completed at least one day prior to the focus group. Arrival should be at least 30 minutes prior to start time to prepare any refreshments (tea or fruit) and protocol material. Moderators should discuss the order in which topics will be discussed and who will say what.

- People and Materials
    - (2) Moderators – WPI Students
        - (2) Laptops with focus group protocol to refer to
    - (1) Translator – HDU Student or Faculty member
    - (1-2) Scribes – WPI Students
        - May use laptops to document conversation and any noticeable body language.
- Location
    - (1) Faculty Focus Group: Building 9, Room 118: Sociology Department
    - (1) Boye Software Company Focus Group

Appendix D2: Focus Group Protocol Version 2

1. Begin with an introduction:
    a. Welcome and thank everyone for volunteering to participate in the focus group.
    b. Introduce the WPI moderators, HDU translator, and scribe(s).
    c. Explain activity: questionnaires first, then focus group.
2. Briefly review the purpose of the activity and focus group in relation to the entire project.
    a. *The purpose of this focus group is to discuss how satisfied you and others are with transportation to allow us to gauge transportation satisfaction in Hangzhou. We will ask you about different forms and aspects of transportation. Please tell us your thoughts on each method of transportation you use for the given feature, and explain why you feel that way. In order for you all to have a better understanding of the subject please take this questionnaire.*
3. Review guidelines and expectations for participants.
    a. Explain the questionnaire guidelines and expectations.
    b. There are no “right” or “wrong” answers, only different points of view. This is a safe zone, so feel free to speak your mind.
    c. Everything said in this room is said in confidence, no one’s opinions will be shared in any way as to identify that person.
    d. Ask the participants if it is acceptable to tape record the session.
    e. If you do not understand a question, please stop one of the moderators and ask for further explanation.
    f. Please turn off any cell phones.
    g. Only one person should speak at a time.
    h. Listen respectfully to others when they are speaking.

i. We ask that you please try to stay on topic, but if the conversation strays too far the moderator will bring everyone back on topic.

4. Guided Discussion Points
    a. What types of transportation use for the following purposes:
        i. Work / Commute
        ii. Shopping / Leisure
    b. What do you like and dislike about each of the different types of transportation?
    c. Do you think the system could be improved? If so, how?
    d. What categories are most important to you when choosing a type of transportation for the following purposes:
        i. Work / Commute
        ii. Shopping / Leisure
    e. Briefly review the questionnaire and ask for explanations of questions on the most popular forms of transportation for that group.
5. The moderator will restate the purpose of the study and then will ask the participants: "Have we missed anything?"
6. Thank everyone for participating.

<u>Focus Group Set-up</u> (day of):

Role assignments should be completed at least one day prior to the focus group. Arrival should be at least thirty minutes prior to start time to prepare any refreshments (tea or fruit) and protocol material. Moderators should discuss the order in which topics will be discussed and who will say what.

- People and Materials
    - (2) Moderators – WPI Students

        - (2) Laptops with opened focus group protocol for reference
    - (1) Translator – HDU Student or Faculty member
    - (1-2) Scribes – WPI Students
        - May use laptops to document conversation and any noticeable nonverbal behavior that may enhance understanding.
- Location
    - (2) Student Focus Groups: Building 11, Room 422: Sociology Department

Appendix E: Questionnaire Iterations

Appendix E1: Initial Questionnaire

City Satisfaction Survey

We are interested in gathering data about transportation satisfaction in Hangzhou, China. This data is intended to improve the Hangzhou transportation system. All responses are anonymous and no identifying information will be used. Please take a few minutes to answer our questions. Your responses are important to us.

Demographics

Please answer some demographics questions before continuing to the survey.

Age	< 18	19-30	31-50	51-75	> 76
Gender	Male	Female			
Years living in Hangzhou	< 1 year	1-3 years	4-5 years	6-10 years	> 10 years
Which economic class do you fall under?	Low class	Low-middle class	Middle class	Upper-middle class	Upper class
Commute distance	< 1 kilometers	2-5 kilometers	6-10 kilometers	10-25 kilometers	> 26 kilometers

If you do not use a specific type of transportation, please skip the rest of that section.

Public Transportation

Please circle your answer.

Trains					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly	Mildly	Neutral	Mildly	Strongly

	Dissatisfied	Dissatisfied		Satisfied	Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Crowdedness	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Train Stations	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Buses					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Crowdedness	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Bus Stations	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Bikes (Rented)					
Frequency of	Never	Once a	Once a week	Once per day	Multiple times

Use per week		month			per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Traffic	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Bike Stations	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Mopeds (Rented)					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Traffic	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Rental Stations	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Water Transit					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Crowdedness	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Ferry Stations or Docks	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Taxis					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Availability	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Personal Transportation

Please circle your answer.

Bikes (Owned)					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Traffic	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Bike Racks	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Mopeds (Owned)					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Travel Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly	Mildly	Neutral	Mildly	Strongly

	Dissatisfied	Dissatisfied		Satisfied	Satisfied
Traffic	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Parking	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Car (Owned)					
Frequency of Use per week	Never	Once a month	Once a week	Once per day	Multiple times per day
Commute Time per trip	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Travel Cost	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Improvement	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Sanitation	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Traffic	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Safety	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied
Parking	Strongly Dissatisfied	Mildly Dissatisfied	Neutral	Mildly Satisfied	Strongly Satisfied

Hangzhou, China
City Satisfaction Survey

We are interested in gathering data about transportation satisfaction in Hangzhou, China. This data is intended to improve the Hangzhou transportation system. All responses are anonymous and no identifying information will be used. Please take a few minutes to answer our questions. Your responses are important to us. Feel free to skip any question you cannot or do not want to answer.

Part 1: Demographics

Check your corresponding age, gender, residence, and income.

Age	❑ < 18	❑ 19-30	❑ 31-50	❑ 51-75	• > 76
Gender	❑ Male	❑ Female			
Years living in Hangzhou	❑ < 1 year	❑ 1-3 years	❑ 4-5 years	❑ 6-10 years	❑> 10 years
Household or family income	❑ 0-20,000	❑ 20,000-100,000	❑ 100,000-200,000	❑ 200,000-500,000	❑ 500,000+

Part 2: Open Ended Questions

Check how you prefer to pay for transportation

❑ Cash ❑ Alipay ❑ WeChat ❑ Credit Card

Please write how many times you use each type of transportation per week.

	Metro	Buses	Bikes: Public	Bike: Apps	Bikes: Personal	Taxis	Hired Cars	Cars	Water Transit	Moped
Number per Week										

Write your preferred form of transportation for each distance below.

	<1 km	2-5 km	6-10 km	10-25 km	>25 km
Preferred Method of Transportation					

When you go to work, check which modes you use:

❑ Metro ❑ Buses ❑ Public Bike ❑ Shared Bike ❑ Personal Bike ❑ Taxis ❑ Hired Cars ❑ Cars ❑ Water Transit ❑ Moped

When you go shopping/hang out, check which modes you use

❑ Metro ❑ Buses ❑ Public Bike ❑ Shared Bike ❑ Personal Bike ❑ Taxis ❑ Hired Cars ❑ Cars ❑ Water Transit ❑ Moped

Part 3: Satisfaction Chart

Please answer on a scale of 1 to 5. If you do not use a type of transportation, skip the column.
1 = very dissatisfied 2 = dissatisfied 3 = neutral 4 = satisfied 5 = very satisfied

City Satisfaction										
Contributing Factors	Public Transportation							Personal Transportation		
	Type							Type		
	Metro	Buses	Bikes: Public	Bike: Apps	Water Transit	Taxis	Hired Cars	Cars	Bikes	Moped
Number of Stations										
Location of Stops										
Waiting Time										
Damage										
Environmental Impact										
People Traffic										
Car Traffic										
Ease of Use										
Cleanliness										
Safety										
Number of Stations										
Location of Stops										

Hangzhou, China City Satisfaction Survey

We are interested in gathering data about transportation satisfaction in Hangzhou, China. This data is intended to improve the Hangzhou transportation system. All responses are anonymous and no identifying information will be used. Please take a few minutes to answer our questions. Your responses are important to us.

Part 1: Basic information

1. Your age:
   ①≤18 ②19-30 ③31-50 ④51-75 ⑤≥76

2. Your gender:
   ①Male ②Female

3. How long have you lived in Hangzhou?
   ① < 1 year ②2-3 years ③4-5 years ④6-10 years ⑤ > 10 years

4. Family annual income:
   ① < 20,000 RMB ② 20,000-50,000 RMB
   ③ 50,000-100,000 RMB ④ 100,000-200,000 RMB
   ⑤ > 200,000 RMB

Part 2: The open ended question

1. Which way do you prefer to pay for transportation?
   ① Cash ② Alipay ③ WeChat Pay ④ Credit Card

2. Please tick (√) selected weekly use of each transport mode frequency.

		Frequency				
	Types	**Never**	**Seldom**	**Sometime**	**Often**	**Always**
Public Transportation	**Metro**	1	2	3	4	5
	Bus	1	2	3	4	5
	Public Bikes	1	2	3	4	5
	Taxis	1	2	3	4	5
	Water bus	1	2	3	4	5
New Transportation	**App Taxis**	1	2	3	4	5
	Shared Bikes	1	2	3	4	5
Personal Transportation	**Car**	1	2	3	4	5
	Bikes	1	2	3	4	5

Moped	1	2	3	4	5

3. What kind of transportation do you prefer in different distance, please tick (√)
(You can have multiple choices.)

Type	Car	Metro	Bus	Taxis	App Taxis	Moped	Public Bikes	Bikes	Shared Bikes	Water Bus	Walk
< 1km											
2-5 km											
6-10 km											
10-25 km											
>25 km											
Work											
Shopping or Stroll											

Part 3: Satisfaction

Please choose(√) your commonly used means of transportation and answer on a scale of 1 to 5, 1 represents very dissatisfied, 3 represents neutral, and 5 represents very satisfied. If you do not use a type of transportation, skip the column.

1. Satisfaction regarding Personal Vehicles

Personal			
tick (√)			
Contributing Factors	Car	Moped	Bike
Parking			
Traffic jam			
Cost			
Security			

2. Satisfaction regarding Public Transportation

Public			
tick (√)			
Contributing Factors	Metro	Bus	Water bus
Number of stations			
Location of stations			
Waiting time			
Sanitation			
People traffic			
Cost			
Speed			
Security			

3. Satisfaction regarding Taxis

Taxis		
tick (√)		
Contributing Factors	Taxi	App Taxi
Waiting time		
Broken or not		
Sanitation		
People traffic		
Cost		
Traffic jam		
Speed		
Security		

1. Satisfaction regarding Bikes

Bikes		
tick（√）		
Contributing Factors	Public Bikes	Shared Bikes
Number of stations		
Number of bikes		
Broken or not		
Cost		
Traffic jam		
Speed		
Security		

Appendix F: Interview Protocols

Formal interviews will be conducted with employees of the transportation system including bus and taxi drivers and social workers. The purpose of these interviews is to get an alternative viewpoint on the transportation system, but also to receive feedback on our suggestions. These interviews will be conducted with the assistance of HDU students acting as translators. Specific questions tailored to the interviewees' field of work.

Thank participants for attending.

Thank you for taking the time to participate in this interview.

Introduce the team. Discuss project purpose and goals of the meeting.

Hello, we are students from America, and our project seeks to understand what Hangzhou's residents think of the transportation system in order to recommend solutions. We would like to ask you questions about your job, and how it relates to the city's transportation.

Review guidelines and expectations for the meeting. Ensure audio recording is acceptable.

Everything you tell us will be in confidence and you will remain anonymous. Would it be okay to record this session for later review? If you have any questions about our questions or project, please ask us.

Appendix F1: Bus Driver Interview Questions:

1. Which route do you drive?
2. Can you describe to us the nature of your job and about your company?
3. What do you think of the bike lanes and bikes around Hangzhou?
4. How do drivers take breaks and how does the system work?
5. What do you think of the traffic safety in Hangzhou?
6. How is the quality of the vehicle?

Appendix F2: Bus Operator Interview Questions:

1. Why do you think people choose or do not choose busses?
2. Can you tell us what the bus schedule is like?
3. Do you have any recommendations on future improvement?
4. Do you feel that the busses are timely/are wait times acceptable?
    a. How do you feel about the lack of a regular schedule?
5. What do you think the quantity and/or distribution of busses?
6. Is there any place (website, office) we can go to learn more about the bus routes? (Map of routes or stops)

Appendix F3: Ofo Manager Interview Questions:

1. How long have you been working at OFO?
2. What are your daily responsibilities?
3. What is good about OFO bikes?
4. What do you dislike?
5. What could be improved?
6. Compared to government bikes, how is OFO different?
7. Is there a lot of bike traffic?
8. What do you think about the number of OFO bikes?
9. If there is a damaged bike, what do you do?
10. How often are the bikes redistributed?
    a. How do you decide how to distribute them? What areas are higher priority, if there are any other than around metro/bus stations?
11. How often are the bikes repaired/taken out of service?
    a. Are bikes checked often for damages?
12. What are some improvements you think could be made to improve user satisfaction with your and other companies' shared bikes?

Appendix F4: Didi Taxi Driver Interview Questions:

1. How long have you been working?
2. What is the day to day work like?
3. How do you get to work?
4. What do you think of the shared bike system in Hangzhou?
5. What does it mean for you to be a DiDi Ride-Sharing Driver?
6. How is the traffic in your region?
7. Are there any improvements that you can think of for transportation within Hangzhou?
8. Why do people choose Didi over other options?
9. What rules do you have to follow as a Didi driver?
10. How would you improve Didi? Do you see it changing much in the future?

11. Do you receive feedback from Didi or the passengers?

Appendix F5: Taxi Driver Interview Questions:

1. How long have you been working as a driver?
2. What do you think is good about taxis?
3. How do you think normal taxis compare to Didi?
4. What do you think can be improved with normal taxis?
5. What do you think about the road traffic?
6. Are there too many taxis? Is there much competition?
7. Why do people use taxis over other types of transportation?
8. Are you satisfied with your current job?

Appendix G: Focus Group Transcripts

Appendix G1: Faculty Focus Group Transcript

City Satisfaction
Focus Group Meeting Minutes
10/30/2017 (Monday)
10:00 - 11:30 AM, HDU Campus Building 9

Chairs: Emily and Rosie
Secretaries: Michael and Ryan
Translator: HDU Faculty
Attendees: 8 HDU Faculty Members

Introduction

- Chairs opened the floor with an introduction and welcoming remark to all of the participants.
- One professor acted as the main translator, and was the person we listened to for the bulk of the translation.
- Discussion was audio-recorded for further analysis with given consent.

Discussion

- Which vehicles do each of you use for daily commute / leisure?
    - Private vehicles, if owned, are used often for daily commute, but only a few members mentioned ownership as they can be quite expensive.
    - Metro seemed to be used often for non-daily travel, to hang out or go shopping.
    - For HDU Faculty specifically: employees are provided a school bus that takes them to and from work to increase ease of use and reduce cost of living.

For each of the following types of transportation, the following questions were asked:

a. What do you like about this transportation? Please explain your reasoning as to why you feel that way.
b. What do you dislike about this transportation? Please explain your reasoning as to why you feel that way.
c. Some sections had additional follow-up questions tailored specifically to that transportation type. These questions will be listed under each sector of transportation.

Shared Bikes:

a. Pros
    i. Everyone agreed that shared bikes were definitely the most convenient method of transportation. It is a great way to get around the city, it reduces traffic & pollution. It is inexpensive, which further encourages us to use it over other methods.
    ii. Used often as the 'last leg' of a trip since you can get to any location easily and quickly with bikes.
    iii. Shared bike is a supplement to public bikes, but could use more rigorous administration and regulation. They occupy public space since they can be placed anywhere, which can clutter the public area.
    iv. Shared bikes have sprung up very quickly this year, especially in Hangzhou. Other cities by comparison, do not have quite as many. Bike share systems require quite a bit of time to develop and improve, so it will only get better as time goes on. One participant thinks that most issues will be resolved within 2-3 years from now.
b. Cons
    i. The placement and distribution of bikes around the city can be unreliable at times, in addition to the codes not always working. One mentioned that the bike quality is lacking, but the rest did not seem to have any issues with the quality.
c. How do you feel about the safety of shared bikes?
    i. As for safety, everyone seemed to agree that it is not a serious issue because bike lanes are almost everywhere. It is dependent on the skill of the user. One participant said any issues are minor and can be solved with time.

Public Bikes:

a. Pros
    i. Very inexpensive to use, excluding the initial deposit. Otherwise it is free to use.
b. Cons
    i. While they cost nothing, you do have to pay a deposit, which you receive when you return the bike. This deposit can be quite costly for some people, and range from 100-200 RMB.
    ii. In comparison to the shared bikes, these government bikes are not as convenient because they are still limited by location.
c. Can you tell us more about the government bike system set in place in Hangzhou?
    i. Government bikes are different from shared bikes in that you have to go from one specific locations to another. These station locations are often placed by metro stations.

ii. Have been present for a while in many cities, but is being overtaken by shared bikes.

Private Bikes:

a. Pros
    i. Good to use if you don't have access to a working mobile phone. One participant doesn't have a cell phone, and owns private bike because she can't use the shared bikes without one.
    ii. Another uses a private bike simply so that she can take it wherever she wants, like inside of school buildings to store it between trips.

Private Cars:

a. Pros
    i. Private cars are better for longer distance trips. Most seemed to agree that cars are needed for trips longer than a half-hour bike ride (5-10 miles).
    ii. Private cars are convenient when going grocery shopping, as parking is free and having the space to store bags is almost necessary.
    iii. There are enough gas stations, it is not prohibitively expensive.
b. Cons
    i. There are some traffic issues, which is perhaps the main reason why people avoid using cars. Parking can be expensive and hard to find depending on location. However, parking near schools and hospitals is fine.
    ii. There are many other options that have different or less drawbacks, which may encourage others to use public transportation instead.
c. What are some decisions people make when deciding what to use/own for private vehicles?
    i. Bikes and cars seem to be the most commonly used private forms of transportation, with the distinction between the two being distance traveled per trip.
    ii. Used to be a very large number of cars used, but over time bikes have risen and reduced the need and use of cars. Now there aren't as many car owners.
    iii. Parking can be expensive, between 4 and 10 RMB or even more.
    iv. Cars seem to have specific instances where they are very useful and advantageous, but otherwise don't have any benefit.

Bus:

a. Pros

i. It is very inexpensive.
ii. As for safety, buses are generally good about obeying traffic laws. No one felt particularly threatened by their driving. The participants stressed that they are good about letting pedestrians cross.
iii. Bus stops also give alerts when buses are coming so you know which ones are close
iv. Everyone seemed to agree that buses are reliable and timely.

b. Can you tell us more about the different payment options and lines offered in Hangzhou?
    i. There are several payment options: four different types, total. One of which is a monthly card, which gives unlimited rides and is a great option if you use it a lot. There are also elderly cards (half cost), student cards, and senior cards. Bus rides are free for riders older than 70.
    ii. There are also many different bus lines that are offered to the public like: holiday line, tourist line, speed line, night line, and lines between urban and rural areas

<u>Metro</u>:

a. Pros
    i. Metro lines between cities are currently being constructed, which everyone seemed to be happy about. As for construction specifics, many lines are being added within the city so that within the next decade there will be a total of ten lines running through every district. Everyone is sure it will be widely used once it is complete.
b. Cons
    i. The metro is more expensive than other methods. Everyone seemed to agree it is on the more expensive side, and especially compared to that of other large cities like Beijing and Shanghai.
c. When would you use the metro?
    i. The metro is often used as the main leg of distance, with the rest of the remaining length covered by the shared bike. Additionally, you can sometimes ride the bus for free after taking the metro depending on distance travelled, which offsets the initial cost.
d. What do you think of the security checks in the metro?
    i. Security checks seem to be a deterrent. None of the participants expressed a particular appreciation for them and some thought they were redundant. People are worried about them being harmful, specifically the metal detector (called them x-ray). An argument over security started between participants, from which we only gathered the main points.
e. General Observations

i. No one really seemed to be overly fond of the Metro as a whole.

Taxi:

a. Pros
    i. Because not everyone has a private car, this fills an important gap when necessary. Some examples of situations when people would utilize this service includes emergencies or when you need to get somewhere in a hurry.
    ii. It is used often for trips like going to the airport or whenever you need to carry luggage or bags with you.
b. Cons
    i. Both forms of taxi are more expensive, but worth it when needed.
    ii. It is expensive, however, and may be upwards of 100 RMB for a one-way trip to the airport.
c. How is Didi different from normal taxis?
    i. No one made much of a distinction between Didi car (Chinese Uber) or general taxis when asked. They said that app taxis are a little less expensive and more convenient if you own a good mobile plan.

Preferences / General Observations:

- When commuting to work people seem to prioritize convenience over everything.
- For general personal travel convenience is still the priority for most people. Those with private cars tend to use them for personal travel. Often times transportation isn't needed since there are many malls and grocery stores within walking distance.
- The purpose of the trip has a huge impact on the transportation used.

Appendix G2: Student Focus Group Transcript

City Satisfaction
Focus Group Meeting Minutes
11/3/2017 Friday
10:00 AM HDU Building 11 Room 208

Chair: Michael
Secretary: Emily
Translator: Cindy
Attendees: 10 HDU Sociology Students

Introduction:

- Cindy introduced the two chairs, Emily and Michael, and reviewed the guidelines and expectations for the talk.
- She told them the general expectations for focus groups and promised that their anonymity would be respected, as well as guidelines for participating in one.
- This means no cellphones, remaining quiet unless it is your turn to speak, as well as respect for others when they are speaking.
- Discussion was audio-recorded for further analysis with given consent.

What method of transportation do you prefer for going to classes / work? For shopping / leisure?

- The methods that the participants used to go to work included shared bikes, Ofo, walk, and subway. The methods that the participants used when shopping included subway, bus, and DD cars.

For each method of transportation, the following questions were asked:

a. What do you like about this type of transportation and why?
b. What do you dislike about this type of transportation and why?

Shared Bikes:

a. They liked bikes because there are many available, it is convenient and it saves time. Ofo has a student discount and the basket is nice to have. Also the bike lane makes it convenient and safe to travel. Since shared bikes are so popular and are found almost anywhere, it is not necessary to buy a personal bike.
b. They did not like the bikes because they are often broken and in between classes not a lot of bikes are available because the workers do not move them on time. They said people often leave bikes in the walkway so the walkways get very congested. Different

companies compete with their bike sharing services and each of them has too many bikes. Also the deposit is very expensive CNY 200. They said workers do not dispose of or fix broken bikes and there is no manager for the bikes, except for Ofo. Sometimes cars will park in the bike path, but there are no police to punish them.

Uber/Taxi/DD car:

a. They liked DD cars because they can know the price and route before the car arrives. They can also request a car with food and water. The drivers are funny and nice. It is convenient because the wait time is not long and one can choose to share a ride to make the price cheaper.
b. They do not like taxis because they do not know the price or route before the taxi arrives. The drivers are serious and would not ask if they want to share a ride or not. The price can also be too expensive.

Walking:

a. They liked walking when the weather is good and when they want to buy something little at the shopping mall near the university. If they have a lot of free time, have not exercised in a while, or just ate a big meal they will walk to their destination.

Metro:

a. They liked the metro because there is no traffic jams, sanitation is good, faster than other methods, white stations make people feel comfortable, pretty decorations and entertaining cultural television.
b. They did not like the metro because it gets crowded, the location of stations is sometimes inconvenient, some stations do not have escalators that go down, some people eat smelly food, the air quality is not good inside the train car, not enough lines to popular places, not enough seats, fake advertisements, cost is high, center station is confusing about the opposite side of the platform, some stations have no elevators so when they carry a heavy bag they have to take the stairs, signs are confusing, security check belt is high so if you have a heavy bag it is difficult to lift, only one line to West Lake so it takes a long time with no seat.

Boat:

Those who took the boat did not like it because the people are rude and the water is dirty.

Bus:

a. Those who use buses like it because they can use Alipay, it is convenient, and stations have a guardrail to prevent cutting in line.
b. They did not like it because the student discounts are not enough and some stations do not have a guard rail

What improvements would you make to the transportation system, and why?

- Add more seats to the subway.
- Improve bike quality of OFO vehicles.
- Improve clarity of bus schedule lines.
- Increase number of buses on holidays and weekends.
- Increase the number of subway lines.
- Introduce trolley cars around campus like the ones that go around West Lake.
- Introduce the option of being able to open a window on the bus to allow fresh air to flow.
- Forbid private cars downtown and around West Lake during festival/holiday/weekend time. The no driving rule should be according to driver license number not license plate because people can lend cars to others.
- People should be held liable for proper bike use and treatment.
- Taxi driver may refuse you if you want to go short distances such as 2 km, so get rid of this option.
- Be able to use Alipay to recharge transportation card since you can use Alipay for single use

General Notes:

- The participants thought that the rules of transportation in Hangzhou are good because pedestrians are given the right of way.
- They thought that the subway was the safest and fastest method. Sometimes DiDi car can be faster depending on the location since you can go directly to the location without stopping.
- They like using Alipay, but Union pay is competing by offering large discounts.
- When they are shopping, they most care about the speed of transportation.
- When they are going to work, one thought the location of the station is the most important feature. Two said safety, two said price, and three said speed.

Appendix G3: Boye Focus Group Transcript

City Satisfaction
Focus Group Meeting Minutes
11/6/2017 (Monday)
4:00 - 5:00 PM Boye Office Building

Chairs: Michael and Ryan
Secretaries: Rosie and Emily
Translator: Cindy and Sophie
Attendees: 5 Boye Employees

Introduction

- Cindy began the meeting by introducing everyone and discussing the purpose of the meeting.
- She told them the general expectations for focus groups and promised that their anonymity would be respected, as well as guidelines for participating in one.
- This means no cellphones, remaining quiet unless it is your turn to speak, as well as respect for others when they are speaking.
- Discussion was audio-recorded for further analysis with given consent.

Participants

Each of the members was asked the following questions:

- What is your role within the company and how long have you been working there?
- What preferred method of transportation?

1. Boss
    a. Handles business with other companies. Has worked for 6 years.
    b. Owns a private car
2. Assistant to Boss
    a. Administrative daily tasks. Has worked with the company for 5 years.
    b. Metro
3. Software Engineer 1

    a. Coding. Has worked for the company for 2 years
    b. Moped
4. Software Engineer 2
    a. Has worked for the company for 4 years.
    b. Metro
5. Marketing Manager
    a. Works on company brand and labelling
    b. Metro

For each of the following methods of transportation, the following questions were asked of the group. The focus group was quite formal, and each member said their comments one by one, down the line. Notes were taken by employee role.

a. What do you like about this transportation? Please explain your reasoning as to why you feel that way.
b. What do you dislike about this transportation? Please explain your reasoning as to why you feel that way.
c. How do you think this type of transportation can be improved?
d. Some sections had additional follow-up questions tailored specifically to that transportation type. These questions will be listed under each sector of transportation.

Metro:

- Assistant and Coder:
    - They think the metro is convenient because where they live is close to the station. No clear disadvantages.
- Engineer and Manager:
    - They seldom use the metro. One owns a moped, so only uses the metro when the distance is long. When on the metro, they said that it was easy to use, but usually pretty crowded. Payment methods are also convenient. Weather also heavily affects the metro.
- Boss:
    - The metro is four years old, and the sanitation is also good. It's clean, the decoration is pretty and creative. There are only 3 lines so it can't really compare to that of Nanjing, Beijing, Shanghai.

DD car:

- Boss:
    - He uses this option primarily when he knows he's going to drink or party.

        - There is a feature within DiDi that allows users to have someone drive their car home if needed. He uses this when he knows he will be unable to drive his car back home if he goes out to drink.

Taxi:

- Assistant:
    - Only one user said she used normal taxis, and she did not make any comments about the taxi.

Moped:

- The one moped user mentioned that it is more convenient than the metro. It allows users to arrive to their destination directly. There is no fixed time schedule users must follow to use the mopeds, and they are also ideal for shorter distances.
- One negative to using mopeds is that it is dependent on the weather outside, and charging it can be quite an issue with parking and general travel. The power conditioner may be stolen.

Walking:

- Participants agreed that they would be willing to walk only if the distance was less than 2km; otherwise, it would be too inconvenient.

What are your preferred methods of transportation when going out shopping or for leisure?

- Assistant preferred to walk because the supermarket is close to her home.
- One of the software engineers preferred to walk.
- The marketing manager preferred DiDi or walking.
- The boss preferred private car or walking, depending on distance.

What are some improvements that the city of Hangzhou can do to increase user experience with transportation?

- Increase regulation of shared bikes on public walkways. This can be carried out by the government.
- Increase the number of metro lines available.
- Increase equal distribution of available bus stops throughout Hangzhou. For example, downtown Hangzhou has significantly more stops than the Xiasha district.
- Increase regulation, organization, and availability of private parking in the city.
- Increase frequency of metro stops; wait time is too long between trains.

Do you feel that driving a moped in traffic is safe?

- Safety depends on the skill and patience of the driver.

How do you think Hangzhou's Bike Share system compares to that of other cities?

- One preferred public bikes because they are better quality, free after deposit, and only require a citizen card to use.
- Others preferred shared bikes because of convenience and greater abundance. However, the quality is not as good as public bikes.

Of all the mentioned factors when deciding on a method of transportation, which do you think are the most important?

- Punctuality; reliability(2)
- Convenience
- Comfort
- Speed (3)
- Price

Has anyone taken the public bus system in Hangzhou? If so, what were your experiences; what did you like, and what did you dislike?

- No one in this focus group had used the bus system.

What do you think about the security checks in the metro?

- Some mentioned that while they are troublesome, they are also necessary to stop terrorists.
- The boss said that these stations were unnecessary because we need to trust people more. Maybe the police can check our ID's instead of the x-ray machines.
- These stations delay passengers during rush hour. While the body scans don't take much time, the long lines can be aggravating.
- Checking ID card may not be a good solution, as it will take more time

Appendix H: Interview Transcripts

Appendix H1: Didi Driver Interview Transcript

City Satisfaction
Interview Minutes
11/7/2017
Housing Real Estate Office

Chair: Ryan
Secretary: Emily
Translator: Two Sophomore HDU Students
Interviewee: Social worker who part-times as a Ride-Share Didi driver

Discussion:

1. How long have you been working here?
   I've been working under Didi for 3 years.

2. What is the day to day work like?
   I service the residents. I also do additional things like fix the electricity and manage my tenants.

3. How do you get to work?
   I use my private car, but one inconvenience I've noticed is private parking.

4. What do you think of the shared bike system in Hangzhou?
   It is convenient because if you ever run into an issue with bike quality, you can always call someone to come and repair it. There are too many bikes along public walkways, and it disrupts the town's layout. Many bikes aren't great quality, and are usually broken.

5. What does it mean for you to be a DiDi Ride-Sharing Driver?
   I drive along my specified route and pick up university students along the way. They are all very nice, and easy to deal with. This job covers about 80% of all my gas bills, including recreational use. There is a rule for Didi drivers that you must replace your car every 8 years you work for them, but as a ride-sharing driver, I can bypass this rule. In my area, there are no subway stations, so many users use this app to finish the last portion of their trip.

6. How is the traffic in your region?

It’s not too bad, and is only busy during the morning and evening rush hour periods.

7. Are there any improvements that you can think of for transportation within Hangzhou?

There should be more subways near my workplace. This would decrease workflow and make it more convenient for users. They should also control the number of shared bikes in the area, and maybe create a station for these shared bikes to be placed into. Right now the government bikes are cleaner, but they are too expensive right now and not as convenient.

Appendix H2: Taxi Driver Interview Transcript

City Satisfaction
Interview Notes
11/15/2017
Taxi Rides

Interviewer: Cindy and Sophie
Interviewees: Two normal Taxi drivers
Assistants: Rosie, Ryan, Emily and Michael

Notes on Two Normal Taxi Driver Semi-Structured Interviews

- Two taxi drivers were interviewed by two teams of HDU + WPI students, respectively. Each team consisted of one HDU student and two WPI students. The HDU student asked the questions, and the WPI students were there to answer any questions the HDU student might have.
- Each HDU student took notes in Chinese, which they later gave to the WPI students after translating them into English.
- Both taxi drivers were asked the same base set of questions, but were structured to leave enough room for flexibility if the driver was not responding well to the given question.

Questions asked of each Taxi Driver

1. How long have you been working as a driver?

    I have been a taxi driver for 3 years.

2. What do you think is good about taxis?

    I think taxis are safer than Didi's because normal taxis are all licensed taxi drivers and belongs to a company. Unlicensed drivers in Didi can introduce liability issues.

3. How do you think normal taxis compare to Didi?

    I don't like Didi because there is too much competition. I had to join Didi to keep up with the rest of the drivers. Half of my business is from the Didi platform, and the other is from normal taxi business.

4. What do you think can be improved with normal taxis?

The traffic signal rules should be improved upon to be fairer. The traffic monitor should be combined with machine and human. Roads are not well designed for heavy traffic. Turn lanes in particular are often too narrow, or there will only be one which slows down traffic even though there is no one going straight. Often lines form at turn lanes even though the three ‘straight roads’ will be empty. Because parking is difficult to find, this makes finding and picking up passengers difficult.

5. What do you think about the road traffic?

Traffic is very crowded. Bad days can have up to 30 minutes of extra waiting.

6. Are there too many taxis? Is there much competition?

Yes, there is too much competition.

7. Why do people use taxis over other types of transportation?

Taxis are preferable because parking for private vehicles is very hard to find.

Taxi Driver 2:

1. How long have you been working as a driver?

I have been a driver since 2009, so 8 years now.

2. How do normal taxis compare to Didi taxis?

People prefer to take app taxis when choosing taxis, even though the app can call normal taxis and Didi drivers. Almost all taxi drivers use apps to get more business.

3. What do you think of the traffic?

Traffic downtown is far worse, but many more people call taxis downtown.

4. What is good about normal taxis?

I rent a car from a taxi company, so I don’t have to pay insurance on the car or have to deal with maintaining the car to meet taxi standards. Some drivers work 9AM – 10PM and can earn 10,000RMB a month.

5. Are you satisfied with your current job?

I am satisfied with my salary and I feel like I can earn more working this job than at a normal public institution.

Appendix H3: Bus Driver and Operator Interview Transcript

City Satisfaction
Bus Operator / Bus Driver Interview Notes
11/15/2017 (Wednesday)
Bus Rest Stop near HDU

Facilitator: Cindy
Scribe: Sophie
Translator: LiuLiu
Assistants: Ryan and Emily

- Team walked over to the Bus center near HDU.
- Several bus drivers were interviewed there, as well as one Bus Operator.
- Each of the drivers were asked the same base set of questions, with additional questions added as the conversation progressed.

Bus Driver 1 Transcript:

1. Which route do you drive?

    I drive the 377 Route which hhas 23 bus stops.

2. How do drivers take breaks and how does the system work?

    Multiple buses drive each route at staggered times, and drivers get a break after driving the full route. Buses are cleaned each time.

3. How is the traffic?

    Traffic is not crowded for the most part, only near Wenze Road is bad. Rush hour is around 4:00pm, with primary school ending and many children take buses home.

4. How is the quality of the vehicle?

    Eating and drinking is not allowed on buses. However, this eating rule is often broken and can clutter the interior.

Bus Operator Transcript:

1. Why do you think people choose or do not choose busses?

Buses aren't immediate so people choose other methods of transportation if limited on time. They are affected by traffic and aren’t always reliable (on time).

2. Can you tell us what the bus schedule is like?

Bus schedules are regular, but not all companies post the times at stations. Departure interval is 8, 10, 15, or 30 minutes depending on the line. This means a bus should arrive at each stop on that line on that interval.

3. Do you have any recommendations on future improvement?

In the future, bus companies are planning on expanding the number of lines, not cutting, as the metro also expands. Buses will have to take places the metro can’t go, and with more lines people will need buses at more locations.

Group of 3 Bus Drivers Transcript:

1. Can you describe to us the nature of your job and about your company?

Drivers have a salary of 8,000-9,000RMB or 4,000-5,000RMB per month depending on how long they work in a day [2] and which route they drive. Hangzhou public transport company (this particular bus company) belongs to a state-owned enterprise. Our company provides insurance for drivers, which is nice.

2. What do you think of the traffic safety in Hangzhou?

Traffic laws in Hangzhou say all cars have to let people go first. The drivers like these laws, and feel like it makes it safer for people, but think too many pedestrians are distracted and on their phones/walk too slowly.

3. What do you think of traffic in Hangzhou?

There are too many crosswalks and traffic lights in the city. Bus cameras watch driving patterns, and drivers will have their salary deducted if they don’t let pedestrians go before them. Heavy traffic shortens rest times, since they have to leave earlier to be on time.

4. What do you think of the bike lanes and bikes around Hangzhou?

Private cars and OFO bikes often occupy the bus lanes which disrupt everything. Bus passengers express dissatisfaction when they have to stop because the bus lanes are blocked. This happens more on rainy days. There are taxi only parking spots before bus stations that no one (including taxi drivers) knows about.

Appendix H4: Ofo Worker Interview Transcript

City Satisfaction
OFO Interview Minutes
11/22/2017 (Wednesday)
Shared Bike areas HDU Campus
Facilitator / Translator: LiuLiu and Cindy
Assistants: Emily and Michael
Interviewees: OFO Workers (2)

- HDU Colleagues were given a set of questions to ask the OFO workers. There were two that responded, with their answers detailed below.

Discussion

1. How long have you been working at OFO?
    Interviewee 1: Two Days
    Interviewee 2: Half a year

2. What are your daily responsibilities?
    Interviewee 1: I work in a fixed area of a couple blocks and keep the bikes somewhat organized. I see if the bikes are broken and mark them for repair if necessary.
    Interviewee 2: I take away damaged bikes to be repaired. I balance the number of bikes in different locations.

3. What is good about OFO bikes?
    Interviewee 1 & 2: OFO Bikes are cheap, convenient, and comfortable to ride.

4. What do you dislike?
    Interviewee 1 & 2: Shared bikes are always stopped everywhere.

5. What could be improved?
    Interviewee 1 & 2: Shared bike quality should be improved.

6. Compared to government bikes, how is OFO different?
    Interviewee 1 & 2: OFO is more convenient.

7. Is there a lot of bike traffic?

Interviewee 1 & 2: Yes, there is a lot of bike traffic.

8. What do you think about the number of OFO bikes?

Interviewee 1 & 2: No answer; they didn't know.

9. If there is a damaged bike, what do you do?

Interviewee 1 & 2: I label the bikes with a poster and invert the bike seat. Other workers will then check through bikes and pull out the marked ones.

Appendix I: Questionnaire Data Tables

Table 2: 1 km Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
1km Travel Method[a]	car1km	23	6.1%	8.0%
	metro1km	12	3.2%	4.2%
	bus1km	10	2.6%	3.5%
	taxi1km	5	1.3%	1.7%
	appTaxi1km	10	2.6%	3.5%
	moped1km	32	8.5%	11.2%
	publicBike1km	24	6.3%	8.4%
	privateBike1km	16	4.2%	5.6%
	sharedBike1km	74	19.6%	25.9%
	walking1km	172	45.5%	60.1%
Total		378	100.0%	132.2%

Table 3: 2-5 km Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
2km Travel Method[a]	car2km	54	15.0%	19.4%
	metro2km	56	15.6%	20.1%
	bus2km	43	12.0%	15.4%
	taxi2km	20	5.6%	7.2%
	appTaxi2km	21	5.8%	7.5%
	moped2km	46	12.8%	16.5%
	publicBike2km	24	6.7%	8.6%
	privateBike2km	14	3.9%	5.0%
	sharedBike2km	58	16.2%	20.8%
	walking2km	23	6.4%	8.2%
Total		359	100.0%	128.7%

Table 4: 6-10 km Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
6km Travel Method[a]	car6km	87	24.1%	31.0%
	metro6km	117	32.4%	41.6%
	bus6km	43	11.9%	15.3%
	taxi6km	27	7.5%	9.6%
	appTaxi6km	39	10.8%	13.9%
	moped6km	21	5.8%	7.5%
	publicBike6km	2	0.6%	0.7%
	privateBike6km	6	1.7%	2.1%
	sharedBike6km	12	3.3%	4.3%
	walking6km	7	1.9%	2.5%
Total		361	100.0%	128.5%

Table 5: 10-25 km Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
10km Travel Method[a]	car10km	112	33.4%	40.3%
	metro10km	123	36.7%	44.2%
	bus10km	31	9.3%	11.2%
	taxi10km	25	7.5%	9.0%
	appTaxi10km	26	7.8%	9.4%
	moped10km	11	3.3%	4.0%
	publicBike10km	2	0.6%	0.7%
	privateBike10km	1	0.3%	0.4%
	sharedBike10km	2	0.6%	0.7%
	walking10km	2	0.6%	0.7%
Total		335	100.0%	120.5%

Table 6: More Than 25 km Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
2km Travel Method[a]	car25km	133	41.7%	48.0%
	metro25km	110	34.5%	39.7%
	bus25km	22	6.9%	7.9%
	taxi25km	16	5.0%	5.8%
	appTaxi25km	23	7.2%	8.3%
	moped25km	5	1.6%	1.8%
	publicBike25km	2	0.6%	0.7%
	sharedBike25km	8	2.5%	2.9%
Total		319	100.0%	115.2%

Table 7: Commute Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
Commute Travel Method[a]	carWork	77	25.0%	29.4%
	metroWork	80	26.0%	30.5%
	busWork	18	5.8%	6.9%
	taxiWork	5	1.6%	1.9%
	appTaxiWork	8	2.6%	3.1%
	mopedWork	32	10.4%	12.2%
	publicBikeWork	10	3.2%	3.8%
	privateBikeWork	2	0.6%	0.8%
	sharedBikeWork	23	7.5%	8.8%
	walkingWork	53	17.2%	20.2%
Total		308	100.0%	117.6%

Table 8: Leisure Travel Method Frequencies

		Responses		Percent of Cases
		N	Percent	
Leisure Travel Method[a]	carLeisure	84	23.5%	31.1%
	metroLeisure	78	21.8%	28.9%
	busLeisure	20	5.6%	7.4%
	taxiLeisure	10	2.8%	3.7%
	appTaxiLeisure	16	4.5%	5.9%
	mopedLeisure	20	5.6%	7.4%
	publicBikeLeisure	7	2.0%	2.6%
	privateBikeLeisure	4	1.1%	1.5%
	sharedBikeLeisure	23	6.4%	8.5%
	walkingLeisure	96	26.8%	35.6%
Total		358	100.0%	132.6%

Table 9: Bus Speed Satisfaction

Bus Speed Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	5	1.6	5.8
	Somewhat Dissatisfied	14	4.5	16.3
	Neutral	33	10.6	38.4
	Somewhat Satisfied	25	8.1	29.1
	Very Satisfied	9	2.9	10.5
	Total	**86**	**27.7**	**100.0**
Missing	**System**	**224**	**72.3**	
Total		**310**	**100.0**	

Table 10: Bus Weekly Use Frequencies

Bus Weekly Use		Frequency	Percent	Valid Percent
Valid	Never	77	24.8	24.9
	Seldom	123	39.7	39.8
	Sometimes	59	19.0	19.1
	Often	32	10.3	10.4
	Always	18	5.8	5.8
	Total	**309**	**99.7**	**100.0**
Missing	**System**	**1**	**.3**	
Total		**310**	**100.0**	

Table 11: Metro Speed Satisfaction

Metro Speed Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	2	.6	.9
	Somewhat Dissatisfied	5	1.6	2.3
	Neutral	32	10.3	14.8
	Somewhat Satisfied	100	32.3	46.3
	Very Satisfied	77	24.8	35.6
	Total	**216**	**69.7**	**100.0**
Missing	**System**	**94**	**30.3**	
Total		**310**	**100.0**	

Table 12: Metro Crowdedness Satisfaction

Metro Crowdedness Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	25	8.1	11.6
	Somewhat Dissatisfied	62	20.0	28.7
	Neutral	77	24.8	35.6
	Somewhat Satisfied	32	10.3	14.8
	Very Satisfied	20	6.5	9.3
	Total	**216**	**69.7**	**100.0**
Missing	**System**	**94**	**30.3**	
Total		**310**	**100.0**	

Table 13: Metro Weekly Use Frequencies

Metro Weekly Use		Frequency	Percent	Valid Percent
Valid	Never	32	10.3	10.4
	Seldom	91	29.4	29.4
	Sometimes	71	22.9	23.0
	Often	73	23.5	23.6
	Always	42	13.5	13.6
	Total	**309**	**99.7**	**100.0**
Missing	**System**	**1**	**.3**	
Total		**310**	**100.0**	

Table 14: Shared Bike Weekly Use Frequencies

Shared Bike Weekly Use		Frequency	Percent	Valid Percent
Valid	Never	83	26.8	26.9
	Seldom	71	22.9	23.0
	Sometimes	45	14.5	14.6
	Often	74	23.9	23.9
	Always	36	11.6	11.7
	Total	**309**	**99.7**	**100.0**
Missing	**System**	**1**	**.3**	
Total		**310**	**100.0**	

Table 15: Shared Bike Condition Satisfaction

Shared Bike Condition Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	8	2.6	5.0
	Somewhat Dissatisfied	16	5.2	10.1
	Neutral	66	21.3	41.5
	Somewhat Satisfied	48	15.5	30.2
	Very Satisfied	21	6.8	13.2
	Total	**159**	**51.3**	**100.0**
Missing	**System**	**151**	**48.7**	
Total		**310**	**100.0**	

Table 16: App Taxi Speed Satisfaction

App Taxi Speed Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	3	1.0	2.1
	Somewhat Dissatisfied	8	2.6	5.6
	Neutral	36	11.6	25.0
	Somewhat Satisfied	73	23.5	50.7
	Very Satisfied	24	7.7	16.7
	Total	**144**	**46.5**	**100.0**
Missing	**System**	**166**	**53.5**	
Total		**310**	**100.0**	

Table 17: Private Car Cost Satisfaction

Car Cost Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	5	1.6	3.2
	Somewhat Dissatisfied	33	10.6	21.3
	Neutral	70	22.6	45.2
	Somewhat Satisfied	33	10.6	21.3
	Very Satisfied	14	4.5	9.0
	Total	**155**	**50.0**	**100.0**
Missing	**System**	**155**	**50.0**	
Total		**310**	**100.0**	

Table 18: Private Car Traffic Satisfaction

Car Traffic Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	25	8.1	15.7
	Somewhat Dissatisfied	70	22.6	44.0
	Neutral	45	14.5	28.3
	Somewhat Satisfied	11	3.5	6.9
	Very Satisfied	8	2.6	5.0
	Total	**159**	**51.3**	**100.0**
Missing	**System**	**151**	**48.7**	
Total		**310**	**100.0**	

Table 19: Private Car Parking Satisfaction

Car Parking Satisfaction		Frequency	Percent	Valid Percent
Valid	Very Dissatisfied	34	11.0	21.4
	Somewhat Dissatisfied	57	18.4	35.8
	Neutral	44	14.2	27.7
	Somewhat Satisfied	13	4.2	8.2
	Very Satisfied	11	3.5	6.9
	Total	**159**	**51.3**	**100.0**
Missing	**System**	**151**	**48.7**	
Total		**310**	**100.0**	

Table 20: Private Car Weekly Use Frequencies

Private Car Weekly Use		Frequency	Percent	Valid Percent
Valid	Never	85	27.4	27.5
	Seldom	75	24.2	24.3
	Sometimes	42	13.5	13.6
	Often	65	21.0	21.0
	Always	42	13.5	13.6
	Total	**309**	**99.7**	**100.0**
Missing	**System**	**1**	**.3**	
Total		**310**	**100.0**	