Design Implication from Public Life Data Around Bus Stations: Two Case Studies in Seattle

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Abstract

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Public space is essential to people's everyday life. It can improve people's happiness, health, as well as the prosperity of the region. As people rely more and more on public transit, transit stations bring a significant number of pedestrians to the nearby streets. The public space around them should be designed to be more vibrant for pedestrian travel. If good conditions of the built environment are provided for these pedestrians and transit riders, they will have the chance to participate in more recreational and exciting activities. However, some public spaces around transit stations have not been received adequate design and management attention. This study explores the design implications of public space and activity around transit stations, especially bus stations. The study refers to methods and findings of public life studies conducted by Jan Gehl. The research analyzed public life data of people's behaviors in the public spaces around representative bus stations in Seattle and speculates on their interactions with the built environment. Compact and continuous building facades, more quality seats, wider sidewalks with comfortable street furniture, and safety facilities along walkways help to create better pedestrian and public transportation experiences. The research findings could help understand what design makes successful public space, especially around public transit stations.

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Chapter 1: Introduction

Seattle has made great efforts to improve its transit system and make a significant investment to fulfill transit-oriented development. A survey shows that Seattle sees 228 trips per person each year, and an impressive 31 percent of people take public transit to work (Patch, 2019). Public transportation relieves the growing traffic congestions and reduces drive-alone trips from 50% to 30% in downtown Seattle. At the same time, it brings tides of people and civic activities to the public space around the transit stations. The weekday transit riders in Seattle reached more a quarter of million, and they used the transit stations more than twice per day (Seattle Department of Transportation, 2018). Bus stations have become usual destinations for people's everyday travel and public life. People spend their time at transit stations and surrounding public space every day, which makes these spaces important in public life. However, these public spaces are often neglected by planners.

If good conditions of the built environment are provided for the transit riders and pedestrians who walk through the public space around transit stations, more recreational and exciting activities will be generated. In urban design perspectives, the designs of public space around bus stations are supposed to undertake the responsibility of joyful for public life. Thus, I am curious about how people actually use and act in these spaces, how space can be designed efficiently to accommodate better public life, and whether there will be some general principles or implications to the design of space around transit stations. By analyzing people's behavior patterns, as well as the qualities of the visual environment of the surrounding public spaces, I aim to understand the public life and get design implications for future improvements. The

products of this study may contribute to explore a public life supporting design guideline around transit stations. This study referred to the methods of public life studies done by Jan Gehl, as well as the public life data from the Seattle Department of Transportation.

Thus, the **research questions** this study will focus on are:

- How people use the public spaces around bus stations differently from one specific location to another in Seattle, and
- What design factors of the public space interact with the pattern of people's behaviors, and how to improve public space based on public life observed?

What is a Public Life Study?

In this research, I used public life data to understand how people use public space around transit stations, and the data were screened from a public life study conducted in Seattle. First, what is a "Public Life Study"? A public life study is a type of research conducted through observational methods that focuses on measuring the human activity and how people use public space within the study area. It can provide implications of how design, built environment, and urban form influence and interact with people's activities. Thus, a better public space that people enjoy using can be created with those considerations.

There is a long list of literature related to this topic. The progressive history of researching the public life of urban neighborhoods and streets starts from Jane Jacobs's book (1961). Jacobs learned from the existing city blocks about what makes a lively neighborhood, and she advocated avoiding freeway and large, cataclysmic redevelopments and investment. Her work

was based on the observation of civic life in New York as a method to find the interaction of public space and buildings with public life. The designs of the physical environment considering human needs were explored by Christopher Alexander (1977). He learned from people's behaviors in public space and found the importance of the edges of buildings for public space. William H. Whyte (1980), the mentor of Jane Jacobs, conducted basic observational studies of people's social activities in small public spaces, which included both the design of spaces and buildings and human behavior generally and specifically.

There are more works concerning public life at street level. William C. Ellis (1978) discussed the spatial structure of the city. Thomas Schumacher (1978) compared different streets and rethought the social interaction on the street space. Donald Appleyard (1981) found that there was a connection between the amount of traffic and the vibrancy of social life. Peter Bosselmann (1984) and his environmental simulation laboratory studied the potential effects of planned skyscrapers that would occur on the microclimate, and they provided advice that benefits pedestrian experiences. Allan Jacobs (1993) collected examples of streets worldwide and focused on observation of their physical built factors. Then, Jan Gehl and Birgitte Svarre (2013) generated a systematic guide to conducting public life studies. This study tool guides people in gathering quantitative and qualitative data of public life by observing how people use the public space and assessing the visual environment. Gehl conducted public life studies in many cities around the world. Public Spaces and Public Life Study in Wellington (2004), Public Life Study in Seattle (2018), and Defining Public Life in San José (2019) by Gehl set good examples to study public life. Gehl (2018) also created The Twelve Quality Criteria as a tool to evaluate public space in terms of "Protection, Comfort, and Enjoyment."

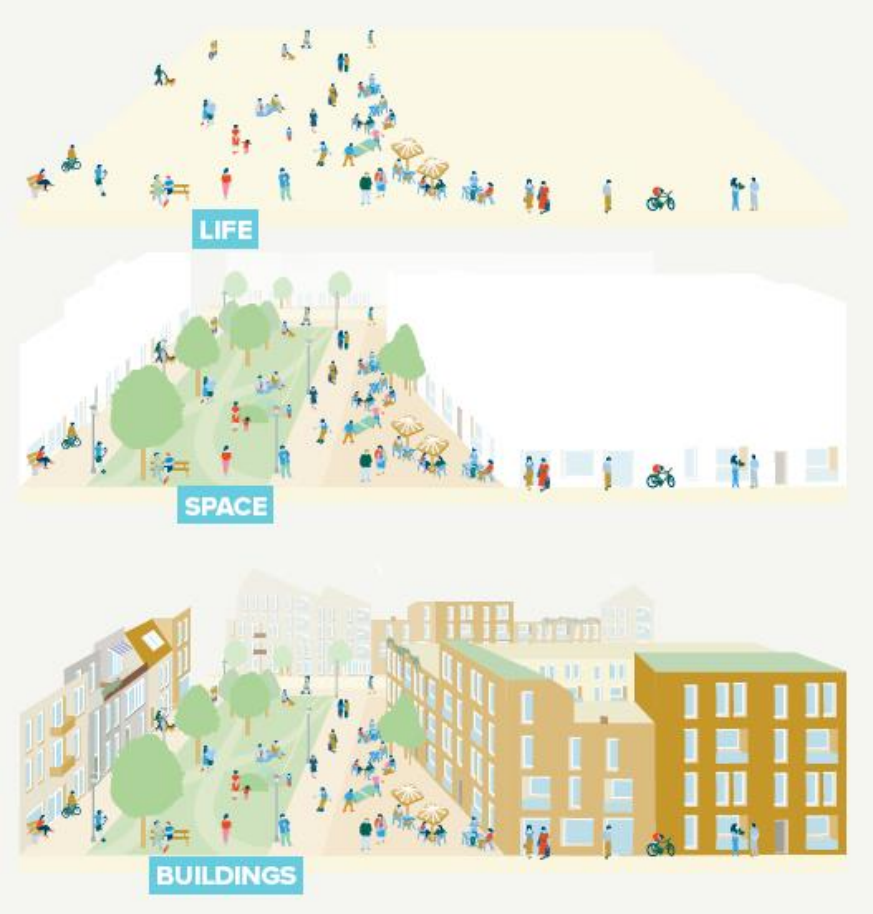

Figure 1.1 Public life and public space, Source: Gehl, Jan. San Jose Public Life Field Guide. 2019.

Why focus on space around the transit station?

Many public life studies have been conducted in different public spaces. Public life researchers study streets, parks, and neighborhoods. However, there are a few specific types of research that focus on public space around transit stations. Public life study needs to proceed in some other specific areas of smaller scales because these spaces are gradually becoming dominant in civic life as the progress of times. Public space around transit stations is such a valuable space that needs to be picked out and studied. Due to the influx of people brought by transit stations, planners should pay more attention to these nearby public spaces. The pattern of people's behaviors in these spaces may vary from other public spaces, and the physical built

environments may differ either.

In the original public life study in Seattle, researchers traced whether the sites they observed included transit stations and noted in their forms. When showing the findings of behavior patterns in each neighborhood, people could know the patterns of behaviors in percentage, included "People Waiting for Transportation." However, that was not enough to show the real behavior patterns in these spaces if mixing with other sites. In detail, not every site has a transit station, so the overall models would not be accurate for representing behavior patterns in those sites that have transit stations located there.

By taking those spaces out and study separately, I can acquire targeted and detailed analysis. The outcome can be a supplement to the original Seattle public life study report, and it will help improve practice as well as policy or decision making.

Purpose of the study

The purpose of these case studies is to explore the design implications of the built environment of public space around transit stations in Seattle by analyzing people's using patterns as well as the quality of the space itself across different sites. At this stage in the research, design implications of the built environment of public space can be generally defined as how to design and improve the public space based on people's behaviors observed and the visual environment of the sites.

The study applies a mixed method to collect and analyze data, both quantitatively and qualitatively. The rationale for this mixed method is the needs of data on both people's behavior

statistics, as well as the evaluation of the built environment of space. The method and analysis procedures are developed primarily based on Jan Gehl's works in Wellington, San Jose, and public life study from the Seattle Department of Transportation.

Limitation:

In this study, I conduct case studies in four specific sites in Seattle and generate a public life supporting design guideline for public space around transit stations. However, the number of case study sites in this study is too few to draw conclusions about the general impacts of built environments, locations, and other environmental attributes on public life, and the implications from case studies are specific to Seattle. Thus, this study is more of an exploration of the method to study public life. The study aims to explore and examine this public life data-based method to design public space in specific areas. This approach can be implemented more conclusively if greater time and resources are available.

Chapter 2: Public Life and Public Space

Public Life Study

Nowadays, designers and decision-makers dedicate to design and build public space based on human needs. Public spaces like parks and streets serve a more pedestrian experience and facilitate mixed modes of non-motorized transportation. However, previous urban reconstruction and urban renewal make all the spaces of human interaction obsolete. Early urban planning before the 1960s filled the space of the city with large-scale buildings and redevelopments. Freeways went through the city center and disrupted the neighborhood fabrics. They neglected the pedestrian's experience and the small lively neighborhoods which used to compose the city. After the early 1960s, planners were forced to appreciate more the complexity of urban socio-spatial interactions.

Jane Jacobs (1961) warned that there was something wrong with modern urban planning. Jacob observed the streets of Greenwich Village in New York City, a lively neighborhood with multi-functions. The patterns there showed the public life in existing city settings. She developed the observation as a tool to learn public life from feeling the interaction of public life and surrounding public space and buildings, and she believed that we could learn it by going out in public spaces.

Kevin Lynch (1960) laid out the five fundamental elements of the city. Transit stations can be considered a “node” in these public spaces, which are the space people wait for transit and transfer transportation modes. These spaces interact with other elements of the system. People walk through the sidewalks as “paths” to get to or leave the transit station, and the transit routes

are other “paths.” Building facades work as “edges” to integrate the public and private worlds. Public life as a dynamic element is also included in the living system of built environments (Christopher Alexander, 1965). Public life occurs on these unchanging elements and creates dynamic coherence, which brings special interests for designers to consider public life when designing the built environments.

Observation of how people use public space is important because we can learn what works and what does not work in built environments of public space. However, systematic observation methods were not developed until William H. Whyte (1980), the mentor of Jane Jacobs, conducted his observational studies of people's social activities in small public spaces. Whyte formed a small research group and began studying New York City's urban spaces, including parks, playgrounds, and city blocks, through time-lapse photography, interviews, and direct observation of users. They were able to collect data of Demographics of space users, gender differences, user behavior, sittable space, the role of natural elements, food, the relationship of the space to the main pedestrian traffic flow, capacity, and "Triangulation," which means strangers are more likely to talk to one another in the presence of a stimulus. His study showed whether the public space was attractive to people by explaining the findings with text, graphs, and narrative pictures. He studied public life by focusing on people's behaviors generally and specifically, the design of surrounding visual environments, as well as the climate conditions. Whyte also systematized the observations, and analyzed the findings into different categories included sun, trees, water, food, seats, etc. Based on the findings, Whyte developed design criteria for small public space, such as movable chairs and enough seating areas, protection from sun, wind, and noise by designing trees and water, availability of food, and

related to streets. Whyte's works set the foundation of observation methodology to many subsequent public life studies.

Christopher Alexander (1977) developed the principles to design everything in urban regions from small scales, such as rooms or stairs, to a larger scale of a city or regional design. Alexander's study not only concerned human needs, but he also urged that the public space users should design themselves for they knew more about public space and city than decision-makers. Alexander learned from the behaviors of people in public space, and he provided solutions to many design problems ranging in scale from urban planning, architecture, to interior designs. He also emphasized the importance of buildings edges and frontages for people's experience in public space. Alexander compared two different edges. One was machine-like with no detail by a modernist building and the other one with details, variations, and opportunities for people to stay. He found the way that building's edges attract people staying, as well as how they influence and contribute to lively public life.

There are more works concerning public life at street level. Donald Appleyard (1981) worked on public life with Kevin Lynch. He aimed to defend the streets as sociable public space and protect those spaces from threats of modernism. Appleyard found that there was a connection between the amount of traffic and the vibrancy of social life. The results showed streets with light, or no traffic would encourage lively and vibrant public life. Allan Jacobs (1993), along with Appleyard, criticized the existing urban planning neglected the sociable functions of the streets. He thought that streets were places for public life besides transportation functions. Jacobs argued that systematic observation of interactions between public space and

public life should be used as a decision-making tool rather than only analyzing the static maps and photographs. Jacobs provided examples from the streets all over the world. He stressed the observed physical factors of those streets and other conditions that support social life.

Besides the influence of traffic on public life, planned buildings would also influence the microclimate and experiences of users of public space. Peter Bosselmann (1984) and environmental simulation laboratory studied the potential effects of planned skyscrapers would on the microclimate. The results led to the adoption of legislation to ensure the light and wind suitable for pedestrian experiences, and it showed how to design by learning and understanding public life.

Jan Gehl (2007) discussed how modern movements had significantly reduced the importance of traditional public Spaces. The liveliness and vibrancy of public spaces depended largely on the quality of the space and whether it welcomes pedestrians to walk, stay, and sit. Jan Gehl and Birgitte Svarre (2013) also talked about the importance of the human dimension. As the progressive development of public life studies, people desire to live in a lively, safe, sustainable, and healthy city. All of these goals could be accomplished by increasing the concerns to pedestrians, cyclists, and public life. Observing people's behaviors became a crucial method to understand and design in the human dimension. Jan Gehl and Birgitte Svarre (2013) developed a systematic guide to conducting public life study. The work answered the question of how to study public life by explaining the meaning and history of studying public life, providing specific methods and tools to guide the observation and data collection process and to present and analyze data. The study emphasized the way to study the interaction between

public life and public space. It led the researchers to measure people's behaviors as well as the built environments. Observing and counting methods were taught by Gehl's works to gather quantitative data, which would show people's behaviors in specific public spaces or a vast region in general. Qualitative data was also needed to observe and evaluate the visual environments in the public space and surrounding areas. The guide represents a classic way to learn public life, which sets the foundation of public life study conducted in many cities around the world. It is also the underlying knowledge of this research.

Jan Gehl (2004) conducted a study on how people use public space in the central city and the waterfront of Wellington, New Zealand. In this study, Gehl assessed how people move and act in public space around the city. He aimed to find the issues and opportunities in the study areas through the observation method and to provide a set of ideas and recommendations on how improvement can be made to raise the quality of public space. Gehl analyzed public spaces and public life separately and provided recommendations for city planning and designs of specific sites based on a comprehensive analysis of results. This method is classic in studying public life and public space, which will also direct my research. This study also provided many references for evaluating the quality of public space. It emphasized ground floor frontages and street furniture when evaluating the visual environment. It also included the number and quality of seats provided when analyzing people's recreation activities. Vehicular traffic flows and parking were also considered factors that influence people's movement and activities. Gehl shared the recommendations with precedent images and analysis graphics, which provided vivid examples to guide the city improvement.

The key guidance and background of our research are the Public Life Study in Seattle (2018), which applied the "Public Life Data Protocol" established by Jan Gehl. This data collection method was utilized by the City of San Francisco and Seattle. In this research, Seattle Department of Transportation collected data through observation on Seattle's sidewalks in 38 different neighborhoods, 108 streets' "block face" across the city, which "block face" essentially means one side of a street from one intersection to another (See Figure 3.1). By doing this, they were able to collect people-centered data that measures how people use the streets and sidewalks. The results would be helpful "to understand what makes a successful public space, to evaluate designs and interventions, to make better public realm investment decisions, to compare public life across neighborhoods, and to measure and benchmark SDOT's core value of vibrancy" (SDOT, 2018). They found that the most significant number of people were observed in Seattle's densest neighborhoods. Still, there was variability in activity depending on the neighborhood, day of the week, and time of day. They showed the patterns and activities by different maps and charts throughout the report. This study included a case study comparing two study areas, which were one block in the University District (University Way NE between NE 42nd St and NE 43rd St, west side) and one block in Pioneer Square (1st Ave S between S Washington St and S Main St, west side). These two sites had a similar number of people moving but completely different patterns of people who stayed there. More people chose to stay on 1st Ave S, which had 28 seats provided on this block face compared to zero on University Way NE. The study found that seats were important factors that influenced the patterns.

However, this study does have some potential to improve. Not every research site SDOT

observed has a transit station, which becomes a distraction to analyze all sites together. The transit stations brought far more people to the public space around them. As a result, the patterns would not be accurate for those sites which have transit stations. My research aims to supplement the original study. From looking through their raw data spreadsheets, I found the needed data which showed the behavior patterns of spaces around bus stations. As an important data source of our research, the Seattle study directed the methods and procedures of our research in choosing research sites, collecting data, and analyzing data.

Jan Gehl (2019) helped the City of San José develop a guide to define and research public life. He provided thoughts on the design of public space. Gehl argued that we need first consider life, then space and buildings. He pointed out the importance of built environmental diversity at the ground level. Vertical diversity can be achieved by the design of mixed functions from floor to floor, and horizontal diversity can be achieved by small units and many entrances. The pedestrian preferred permeable frontages. Gehl also encouraged extroverted urban space and small public space with high quality.

"The Twelve Quality Criteria" generated by Gehl Institute is a helpful tool when exploring the quality of public space. The criteria evaluate whether different features of public space are protective, comfortable, and enjoyable for people. For my research, the criteria can be used to measure the quality of visual environment elements on the sites. The twelve criteria include:

- Protection category: Protection against traffic and accidents; Protection against harm by others; Protection against unpleasant sensory experience
- Comfort category: Options for mobility; Options to stand and linger; Options for

sitting; Options for seeing; Options for talking and listening/ hearing; Options for play, exercise, and activities

- Enjoyment category: Human scale; Opportunities to enjoy the positive aspects of climate; Experience of aesthetic qualities and positive sensory experiences

These criteria can provide a standard to evaluate and score the quality of the public space. My study uses comfort and enjoyment criteria to assess the façade quality, seating opportunity, and sidewalk, and uses the protection criteria to evaluate the sidewalk and vehicle patterns of target sites.

Designs Around Bus Stations

In terms of people's waiting behaviors and design of built environment around bus stops, Ohmori, Hirano, Harata & Ohta (2004) investigated the relationships between passengers' waiting behavior at bus stops and their irritation levels to waiting for the bus. Half of the people were doing some activities while waiting, and others were doing nothing and just waiting. Irritation levels were affected by waiting time, activity engagement at the bus stop, including spending time in a nearby convenience store, time constraints at destinations, and environment of the bus stops. Sitting on benches was very useful for mitigating their irritation levels, especially for the elderly passengers, but some factors, such as lack of seating opportunities, prevented them from sitting on the benches. The study shows different design and built environment can influence bus riders' behaviors. It uses the term irritation level as a bridge of people's behaviors and design of the space. It shows the variations of irritation level affected by activities, which proves better experiences can be created by design activities for waiting

people. That becomes an inspiration that our research uses the ratio of people's extroverted activity as an index to show the relationship between the design of the space and sociable behavior patterns.

There is another study by Mishalan, McCord & Wirtz (2006) might supplement to the study above to understand the passenger's mental activities and needs. This study quantified the relationship between perceived and actual waiting times experienced by passengers awaiting the arrival of a bus at a bus stop. By collecting data of perceived and actual waiting time, the relationship between them can be estimated. The results indicated that passengers do perceive time to be greater than the actual amount of time waited. This study encouraged a more intriguing design of public space around the transit stations.

As for the theme of design factors, Ewing (2000) showed the result of a survey asking people to choose the stop from each pair at which they would prefer to wait, and asked to rate each stop chosen as a place to wait. In this paper, transit users, nonusers, and professionals were shown a series of paired slides of bus stops and asked to choose. Subsequent analysis showed that transit-oriented design features most affecting both choices ratings are a bus shelter at the stop, trees along the street leading to the stop, a vertical curb at the stop, the setback of the stop from the street edge, and a continuous sidewalk leading to the stop. This study showed the needed design directly from transit users, which can be used as a reference when evaluating the design of space.

A spatial analysis of pedestrian preference was reported by Agrawal, Schlossberg & Irvin (2008). It was a report on a survey of pedestrian trip preference to stations, and it mentioned a

few design factors. The paper discussed that aesthetic elements of the built environment were rarely mentioned. However, it was a critical route choice factor for the pedestrian.

For safety concerns, Liggett, Loukaitou-Sideris & Iseki (2001) aimed at exploring the relationship between environmental variables and bus stop crime. The study showed that the most important predictor of crime is the location. If the environment is controlled, undesirable facilities and litter result in higher crime rates, whereas visibility and many pedestrians lead to lower crime rates. Also, the appropriate design and layout of the physical environment can reduce opportunities for criminal actions.

Chapter 3: Methodology

Method Design

To gain a better insight into the potential improvement of public space around transit stations, I need to understand how people use the public space, as well as the quality of the space itself. In this research, I used two case studies to explore public life and its relationship with public space. The public spaces I focused on are the streets' "block face" (SDOT, 2018), which "block face" essentially means one side of a street from one intersection to another.

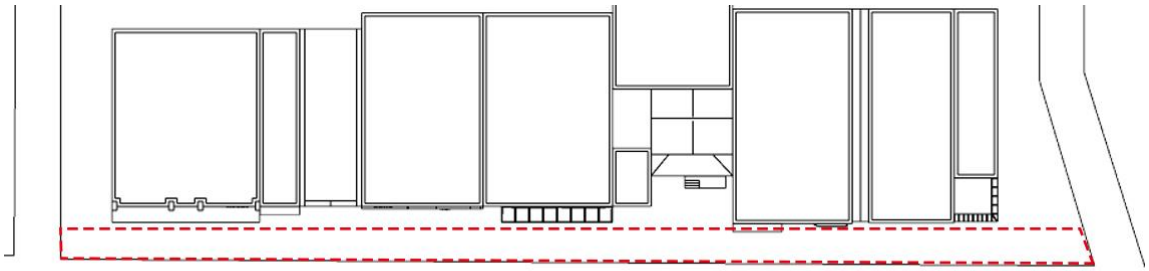

Figure 3.1 Plan view shows a street "block face"

Case studies were conducted with the data of people's behavior and visual environments of target sites. I set up 2 case studies. Each case study included two commercial streets' "block face" as a comparison. The target streets in the comparison were screened to ensure they are similar in terms of the volume of passengers and the neighborhood types they located in. It allows them in the same level of street classes. One would expect those streets have similar patterns of people’s behavior. However, people act in different ways on those sites, and thus the differences will have more research value to show what design benefits public life. Based on the results and findings, I could make recommendations to improve the quality of these public spaces to encourage a more vibrant public life and try to summarize some key points

regarding the design principles applicable to the general design process of these kinds of public spaces.

This research applied a convergent mixed-method approach. By adopting this approach, I collected both quantitative and qualitative data, analyzed them separately, and then compared and related the results of both. The quantitative method was used for counting and analyzing people's behavior patterns. The qualitative method was for evaluating the quality of the public space. After getting the results of both people's behavior patterns and the evaluations of physical built environments of study sites, I related and analyzed the results to find their interactions and design implications.

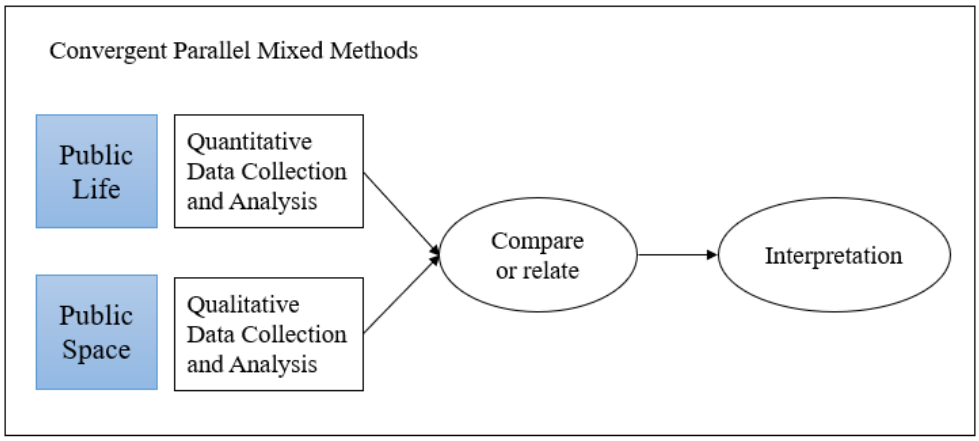

Figure 3.2 Mixed methods of this research

a) Why is it an appropriate strategy?

The reason for applying this strategy is because I need different types of data. Public life study requires the researchers to acquire information on public life, public space, as well as the surrounding building. For my study, I need to count numbers and percentages of people's behaviors pattern and conduct a qualitative assessment of the quality of the space. It is vital to look for design implications based on how people actually use public space.

b) Challenges in using this design and how to resolve

This study needs to collect both forms of quantitative and qualitative data and analyze them. However, it is also necessary to relate the findings of both forms using the same concept, that is, to evaluate if the public space corresponds to public life, which was observed there. Narrative findings and interpretation of the quality of the space can hardly be related to the numbers and percentages of people's behavior patterns. Thus, I learned from "The Twelve Quality Criteria" generated by Gehl Institute when evaluating some factors related to the sites' visual environments. It is a helpful tool when exploring the quality of public space, and it enables public life researchers to score the physical built environment based on its criteria in different categories. Then the tool becomes a bridge between the quantitative and qualitative analysis in this research.

c) Background information and examples of the design

An example of a similar approach is the study on how people in Wellington use public spaces in the central city by Gehl (2004). In this study, Gehl analyzed people’s movement and recreation behaviors, as well as the visual environments of public space. Based on the analysis, he made recommendations to improve people’s experience in public space. Gehl also applied the criteria when evaluating the qualities of some factors in the visual environment, such as the quality of seats and the building frontages, which I used as references in the sections of evaluation of visual environments of study sites.

d) How will the method design shape this study’s process?

The research process of this paper always concerns the interaction of both "public life" and "public space," which are both people's experiences and physical patterns. For data collection and analysis, this design requires collecting and analyzing data separately for both quantitative data of public life, and qualitative data of the evaluation of public space. Then there would be a mixed-methods analysis to relate and compare the results.

Quantitative data collection

In this research, I use the existing data of public life study done in Seattle in 2018 for analyzing people's behaviors for each research site in case studies. Seattle Department of Transportation (SDOT) collected data through observation on Seattle's sidewalks in 38 different neighborhoods, 108 streets across the city. Trained surveyors observed those sites during anticipated peak hours, morning (8-10am), mid-day (12-2pm), and evening (4-6pm) in weekday and weekend. They documented records of people moving and staying for every 20 minutes, and then organized the records to get hourly public life data. By doing this, they were able to collect people-centered data that measures how people use the streets and sidewalks. After a series of calculations and analyses, they found that people's activity patterns varied depending on the neighborhood, day of the week, and time of day. Also, One-in-ten people moving ends up staying still on our sidewalks. Some of the public spaces are not inviting to specific groups of people. Besides, people's posture suggested a significant demand for additional seating opportunities. For example, more people will stand or lean if there is no seat provided. Of course, there were more findings people can explore from their study, and I will use their raw dataset as the source of analyzing people's behavior patterns for the case studies.

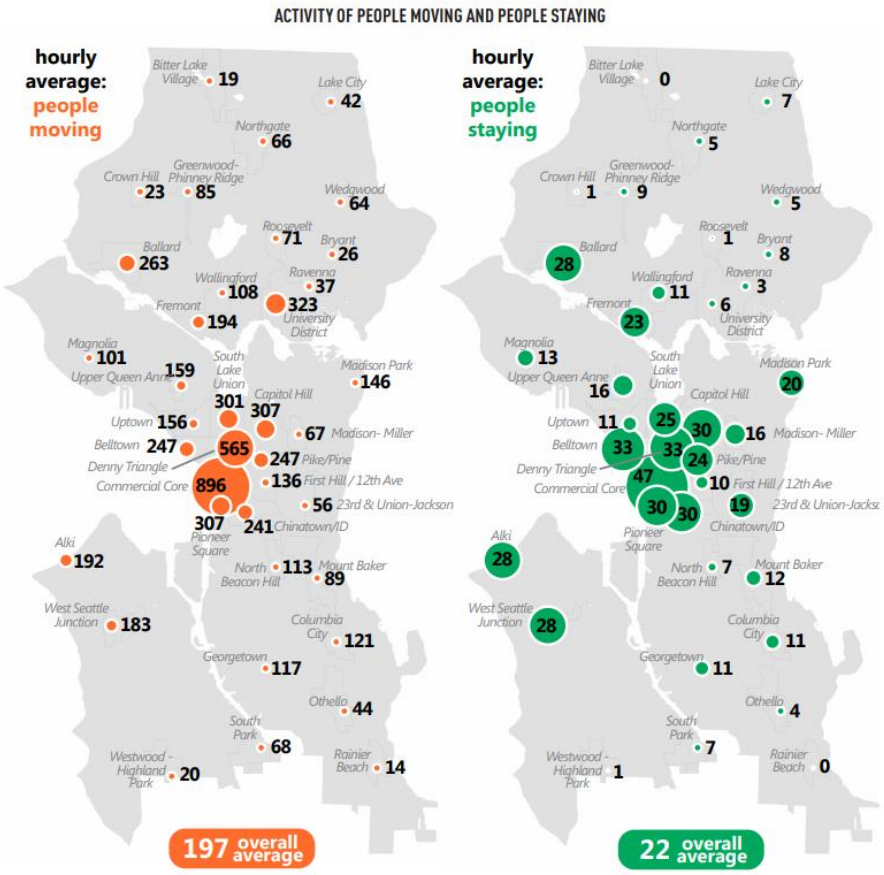

Figure 3.3 Map of People Moving and People Staying in Seattle Neighborhoods.
Source: SDOT. Public Life Study: 2018 Summary Report. 2018

The data is publicly available and accessible. This dataset has been published by the Seattle Department of Transportation (SDOT) of the City of Seattle, which the dataset and the original report can be traced at the website: https://www.seattle.gov/transportation/projects-and-programs/programs/urban-design-program/public-life-program.

The data needed for this study is "2018 Public Life Data". The datasets include information of:

a) "Locations" dataset provides details on the sites selected for the 2018 study, including various attributes to allow for across-site comparisons, such as transit stop, neighborhood type, and seating opportunities.

b) “People Moving” dataset provides data on how people moving through the sites, including the total number observed, gender breakdown, and group size.

c) “People Staying” dataset provides data on people staying still in the space, including the total number observed, demographic data, group size, postures, and activities.

Quantitative data analysis

1. First, I organized the data to find suitable research sites for two case studies.

I screened all the 108 streets observed from the original data source and find the sites that have a bus station or multiple transit station located in. Then, I found 36 sites that meet the standard. After that, I put these 36 streets into different categories based on neighborhood types, including urban center village, urban center, hub urban village, residential urban village, and outside. The reason to classify these sites is that people's travel and activity patterns vary in different neighborhoods. For example, there will be more travel and behavior found in an urban center on weekdays, and they will increase in outside neighborhoods at weekends according to the general status of people's work and life. Thus, I researched and compared the case study sites within the same neighborhood type, so people's behavior patterns could be better compared and analyzed.

Then, I calculated the number of pedestrians observed per hour for all 36 sites based on the data of people moving through sites. One would expect the activity pattern to be similar to two sites that are in the same neighborhood type and have a similar number of people moving observed. To examine it, I selected and set up comparison streets with a similar influx of

pedestrians in each case study. Two case studies are conducted. Each case study included two streets in the urban center village, and another one was for the residential urban village. I would focus on those comparison sites in the following analysis.

2. Then, I explored the behavior patterns of each site based on the "people staying" data. The behavior patterns include:

    a) Based on the number of people staying and people moving, I calculated the ratio of people staying to people moving for each site, as defined as "Linger Factor" (SDOT,2018), which shows how attractive the site is for activities and lingers. In this case, people who "linger" on the target sites are not people who are loitering, but people who are enjoying the public space and doing those activities (See figure 3.4). Linger factor is a good indicator of the capacity of the public space at attracting and retaining pedestrians who like to stay at the space for non-necessary purposes. Linger factor was defined by the original public life study in Seattle, and this factor could help to explore the interactions between pedestrian experiences with the area's aesthetic appeal, commercial opportunities, infrastructure to support public life, and perceived comfort and safety by passengers.

    b) Then, I found people's staying behaviors for each location, which could be split into an activity theme and a posture theme. Surveyors from SDOT collected these data exclusively from observational methods. They counted the number people staying, who stayed, and the activities they did. The activities include talking, doing commercial activities, eating or drinking, doing cultural activities, using electronics,

waiting for transportation, hanging out, smoking, and living in public. In this case, talking stands for talking to others face-to-face. Talking on the phone is not counted as talking. People's postures include standing, leaning, sitting formal, sitting informal, and lying. In this section, I calculated the hourly activities and postures and analyze the proportions of each component of the total for both themes. Then, I visualized these findings and analyzed special and essential patterns.

Activity Theme:	**Posture Theme:**
Talking Commercial activities Eating/drinking Cultural Activity Using Electronics Waiting for Transportation Hanging out Smoking Living in Public	People standing Leaning Sitting Formal (commercial seats) Sitting Formal (public seats) Sitting Formal (private seats) Sitting Informal Lying

Figure 3.4 People's activities and postures

c) Finally, I calculated the ratios of Extroverted VS. Introverted behaviors (SDOT, 2018) for each site. Extroverted activities require engaging with others, including talking, commercial activity, cultural activity, or hang out. Introverted activities are undertaken alone, including using electronics, smoking, or waiting for transit. This factor indicates whether the public space is more solitary where people choose to stay alone, or the space encourages vibrant and interesting public life.

Qualitative data collection

To collect data on the visual environment of study sites, I used a combination of desktop

research and field observations. I acquired information online to find existing data and satellite images of the sites as a reference for analysis and mapping. Also, I went to research sites to capture first-hand data by observations. The understandings of the public spaces addressed in our research are from personal interpretation, which makes no warranty of the accuracy for other uses.

Qualitative data analysis

In this part, I evaluated the quality of the public space for each site. By finding and assessing the existed patterns of visual environments, I could understand whether the space encourages public life positively or not. In order to evaluate the quality of spaces and compare them among each site, I referred to Gehl Criteria as a tool to evaluate and score the space with scale 1-5 for each factor of the public space. Then I summed all the scores to get the total score for each site. The factors of the visual environment to be evaluated include façade quality, Number and quality of commercial seats or public seats, sidewalk and Street furniture, and vehicle pattern. For each factor of each case study site, I graded 1-5, which 1 represents the quality of space is "Unattractive" to public life; 2 represents "Dull"; 3 is "Somewhere-in-between"; 4 represents "Pleasant"; and 5 means the space is "Attractive"(Gehl, 2004).

a) Façade Quality: Building facades along the streets create the dynamic of street frontage. For the transit riders and pedestrians, their experiences and activities will be largely influenced by the design and quality of building facades around the space. Refer to Gehl's 2004 report in Wellington, New Zealand, the criteria were applied to identify whether the façade is attractive. My evaluation was based on whether the

building facades meet the standard below.

Unattractive	Large units with few or no door; No visible variation of function; Closed and passive facades; Monotonous facades; No details, nothing interesting to look at	Score: 5
Dull	Larger units with few doors (2-5 units per 100 m); Little diversity of functions; Many closed units; Predominantly unattractive facades; Few or no details	Score: 4
Somewhere-in-between	Mixture of small and larger units (6-10 units per 100 m); Some diversity of functions; Only a few closed or passive units; Uninteresting facade design; Somewhat poor detailing	Score: 3
Pleasant	Relatively small units (10-14 units per 100 m); Some diversity of functions; Only a few closed or passive units; Some relief in the facades; Relatively good detailing	Score: 2
Attractive	Small units, many doors (15-20 units per 100 m); Diversity of functions; No closed or passive units; Interesting relief in facades; Quality materials and refined details	Score: 1

Figure 3.5 Criteria to evaluate the quality of building facades.
Source: Gehl, Jan. City to Waterfront: Public Spaces and Public Life Study: Wellington. 2004.

In this case, “units” stands for the stores and businesses on the streets, and there are also few residential units in the case studies. “Relief” means the special design style or language on the building facade, and “detailing” stands for whether the façade was intricate, which provides visual interests for people to look at.

b) Number and quality of commercial seats or public seats: Resting is an important behavior in public life. Adequate seats provide people with seating opportunities, which helps them enjoy public life. I counted and evaluated (1) Commercial/public seats’ numbers provided for each site and (2) Quality of seats. The evaluation of the quality of seats is based on these criteria.

Unattractive	Poor view; Loud noise and heavy air pollution; Broken or uncomfortable seats; Random placed	Score: 5
Dull	Common view; Little noise or air pollution; Moderate seats; Random placed	Score: 4
Somewhere-in-between	Common view; No noise or air pollution; Moderate seats; Placed in order	Score: 3
Pleasant	Good view; No noise or air pollution; Fine seats; Placed in order, sheltered	Score: 2
Attractive	Great view; No noise or air pollution; Comfortable seats; Placed in order and along edges, sheltered	Score: 1

Figure 3.6 Criteria to evaluate the quality of seats

c) **Sidewalk and street furniture:** I evaluated the quality of sidewalk and street furniture by assessing (1) Width of Sidewalk, whether the sidewalk is wide and comfortable enough to accommodate varieties of activity. (2) Street furniture condition, whether street furniture such as bins, lighting, benches, and paving is in good quality and well-maintained, and whether its styles are coordinated with overall neighborhood or city characteristics. (3) Designs of transit stations, the quality of the station area, and whether the station is designed to facilitate people's waiting, resting, and other behaviors.

d) Vehicle pattern: "The more traffic, the less life and sense of community." the conclusion drawn by Donald Appleyard shows that public life relevant to the traffic pattern. Thus, I also evaluated the vehicle pattern for each site by analyzing (1) Street Parking and whether vehicle parking blocks people from moving and staying. (2) Traffic volume, whether the street has a high volume of traffic. (3) Safety of pedestrians, whether the design of built environments addresses the safety issue.

Mixed methods data analysis procedures

a) By comparing the findings of each site, I can find sites with more people staying, which suggest that they are more intriguing for public life. I can understand how attractive the public space is for people to stay by looking at the linger factor I calculated. By relating the linger factor with the evaluation of each site's physical quality, I can find whether they match in some sort of logic and how they correspond to each other. Then I can summarize the potential improvement of each public space in terms of its aesthetic appeal, diversity of functions, infrastructure to support public life, and perceived comfort and safety by users of the space, etc.

b) I analyzed the behavior pattern for each site, then compared and found the outstanding elements or behaviors. I aimed to find the interaction between behavior and the built environment by related these special behavior patterns with the visual environment I evaluated.

c) To determine what behavior pattern indicates a more vibrant space for public life, I conducted a similar data analysis method with Seattle's report, which divided the observed behaviors into "Extroverted activities" and "Introverted activities." More extroverted activities make the space more vibrant. Analysis of the extroverted and introverted activities ratio of each site can also help to understand how the quality of space interact with the behavior pattern and how to design a more vibrant space for public life.

d) By measuring how people orient their bodies in public space, I can understand the

degree to which facilities meet the needs of people staying still in space. By analyzing the relationship between people's posture pattern with the number and quality of seats provided on each site, I can interpret whether there are enough facilities to support public life. For instance, if a large number of people are standing, leaning, or sitting informally on items that are not intended to be used as seats, such as a curb or bollard, there may be demand for more seating.

e) I compared the score of each site and compared each factor of the visual environments, which allowed this study to find the potential improvement for each site.

Potential outcomes of the study

Based on the analysis of public life and public space, I aimed to

- Provide recommendations for each site to improve the design of public space, and
- Summarize implications for overall principles of designing public space around transit stations

Case study sites selection

First, by using SDOT's public life study data, the number of people moving and people staying observed per hour for all 36 sites which have bus stations nearby are classified in the tables below. The results are classified by neighborhood types, including urban center, urban center village, hub urban center, residential urban center, and outside. Primary street locations

and data of people moving through and people staying still for each site are presented.

Location_ID	Location_Name_Primary	Neighborhood_Type	People Moving per hour	People Staying per hour
NOR1	5TH AVE NE	Urban Center	18	18
NOR2	NE NORTHGATE WAY	Urban Center	114	46
SLU3	FAIRVIEW AVE N	Urban Center	302	47
UPT1	QUEEN ANNE AVE N	Urban Center	213	25

Figure 3.7 Candidate sites in urban center

Location_ID	Location_Name_Primary	Neighborhood_Type	People Moving per hour	People Staying per hour
BLT1	3RD AVE	Urban Center Village	426	96
CAP1	BROADWAY	Urban Center Village	561	64
CAP2	15TH AVE	Urban Center Village	271	62
CAP3	E JOHN ST	Urban Center Village	284	52
CID4	S JACKSON ST	Urban Center Village	152	50
COM1	JAMES ST	Urban Center Village	236	54
COM3	3RD AVE	Urban Center Village	908	94
FHT2	BROADWAY	Urban Center Village	158	34
FHT3	MADISON ST	Urban Center Village	170	7
PIK3	BROADWAY	Urban Center Village	302	38
PIK4	PINE ST	Urban Center Village	228	21
RAV2	25TH AVE NE	Urban Center Village	20	5
RAV3	25TH AVE NE	Urban Center Village	41	8

Figure 3.8 Candidate sites in urban center village

Location_ID	Location_Name_Primary	Neighborhood_Type	People Moving per hour	People Staying per hour
BAL1	NW MARKET ST	Hub Urban Village	339	8
BAL2	NW MARKET ST	Hub Urban Village	332	11
MTB2	RAINIER AVE S	Hub Urban Village	127	48

Figure 3.9 Candidate sites in hub urban village

Location_ID	Location_Name_Primary	Neighborhood_Type	People Moving per hour	People Staying per hour
BEA2	BEACON AVE S	Residential Urban Village	186	13
CRO2	NW 85TH ST	Residential Urban Village	26	3
GPR1	GREENWOOD AVE N	Residential Urban Village	81	9

GPR4	GREENWOOD AVE N	Residential Urban Village	99	15
MAM2	19TH AVE E	Residential Urban Village	104	30
OTH1	M L KING JR ER WAY S	Residential Urban Village	36	11
OTH2	M L KING JR ER WAY S	Residential Urban Village	51	39
RAI1	57TH AVE S	Residential Urban Village	23	3
RAI2	RAINIER AVE S	Residential Urban Village	6	4
SOP1	14TH AVE S	Residential Urban Village	71	10
TUJ1	E UNION ST	Residential Urban Village	57	15
TUJ2	S JACKSON ST	Residential Urban Village	55	23
UQA1	QUEEN ANNE AVE N	Residential Urban Village	114	24

Figure 3.10 Candidate sites in residential urban village

Location_ID	Location_Name_Primary	Neighborhood_Type	People Moving per hour	People Staying per hour
ALK1	ALKI AVE SW	Outside	215	28
BRY2	NE 65TH ST	Outside	32	17
GEO2	AIRPORT WAY S	Outside	163	9

Figure 3.11 Candidate sites in outside neighborhoods

Second, I set up two case studies. Each case study included two comparison sites with a similar influx of pedestrians and within the same neighborhood type. According to the first step, we found that all those sites have different numbers of people moving per hour, which is essential because of their differences in nearby population, level of employment, and transportation capacity, etc. However, for those sites with similar numbers of people moving through, the numbers of people who stay still on those sites also differ greatly. By researching and comparing these streets, I can understand why some public spaces attract people to stay and have activities while others not.

I conducted one case study for two comparison sites in the urban center village, including one block face on 15th Ave and one on Broadway. Those streets are generally busier. They have relatively more people moving through, and more activities were observed than the average. Then, I set up a case study of the less dense streets in the residential urban village, including

one block face on E Union St and one on M L King JR ER Way S. These commercial streets are often regarded as the auxiliary space near residential areas, which is also worthy of attention. Subsequent analysis concentrated on those chosen sites, and primary location information is shown below.

- Case study 1 on 15th Ave and Broadway in Urban Center Village neighborhood.

Figure 3.12 Target sites of case study 1

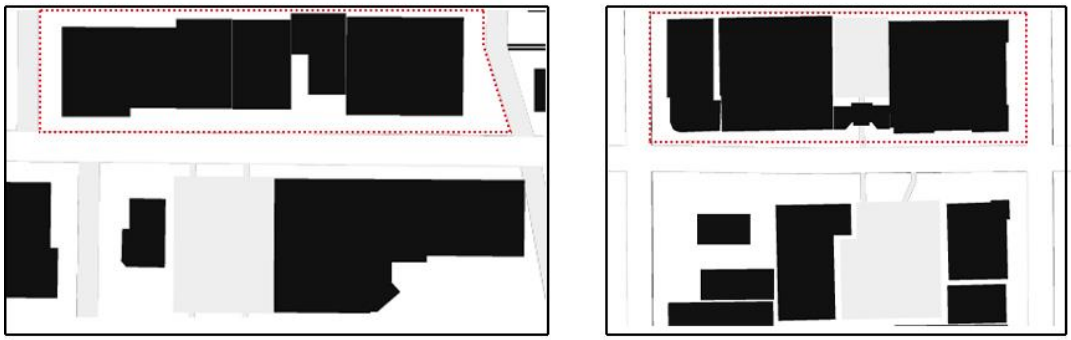

Figure 3.13 Figure/ground of case study 1. Left: 15th Ave. Right: Broadway

- Case study 2 on E Union St and M L King JR ER Way S in Residential Urban Village neighborhood.

Figure 3.14 Target sites of case study 2

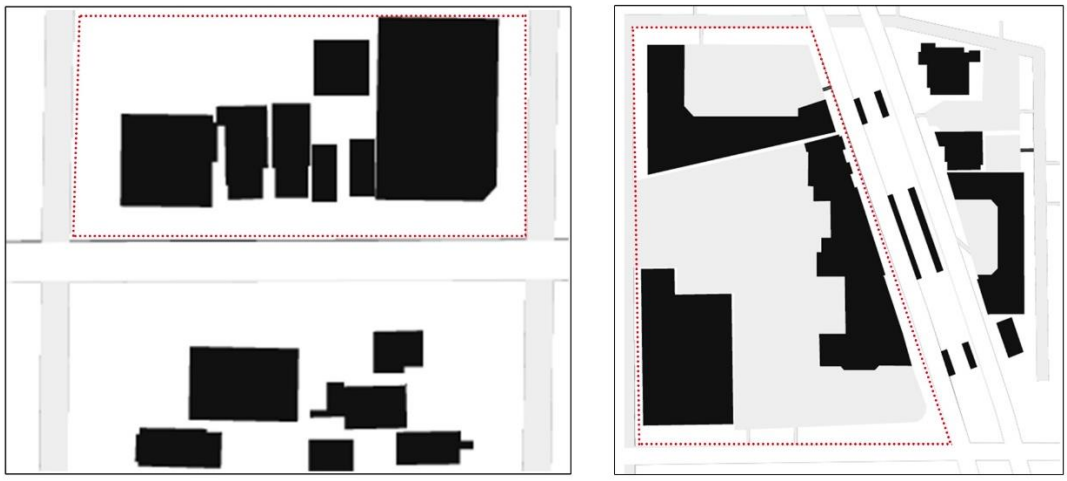

Figure 3.15 Figure/ground of case study 2. Left: E Union St. Right: M L King JR ER Way S

Chapter 4: Case Study Results and Analysis

Case study 1:

- 15th Ave, between Harrison St and Republican St, looking West, and
- Broadway, between Pike St and Pine St, looking West

1) Linger Factor: Based on the data of people moving and people staying, I calculated the linger factor s for both sites, and the results are shown below. Overall, of all pedestrians moving through 15th Ave, 22.88% stayed still on this site for some reason. However, the ratio of people staying to people moving was only 12.58% for Broadway.

Location_ID	Location_Name_Primary	People Moving per hour	People Staying per hour	Linger Factor
CAP2	15TH AVE	271	62	22.88%
PIK3	BROADWAY	302	38	12.58%

Figure 4.1 Linger factor of case study 1

Location ID	CAP2	PIK3
Activity		
Talking	34	13
Commercial activities	24	3
Eating/drinking	22	2
Cultural Activity	0	0
Using Electronics	19	11
Waiting for Transportation	5	29
Hanging out	12	5
Smoking	6	1
Disruptive Activity	0	1
Living in Public	0	1
Posture		
Standing	28	26
Leaning	4	4
Sitting Formal (commercial seats)	14	0
Sitting Formal (public seats)	12	0
Sitting Formal (private seats)	2	0

Sitting Informal	3	6
Lying	0	0

Figure 4.2 Hourly Behaviors of case study 1

2) Behavior Patterns: I calculated people's behavior patterns for the two sites. Both activities and posture were vastly different between the two sites, which I would address and analyze in detail in the following data analysis chapter.

3) Extroverted VS. Introverted activities: 58% of pedestrians who stayed still on 15th Ave were doing extroverted activities, and 24% were doing introverted activities. While the pattern differed on Broadway. Only 31% of total activities were found to be extroverted, and more people, 62%, were doing introverted activities.

Location ID	CAP2	PIK3
Extroverted Activity	71 (58%)	20 (31%)
Introverted Activity	30 (24%)	41 (62%)

Figure 4.3 Hourly Extroverted VS. Introverted activities of case study 1

4) Quality of Public Space: Both sites were evaluated based on the criteria addressed in the method chapter. Overall, 15th Ave scores 13 and Broadway scores 10. The result shows that 15th Ave has better façade quality and more seating opportunities than Broadway. While the vehicle pattern of Broadway can facilitate better pedestrian experiences. All these factors will be analyzed and related to people's behavior patterns in the following discussion chapter.

Figure 4.4 Façade of case study 1

15th Ave. Total Score: 13	**Broadway. Total Score: 10**
	
Figure 4.5 Photo of 15th Ave. Source: Google map	Figure 4.6 Photo of Broadway. Source: Google map
Facade quality. Score 4: Pleasant - 354ft (108m) of the street has 11 units, average 10 unit every 100m, all relatively small units - Some diversity of functions - No closed or passive units - Some relief in the facades; Relatively good detailing	**Facade quality.** Score 3: Somewhere-in-between - 358ft (109m) of the street has 8 units, average 7 unit every 100m, a mixture of small and larger units - Some diversity of functions - Only one closed or passive units - Uninteresting facade design Somewhat poor detailing
Number and quality of commercial seats or public seats. Score 4: Pleasant - Number of Commercial Seat: 15 - Number of Public Seat: 9 Quality of Seats: - Good street view - Clean and Comfort - Some under shields	**Number and quality of commercial seats or public seats** Score 1: Null - Number of Commercial Seat: 0 - Number of Public Seat: 0
Sidewalk and Street furniture. Score: 3 - Width: 13ft (4m) - Few street trees or vegetation - Public Bench at the bus station - Bicycle parking zone - Medium level of Street furniture	**Sidewalk and Street furniture.** Score: 3 - Width: 13ft (4m) - Few street trees or vegetation - Mixed-transit station; Sidewalk gets wider in the station; Railings designed when sidewalk going downhill - Medium level of Street furniture
Vehicle pattern. Score: 2 - On-Street Parking - Relatively high traffic volume (According to SDOT Traffic Flow Map, the average annual weekday traffic volumes was 11923) - No buffer between sidewalk and vehicle roadway	**Vehicle pattern.** Score: 3 - On-Street Parking - Medium traffic volume (According to SDOT Traffic Flow Map 2019, the average annual weekday traffic volumes was 11430) - Safety of pedestrian: Yellow Zone designed to buffer traffic around the transit station; trees buffer on the sidewalk

Case study 2:

- E Union St, between 20th Ave and 21st Ave, Looking North, and
- M L King JR ER Way S, between S Myrtle St and S Othello St, Looking West

1) Linger Factor: About 26% people moving through E Union St ended up staying there, and the number comes to a surprisingly 76% for M L King JR ER Way S.

Location_ID	Location_Name_Primary	People Moving per hour	People Staying per hour	Linger Factor
TUJ1	E UNION ST	57	15	26.32%
OTH2	M L KING JR ER WAY S	51	39	76.47%

Figure 4.7 Linger factor of case study 2

Location ID	TUJ1	OTH2
Activity		
Talking	6	15
Commercial activities	2	2
Eating/drinking	2	2
Cultural Activity	0	1
Using Electronics	5	11
Waiting for Transportation	10	36
Hanging out	1	1
Smoking	1	1
Disruptive Activity	0	0
Living in Public	0	0
Posture		
Standing	11	27
Leaning	1	2
Sitting Formal (commercial seats)	0	0
Sitting Formal (public seats)	4	9
Sitting Formal (private seats)	0	1
Sitting Informal	0	1
Lying	0	0

Figure 4.8 Hourly Behaviors of case study 2

2) Behaviors Pattern: Since the numbers of hourly people staying of the target sites are

different, the hourly behaviors observed differ correspondingly. However, the proportion of each activities are similar, which I would address in discussion chapter. For the posture patterns, there were few people sitting formal in private seats, and there were also few people sitting informal on M L King JR ER Way S.

3) Extroverted VS. Introverted activities: 35% of pedestrians who stayed still on E Union St were doing extroverted activities, and 56% were doing introverted activities. The pattern differed on M L King JR ER Way S. 27% of total activities were found to be extroverted, and more people, 69%, were doing introverted activities.

Location ID	TUJ1	OTH2
Extroverted Activity	10 (35.14%)	19 (27.03%)
Introverted Activity	16 (56.76)	48 (69.19%)

Figure 4.9 Hourly Extroverted VS. Introverted activities of case study 2

4) Quality of Public Space: Overall, E Union St scores 11 and M L King JR ER Way S scores 12. E Union St provided quality seating opportunities for people to rest. However, in terms of façade quality and sidewalk quality, it was not as inviting as M L King JR ER Way S for pedestrians.

Figure 4.10 Façades of case study 2

E Union St. Total Score: 11	**M L King JR ER Way S. Total Score: 12**
	
Figure 4.11 Photo of E Union St. Source: Google map	Figure 4.12 Photo of M L King JR ER Way S. Source: Google map
Facade quality. Score 2: Dull - 248ft (75m) of the street has 6 units, average 7 unit every 100m, all relatively large units with few doors - Little diversity of functions - Some passive facades - Predominantly unattractive facades; Few details	**Facade quality.** Score 4: Pleasant - 446ft (135m) of the street has 14 units, average 10 unit every 100m, a mixture of small and larger units - Diversity of functions - No closed or passive units - Some relief in the facades; Relatively good detailing
Number and quality of commercial seats or public seats Score 3: Somewhere-in-between - Number of Commercial Seat: 0 - Number of Public Seat: 8 Quality of Seats: - Good street views - Clean and Comfort - No shields - May influenced by traffic noise	**Number and quality of commercial seats or public seats** Score 2: Dull - Number of Commercial Seat: 0 - Number of Public Seat: 3 Quality of Seats: - Common view - No noise or pollution - Moderate seats - Hard to find
Sidewalk and Street furniture. Score: 3 - Width: 16ft (5m) with landscape zone - Lack of maintenance for landscape and planting - Low level of Street furniture	**Sidewalk and Street furniture.** Score: 3 - Width: 11ft (3.5m) - Sidewalk interacts with trees - Elevated zebra crossings - Medium level of Street furniture
Vehicle pattern. Score: 3 - On-Street Parking - Low traffic volume (According to SDOT Traffic Flow Map, the average annual weekday traffic volumes: 4931) - Safety of pedestrian: Planting strips designed to buffer sidewalk	**Vehicle pattern.** Score: 3 - No on-Street Parking - High traffic volume high (According to SDOT Traffic Flow Map 2019, the average annual weekday traffic volumes: 23819) - Safety of pedestrian: Sidewalk is buffered by trees

Chapter 5: Discussion

Case study 1:

- 15th Ave, Between Harrison St and Republican St, Looking West (Location ID: CAP2), and
- Broadway, Between Pike St and Pine St, Looking West (Location ID: PIK3)

1) Higher linger factor on 15th Ave

Compared to Broadway, there were a similar number of people passing through the 15th Ave hourly. However, more pedestrian on 15th Ave would stay in this space and participate in various civic activities. In terms of Linger Factor, about 23% of people who move through 15th Ave finally stayed on the site, which is higher than the 13% of Broadway. This difference shows that 15th Ave is more intriguing for public life. The higher linger factor of 15th Ave corresponds to the evaluation result of the visual environment of these two sites. 15th Ave wins a higher score on façade quality and seating opportunity than Broadway. It has a pleasant façade quality with dense small units, which serves a diversity of functions (See figure 5.4). It gives pedestrians more interests and surprises, which attracts them to stay still and enjoy public life. 15th Ave also provided enough commercial seats and public seats to help people rest. In comparison, Broadway's façade was less vibrant and provided no seats at all for pedestrians passing through the site.

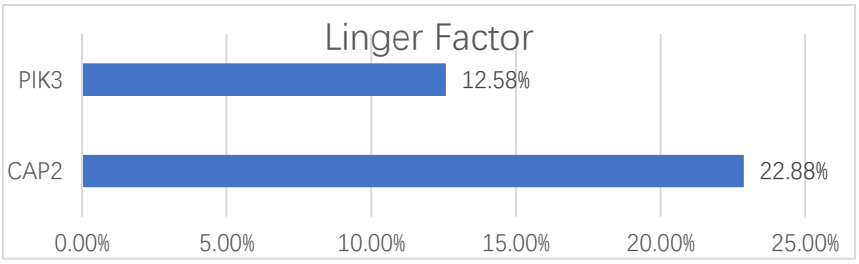

Figure 5.1 Linger factors of case study 1

2) More extroverted activities on 15th Ave

I find that talking was a prevailing activity on both sites by looking at the details of the people's behavior patterns on these two sites (see Figure 5.2). More people were doing commercial activities on 15th Ave, and there was also a more significant proportion of people eating or drinking on 15th Ave than Broadway. Few commercial activities and eating or drinking were observed on Broadway. However, there was a high proportion of people observed waiting for transportation on Broadway. People using electronics was another preferred activity for pedestrians. This pattern shows that pedestrians were likely to do various activities on 15th Ave. At the same time, they tend to do similar activities on Broadway, in which most people were waiting for transportation and watching their cell phones.

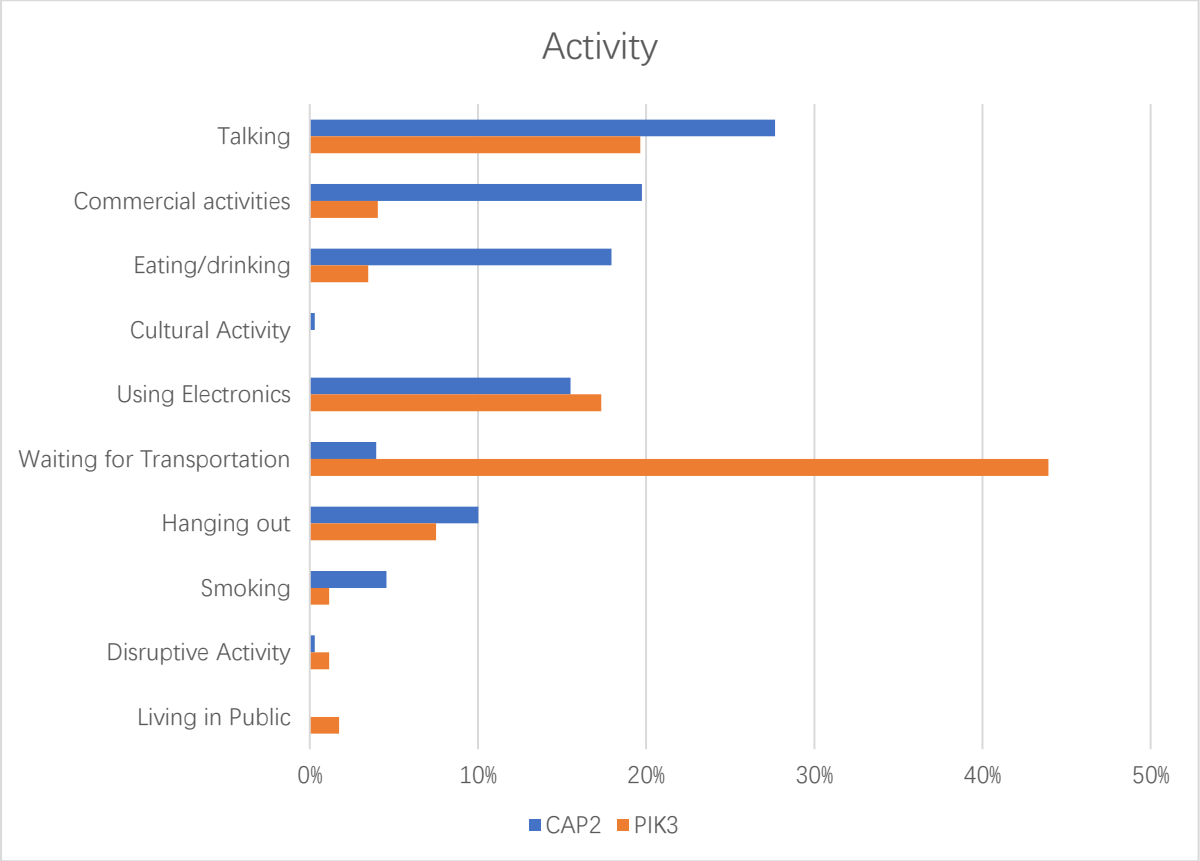

Figure 5.2 Proportion of Activity of case study 1

In terms of extroverted and introverted activity, people on 15th Ave tend to do more extroverted activities, while more Introverted activities were found on the Broadway (see Figure 5.3). More extroverted activities show the 15th Ave encourage people to interact with others and do more sociable activities, while people preferred to stay alone on Broadway.

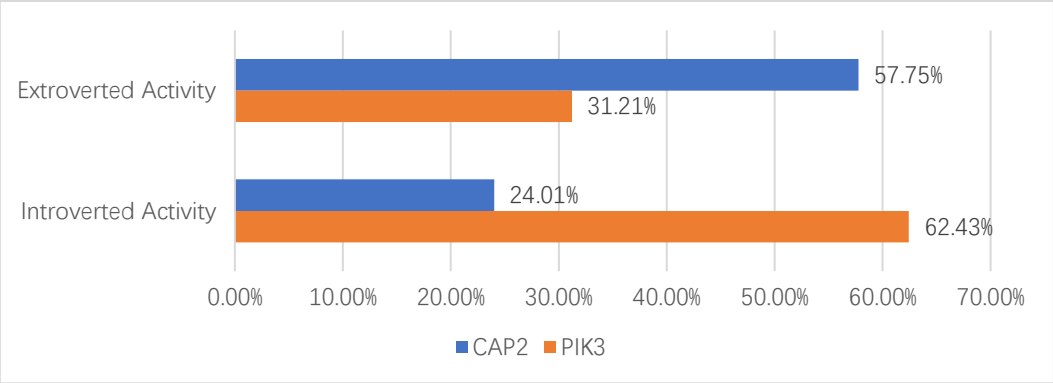

Figure 5.3 The proportion of Extroverted VS. Introverted activities of case study 1

15th Ave, which has a higher total score of 13 than Broadway's 10 on the evaluation of public space quality, has a vibrant façade quality. It gives people more options and opportunities to do various activities. Here lists all the business on the block faces of the two sites (see Figure 5.4). On 15th Ave, 11 units are running the business, including 5 restaurants, 3 retails stores, a barbershop, a dry cleaner, and an insurance company. There is no residential unit on this block face. On Broadway, there are 8 units, including 4 restaurants, a retail store, 2 units of 6-floor apartments, a barbershop, and a print store. As we can see, more restaurants and retails increased pedestrians' travel experiences and attracted them to stay still on 15th Ave. Besides, restaurants on 15th Ave provided commercial seats on sidewalks, and they also applied transparent and opened walls to create a sense of indoor and outdoor connection. This design helped people to see and interact with each other, and people were proved to prefer this kind of lively public life. There are two units of high-rise apartments and another unit apartment on

top of the retail store on Broadway. These 6-floor building facades contrasted with other units on the street and brought a sense of oppressive to pedestrians. People like to put themselves in a place which is of human scale. An appropriate ratio of building height and street width helps to create this walkable scale. 15th Ave and Broadway have similar width of the sidewalks, but the apartment building make the façade higher and bring more pressure to people who pass through the space, which is one of the reasons why 15th Ave were observed to own a better public life pattern than Broadway.

15th Ave (11units)	5 Restaurant 3 Retail 3 Service, including: barbershop; dry cleaners; insurance
Broadway (8 units)	4 Restaurant 1 Retail (under apartment) 2 Apartment 2 Service, including: barbershop; print

Figure 5.4 List of business of case study 1

3) Lack of seats on Broadway

By looking at the Posture Pattern observed on the two sites (see Figure 5.5), I can find that there was a more significant proportion of people standing, leaning, sitting informal, and even lying on Broadway than on 15th Ave. More people were sitting formally on commercial and public seats on 15th Ave. The pattern shows demands for seats on Broadway to meet the needs of people staying still in the space. Then I can understand the pattern based on the condition of seats provided. On 15th Ave, there were 15 commercial seats and 9 public seats provided to facilitate public life. However, there was not even one seat provided for the 302

pedestrians who passed through this space hourly.

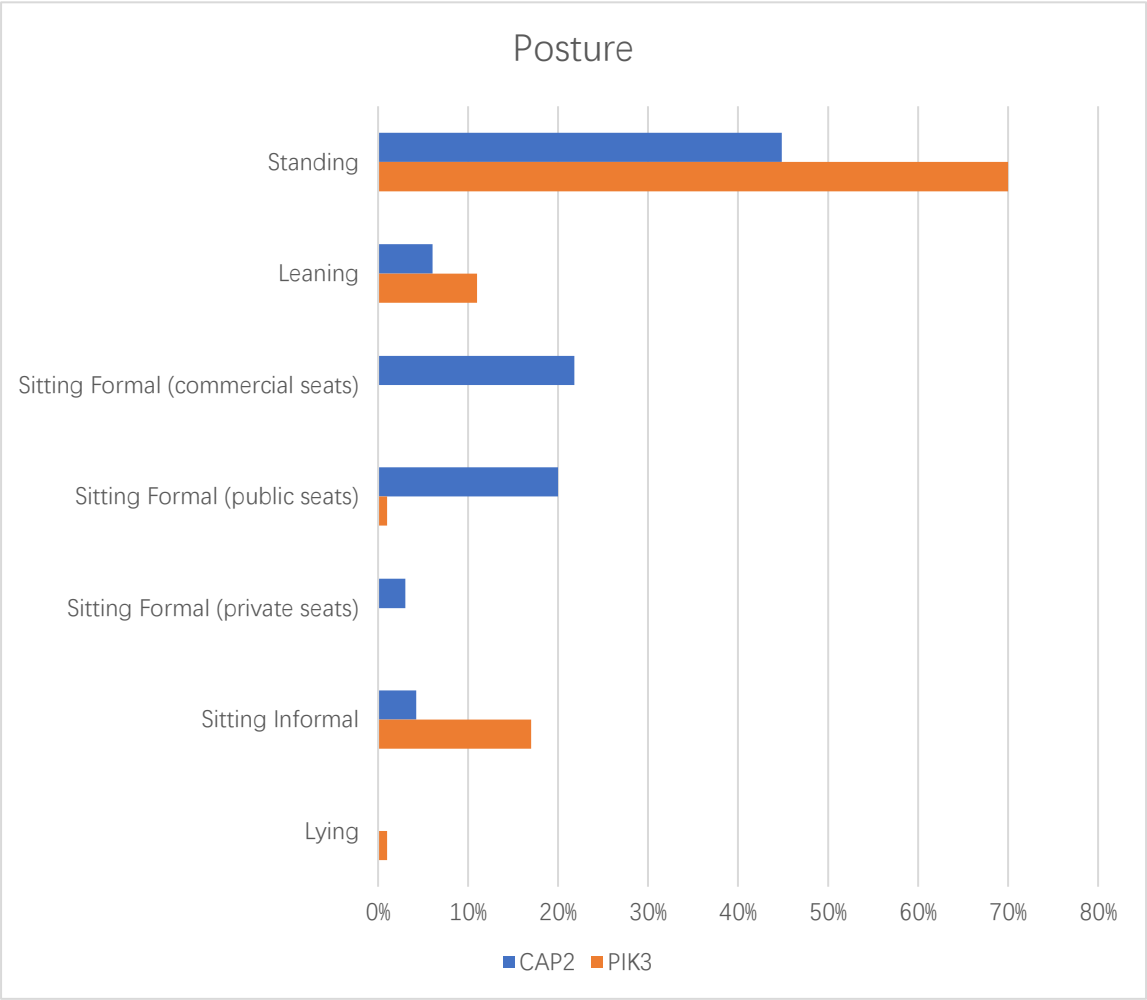

Figure 5.5 Proportion of Posture of case study 1

4) Analysis of visual environments of two sites

The evaluation of visual environments of two sites relates and corresponds with people's behaviors pattern. 15th Ave wins a higher score of 13 compared to 10 of Broadway. The above behaviors' analysis shows that people were more likely to stay on 15th Ave and did more extroverted activities there. I would explore deeper on how the built environment influenced this trend.

Based on the evaluation results, these two sites are different in terms of façade qualities,

the number of seats provided, and sidewalk facilities such as buffer zone and landscape zone. The façade of the 15th Ave has more units than Broadway. They are smaller units with excellent detailing, which provides pedestrians diverse services and activities. Small and narrow units will make the space more intriguing. People like to see more interesting stuff on a short walk. Moreover, the small units also affect people's feelings to make the distance feel shorter. As a result, people are likely to walk and spend more time in this space. 15th Ave also provides transparency on facades and outdoor commercial seats to increase indoor and outdoor connection. Several units have big horizontal windows or open windows, which makes the public space more intimate.

Figure 5.6 Building facades with big horizontal windows or open windows on 15th Ave.

In comparison, Broadway’s façade was less vibrant. There is one closed unit. The gate disrupted the consistency of the façade. The 6-floor apartment building makes the façade uninteresting and refuses commercial activities. It also increases the sense of enclosure and leaves less skyspace in pedestrians' eyes. Besides, the details and designs of façade of the Broadway are not as good as it on the 15th. Several units on Broadway have blank facades consisted of colored panels. However, most of the units on 15th Ave have variations of styles and materials on their facades. These differences of facade qualities correspond to a more

vibrant public life pattern observed on 15th Ave.

Figure 5.7 Poor detailing façade, passive unit, and high-rise apartment on Broadway (from left to right)

When looking at the relationship of people's postures observed with the number of seats provided on the two sites, I find that people were standing, leaning, and even sitting informally because they could not find a seat to rest. The improvement of facilities, especially more seats, will be important for Broadway.

Broadway provided a safer space for public life. There is no buffer designed between the sidewalk and the vehicle on 15th Ave. While on Broadway, the sidewalk becomes wider when approaching the transit station, and the yellow zone was designed to warn people and avoid parking at the curb around the transit station. Railings are designed when the sidewalk is going downhill. Those are all great designs to ensure the safety of pedestrians around the space. Bicycle parking space is provided on 15th Ave, helping bike riders come to business on this street. However, there is no bike lane, and it would be better if it cooperates with bike lanes to ensure the safety of bike riders and pedestrians.

Case study 2:

Research Sites:

- E Union St, between 20th Ave and 21st Ave, Looking North (Location ID: TUJ1), and
- M L King JR ER Way S, between S Myrtle St and S Othello St, Looking West (Location ID: OTH2)

1) Extremely high linger factor on M L King JR ER Way S

Compared to the two streets in the urban center village, these two streets in the residential urban village both have higher linger factors. Fewer people would pass through these streets for commuting purposes, and a greater proportion of people would linger. Also, the difference in neighborhood types results in different rhythms and habits of life for people when passing through and staying in these spaces. People usually slow down their paces of life in the residential urban village. While in the urban center areas, most people are not living here. They are likely to come to this space on the way to work or transportation. Thus, fewer people will stay still when passing through.

On M L King JR ER Way S, the ratio even comes to 76%, which means most of the pedestrians observed finally decided to stay still on this street. It shows a big difference compared to 26% of E Union St. This comparison shows that the public space on M L King JR ER Way S is far more attractive for people than the latter. Although the existence of light rail stations around brought people who were waiting for transportation. The difference between the two sites on public life can also be explained by their quality of the visual environment. There was a better façade quality on M L King JR ER Way S, which had smaller units of various functions, uniformed reliefs and decorations, and good detailing. It also had a better level of

street furniture than the latter street. The landscape zone of the sidewalk was well designed and maintained. It also did not allow on-street parking, which gave a better experience for pedestrian travel. However, on E Union St, there were all relatively large units, and some of them were not connected with each other, and there were dull units among them. People walked a long distance from one unit to another, making the façade less interesting for pedestrians. The battered street furniture also made the space less attractive.

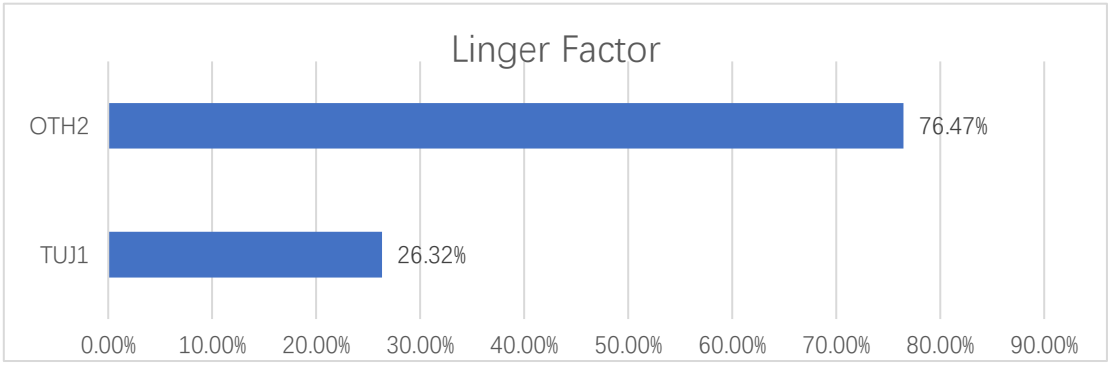

Figure 5.8 Linger factors of case study 2

2) Large numbers of people waiting for transportation on both sites

Based on the observation data, people's behavior patterns on these two sites (see Figure 5.9) are very similar. In this case, waiting for transportation was the most prevailing activity observed. There was more than 50% of people were waiting for transportation on M L King JR ER Way S, which was influenced by the light rail station around this space. Many people transferred between bus and light rail, which led to a big proportion of waiting behaviors. Talking was also counted for a significant portion among all the behaviors for both sites. E Union St had a bigger proportion of the behaviors while less in the exact number observed in terms of commercial activities, people were eating or drinking, and hanging out. There

appeared people who were doing cultural activities on M L King JR ER Way S while the former did not. We can hardly find the interactions if we relate these behavior patterns to our evaluation of these public spaces. There were 27 behaviors observed hourly on E Union St, while 69 on the latter. This lack of activities on E Union St resulted in the deviation and enlargement of every kind of behavior in the record. Thus, M L King JR ER Way S showed a less vibrant behavior pattern but a higher score of quality of the space. However, E Union St had its strength. It provided more public seats with good quality, wider sidewalk, and wider planting strips to buffer the traffic, which was positive for encouraging public life.

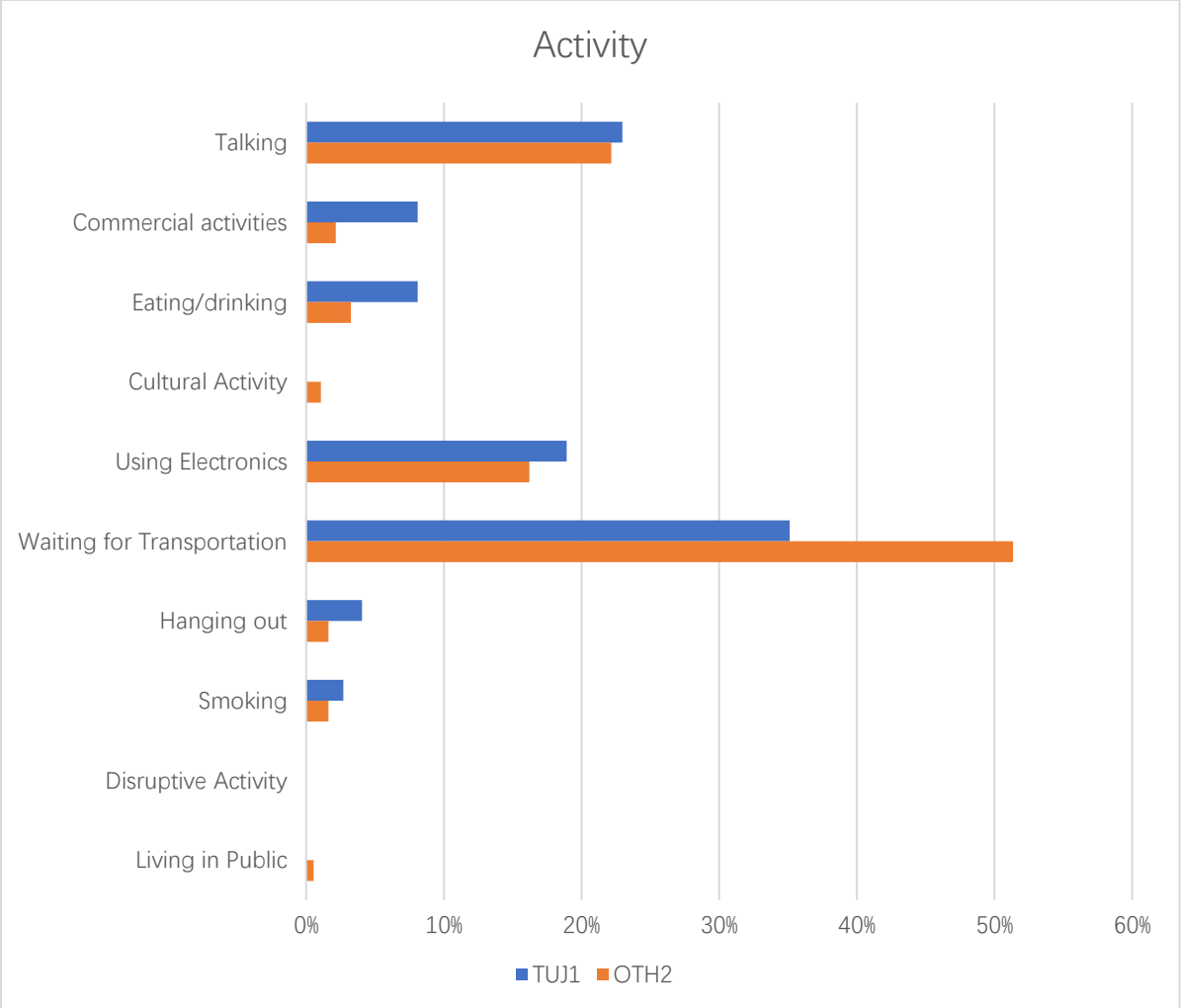

Figure 5.9 Proportion of Activity of case study 2

As for extroverted and introverted activities, while more extroverted activities were observed on M L King JR ER Way S, the total proportion of extroverted activity was lower than that on the E Union St because waiting for transportation counted too much of the proportion. Both the two sites showed more introverted activities than extroverted activities. (see Figure 5.10)

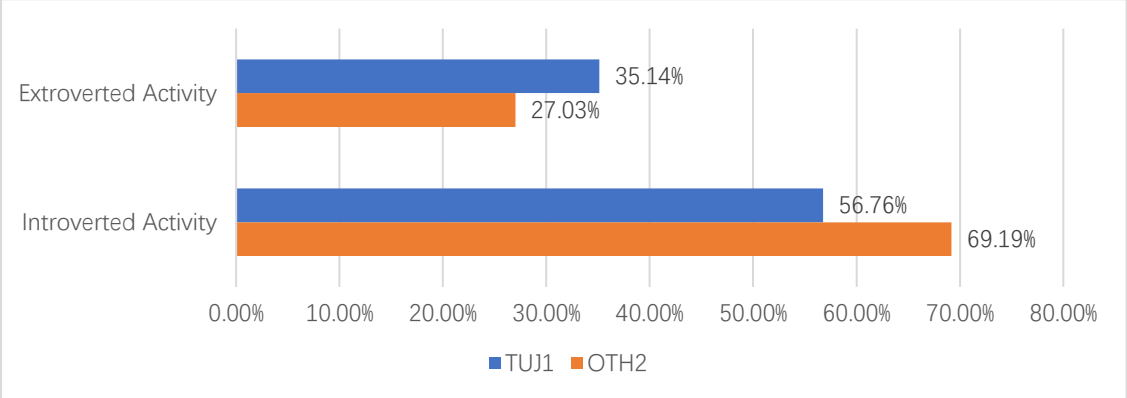

Figure 5.10 proportion of Extroverted VS. Introverted activities of case study 2

Since waiting for transportation was the dominant behavior, it would be important to consider designing the space to facilitate multi modes of transit on M L King JR ER Way S. Transit riders' experience was largely influenced by the design of the surrounding environment of the stations. Elevated zebra crossings were designed on M L King JR ER Way S to ensure pedestrians' safety. And public bench provided at transit stations to give transit riders opportunities to rest. There were many small stores near the bus station, which would make the waiting experience more colorful. Business included 2 restaurants, 4 retail stores, 8 service units consisting of barbershop, beauty, phone repair, religious service, and bank. In contrast, there were only a restaurant, a retail store, a body training school, and residential units on the E Union St. This difference in diversity of functions made M L King JR ER Way S a more attractive public space.

E Union St (6 units)	1 Restaurant 1 Retail 2 single family houses 1 apartment 1 Service, including: body training;
M L King JR ER Way S (14 units)	2 Restaurants 4 Retails 8 Services, including: barbershop; beauty; phone repair; religious; bank

Figure 5.11 List of business of case study 2

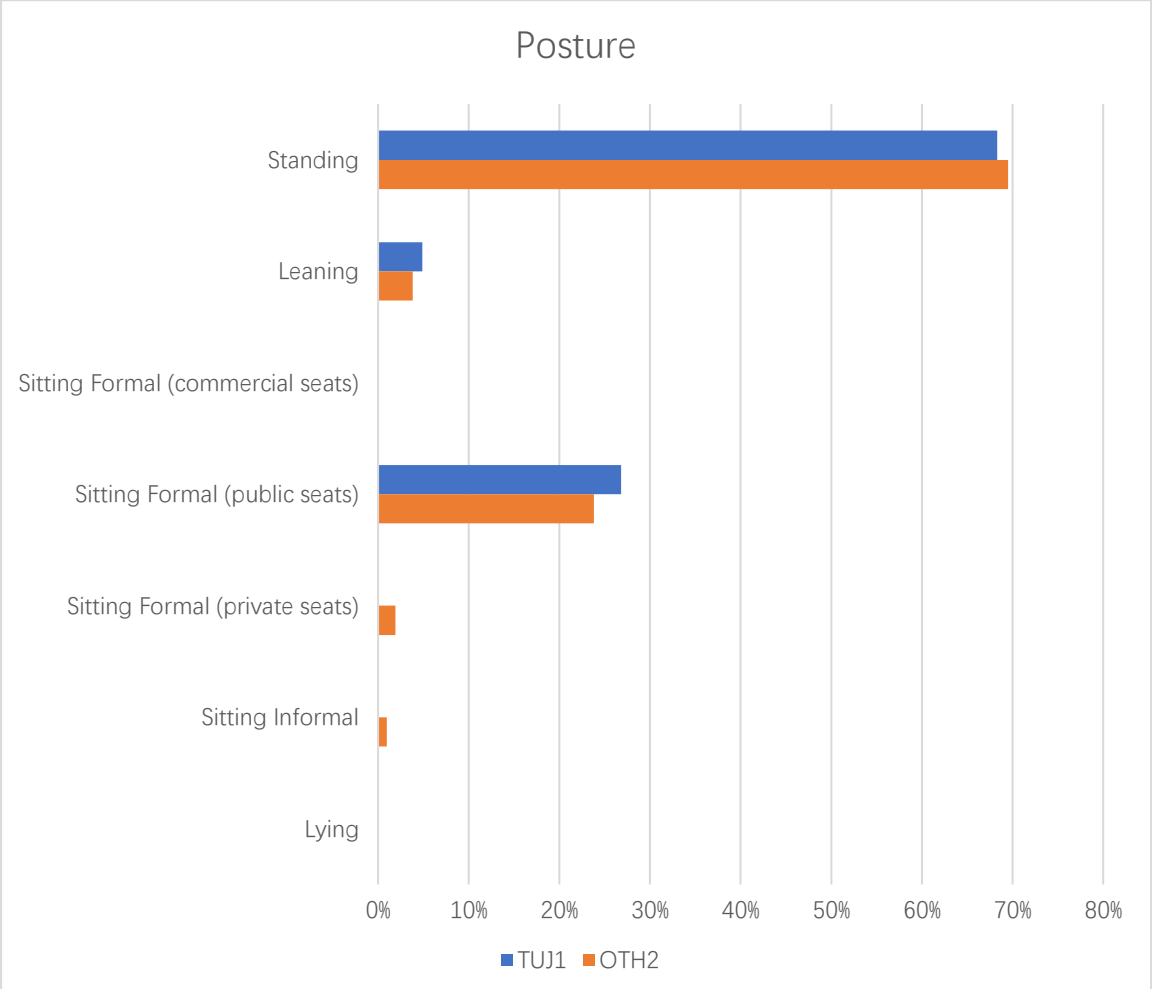

Figure 5.12 Proportion of Posture of case study 2

3) Lack of seats on M L King JR ER Way S

By looking at the Posture Pattern observed on the two sites (see Figure 5.12), we can find that the proportions of people standing and sitting formally on public seats are similar. However, there was a small proportion of people sitting on their private seats and sitting informally on M L King JR ER Way S. When looking at the number and quality of seats provided for both sites, E Union St provided 8 public seats. M L King JR ER Way S had 3 public seats placed. The seats provided on the former street were in good condition with good views, while seats on the latter site were hard to be found. This difference in both the number and quality of seats created the difference in people’s posture patterns.

4) Analysis of visual environments of two sites

Focusing on the evaluation of two sites' visual environments, E Union St wins a score of 10, and M L King JR ER Way S earns a score of 12. The evaluation details show that the former site had more seats for the pedestrians, and those seats were relatively good. It also provided a wider sidewalk with a planting strip to buffer the traffic. Low traffic volume made the space safe during people walking and doing various activities. The weakness of E Union St would be the lack of variation of façade. Large units were unattractive and lack of details, which could not attract people's attention. Buildings were not connected closely, which required people to walk a long distance from one attraction to another. Apartment building and the single-family house would hardly attract pedestrians' interests on a commercial street, and the privacy needed for these residential units would be against creating a lively street frontage for the transit riders and pedestrians.

Figure 5.13 Residential units on E Union St

As for M L King JR ER Way S, it provided a desirable façade for pedestrian travel. There were more than 10 units within every 100 meters' distance. The units were small and interestingly detailed and served a diversity of functions. Also, the sidewalk was designed with trees, and street furniture was in good condition. The high traffic volume might cause noise, pollution, and dangers to pedestrians. The trees could buffer the sidewalk and vehicles, and the streets limited on-street parking, which compensated the harm from traffic to some extent. There were also elevated zebra crossings designed to ensure pedestrians' safety and helped transfer riders walk between the bus station and the light rail station.

Figure 5.14 Elevated zebra crossings on M L King JR ER Way S. Source: Google map

Chapter 6: Conclusion and Recommendations

Based on the analysis of the case studies, the patterns of public life always correspond to the quality of built environments on target sites. More active and vibrant street lives were found on the streets which were evaluated as better public spaces. From a designer's perspective, it is important to consider the dynamic coherence of public life and the physical environment. In this chapter, I provide recommendations on designing and improving public space around transit stations. Many of these recommendations are already included in urban design guidelines, such as "City Life at Street Level" by City of Seattle, 2019.

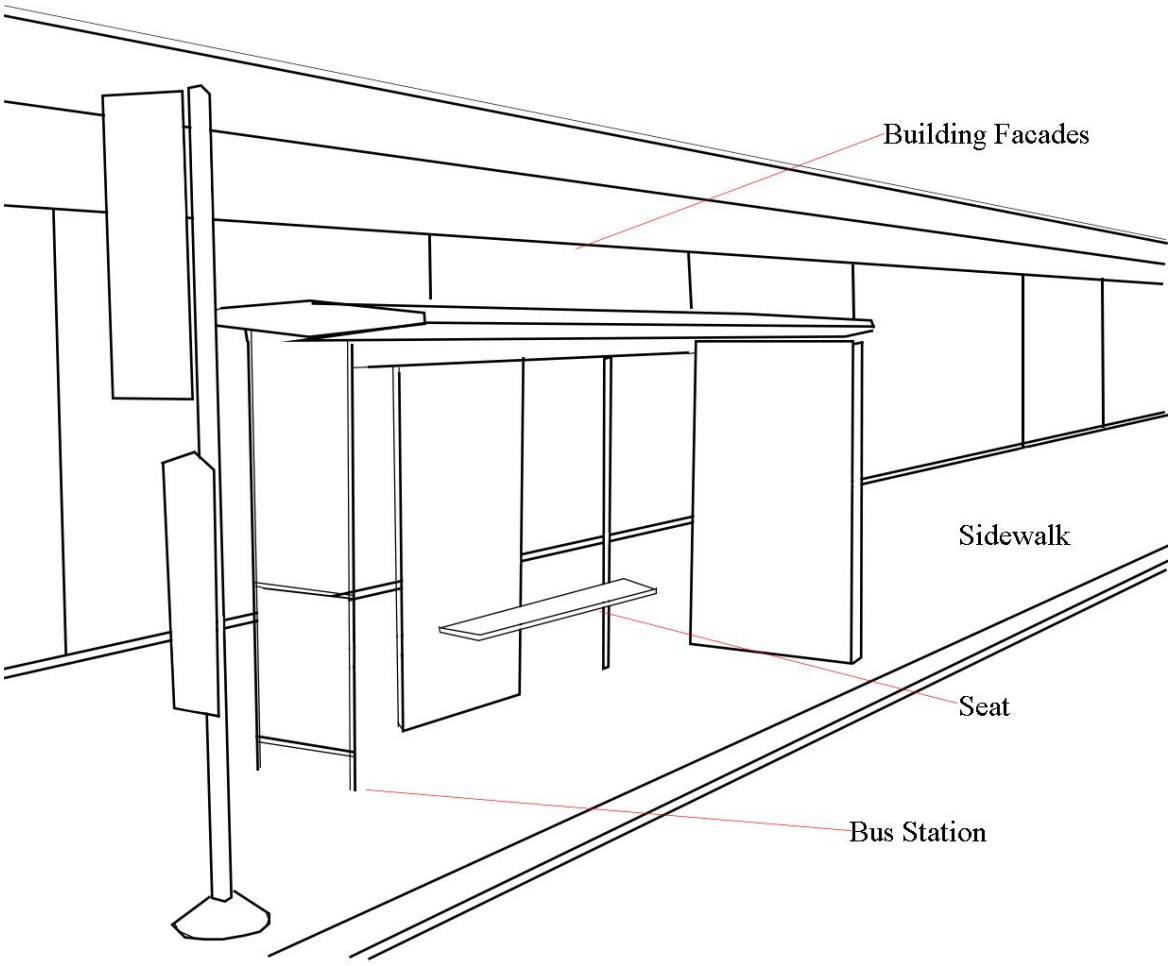

Figure 6.1 Bus station fits in the environment

Building facades

Building facades along the streets create the dynamic of street frontage. For pedestrians, their walking experiences will be largely influenced by the design and quality of building around the space, especially the building facades. While the facade is part of private property, it works as the edge of private land and public right of way. Thus, its design needs to concern public uses and dedicate to create a better environment for pedestrian travel and civic activities. It is not just architects' work, and planners started to pay more and more attention to facade design, especially in some pedestrian prioritized commercial streets. When walking along commercial streets, people expect the building façades are intriguing and rich in detail. The public spaces there are required to provide comfortable and interesting walking experiences for the pedestrians, and building facades undertake the needs to attract people staying and enjoying. Base on the analysis of case studies, here are some general principles and recommendations.

Attractive facades usually include a diversity of functions. A mix of various restaurants, retails, services, and entertainment together forms interesting space for people to spend time. Small units with different uses and many doors opened to the sidewalk are preferred, because they can provide interest even on short-distance walks. Also, this kind of narrow facades has an important visual effect of making distances feel shorter, which interacts with pedestrians' walking ability. (Gehl, 2004) Besides, the diversity of functions and services can meet people's demands and interests. This form of design can also ensure the space to be durable and adapt to evolving markets over time.

The human scale is another factor that makes attractive building façades. Buildings should

avoid being excessively tall and thick. Tall façades increase the sense of enclosure and leave less sky space in pedestrians' eyes, which will bring pressure to the pedestrians. Also, transparency between inside and outside the building is important because people like to stay in a space where they can see other's activities. Thus, permeable façades with more windows and entrances open to the streets are desirable for pedestrians. It can invite people to walk in and out and do various activities. Thick and blank walls, on the contrary, will block people's interests. The Wandering Goose on 15th Ave has large windows and commercial seats provided to engage passengers. Another example will be Cafe Solstice on University Ave. It provides tables and chairs open to sidewalk, and it also has many floor-to-ceiling windows to increase the connection between the indoor space and sidewalk. People who are waiting for bus or passing by can interact with this restaurant and see what is inside. This casual environment helps to draw people in and create a vibrant public life.

Figure 6.2 The Wandering Goose on 15th Ave and Cafe Solstice on University Ave.
Source: Google map

Uniformity and consistency of the units on a commercial street can influence pedestrian experiences. It will be pleasant to walk on a street with no closed or passive units, and no vacant property to disrupt the consistency of facades. Also, the architecture style of façades needs to follow its function. The reliefs and decorations on the facades can often conduct the

information to passengers what it is inside the buildings. The facades of all units need to reflect the core value of the neighborhood or city. Also, Materials, colors, and details of building facades decide the level of delicacy. Building facades need to be carefully designed and built as well as well-maintained to ensure better pedestrian experiences.

Provision of seats

From the analysis of case studies, we find that seats are the key element to direct people's posture in public space. Providing an adequate number of seats is important for public life. It gives people the option to have a rest and enjoy the space. People tend to sit formally in public or commercial seats when they need rest. If there are no adequate seats, there will be more people standing, leaning, and sitting informally, even lying. Also, more commercial seats will lead to more interests for people to stay, and it also helps to create the indoor and outdoor connection of the buildings.

The quality of the seats is also important. An attractive seat for the pedestrian should provide a good street view, no noise or pollution nearby, good condition and well-designed seat, and better to be placed under shield along the building edges.

Sidewalk and street furniture

The sidewalk should be designed wide enough for people to pass through and provide additional space for people to do various activities. Sidewalks with transit stops should be required wider to accommodate the crowd. Landscape and furniture zone, such as planting strips between sidewalks and vehicles, can ensure pedestrians' safety while they are walking,

as well as improving the aesthetics of public space. Especially on a busy street, the high traffic volume causes noise, pollution, and dangers to pedestrians. And landscape zone could buffer these harms and ensure a good sidewalk quality for pedestrians.

Street furniture should be maintained and updated regularly. Well-maintained landscapes and street furniture can physically improve the streetscape, and they can also affect pedestrians' feelings about public space. The worn-out street furniture should be replaced by new furniture which coordinates with the neighborhood or city character in uniformed styles.

Public transit waiting zone

The design of public space around the bus stations should provide seats or benches for people to rest. Considering the stations with a high volume of transit riders or transfer stations of multi transit methods, the sidewalk around the stations can be enlarged to accommodate more people waiting. The safety issue is essential in this space. Some unique designs can be applied to ensure people's safety, such as a yellow zone to warn people waiting away from vehicle roads, railings designed on sidewalks in some uphill and downhill areas, and elevated crossroads on the intersections.

The station itself can also be designed more vibrant and engage more in public life. For example, a bus station in Singapore was designed to have a reading area providing books and magazines, a poster zone showing some public arts and events, and screens playing some videos or time lists of the coming bus. There were enough seating opportunities provided for bus riders, and warning pillars separating the space with traffic for safety concerns. Besides, new technology is applied. The station is partially powered by solar panels, and it has

vegetation on its roof. People enjoy this place, and the design makes this space a place for people to wait for a bus and a place for entertainment and public life.

Figure 6.3 A bus station in Singapore.
Source: Courtesy of Infocomm Media Development Authority

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