

The Millennial Bus Experience in Pittsburgh, PA



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Executive Summary

Existing conventional modes of public transportation for people in Pittsburgh primarily consists of five types: driving, bussing, biking, walking, and ridesharing. The city has worked hard over the last decade at becoming more appealing to young people, and the efforts have paid off. An influx of people in their 20s and early 30s (i.e., Millennials) are flooding into the city at ever-growing rates.

Millennials are choosing to live their lives in ways that are radically different from previous generations. Car ownership is not important to them, and they would rather spend money on experiences than things. The focus of this study is on bussing. How might we make riding the bus a more enjoyable experience for the asset-light generation in Pittsburgh?

If the city of Pittsburgh plans to continue to acquire young residents and retain the ones who are already here, then the transportation system must reflect the exciting, asset-light, urban lifestyle that Millennials are seeking. A superior bus riding experience would be a major competitive advantage over other cities that are magnets for these valuable residents. Compared to competing cities, the bus experience should be:

- Safer
- Faster
- More convenient
- More comfortable
- Equally low cost

In developing an effective solution to the proposed question, a research plan was crafted to deepen the team's understanding of the problem. A wide variety of qualitative and quantitative research methods and techniques were used to observe the current state. The elements of this report will follow a sequence of exploratory, generative, and evaluative methods that were used. Ultimately, the report will conclude by synthesizing insights and prescribing guiding principles for generating new product opportunities.

Constructive feedback that can help bring these ideas from concept to reality is certainly welcomed by the authors.

Table of Contents

I.	Exploration	4
a.	Overview	4
b.	Secondary Research – Online Media.....	4
c.	Review of Bus Experience Landscape.....	6
d.	Heuristics Analysis	7
e.	Contextual Inquiry – Observation.....	9
II.	Generative Research.....	10
a.	Interviews	10
b.	Co-Design Activity.....	16
III.	Evaluative Research	20
a.	Questionnaire	20
b.	Usability Testing.....	20
IV.	Conclusions	23
a.	Moving Forward: What a Good Product Addresses.....	23
b.	Highlights & Key Insights	24

I. Exploration

a. Overview

Beginning with the assumption that young people are moving into urban centers, and given the ubiquity of ride sharing services that are becoming available, the expectation among the team was that car ownership among Millennials in Pittsburgh is declining. Therefore, usage of public transportation was expected to be increasing.

Based on personal experiences, the team also expected to validate the assumption that young people find the current state of the Pittsburgh bus experience to be, by and large, inconvenient, uncomfortable, and tedious. Additionally, after crafting a Love/Hate list, the team concluded that there were definite areas that were personally dissatisfying: overcrowding, uncleanliness, noisiness, safety concerns, and navigation problems -- to name a few. There were also aspects of the bus experience that the team liked and would like to maintain or improve upon, such as climate control and freedom to be more or less productive.

In conducting this study, the team planned to use a variety of techniques and approaches that would constitute an integrated research strategy. The strengths of the individual team members were considered and leveraged to maximize efficiency and results.

Phase			Exploratory Research		
			Planning	Execution	Analysis
	Source Type	Research Method			
2 b	Direct User Engagements	Interviews	Done		
2 c	Direct User Engagements	Contextual Inquiry - Observation	Done		
2 d	Remote User Engagements	Cultural Probes	Done		
2 e	Remote User Engagements	Questionnaires	Done		
2 a	Simulations	Heuristics Analysis	Done		
1 a	Secondary Sources	Online Media	Done		

Figure 1. Planned Research Methods for Exploratory Research

b. Secondary Research – Online Media

In order to begin developing a fact based understanding of the Millennial environment, extensive online research was conducted, and the team curated a list of insightful articles.

- Where Young College Graduates are Choosing to Live - NYTimes¹

¹ "Where Young College Graduates Are Choosing to Live ..." 1 Dec. 2014 <<http://www.nytimes.com/2014/10/20/upshot/where-young-college-graduates-are-choosing-to-live.html>>

- Why Millennials are Ditching Cars and Redefining Ownership - NPR²
- Welcome to the New Millennial Economy: Goodbye Ownership, Hello Access-Forbes³
- Generation Sell - NYTimes⁴
- What Millennials Love About Pittsburgh - The Atlantic⁵

These source materials provided a comprehensive overview of key social, economic, and technological trends that could be causal mechanisms for changes in the environment. To simplify these SET factors, the following Venn Diagram was created.

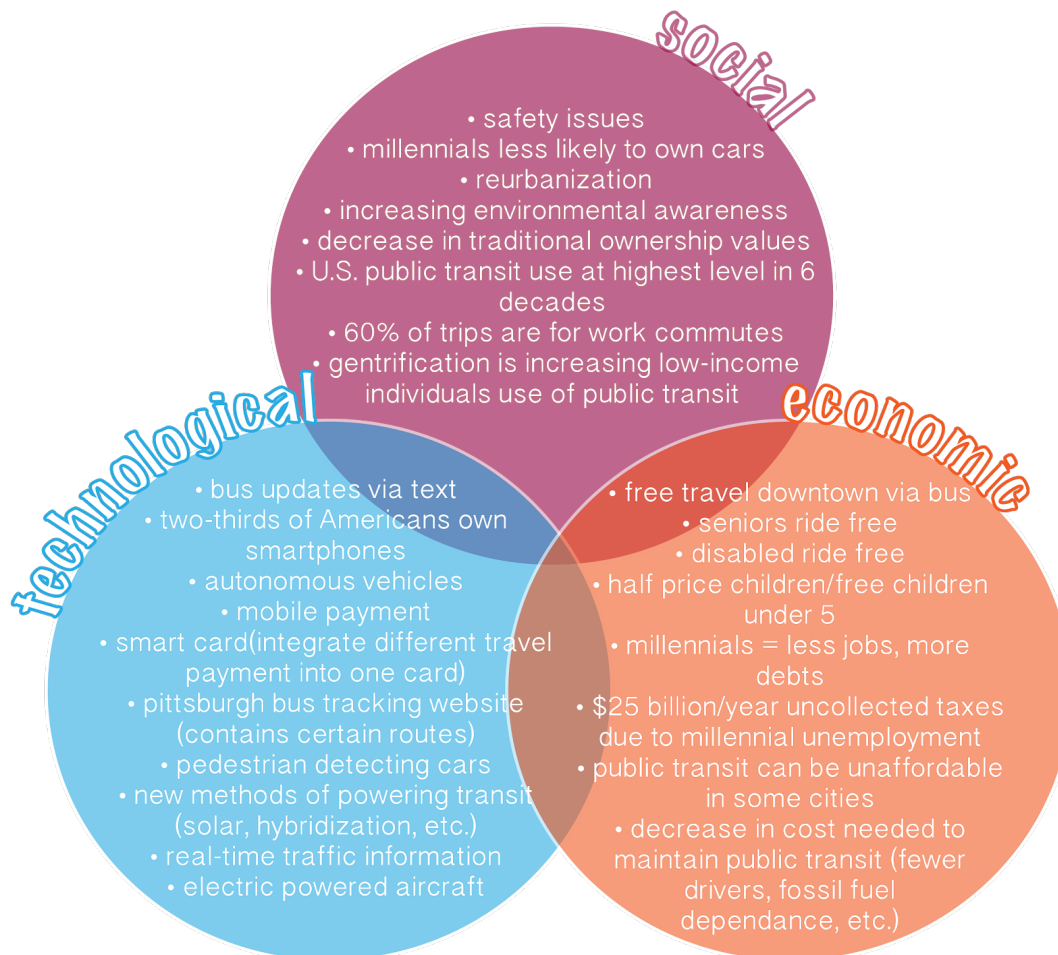


Figure 2. Venn Diagram of SET Factors

² "Why Millennials Are Ditching Cars And Redefining ... - NPR." 2013. 1 Dec. 2014 <<http://www.npr.org/2013/08/21/209579037/why-Millennials-are-ditching-cars-and-redefining-ownership>>

³ "The New Millennial Economy: Goodbye Ownership ... - Forbes." 2012. 1 Dec. 2014 <<http://www.forbes.com/sites/jjcolao/2012/10/11/welcome-to-the-new-Millennial-economy-goodbye-ownership-hello-access/>>

⁴ "The Entrepreneurial Generation - NYTimes.com." 2011. 1 Dec. 2014 <<http://www.nytimes.com/2011/11/13/opinion/sunday/the-entrepreneurial-generation.html?pagewanted=all>>

⁵ "What Millennials Love About Pittsburgh - The Atlantic." 2014. 1 Dec. 2014 <<http://www.theatlantic.com/national/archive/2014/11/what-Millennials-love-about-pittsburgh/383074/>>

c. Review of Bus Experience Landscape

For the most part, current products intended to improve the bus-going experience are focused around the smartphone. Both the Port Authority and third-party application developers are trying to resolve the ever-present lack of transparency between predicted and actual bus arrival times. More generally, products used by riders that improve their experience are often not designed specifically for bus riding, such as headphones and books. The following solutions are currently available to bus riders:

The Port Authority Website - TrueTime

Features: The desktop version of the website offers riders TrueTime, a feature that has both an interactive map showing bus locations at a given moment and a series of drop-down menus where riders can select their location and see when buses will arrive.

Pros: The system is handled directly by the Port Authority, and has proven to be the most reliable source of accurate bus arrival times.

Cons: The interactive map is not available on mobile phones, so the drop-down menu is the only method available to users to find bus locations. This requires knowledge of both the needed route and the stop location. The website offers a trip-planner feature to help you find this information, but it is far more cumbersome to use than Google Maps.

Google Maps

Features: Google Maps provides users with both mobile and desktop interfaces delivering information about what route riders need, where the nearest stop is, how to get to their destination once they are off the bus at the end of their trip, and their current GPS location. It also offers predictions for bus arrival and departure times.

Pros: It is the best user interface with the most precise and helpful maps. For bus riders who are new to the city, it is the simplest way to figure out what route they need to get from A to B and where the stops are in relation to their current location.

Cons: The biggest problem with Google Maps is that it does not display accurate bus arrival and departure times. It has the scheduled times, which are rough predictions, but it is rarely accurate and can lead to confusion for users who expect a bus when there are none nearby.

Tiramisu

Features: Tiramisu provides real-time bus location and crowd information through crowd sourcing. Users can get real time information on the route they need, and mark their ride using the GPS in their phone to update the information.

Pros: It provides relatively accurate information of the bus arrival and fullness. Since passengers on the bus update the app's information database, it is generally reliable.

Cons: The accuracy depends on the updates of users. If no Tiramisu riders are on the bus, there is going to be less accurate information.

BusGazer (To be discussed more extensively in the Usability Testing section)

Features: BusGazer is a mobile application that offers riders maps of routes, bus arrival and departure times, and bus stop locations.

Pros: The application appears to be tied to the Port Authority website, so it is more accurate than Google Maps in terms of predicting the bus arrival and departure times (with some exceptions).

Cons: The interface is poorly designed and difficult to understand. Riders must have knowledge of what route they need in order to use the application successfully, and some features seem incomplete or have poor functionality.

Non-Software Solutions

Most riders use highly individualized methods to increase their personal comfort during the bus ride experience. Products from books, headphones, sunglasses, and others are used to varying degrees by many riders. These will be described more in-depth throughout the report, in both the questionnaire/interview findings and the Co-Design activity.

The bus itself is also an essential element of the rider experience, providing at times both comfort and discomfort to users depending on specific scenarios. No discernible architecture for the bus layout could be discerned beyond maximizing utility and rider capacity. The bus layout will also be discussed further later in the report.

d. Heuristics Analysis

The team first identified potential pain points in the bus riding experience by breaking the process down into individual components -- mapping the steps in the process (e.g., waiting for the bus or riding the bus) and then further refining the process by looking at flows across multiple channels (e.g. mobile, web, physical, etc.).

It was decided that a simulation should be conducted to test usability in the area of bus tracking across mobile and web channels, based on ease of access to testable interfaces and our own lack of bias towards the product. Four personas and four scenarios were created and then a heuristics analysis was conducted on both the Pittsburgh Port Authority website and an “ezRide PGH” mobile app. The heuristics violations were mapped on an affinity board and grouped according to level of difficulty to implement and importance to the user experience.



Figure 3. Affinity Diagram with Heuristics Violations

Overall, the team found many violations on the Pittsburgh Port Authority website in the high value quadrant, which signals a very frustrating experience for the user. Violations included inconsistencies in the iconography used throughout the website, lack of explanation for various technical terms and features of the software, and confusion related to the location of the user versus the bus stop they were instructed to use. Figure 4 shows several of the heuristics violations mapped versus their importance and cost of improvement.

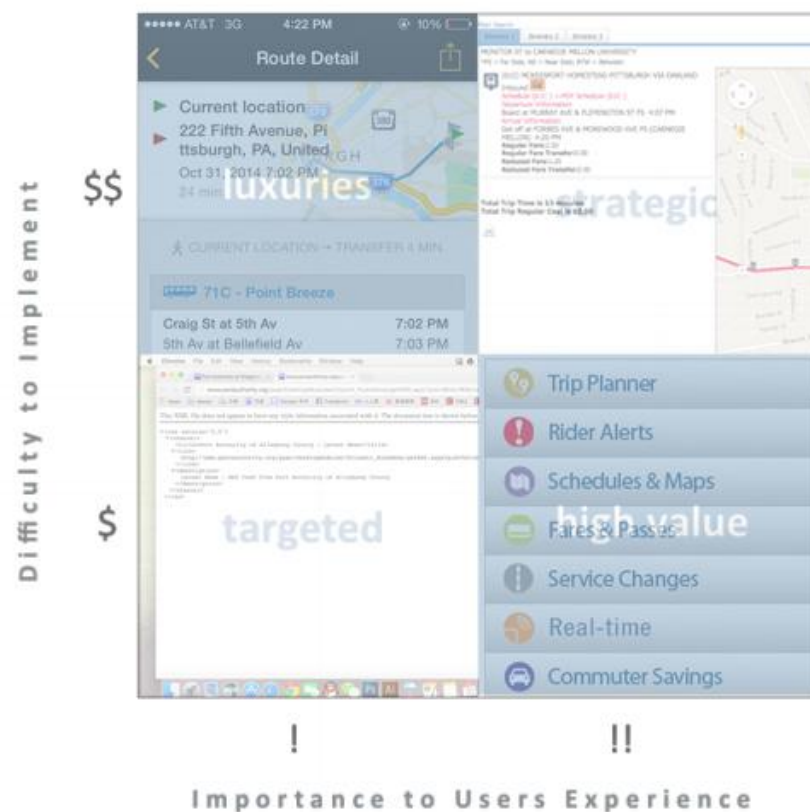


Figure 4. Overlay of Affinity Diagram and Screen Shots of User Issues

e. Contextual Inquiry – Observation

In addition to interviewing people, the team strategically selected a variety of bus routes and rode the bus at different times of day to see what people really do on the bus. It became clear that there were very different crowds at different times of day. The early morning routes tended to be occupied by a working crowd that seemed surprisingly happy. They proved to be very familiar with the bus routes and the schedules. The commuters who worked downtown enjoyed not having to worry about finding and paying for parking, as well as saving money on gas.

One interesting finding regarding bus behavior was that people were more likely to keep to themselves -- and their smartphones -- in the morning. By contrast, the evening and night crowd tended to interact with other people more frequently (especially the night crowd coming to and from the bars).

II. Generative Research

a. Interviews

After taking a deep dive into the pre-riding experience, the team zoomed out to gain a more comprehensive overview of how young people feel about different aspects of Pittsburgh bus riding. An interview guide was crafted and the team went out into the field and conducted twelve interviews and released a questionnaire (to be discussed shortly). The answers were then loaded into a spreadsheet to be sorted and analyzed.

Our user research flow of questionnaires and interview is shown in the chart below:

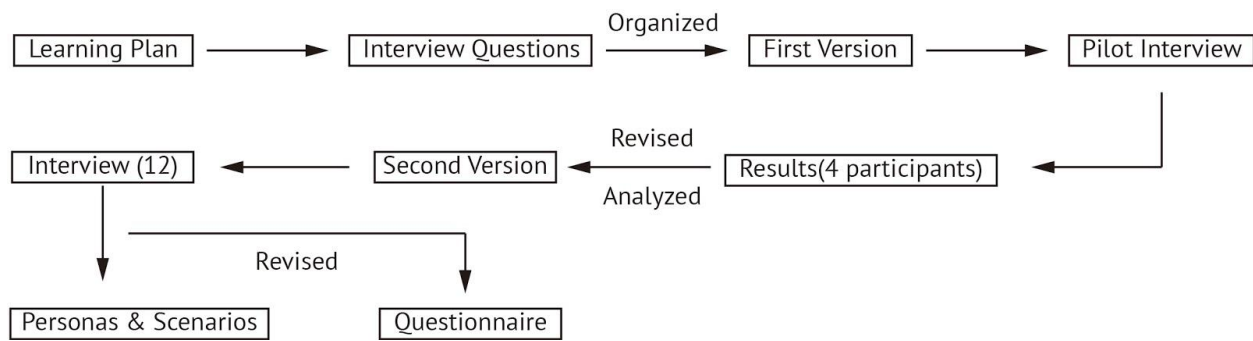


Figure 5: Research Flow Diagram

To begin constructing our interview, we listed what we know about Millennials from personal experience and research, and what we needed to learn through the interview process. The following table is an excerpt of our learning plan. We wanted to find out the overall feelings Millennials had concerning the bus experience, how they spend their time when waiting for and riding on the bus, what problems they might have with the experience that we were not previously aware of, and to see if we could gather some insights into people's behavior physically and mentally on the bus that might not have surfaced during our observational research.

BELIEF	CERTAINTY	NOTES	RESEARCH METHODS	EVIDENCE
"sucks" - overall, the bus experience is negative most of the time for most people	Low	Overall, the group members feel like the bus system "sucks" in Pittsburgh, but realize we are only 4 people out of a large population.	contextual interview + questionnaire: How would you rate your overall bus experience in Pittsburgh :) or :(	
discomfort not knowing location + possibility of missing stop-	Medium	Know that this feeling exists, not sure how often a millennial feels this way.	contextual interview: Have you ever missed your bus stop due to a) driver not stopping b) not knowing when you're stop was and being unsure of when to pull c) missing your stop due to distraction/zoning out? frequency- When was the last time you missed your stop/weren't sure of where your stop was/almost missed your stop?	http://www.marketwatch.com/story/40-of-unemployed-workers-are-millennials-2014-07-03
enjoy listening to headphones on bus	Medium		contextual interview- When was the last time you wore headphones on the bus? When was the last time you wore headphones?	

Our interview questions were constructed based on previous research and our learning plan.

We conducted pilot interviews with four participants, all of whom were acquaintances of the team members. We timed the interviews and had several observations:

- It took more than 20 minutes for each interview, which could be too long to complete on an average bus ride
- Some questions seemed out of place or unnecessary
- Layout was generally fine, but some questions needed more/less space for response because on average the interviewees had more or less to say than anticipated

Going forward into the final interview draft, we made the following modifications:

- Shortened and focused the questions, removing several of them and moving some to more logical locations to improve the flow of conversation
- Storytelling questions weighted more towards the beginning, as we found them to be the most informative and wanted to ensure they were answered in case the interview was cut short (a likely scenario, given the interview setting)
- Removed redundancies
- Increased space for note-taking if necessary

Here is the finalized version of our interview questions:

Hi, my name is _____ and this is _____. We are graduate students at Carnegie Mellon researching the Pittsburgh Port Authority bus riding experience for the Millennial generation. Would you be willing to answer a few questions for us? All of your responses are strictly confidential and will remain anonymous in any written reports. Would you be willing to allow us to videotape the interview for the purposes of our study? Again, this footage would remain strictly confidential and not shared in any way. There are no right or wrong answers to these questions, so please answer to the best of your ability. Feel free to interrupt at any point to ask us for any clarification you might need.

to be filled by interviewer:
 interviewer name: _____
 scribe name: _____
 audio file/video file name + location: _____
 bus route: _____
 date: _____
 time: _____

1 How old are you? units: years

infillable must be 18-55 years old (+/- 1 year)

2 Are you a student? YES NO

2a What do you study? _____

3 Are you currently employed? YES NO

3a What do you do? _____

4 Are you from Pittsburgh? YES NO

5 Do you use a smartphone? YES NO

6 In the last month, what did you spend money on that you enjoy the most? _____

7 What are your primary modes of transportation? _____

8 How do you spend your time when you are riding the bus? _____

9 Do you frequently listen to headphones when you ride the bus? YES NO

9a What do you listen to? _____

10 Can you tell me what you like about taking the bus? _____

11 Can you tell me what you don't like about taking the bus? _____

12 Can you tell me about a time you were satisfied with the bus? _____
WRITE FACTORS + SATISFACTION

13 Can you tell me about a time you were dissatisfied with the bus? _____
WRITE FACTORS + DISSATISFACTION

14 Overall, are you satisfied or dissatisfied with the bus experience in Pittsburgh? SATISFIED MIDDLE DISSATISFIED

15 Do you track the bus? YES NO

15a What do you use to track the bus? _____

16 Do you ever miss the bus? YES NO

16a Can you tell us about that time? _____

17 Do you ever miss or almost miss your stop? YES NO

17a Can you tell us about that time? _____

18 What's the longest time you've had to wait for the bus? units: min

19 How many times would you say you ride the bus in an average week? units: times/week

20 How long is your average ride? units: min

21 What are your primary destinations when you ride the bus? _____

22 What belongings do you normally bring with you on the bus? _____

Figure 6: Interview Question Sheet

We conducted further interviews in two teams, one aimed at students on the Carnegie Mellon campus, the other aimed at young professionals during morning commute. We planned to videotape or audio record the interviews for analysis and quotation in our subsequent data evaluation.

In total, we interviewed 12 individuals. The raw data was compiled into a spreadsheet.

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X
1	Interview	Age	School	Work	Pittsburgh	Smartphone	Spending	Transportation	Time Spent on Bus During...	Headphones	Likes	Dislikes	During or Pre-Ride	Satisfied when	Dissatisfied when	Overall, feeling...	Tracking	Missed the bus when...	Missed their stop when...	Longest wait time	Bus rides/week	Length of ride	Primary destinations	Belongings
2	1	20	yes - mech engineering	year part time employment services office	no	no	video game	bus	listening phone	no	it's free	not on time, comes late	Pre	when it's crowded	satisfied	no	bus didn't stop on time but the driver said it was 2 min late, missed it	no	60-10	30	30	downtown, waterford	money, phone	
3	2	20	yes - mechanical engineering (mcs/material science)	desk attendant at school, do research	no	yes	mechanic at foot rest	bus, bike	listen to music	yes - starts to rap, hip hop	temperature control	crowded, especially at rush hour	During	waterford bus, when it comes on time	satisfied	yes - google maps	yes/no port 4-philly app, misses (phones, movies, android)	no	70-2 to 3	4-15	40	center avenue, forties	phone, bag, headphones, wallet, small bag, pack, water, clothes	
4	3	20	yes (engineering)	part time at school, do research	no	no	book reading	bus	talking with friends	no	faster than walking, free	inconvenience of the schedule	Pre	when its on time	satisfied	no	really fun thing can to the bus stop and I was leaving, asked "Can you stop?" didn't stop	no	65-10	1-2 times round	30	back climbing		
5	4	20	yes (psychology and human computer interaction)	monitor for laser cutter	no	yes	movie	bus, friend's car, walking	N/A	no	don't have to think about it	late, connections are annoying, seats are gross	Both	when its on time	satisfied	yes/no port 4-philly app, misses (phones, movies, android)	no	45-3	80-15	30	South Hill, grocery shop	shopping bag, or just purse		
6	5	19	yes (information system)	no	yes	yes	net	walking, bus, brother's car	headphone, phone	yes (rap)	easy, free	wait for it	Pre	never, except when there's traffic	satisfied	no	yes, frequently, but there's one 7 minutes later so it's not walking up to see the bus and it's not going	no	10-2	5	downtown	phone, bag with book, jacket, backpack, phone, headphones		
7	6	22	No	Welfare office - process requests for welfare	Yes	Yes	going out with friends	bus, car	reading & listening to music	yes (music)	inexpensive, bus drivers nice & helpful	it takes longer than driving	During	waited 2 minutes, it was right on time	satisfied	no	yes, frequently, but there's one 7 minutes later so it's not walking up to see the bus and it's not going	no	30-10	30	morning, 50 right	downtown, home	phone, bag with book, jacket, backpack, phone	
8	7	30	yes sustainable architecture	no	no	yes	jacket	bus or car (own)	walking out with	no	convenient, free, quick	when it's late	Pre	when I want to go on time	satisfied	yes - Strides Google maps + all bus bus tracker (only some routes)	no	reading email	45 min	10	20	home and school	Phone, wallet, keys, maybe a bag	
9	8	22	rita	Sales @ Nordstrom	Yes	Yes	Setting out waiting out going out of town	Bus, bike	Phone - iFB, social media, news	Top 40 music	Convenient (sometimes)	Bus schedules + routes (taking between neighborhoods, have to go downtown to transfer)	Pre	The bus is on time	satisfied	no	yes - Strides Google maps + all bus bus tracker (only some routes)	no	60-12	40	30	home	Phone, wallet, keys, maybe a bag	
10	9	25	chemical engineering	cooper coop	yes	yes	car phone or meeting	bus, car	reading, listening to music, sleeping	no	easy and you don't have to think, cheaper than owning and parking an option for someone without a driver's license, can do other things while riding	public space	During	most of the time gets her to where she's going	satisfied	google maps + transit app	no	10-3 to 4	10-15	30	work, home	purse and bag, backpack, lunchbox, phone		
11	10	21	biology	work study	yes	yes	new t-shirt	bus	music and podcasts	no	Free, no driving/looking, relatively convenient (don't actually need to pay)	Overcrowded, sometimes unreliable, crowded if you actually need to pay	During	Off peak hours, unexpected (as you get a seat)	satisfied	no	yes - missed it this morning	no	20-12	35	school, home	Books, computer, change of clothes, work papers		
12	11	38	Social work	Performance auditor for city	No	Yes	Headphones	Bus, bike	Reading	no	Overcrowded, sometimes unreliable, crowded if you actually need to pay	Overcrowded, sometimes unreliable, crowded if you actually need to pay	Both	Bus is not on time, takes alternate bus, you get a seat)	satisfied	no	Yes - missed it this morning	no	30-20	40-75	30	school, home	backpack	
13	12	23	biology	no	no	yes	not sure	car	not sure	no	doesn't like being on the bus	During	none	none	satisfied	no	no	doesn't know	3-4	30	school, home	backpack		

Figure 7: Interview Raw Data Table

All the interviewees said they were satisfied with the bus, which was completely different from our expectations. Although they claimed satisfaction, there were still recurring themes of dissatisfaction with particular aspects of the bus experience. The following charts show the frequency of the likes and dislikes we found.

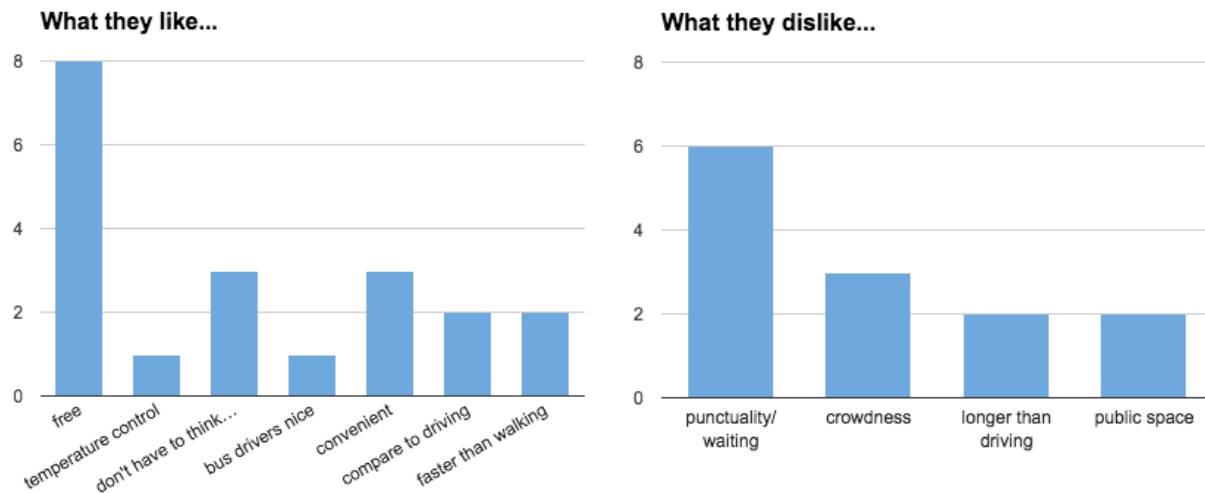


Figure 8: Interviewee Likes & Dislikes

The team pulled the questions and answers from the raw interview data, color-coded them on post-it notes based on the phase of the bus experience they were dissatisfied with, and organized the notes to find patterns. This organization helped clarify and condense the interview results.

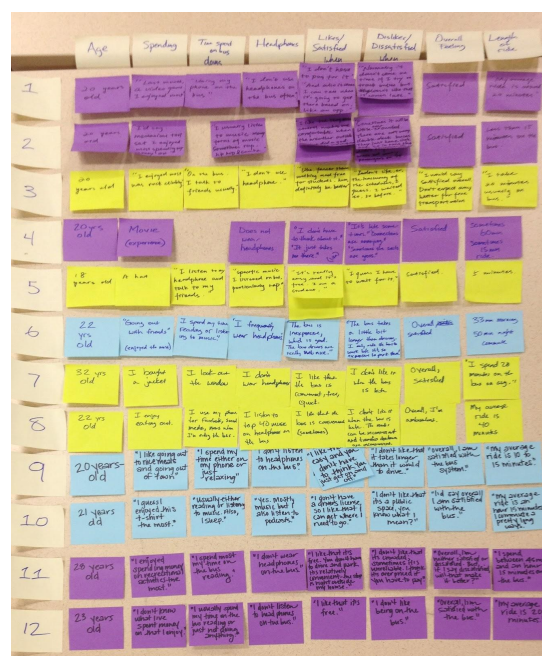


Figure 9: Pattern Recognition from Interviews

Simplifying the data in this format was quite helpful. From here, the team was able to spot several patterns in user behavior on the bus. The behavior could be generalized into two types of bus rider.

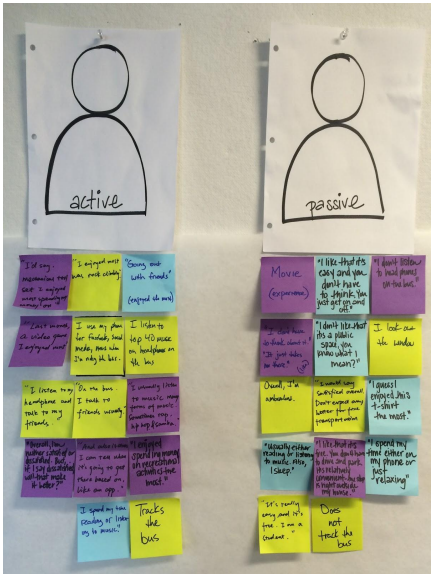


Figure 10: Persona Exploration

One type was interested in a lean-forward experience both on and off the bus. By contrast, the other type was much less engaged and preferred a lean-back experience. Two personas were created based on these insights. We reorganized our post-its to reflect these findings, then finalized the personas and scenarios based on them.



ACTIVE
ALEX
mechanical engineering

"This one time, a guy took off his pants. I think I would describe that as dissatisfying."

- interested in things that will save her time
- concerned about her appearance
- values new experiences

personal information:

age: 22 years old
profession: engineering student
home life: lives with 2 roomies
hobbies: rock climbing
favorite TV show: game of thrones
personality: outgoing, social, adventurous, self-promoting, and charitable

user goals:

Alex uses the bus system to:

- save money for recreational activities
- catching up with friends
- get to and from school
- stay current with news



PASSIVE
PAT
accountant

"It's easy and you don't have to think; you just get on and off."

- concerned about safety and security
- likes things that are familiar
- loyal

personal information:

age: 26 years old
profession: accountant
home life: lives with girlfriend
hobbies: movies + walking his dog
favorite TV show: whatever's on
personality: easy-going, even-tempered, spiritual, skeptical and reserved

user goals:

Pat uses the bus system to:

- save money for a house
- get to and from work
- wind down after a long day at the office
- to avoid coping with traffic

Figure 11: Final Personas

Scenarios

Active Alex has a job interview this morning. She has her routine planned out and has figured out the correct bus stop and route to get to her appointment early. However, the bus doesn't arrive on time, and the trip takes longer than expected.

Pat's girlfriend wants to meet him at a new restaurant in South Side, but he's never been there before. It deviates from his traditional bus routes, so he needs to figure out how to get there on time from the office.

Image Board

Following the interview process, our team created an image board to get a better idea of the emotions we found associated with the bus experience. Our image board was in the format of "this not that". The bus experience should be easy, enjoyable, interesting, quick, and with friendly drivers. It should not be boring, crowded, expensive, or annoying. We arranged the images in the format shown below.



b. Co-Design Activity

Our co-design experiment was tailored to investigate the interactions between Millennial passengers on the bus and other bus riders, focusing on personal space and comfort. We intended to devise a simulated bus experience for our co-design participant to interact with. The simulation would expose the participant to violations of personal space frequently encountered on the bus. For each scenario we wanted to study:

1. How the participant would *physically cope* with the particular personal space violation,
2. How the participant would *externally cope* using outside tools
3. What the participant *feels*, and to what extreme, in each scenario
4. What the participant is *thinking* (this is accomplished through using a think-aloud technique).

We prepared the following tools and materials before running our co-design session:

- Two scale models of bus seating – one with seats parallel to bus and facing the front of the bus, one with them perpendicular and facing the isle
- Two figures, one male, one female, with articulating joints for positioning and exploration of personal space and body language
- A sheet of emotional faces that can be cut out and affixed to provided scales
- A series of post-it notes with items (external coping tools) that can be used to increase the user's comfort in their situation, along with some blank post-its for participant use
- Scissors and tape

The models of the bus would serve as a realistic context and setting for the described scenarios. The male and female figures would give the participant an accurate depiction of the scenario and allow them to alter the figures' bodies to display physical coping mechanisms, and also give the participant personal investment in the activity. The scale and emotional faces would give the participant the opportunity to communicate feelings for each scenario. The post-its would give the participant a starting point for determining which, if any, external tools he or she uses or would use to cope with physical space invasions, as well as the opportunity to create their own coping tools.

We asked one of our previous interviewees to participate in the co-design activity. To capture what the participant was thinking during each scenario, we asked her to think aloud and videotaped the entire session for future reference.

The first scenario was: *the participant is sitting between a stranger and the window and both are facing the front of the bus*. While being videotaped, we presented her with the dolls arranged in a specific way to reflect the scenario. She then used the scissors to cut emotions from the sheet of faces and affix them to a scale indicating each emotion's intensity. Then, she re-arranged the doll that represented her in the scenario to display what physical coping strategies she would use. She then chose from the post-its which items or tools she would use to alleviate her discomfort; she was also able to write/draw her own coping tools on blank post-its if necessary.

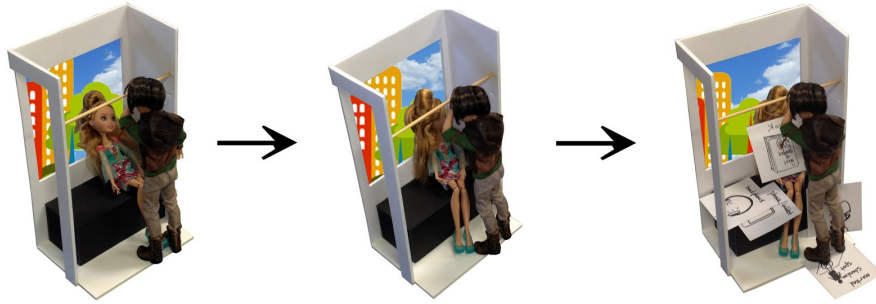
This process was repeated with three more scenarios:

1. The participant is seated facing the aisle, with a stranger standing directly in front of her and facing her.
2. The participant is standing in front of a seated passenger, facing them
3. The participant and a stranger are standing next to and facing each other

The experimentation exceeded our expectations. Our participant felt that the emotional faces she was offered allowed her to tap into her emotions and also felt that the dolls helped make the physical situations seem more real and easy to associate with. She eagerly created her own coping tools when they were not provided by us, and was happy to participate in the experiment. The following images display her responses to each of the four scenarios.



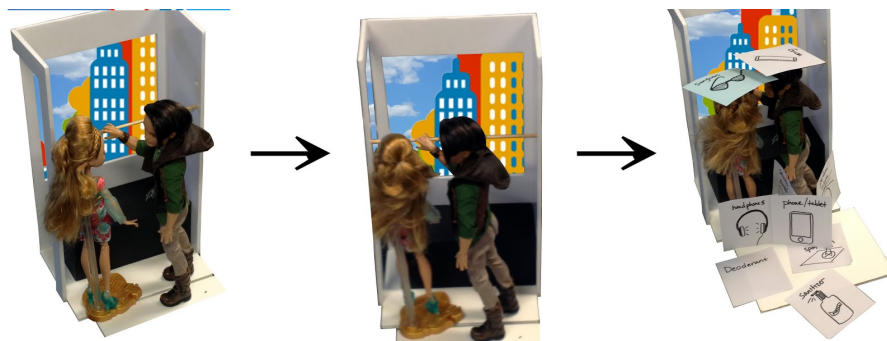
Scenario 1: physical coping by moving towards window and looking out window; externally coping by using her phone, hand sanitizer, headphones, and a TV monitor on the bus; experienced emotions from least to most intense were pained, disappointed, and cautious.



Scenario 2: physical coping by looking away from the stranger and moving her legs towards the back of the bus; externally coping by using her phone, reading a book to create a physical barrier, headphones, and a designated standing spot; experienced emotions from least to most intense were miserable, disapproving, sheepish, and prudish.



Scenario 3: physical coping by looking away from the stranger towards the front of the bus and rotating her body towards the front of the bus; externally coping by wearing sunglasses, headphones, deodorant, using her phone, and standing on a designated spot; experienced emotions from least to most intense were envious, concentrating, apologetic, sheepish, and bashful.



Scenario 4: physical coping by looking away from the stranger, turning away from the stranger, and pulling in her arms to make herself occupy less space; externally coping by wearing sunglasses, headphones, phone, deodorant, hand sanitizer, gum, perfume, and designated standing spot; experienced emotions from least to most intense were paranoid, bashful, sympathetic, surly, indifferent, and prudish.

The feedback she gave us was helpful – namely, she felt that we should add blank faces for participants to generate their own emotions, and that we should provide fewer items, allowing the participant to create more of their own. She also felt that we should provide physical props for the dolls, such as a backpack to make the situation even more realistic than it already was.

The purpose of this experiment was to use some generative tools and techniques to better understand the experience of bus riders within the domain of personal space. After running the experiment we were able to discover some gaps between what people say (i.e., satisfied) and what people really think, feel, and do (i.e., feeling guilty for standing next to someone). One solution that seems viable is to create marked spots on the floorboard of the bus that serve as recommended spaces for standing when it's crowded; our participant used this particular tool in almost every scenario.

III. Evaluative Research

a. Questionnaire

We planned to launch our questionnaire after our interviews were completed to leverage the interview experience and modifications according to the results. Namely, we changed the question “Are you satisfied or unsatisfied with the bus experience?” to “How much do you enjoy Pittsburgh bus experience?” Participants felt that satisfaction or dissatisfaction referred to whether the bus accomplishes its job, which is one possible explanation for the number of users who claimed satisfaction. Still, half of the questionnaire participants claimed that the bus was a 6 or 7 on a scale of 1 to 10, indicating mild enjoyment with the bus ride. The additional question, “if you don’t take the bus, why?” gave us further insight into why some individuals avoid the bus – the answer commonly was the shortness of their commute or convenience in terms of carrying a number of items with them to and from the office.

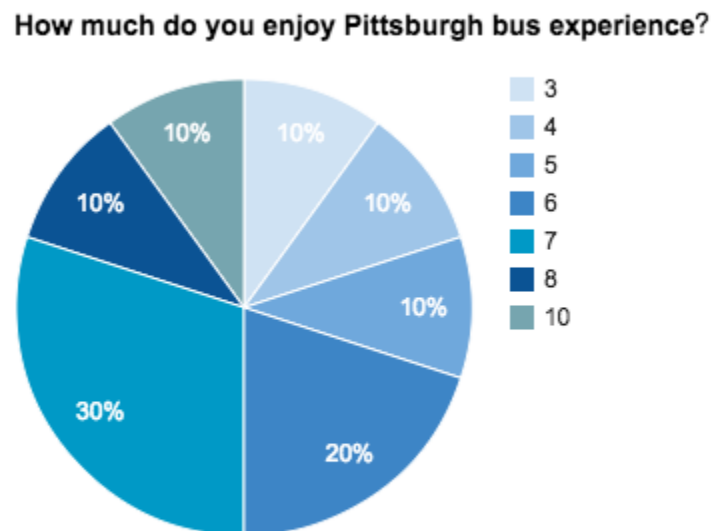


Figure 13: Questionnaire Participant Bus Enjoyment – 10 = Enjoy, 1 = Don’t Enjoy

b. Usability Testing

Our team tested BusGazer, a bus tracking app that none of us had any experience with. Our main questions were:

1. Does it accomplish the goal of telling the user when the bus will arrive?
2. Can it help the user get on a bus and where he/she wants to go?
3. Is it straightforward to use?

4. Can anyone figure it out without prior knowledge?
5. What does it do better than Google, if anything?

We constructed the following scenarios to present to participants:

1. Do you usually ride the bus?
 - a. If yes, check and see when the bus you usually take will leave the nearest stop.
 - b. If no, find a bus route that will take you home.
2. You are taking the 61D bus to the Waterfront.
 - a. Does the route to the Waterfront go through Frick Park?
 - b. Which stop do you need to catch the bus?
 - c. What time is the bus expected to pass your stop?
 - d. What stop do you want to get off at?
 - e. Can you find an alternate route?
3. Find a bus that will take you to the closest Giant Eagle.
 - a. Where will you catch that bus?
 - b. What time will it arrive?
 - c. What till will you arrive at Giant Eagle?
 - d. What bus can you take from the Giant Eagle to get home?

We had eight participants and wanted a fair distribution between both people who frequently ride the bus and those who are unfamiliar with the bus system in Pittsburgh. After giving each participant 1-2 scenarios, we would ask them to fill out the System Usability Scale.

We averaged each participant's SUS score for each of the ten SUS statements. Based on each statement, BusGazer only scored adequately on one characteristic: users do not need outside technological help to use the app. On the remaining nine statements, BusGazer did not score above a 2 out of 4. The total SUS scores for all eight participants were well below the accepted SUS average score of 68 out of 100. The scores ranged from 17.5 to 48.75 with an average overall SUS score of 25.4 between the eight participants.

Overall, we found that the BusGazer app was difficult to use for most users, and this is definitely reflective in the SUS scores. The app makes the assumption that users already know which route to take, which would require new bus riders to use an outside source, such as Google, to find this information before being able to utilize the BusGazer app. It also requires the users to know the exact address or map location of their destination and doesn't allow users to keyword search for locations such as *Giant Eagle*. Again, this would

require users to use an outside information source to find the exact address of their destination before being able to use BusGazer.

We suggest that the app has a more sophisticated address input, allowing for a destination and keyword search. Bus routes should be more easily accessed, instead of requiring the user to first find a specific bus stop on the map. Features should be more intuitive; it is still difficult to discern a specific goal and purpose behind this app and users should be informed of what features are available to them. It should also utilize the users' location information more effectively; perhaps by making suggestions for nearby stops and routes.

IV. Conclusions

a. Moving Forward: What a Good Product Addresses

The Port Authority bus service as a product to paying users has been shown through our research to be serviceable, but if Pittsburgh is committed to improving the experience and increasing ridership among the Millennial generation, there are key ways it could be improved. The following is a list of our suggestions for an improved Millennial bus-riding experience.

Must Haves

- Transparency in scheduling, cohesively integrated with route maps. This could be a Port Authority-sponsored app, or a third-party app. Regardless, users with no knowledge of the Port Authority system should be able to use the bus without confusion and with full knowledge of when the buses will arrive and where they are coming from/going. Simultaneously, this app must also appeal to veteran Port Authority riders who already know their way around the city and just want to know arrival times. If the bus is going to be 30 minutes late to a stop, riders should be able to find out this information and make plans accordingly.

Should Haves

- The buses themselves can be crowded and uncomfortable. To increase comfort for riders, it would be helpful to have a pattern of standing places printed on the floor of the bus to give riders a place to stand that will help alleviate any social discomfort associated with being in someone's personal space.

Could Haves

- Stemming from the above Should Have, the designated standing spots could be placed strategically in a way that would promote standing riders to uniformly spread out throughout the bus. This would prevent standing riders from congregating in certain areas, such as near the doors (which generally makes entering and exiting the bus more difficult).

b. Highlights & Key Insights

Our research presented us with a complex understanding of the Millennial experience using the Port Authority bus system. Our initial assumptions - that the bus system “sucked” and was an unsatisfactory experience for most users - proved to not necessarily be true. A significant number of riders had few complaints, and some even said that they found the bus experience to be satisfactory. Interestingly, these responses were all in spite of the poor performance of many of the digital applications available. Through our heuristics analysis on the Port Authority website and our review of the smartphone apps for scheduling trips, we found a landscape full of holes and lack of scheduling transparency for users. On top of this, seven of the twelve individuals we interviewed claimed that the bus scheduling was something that they did not like about the bus. Five of them cited comfort factors on the bus as something they disliked.

Clearly, the bus has pain points. These findings point to a system that is flawed, but despite its flaws, is still considered useful and worthwhile for many Millennials. Commuters were happy that it brought them to work without necessitating the use of a car, and because of the frequency of rush hour buses, they were less likely to be negative about bus scheduling. Students were happy that the bus was free for them.

It seems that the Port Authority bus system’s advantages often outweigh the disadvantages for its riders. We did not encounter anyone who claimed they stopped using the bus system because of a negative experience, nor anyone whose sole reason for not riding the bus was due to the bus experience in and of itself. Yet, the prevalence of complaints about scheduling and crowds were persistent enough to demand attention. If Pittsburgh intends to attract younger generations and compete with similar cities, having a well-integrated and easy-to-use bus system is essential. The targeted improvements that we have discussed in this report could be made to take the service from acceptable to far above average.