Exploring Public Transportation Safety in San Francisco

Minerva University

NS51: Empirical Analyses

Professor Moy

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Introduction

To reach the greenhouse gas emission zero net by “2040 while advancing racial and economic justice”, we aim to encourage more people to use public transportation as part of the San Francisco Climate Action Plan strategy of building a fast and reliable transit system to mitigate carbon emissions from private transportation (SF Environment, 2021, p. G-1). As a result, we are focusing on the following supporting action: “Greatly improve rider comfort, safety, and experience on transit across age, gender, race, and ability to encourage more people to ride transit” (SF Environment, 2021, p. 72).

Concrete Solution

In devising specific solutions for the supporting action, it is crucial to consider the dependency of San Francisco's public transportation systems on city-based resource allocation, managed by the Budget and Analysis Division (BAD) of San Francisco (*Budget and Analysis Division, Office of the Controller*, n.d.). Therefore, our solution will be constrained by the allocated limited budget and staffing. Addressing the broad challenge of enhancing "comfort, safety, and experience" could exceed budgetary constraints. Thus, we decided to focus only on improving riders’ safety. Additionally, to ensure racial inclusivity, the solution must satisfy equal accessibility in terms of languages, technological literacy, and financial capabilities of users across diverse demographic backgrounds.

Transit systems have implemented many solutions in San Francisco and Mexico to ensure the safety of both riders and passengers. However, some existing gaps render those solutions inefficient, as described in the table below:

Existing solution	Description
MuniSafe (MUNI's current reporting system)	Passengers fill out a feedback form on a website to provide their complaints about the incidents they encounter, destination, time of day, 4-digit vehicle number and the direction of travel (Padilla, 2017).
BART Violence & Safety Reporting System	Help users seek help and report incidents in service kiosks inside Metro stations. BART Watch App is a mobile app freely accessible that allows users to quickly and discreetly report criminal or suspicious activity directly to BART Police (*Safety & Security | Bart.Gov*, n.d.).
MUNI cell phone	Users can use the cell phone embedded in the underground metro buses to report emergencies.
The Traveling Safely Program in Mexico City	Service kiosks are placed inside Metro stations where users can seek help or report incidents (The World Bank, 2016).

The solutions listed above are slow and require passengers to fill out logistic-related information, which could be quickly auto-filled, discouraging people from providing information

about what makes them feel uncomfortable and unsafe on the buses. Furthermore, they primarily address emergencies, not general issues. [1]

Before considering possible concrete solutions, we began by changing perspectives from policymakers to the individuals actively using public transportation. To this end, we spent time observing travelers on the MUNIs. We noticed a few things: there are substantial unused posters and banner spaces, most travelers were on their phones, and very few other people were on public transportation during the night. From here, we generated multiple explanations for why passengers may feel "unsafe," which included the possibility of a lack of accessibility to reporting or surveillance, overcrowding, and insufficient security personnel. Finally, we thought of implementing a digital reporting process that enhances accessibility to issue-reporting during public transit rides by implementing a Poster/QR code system that automatically fills in the corresponding time, location, bus number, drivers, and security personnel. This solution supports our observation that most passengers had (and were actively using their phones) addressing the possible accessibility concern in reporting safety hazards. Although this may increase the demand for trained personnel to respond to these reports, it reduces the need for a constant

[1] **#gapanalysis:** In developing the concrete solution for the issue of safety on public transportation, we have identified multiple existing solutions implemented by MUNI and BART in San Francisco as well as in Mexico city. We came to the conclusion that the current reporting system of MUNI is inefficient and manual, which discourages people from filling out the feedback form. Therefore, we suggested an improvement to make the reporting system and processes much quicker and more automatic by creating a QR that can auto-fill logistic-related information when scanned. In this case, a new solution needs not be implemented.

presence across all public transportation forms and requires minimal funding to print and post the posters.[23]

Survey Discussion

The target population is San Francisco tourists and residents who use public transportation. We seek to gather insights into their experiences and attitudes toward public transit and the proposition of our QR-code posters to bolster travelers' safety. We conducted a pre-test of our survey using a convenience sampling method. We received 19 responses. After the pre-test, we tweaked the wording of the many questions, removing possible leading or confusing diction, and coded qualitative responses into a “select all that apply.”

As it is impossible for us to obtain a full frame of reference, we followed up with a cluster sample in which each bus consists of a heterogeneous sample of all public transportation users at that time (11am to 7pm). We used a random number generator to select bus numbers to board, asking all commuters to complete our survey (Appendix A).

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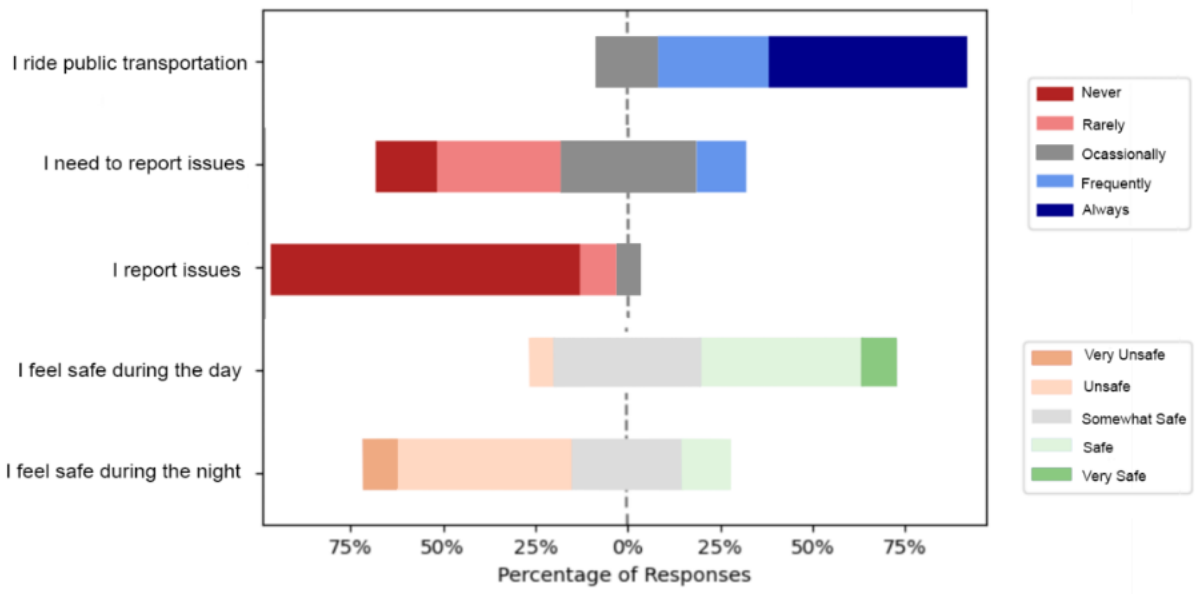
[2] **#heuristics:** In the development of our solution, we leveraged multiple creative heuristics to explore the solution space. By applying the "changing perspectives" heuristic, we shifted our viewpoint from policy-makers to MUNI travelers, allowing us to better understand their needs and concerns. Within this shift, we utilized the "observation" heuristic to gather insights directly from users of the public transportation system. This enabled us to generate multiple explanations for the perceived lack of safety, such as accessibility, reporting process complexity, and absence of security personnel. In addition, in the letter to Mayor London Breed, we suggest using successive approximation as a way to satisfy budget and staffing constraints and address the generalization limitation of our original sampling method. We also employed means-ends analysis to explore the present and goal states, and proposed the sub-goal of using implementation phases as a means to getting to the goal state of having Poster/QR code forms in all public transit systems in San Francisco.

[3] **#constraints:** We outlined the constraints in the solution space including resource allocation, budget, and staffing, and inclusivity requirement for San Francisco's public transportation systems, stemming from structural choices that we do not have the ability to change. By understanding these constraints, we were able to explore potential solutions that addressed the issue of rider safety that satisfy the imposed constraints. This process involved evaluating various solutions (leveraging #heuristics) and evaluating the extent to which the satisfied the constraints. By iteratively applying #constraints and #heuristics, we landed on our QR-code solution that is both practical within the existing limitations.

Figure 1.

Likert Scale for Passengers' Perspectives Towards Safety on MUNI in San Francisco



Note. n = 30 respondents.

Figure 1 shows that about 70 percent of respondents have either felt the need to report occasionally ("I sometimes feel the need to report issues or emergencies") or more frequently. However, more than 75 percent never reported issues when they arose. Observing the traditional $\alpha = .05$ using the proportion of people who *feel* the need to report issues as the null hypothesis, we assume the following hypotheses for the proportion of people who *actually* report issues:

$$H_0: p_{never} = .167,\ p_{rarely} = .333,\ p_{occasionally} = .367,\ p_{frequently} = .133$$

$$H_a = \text{at least one } p_i \text{ is not equal to the expected value}$$

Table 1.

Chi-square Goodness of Fit Test for the Comparison Between the Frequency of Passengers Feeling the Need to Report Issues and Actually Reporting Issues

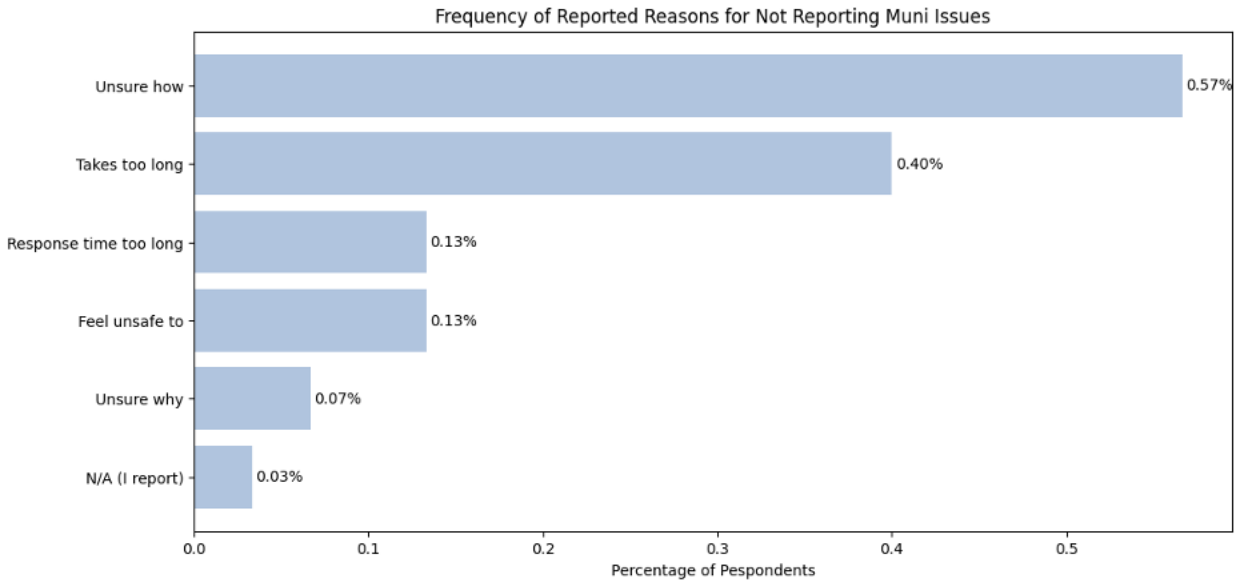
Reporting Frequency	**Actually Report**	**Need to Report**	**(Actually - Needed)²/Needed**
Always	0	0	0
Frequently	0	4	4
Occasionally	2	11	7.363
Rarely	4	10	3.6
Never	24	5	72.2
		X^2	87.163
		p-value	5.27E-18

The chi-square test of goodness of fit resulted in a p-value less than alpha $\alpha = .05$ [$X^2(29, N = 30) = 87.164$, $p = 5.27E\text{-}18$]; therefore, we have significant evidence that the true proportion of people who feel the *need* to report issues is different from the proportion of people who actually do with varying frequencies. While the chi-square goodness of fit test does not provide direction of the difference, Figure 1 shows that more people feel the need to report issues than they actually do, supporting our assumption that improving reporting procedures could improve how safe travelers feel on San Francisco's public transportation system. For further analysis, we asked survey participants to list reasons that hindered them from reporting. The results are summarized in Figure 2.[4]

[4] **#significance**: We applied a Chi-square goodness of fit test to evaluate the statistical significance of the difference between the proportions of people who feel the need to report issues on public transportation and those who actually report them with varying frequencies. This test is appropriate as our Likert scale survey questions are ordinal variables. As our p-value is less than our predetermined alpha, we reject the null hypothesis and conclude that random chance alone does not account for the observed difference between the frequency at which people felt the need to report and actually did report. We acknowledged that this test does provide insight on the direction of difference; therefore, we connected these findings to Figure 1.

Figure 2.

Reasons for Why Respondents Did not Report Issues on MUNI Buses



57% of respondents identified not knowing how to report an issue when one arises, and 40% described the reporting process as too time-consuming (Figure 2), supporting our assumption that the reporting process is too cumbersome. Finally, we investigated participants' opinions of our proposed solution, asking them to rank their preferences on a few different solutions.

Figure 3.

Respondents' Ranking of the Most Accessible Reporting Methods

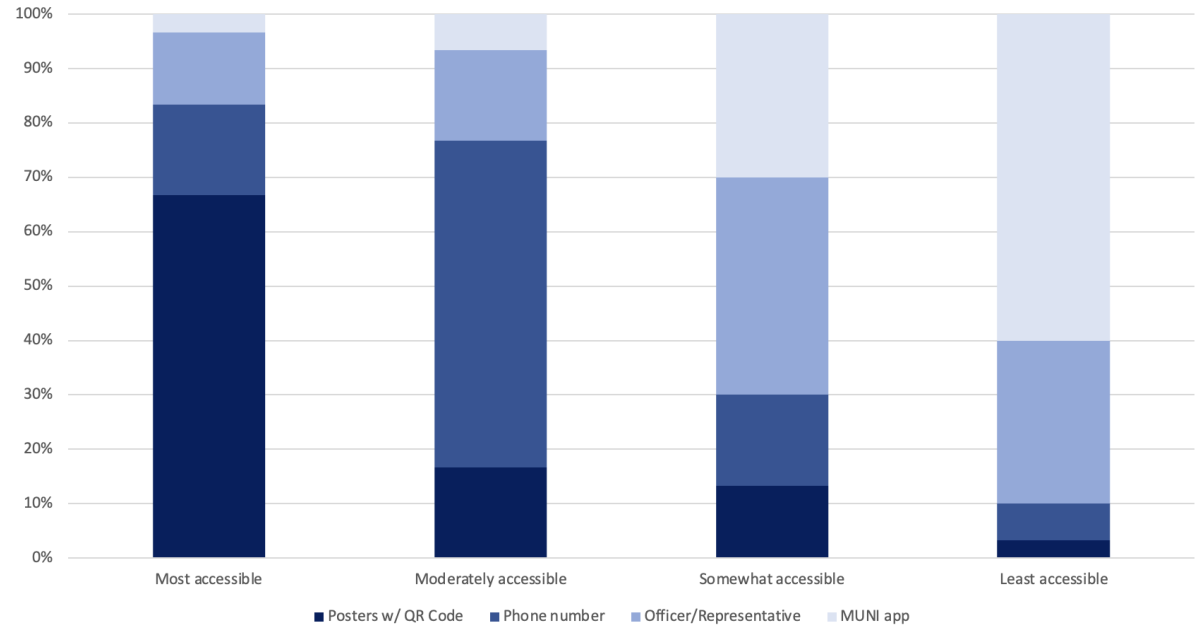
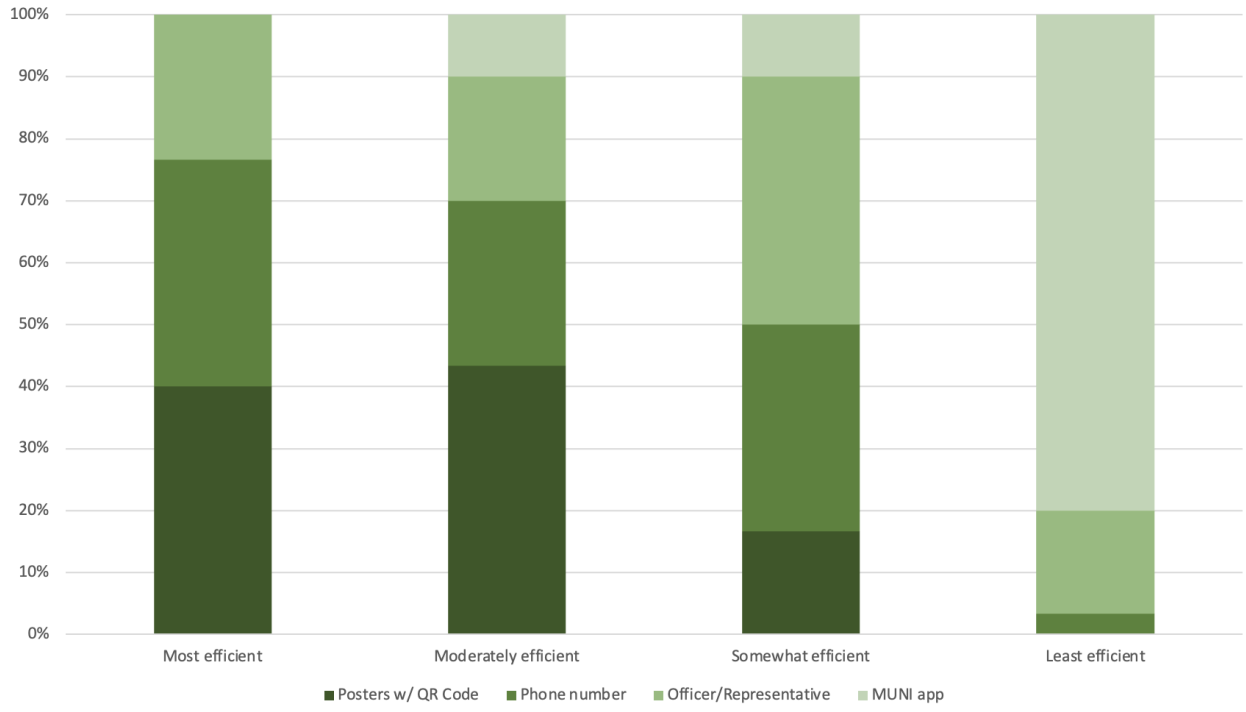


Figure 4.

Respondents' Ranking of the Most Efficient Reporting Methods



Nearly 70% of respondents ranked the addition of posters with QR codes as the most accessible solution (Figure 3), and over 80% ranked the QR-code solution as the most and moderately efficient. These results support our solution, as respondents identified QR codes as an effective solution to fill the gap between needing to report and actually reporting (Figure 1), by addressing the concerns in Figure 2.[5]

It is crucial to acknowledge that our method's results may be significantly influenced by the individuals who opted not to participate and the exclusion of specific population segments, such as early-morning or late-night commuters. Furthermore, those who chose to participate might have different experiences or perspectives on safety compared to those who declined, potentially skewing the results. Consequently, the findings may not accurately reflect the overall sentiments of all public transit users in San Francisco, limiting the generalizability of the findings.[6][7]

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[5] **#dataviz:** Based on the quantitative data from the survey, we created 4 graphs to represent the number of answers based on a Likert Scale questions in the survey as frequency: 1) passenger's perspectives towards safety, 2) reasons for why respondents did not report issues, 3) accessibility ranking, and 4) efficiency ranking. The visualizations are appropriately labeled and explained in detail to highlight the most notable statistics that inform whether our solution is preferred and suitable to address the issue of safety.

[6] **#sampling:** We identified 2 different sampling methods for the pre-test (convenient) and the official report (cluster). For justification of cluster sampling, we make an assumption that the characteristics of interviewees reporting behaviors are not dependent on the selected buses' condition, having equally distributed demographics of participants and responses related to what we are surveying. We surveyed everyone from the bus to adhere to the method (although many did not respond). Additionally, we explain the impacts that our sampling design (and the potential for response bias) has on the generalizability of our survey.

[7] **#interviewsurvey:** We used interview questions to explore the possible reasons why public transport participants feel "unsafe". We explore different aspects such as timeframe (day vs night), the belief vs the action, etc. The questions were specifically designed to portray and record user responses without influencing them. Hence the survey questions were carefully modeled to not have leading questions in addition to being used in pairs such as the "How often do you feel the need to report?" and the "How often do you actually report?" in order to examine the discrepancy as well as reasons for the discrepancy between wanting to report and not reporting. From the answers, we make interpretation of their real *need* for a more reliable reporting system. After investigating the need, we asked about the problem with the current system, is divided into 2 main themes: accessibility and efficiency. We interpret the ranking by comparing QR with other existing solutions to support our chosen supporting action.

Letter to Mayor Breed

Dear Mayor Breed,

We hope this letter finds you well. First and foremost, we would like to extend our congratulations on your election. As your administration takes on the critical task of governing San Francisco, we wish to draw your attention to the urgency of the Climate Action plan and provide a concrete solution that will help your office propel the city to a climate-friendly city.

We suggest implementing a digital reporting process that enhances the accessibility and efficiency of incident reporting using a Poster/QR code system. This solution works on two levels: it creates a disincentive structure and improves reporting accessibility. Having the posters posted around buses with an easy way to report issues discourages committing crimes and compromising the safety of others. Additionally, this solution will leverage MuniSafe's existing reporting form by automatically filling out vehicle and passenger information so the passenger can focus on reporting the actual incident as quickly as possible.

We conducted a survey to gather insights into public transportation users' opinions on our proposed solution. Notably, the results showed a discrepancy between the proportion of people who felt the need to report incidents and those that actually did (Figure 1). Furthermore, more respondents identified a lack of knowledge, inaccessibility, and inefficiency of reporting systems as primary explanations (Figure 2). This supports the integrity of our solution that aims to increase the ease with which individuals can report. Finally, responses regarding our Poster/QR code solution were positive, with nearly 70% of respondents ranking the solution as the most accessible (Figure 3). In addition, over 80% of respondents ranked the proposed solution as the most and moderately efficient (Figure 4). This further supports the solution's needs from your administration's perspective and the people's needs and wants.

In order to reach our goal of implementing the Poster/QR code solution across public transit systems in San Francisco we suggest implementing this solution in successive phases as a means to do so. First, the solution should first be implemented in one district. Then, informed by the number of actual reporting cases and the feedback of users to determine their receptiveness and responsiveness to the proposed solution, you may iteratively refine and extend this solution to more districts within San Francisco. In addition, trained personnel may be allocated to certain districts based on the frequency and number of incident reports to optimize responsiveness. We acknowledge how the conclusions made from this survey are limited in terms of sampling since it does comprehensively account for demographics like early and late commuters. Hence, we recommend doing further data collection and analysis to iteratively refine the solution to be as representative of public transportation user needs as possible.

Sincerely,

The Climate Action Solution Development Team.[8]

Word Count: 1598 words

AI Statement:

We did not use any AI tools to assist us in completing or writing this assignment.

[8] **#professionalism:** This assignment has been proofread and checked by Grammarly to erase any grammatical mistakes and to make sure we address all the relevant points required by the assignment. In addition, respondents were approached and asked for their consent in taking the survey in a respectful manner (Appendix B). The survey was conducted in an ethical manner according to the HSR guidelines. We ensured the high quality of this survey design by iteratively refining it over the course of multiple team meetings. Finally, we decided to follow APA guidelines in presenting and formatting Tables and Figures.

References

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Appendix A

Survey Questions

Demographic questions (3):

1. What gender do you identify with?
    a. Male
    b. Female
    c. Non-binary
    d. Prefer not to say
2. What age range do you belong to?
    i. 18-25
    ii. 26-35
    iii. 36-45
    iv. 56-65
    v. 66+
3. What is your ethnic or racial background?
    a. White/Caucasian
    b. Black/African American
    c. Asian
    d. Native American/Indigenous
    e. Middle Eastern
    f. South Asian
    g. South East Asian
4. Are you a resident of San Francisco?

a. Yes/No

i. If you answered Yes to the previous question, how long have you been a resident of San Francisco?

1. Less than a year
2. 1-2 years
3. 3-4 years
4. 5 or more years

5. How often do you use MUNI (underground trains - metro or above-ground buses) for transportation?
    a. Daily - I rely on public transportation for my daily commute and other errands
    b. Multiple times a week - Several times a week for various purposes
    c. Once a week - I usually take public transportation about once a week, depending on schedule.
    d. Rarely - Only in specific situations or when options are unavailable
    e. Never - Rely on other means of transportation
6. How safe do you feel using public transportation during the **day**?
    a. Extremely Safe - I have no concerns or fears when using public transportation during the day.
    b. Very Safe - I feel mostly secure, but stay alert of my surroundings.
    c. Somewhat safe - I have some concerns and fears but none that warrant action.
    d. Very unsafe - I often have concerns and fears when using public transportation during the day
    e. Extremely unsafe- I have extreme concerns and fears when using public

transportation during the day.

7. How safe do you feel using public transportation at **night**?
    a. Very Safe - I have no concerns or fears when using public transportation during the night.
    b. Safe - I feel mostly secure, but stay alert of my surroundings.
    c. Somewhat safe - I have some concerns and fears but none that warrant action.
    d. Unsafe - I often have concerns and fears when using public transportation during the night
    e. Very unsafe- I have extreme concerns and fears when using public transportation during the night.
8. How often do you feel the *need* to report issues/emergencies?
    a. Always - I always encounter situations where I feel the need to report issues or emergencies
    b. Frequently - I often encounter situations where I feel the need to report issues or emergencies
    c. Occasionally - I sometimes feel the need to report issues or emergencies.
    d. Rarely - I seldom feel the need to report issues/emergencies, as I don't encounter such situations
    e. Never - I never encounter situations where I feel the need to report issues or emergencies
9. How often do you *actually* report issues/emergencies?
    a. Always - When an issue/emergency arises, I always report it
    b. Frequently - When an issue/emergency arises, I often report it

c. Occasionally - When an issue/emergency arises, I sometimes report
d. Rarely - When an issue/emergency arises, I seldom report it
e. Never - When an issue/emergency arises, I have never reported issues or emergencies

10. What are some reasons that hinder you from reporting issues/incidents? (Check all that apply)
    a. I report the issues/incidents actively
    b. Reporting takes too much time
    c. The response time is too long
    d. I don't know how to report
    e. I don't see a purpose for reporting
11. Please rank these proposed solutions in order of how accessible you feel they will be when reporting incidents
    a. Posters and QR code
    b. Phone number
    c. Officer/Representative
    - MUNI app
12. Please rank these proposed solutions in order of how efficient you feel they will be when reporting incidents
    a. Posters and QR code
    b. Phone number
    c. Officer/Representative
    d. MUNI app

13. Do you feel unsafe on public transportation? If Yes, what is the biggest reason why? [9]

[9] **#interviewsurvery:** To ensure that our questions/survey was clear and unbiased, we used proxy questions to measure the respondents' opinion on our specific solution. To this end, we avoided telling the participants what our concrete solution is to mitigate the effects of response bias in which individuals respond in line with what they think we *want* to hear. For example, we asked participants their general opinion on current reporting procedures, perceived barriers, and potential solutions instead of asking specifically about their perceptions of a QR reporting system. To further refine our survey, we conducted a pre-test with a convenience sample of 19 our target population. Based on their feedback, we identified and rectified issues in question-wording, such as eliminating leading or confusing language, and increasing the cohesion of the survey as a whole (ensuring that each question ranking question has the same order of solutions and each Likert-scale question began with always/frequently). We also transformed open-ended responses into a "select all that apply" format, which made the survey more efficient and user-friendly, increasing the response rate.

Appendix B

Consent Form Included

Please read this consent agreement carefully before agreeing to participate in this study.

Purpose of the research: To assess public perception and gather insights on the San Francisco Climate Action Plan's initiatives, specifically regarding the improvement of rider comfort, safety, and experience on public transit across diverse demographics.

What you will do in this research:

Participants will be asked to share their experiences and opinions on the current public transit system, as well as provide feedback on potential solutions and strategies outlined in the San Francisco Climate Action Plan.

Time required:

Participation will take approximately 5 minutes to complete.

Risks:

There are no anticipated risks associated with participating in this study.

Benefits:

By participating in this study you have helped with the education of students learning about survey research design.

Confidentiality:

Your participation in this study will remain confidential, and your identity will not be recorded. Your responses will not be connected with your name. We may associate the data with certain demographic information (such as age, gender, country of origin), but

that will not be associated with your name or any other identifying information (such as a Social Security number).

Participation and withdrawal:

Your participation in this study is completely voluntary, and you may withdraw at any time without penalty. You may withdraw by informing the investigator that you no longer wish to participate (no questions will be asked).

Contact:

If you have questions about this research, please contact cmoy@minerva.edu

Agreement: (add as multiple choice with only the “I agree” choice. You must require that participants answer this question to move forward into the survey section.)

The nature and purpose of this research have been sufficiently explained.

I understand that I am free to withdraw at any time without incurring any penalty.

If you are 18 years of age or older, understand the statements above, and freely consent to participate in the study, click on the "I Agree" button to begin the survey. If not, thank you for your time.