Perception of Safety on Transit During COVID-19

A Case Study of Berlin, Germany

by

Noah Katt

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Graduate Supervisory Committee:

Deborah Salon, Chair
David King
Sara Meerow

ARIZONA STATE UNIVERSITY

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ABSTRACT

Transit agencies are struggling to regain ridership lost during the pandemic. Research shows that riding transit was among the most feared activities during the pandemic due to people's high perceived risk of infection. Transit agencies have responded by implementing a variety of pandemic-related safety measures in stations and vehicles, but there is little literature assessing how these safety measures affect passengers' perception of safety. This study implements surveys, interviews, and observations in Berlin, Germany to assess how passengers' demographic characteristics and experiences with safety measures are related to their perception of safety using transit. Females and older age groups were more likely to perceive transit as riskier than males and younger age groups. The results provide little evidence to suggest that safety measures have a significant impact on passengers' perception of safety, however. If this result is supported by future research, it suggests that transit agency investments in pandemic safety measures may not help them to regain ridership.

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CHAPTER 1

INTRODUCTION

The COVID-19 pandemic caused transit ridership levels to drop in nearly every city around the world. The drop is partly explained by a decreased need to travel – businesses and schools began operating remotely, non-essential stores closed or reduced hours, and people went to fewer social gatherings. However, the massive drop in transit ridership cannot be explained by reduced overall travel alone, as transit saw a greater decline in usage than any other mode of transportation (Abdullah et al., 2020). There are likely many factors that contributed to this disparity, but fear of transit appears to have been the most dominant and was exacerbated by many governments' active discouragement of using transit (Tirachini & Cats, 2020). In a survey conducted in May, 2020, participants in the United States ranked public transit as the riskiest public place, above schools, hospitals, and restaurants, among other locations (Kassas et al., 2021). According to a McKinsey survey in the summer of 2020, which covered the United States, England, Germany, France, Italy, China, and Japan; risk of infection was the primary mode choice determinant for transportation (McKinsey & Company, 2020).

Although these surveys were conducted relatively soon after the onset of the pandemic and perceptions may have changed, ridership is still well below pre-pandemic levels. In Germany, for example, the number of overall transit passengers in the first half of 2021 was 58% of 2019 levels (Statistisches Bundesamt, 2021). As most transit agencies are reliant, in part, on passenger fare revenue, continued decreased ridership could force agencies to make service cuts, which would likely further exacerbate the decline (Boisjoly

et al., 2018). In short, transit agencies need to recoup ridership to secure their ability to continue operations.

In response, many transit agencies have begun implementing campaigns to restore rider confidence, promote feelings of safety, and increase ridership. One common aspect of these campaigns is implementing additional pandemic safety measures. In Germany, the Verband Deutscher Verkehrsunternehmen (Association of German Transport Companies) launched a campaign to restore ridership using a variety of methods, including increased sanitation and mask compliance initiatives (Cuenca, 2020). In the United States, transit agencies nationwide have launched COVID-19 recovery plans that often include practices such as increased sanitation, rear door boarding, and mask enforcement on transit vehicles (Federal Transit Administration, n.d.). However, there has been no research attempting to quantify the impact of these safety measures on passengers' perception of safety. To better understand how pandemic safety measures might be able to increase ridership, it is necessary to research the relationship between pandemic safety measures and perceived safety.

Additionally, safety is not perceived identically by all people. Gender and age are two demographic variables that are commonly shown to be predictors of perceived safety (e.g., Badiora et al., 2015; Rahimi et al., 2021). Transit agencies looking to restore ridership and improve feelings of safety among their riders would benefit by understanding the relationship between their riders' demographic characteristics and how they perceive safety.

This study attempts to determine whether or not pandemic related safety measures can reduce fear of infection, and how gender and age are associated with perceived safety

during the pandemic. I use a mixed-methods approach consisting of a survey, interviews, and observations, in Berlin, Germany, to answer two research questions:

1. How do safety measures affect passengers' perception of safety during the pandemic?
2. How do gender and age relate to perceived safety on transit during the pandemic?

In this study, I analyze literature relevant to the research questions, describe my methodological approach, summarize the results, and then discuss their potential implications.

CHAPTER 2

LITERATURE REVIEW

Defining 'Perception of Safety'

Perception of safety and perceived safety are used interchangeably in this paper and defined as the extent to which people believe they are at risk of a negative event happening to them. In this section I review the literature surrounding the perception of safety on transit and formulate hypotheses. Since there is little research on how COVID-19 safety measures affect perceived safety, I instead look at two studies that examine the relationship between crime and terrorism deterring safety measures and perceived safety. I also review literature on the association between gender and age and perceived safety

Safety Measures and Perceived Safety

Literature surrounding COVID-19 safety measures on transit and perceived safety is sparse. Kapatsila & Grise (2021) found that passengers in Edmonton, Canada who were more informed of Edmonton Transit Service's social distancing and sanitary measures felt safer, though they did not analyze safety measures individually or attempt to explore any relationship between safety measures and perceived safety in depth.

Studies prior to the pandemic that examine the relationship between crime and terrorism deterring measures and perceived safety may provide better insight into the relationship between COVID-19 safety measures and perceived safety. Wallace et al. (1999) used 1997 and 1998 Ann Arbor Transit Authority (AATA) survey data on passengers' perception of safety to analyze the effects of various safety measures that AATA implemented. AATA added safety measures in between the two surveys, and the responses reflected the differences between participants' expected impact of the safety

measures on their feelings of safety and their actual impact. In the 1998 survey, passengers were asked to rate various situations, such as waiting at the bus stop, as "very unsafe" to "very safe" on a 5-point Likert scale. They also indicated if they had noticed security measures that AATA had implemented in a binary yes/no question and rated how safe each measure made them feel on a 5-point Likert scale. The study found that the safety measures that were most noticeable were also rated as having the greatest effect on perception of safety. Measures that were not noticeable tended to be less effective than 1997 survey results predicted. However, higher visibility did not improve the effectiveness of safety measures that were poorly rated in the 1997 survey. These results indicate that a safety measure's influence on perception of safety is a function of both the visibility of the safety measure and how effective passengers believe it to be.

In 2010, the New Jersey Department of Transportation conducted a study on the effectiveness of their terrorism security measures on passenger perception of safety (Carnegie & Deka, 2010). They reviewed customer complaint data and conducted two rounds of focus groups, the first focusing on participants' awareness of security measures and their perceived efficacy. The study yielded similar conclusions to Wallace et al. (1999). From the focus group discussions, the authors concluded that the most visible safety measures, police presence and security cameras, contributed the most to passengers' perception of safety. Predictably, measures that weren't visible at all (radiation detectors) had no influence on participants' perception of safety. Lastly, the authors found that measures that passengers believed to be ineffective, such as signs and posters with information on how to report suspicious activity, had no influence on perception of safety regardless of their visibility.

Though there is limited connection between pandemic safety measures and crime or terrorism deterring safety measures, it is reasonable to conclude that the effect of pandemic safety measures on passengers' perceived safety will also be a function of the measures' visibility and believed efficacy. I formulated my first hypothesis accordingly:

> H1: Study participants who frequently notice pandemic safety measures they believe to be effective will have higher perceived safety than those who do not meet both criteria.

Gender, Age, and Perceived Safety

Many factors contribute to perceived safety, and they are generally classified into two categories: external factors (factors linked to the negative event) and internal factors (factors linked to the person) (Bouyer et al., 2001). In literature regarding perceived safety on transit, demographic characteristics, especially gender and age, are the internal factors studied most often. Generally, there is a consensus that women perceive lower safety on transit in relation to crime, while age provides more mixed results and appears to depend on the context. For example, Wallace et al. (1999), analyzing survey data from bus riders in Ann Arbor, Michigan, found that women feel less safe than men while age is not a significant predictor, though the crime rate was low and people felt safe in general. Badiora et al. (2015), in a survey of bus passengers on a crime-riddled bus route in Nigeria, found that women and older age groups felt significantly less safe than men and younger age groups. Ouali et al. (2020) studied ten years (2009-2018) of annual survey data from 28 different cities around the world and found that women ubiquitously feel less safe than men. On the other hand, perceived safety tended to increase with age on buses and decrease with age on metros, though the author does not attempt to explain this discrepancy.

Research studying the perception of safety in relation to COVID-19 on transit tells a similar story. Rahimi et al. (2021) found that women are more likely than men to perceive risk of infection on transit in a survey of transit users in the Chicago metropolitan area from April to June, 2020. Kassas et al. (2021) found the same result in their nationwide survey. Rahimi et al. (2021) also found that older age groups were more likely to perceive risk than younger age groups, but research on perceived risk from COVID-19 in general is more conflicting. Rosi et al. (2021) found that while older age groups perceive a higher severity of COVID-19, they also perceive lower vulnerability to contracting it. Neuburger & Egger (2020) found that travel perceived safety during COVID-19 decreased with age. On the other hand, Wolfe et al. (2021) found that young people were significantly more likely to engage in risky behavior during the pandemic (though this does not necessarily mean perceived risk was different), and Han et al. (2021) found that older age was correlated with higher perceived safety during the pandemic, though the sample population in this survey was limited to people ages 60-99.

In general, the literature provided a clear reason to believe that gender will be a significant predictor of perceived safety, but the connection with age was more nebulous. However, older age is, in reality, associated with a much greater risk of contracting severe COVID-19 (Rashedi et al., 2020), and the only study that found an overall positive association between age and perceived safety during the pandemic was limited to people over 60. With these considerations in mind, I made the following hypotheses:

H2: Study participants who are female will have lower perceived safety on transit than male participants.

H3: There will be either no difference in perceived safety between age groups, or older age groups will have lower perceived safety than younger age groups.

CHAPTER 3

METHODS

To answer my research questions and test my hypotheses, I used a mixed methods approach to collect data using surveys, interviews, and observations. Copies of the survey, interview instrument, and observation forms are provided in Appendices A, C, and D respectively. In this section I first give a brief overview of Berlin's transit system and COVID-19 statistics at the time of my survey to help add context to my methods. I then explain the selection of safety measures that I include in my survey. Lastly, I detail the formulation and implementation of the three research methods.

Case Study Context

Transit System Composition

Berlin has two primary transit operators: the Berliner Verkehrsbetriebe (BVG) and Deutsche Bahn (DB). The BVG operates the U-Bahn, tram, and bus system, which altogether carry over a billion passengers per year, while DB operates the S-Bahn, which carries about 300 million passengers per year (Berliner Verkehrsbetriebe, n.d.; Deutsche Bahn, 2021). The U-Bahn is a primarily underground rapid transit rail system that provides wide coverage mostly within the inner city. The S-Bahn is a mixture of elevated and underground rail lines that connect Berlin's surrounding suburbs to the city center.

The tram network is a light rail system that provides extensive coverage in the northeast region of the city. Because of historical development patterns resulting from Berlin's bifurcation during the Cold War, the tram mostly covers areas former East Berlin, while the U-Bahn mostly covers areas in former West Berlin (Berliner

Verkehrsbetriebe, n.d.). The bus system provides extensive coverage nearly everywhere in the city. Maps of the S-Bahn, U-Bahn, and tram systems can be found in Appendix E.

COVID-19 information

I implemented my research methods primarily between mid-November and mid-December 2021, which corresponds with the rise of the Delta variant. Berlin's COVID-19 cases roughly track Germany's, which experienced its peak number of active cases from the Delta variant on December 12, 2021, the day before my survey closed (*Germany COVID - Coronavirus Statistics*, n.d.). On the same date, the Omicron variant was just beginning to circulate and comprised 2% of cases (*SARS-CoV-2 Sequences by Variant*, n.d.). At the time, there was a federal mask mandate on transit, but no other transit-related restrictions were in place (*The Federal Government Informs about the Corona Crisis*, 2022).

Safety Measure Selection

There is a myriad of safety measures that can reduce the risk of COVID-19 infection on transit. It would be impractical to study all of them, especially since transit operators in Berlin have not implemented all of them. To narrow down and select safety measures to include in my survey, I first synthesized literature reviewing COVID-19 safety best practices for transit operators, then selected the six most relevant based on my personal experiences using transit in Berlin.

There were three pieces of literature I consulted: a COVID-19 safety best practice manual commissioned by American Public Transit Association (Schwartz et al., 2020), a master's thesis reviewing transit agency responses to COVID-19 (McGowan, 2021), and Kamga & Eickemeyer's (2021) review of social distancing measures on transit. There were

three criteria I used to select safety measures from the literature. They had to be (1) implementable by transit agencies, (2) relatively quick and easy to implement, and (3) the measure or its effect had to be easily visible. For example, mask mandates did not meet the first criterion, as those are usually under the purview of legislative bodies rather than transit operators. Crowd tracking apps did not meet the second criterion as they require significant development time and cost. Mandatory vaccinations for employees did not meet the third criterion. Of the safety measures identified in the literature, there were six I viewed as being most relevant in Berlin based on my personal experiences.

Mask enforcement: There was a national mask mandate on transit vehicles at the time of this study. Most people wore masks in transit vehicles, but not as frequently in stations. Employees would sometimes come around and check tickets, and there were often security guards patrolling the larger stations, but either of those people would rarely enforce mask requirements.

Open windows on vehicles: Ventilation in general was identified in Schwartz et al. (2020) and McGowan (2021), but opened windows are the most visible form of that. Transit vehicles in Berlin frequently had open windows, and there were signs on most windows on U-Bahn carriages reading “Leave me open, please.”

Hand sanitizing stations: Although Schwartz et al. (2020) and McGowan (2021) identify providing personal protective equipment/supplies in general to passengers as a safety measure, hand sanitizing stations were the only ones freely available in Berlin, though only at the largest stations.

Social distancing markers: Identified in Kamga & Eickemeyer (2021), social distancing signage was very common in Berlin. Many stations and vehicles had floor markings or signs emphasizing the 1.5m recommendation.

Cleaning and sanitation: The transit vehicles in Berlin were remarkably clean, excepting the ubiquitous graffiti. Additionally, I often saw employees sanitizing vehicles when I rode to the end of U-Bahn lines.

Reduced vehicle capacity: Although transit vehicles in Berlin did not have reduced capacities, lack of social distancing was the most obvious issue on transit, so I included it regardless. During peak hours vehicles would often be filled well over seating capacity and people would stand shoulder to shoulder.

Survey

The survey ran from November 13th until December 13th, 2021. I defined the target population as people that rode transit in Berlin during the time of the survey. Participants were recruited using convenience sampling via Humboldt University e-mail lists, which included faculty and students; a Facebook group for international Berlin residents; and an English speaking Berlin themed subreddit. Non-transit users were filtered out with the first question of the survey, which asked how often the participant used transit. Recruitment messages were sent in both German and English, and the survey was also available in both languages. 231 people responded in total, 192 of which were complete and used in the analysis. All results were recorded anonymously.

The survey included five multiple choice questions asking about gender, age, education, transit usage frequency, and vaccination status; and five 7-point Likert Scale questions. The Likert Scale questions asked participants to give ratings for five categories:

(1) how worried they were about being infected on transit (1=not worried, 7=very worried), (2) how safe they felt in various situations (1=very unsafe, 7=very safe), (3) how frequently they noticed each of the six safety measures (1=never 7=always), (4) how important they believed each safety measure was in preventing infection (1=not important, 7=very important), and (5) how important they believed each safety measure was in preventing infection in a hypothetical scenario where all passengers were unvaccinated (1=not important, 7=very important). I refer to the participants' ratings for the third Likert Scale question as their "visibility" ratings, and for the fourth question as their "believed efficacy" or "efficacy" ratings. The survey also included three optional free response questions where participants could list additional situations that made them uncomfortable, safety measures they had seen, or safety measures they thought were important. The final question was an optional field in which participants could enter their email address to be contacted about participating in the interview. In total, the survey was designed to take around ten minutes, as limiting survey length to under fifteen minutes is an effective way to increase response rates (Saleh & Bista, 2017).

Further Survey Analysis

To test Hypothesis 1, I first calculated how many safety measures each participant both frequently noticed and believed to be important by recoding the visibility and efficacy ratings of each participant into binary variables. This process created a 'coordinate' for each safety measure, indicating if the participant noticed the measure frequently, and if they thought it was important. A summary of the recoding process is shown below in Table 1. A (1,1) coordinate for a safety measure would indicate that the participant frequently noticed it and believed it was important. For clarity, I also reversed the ratings from the

first Likert Scale question so that a higher value indicated that the participant was less worried. I refer to this reversed variable as the participant's "perceived safety". I then tested for any significant difference between participants with zero, one, and two (1,1) coordinates using Analysis of Variance (ANOVA) testing. Participants with more than two (1,1) coordinates were not included because there were so few. [1]

Table 1
Variable Recoding Summary

Variable	Rating	Recoded Value	Meaning
Visibility	1-4	0	Infrequently seen
	5-7	1	Frequently seen
Believed Efficacy	1-4	0	Not important
	5-7	1	Important

Although the ANOVA testing would identify differences between groups, it would not reveal any underlying pattern. To get a better idea of the connection between perceived safety, visibility ratings, and efficacy ratings, I created a safety index score (SIS) for each participant. To create the SIS, I assigned each coordinate a value (-1, 0, or 1) based on its expected effect on perceived safety, making the additional assumption that if a participant believed a safety measure was important but did not frequently see it, it would negatively affect their perception of safety. A (1,1) coordinate was assumed to improve perceived safety, while the other two coordinates were assumed to have neutral effects. A summary of this process can be found in Table 2. The sum of all six assigned numbers constituted the participant's SIS.

[1] The variable is recoded unevenly (four ratings are recoded to '0' while three ratings are recoded to '1') because the middle rating of '4' is not truly neutral. This was a subjective decision, and the variable could be recoded differently.

Table 2
Assigned Numbers of Safety Measure Coordinates

Coordinate	Expected Effect on Perceived Safety	Assigned Number
(0,0)	Neutral	0
(0,1)	Negative	-1
(1,0)	Neutral	0
(1,1)	Positive	1

I then plotted the participants' perceived safety (the dependent variable) against the SISs to identify any correlations. To isolate the individual effects of the visibility and efficacy variables, I also plotted the participants' perceived safety against both how many measures they frequently noticed and how many measures they believed to be effective. I performed regressions on all three correlations to determine the significance of any relationships.

Interviews

I conducted interviews between November 19th and December 9th, 2021. Interview participants were recruited exclusively through the survey, which allowed participants to leave their email address at the end. Twelve people left their e-mail address but only four people completed the interview. I conducted two interviews using Zoom, one over the phone, and one using written e-mail communication. I recorded the audio from each of the oral interviews and later transcribed the recordings. The oral interviews were free-flowing and many of the questions were based on the participants answers. The written interview was less comprehensive than the oral ones as I was not able to ask follow-up questions. Each oral interview was between 15 and 20 minutes long. The identities of the interview respondents were kept anonymous.

The interview expanded on many of the survey questions and focused on getting detailed experiences of typical transit trips during the pandemic. I also asked for their opinions on how the transit operators handled the pandemic, what safety measures they would have added, and how their perception of safety changed over the course of the pandemic.

Because there were only four interviewees, I did not try to code their responses or perform any sort of statistical analysis. Instead, I identified common themes and statements that seemed to confirm or contradict survey responses and wove them into some of the explanations for the survey results.

Observations

I collected observations on transit vehicles and at stations between November 19th and November 24th, 2021, at various times of the day on weekdays and weekends. U-Bahn and S-Bahn stations were randomly selected, and the respective vehicles were selected by randomly choosing stations and riding for one to two stops. Bus and tram stations and routes were not randomly selected but selected intentionally to cover both busy and sparse areas. I did not randomly select bus and tram routes because they cover large areas of low ridership, and intentional selection was necessary to ensure that I observed popular routes.

The purpose of the observations was to record the presence of safety measures in transit vehicles and document other safety conditions, such as number of people not wearing masks and how crowded the vehicle was. For each transit vehicle, I recorded 9 safety-related variables, as well as the time of the observation and location of the route, using a mobile version of Microsoft Excel. I recorded six safety-related variables for stations.

I used the data to compare the documented presence of safety measures and how frequently participants reported noticing safety measures, and to comment on the differences in safety conditions between transit modes.

CHAPTER 4

RESULTS

Participant Characteristics

Table 3 shows the demographic information of survey respondents compared to the general population of Berlin according to a 2011 census, the most recent census data available (Statistische Ämter des Bundes und der Länder, 2011). Respondents were significantly younger, more educated, and more likely to be vaccinated than the general population. 45% of respondents were male and 52% were female. 97% of respondents were 18-44 years old, and 98% reported having an “abitur” (slightly more advanced than a U.S. high school diploma) or higher. 49% of respondents rode transit 5 days a week or more, and 95% were fully vaccinated or had a booster shot.

Table 3
Survey Demographic Data

Variable	Sample (%)	Berlin (%)
Gender		
Male	45	49
Female	52	51
Non-Binary or Other	3	N/A
Age[1]		
18-24	37	10
25-34	44	18
35-44	16	17
45-54	2	18
55-64	1	14
65 & over	1	23
Ridership Frequency[2]		
Daily	19	N/A
5-6 days per week	30	N/A
3-4 days per week	28	N/A
1-2 days per week	15	N/A
Less than once per week	9	N/A
Highest attained education[3]		
Less than high school (Ohne Abschluss)	0	7
Some high school (Hauptschulabschluss oder mittlere Reife)	0	14
Vocational or technical training (Ausbildung)	2	46
High school diploma (Abitur)	36	16
Bachelor or Master degree (Studium)	54	15
PhD (Promotion)	6	2
Vaccination Status[4]		
Fully vaccinated + booster	5	8
Fully vaccinated	90	60
Half vaccinated	1	1
Unvaccinated	3	31

[1]Being 18 years of age or older was a prerequisite to taking this survey. Berlin's age distribution was adjusted to remove those under 18.
[2]Respondents who indicated they never rode transit were excluded from the survey results.
[3]For Berlin residents ages 15 or older. The breakdown for ages 18 and older may be different.
[4]Vaccination rates for Berlin's general population were recorded on Nov. 17, 2021

General Survey Results

Table 4 displays the average rating and standard deviation of each Likert scale question. The last section of the table shows the distribution of responses to the question: 'How worried are you about getting infected with COVID-19 while using public transportation in Berlin?'. The average reported degree of worry was 3.8. 76% of respondents reported that their level of worry was between 2-6, with only 15% being on the extremes of either end of the scale.

The situation that caused participants to feel the most unsafe was when other passengers were not wearing masks (mean: 2.2), while a visibly dirty vehicle and being unable to clean their hands were perceived as safest (mean: 4.0). Participants reported noticing signs or floor markings encouraging social distancing (mean: 4.4) and open windows (mean: 4.3) the most frequently, but almost never saw guards enforcing masks (mean: 1.8), hand sanitizing stations (mean: 1.7), and reduced maximum capacities (mean: 1.4). Participants ranked opening windows (mean: 6.0) and guards enforcing masks (mean: 5.5) as the two most important safety measures for reducing the risk of infection. Signs or floor markings encouraging social distancing was perceived as the least important safety measure (mean: 3.9). In a hypothetical situation where all passengers were unvaccinated, participants indicated that all safety measures would increase in importance but mostly retain their relative position, with the exception that limiting vehicle capacity became more important than cleaning and sanitizing vehicles.

Table 4: Likert Scale Results

Variable	Mean	S.D.
Level of Worry of Infection on Transit (1=not worried, 7=very worried)	3.8	1.7
Perceived Safety by Scenario (1=very unsafe, 7=very safe)		
Passengers not social distancing	3.1	1.6
The vehicle is poorly ventilated	3.0	1.5
The vehicle is visibly dirty	4.0	1.6
You are unable to clean your hands	4.0	1.7
Passengers are not wearing masks	2.2	1.7
Measures Noticed (1=never, 7=always)		
Guards or police enforcing mask requirements	1.8	1.3
Open windows on transit vehicles	4.3	1.4
Hand sanitizing station	1.7	1.1
Signs or floor markings encouraging social distancing	4.4	2.0
Cleaning and sanitization of vehicles	2.4	1.5
Vehicles with reduced maximum capacities	1.4	0.9
Belief of Measure's Importance in Preventing Infection (1=not important, 7=very important)		
Guards or police enforcing mask requirements	5.5	1.7
Open windows on transit vehicles	6.0	1.3
Hand sanitizing station	4.5	1.8
Signs or floor markings encouraging social distancing	3.9	1.6
Cleaning and sanitization of vehicles	5.3	1.7
Vehicles with reduced maximum capacities	4.8	1.7
Belief of Measure's Importance in Preventing Infection if Everyone was Unvaccinated		
Guards or police enforcing mask requirements	6.1	1.6
Open windows on transit vehicles	6.4	1.3
Hand sanitizing station	5.4	1.9
Signs or floor markings encouraging social distancing	5.3	1.7
Cleaning and sanitization of vehicles	5.8	1.7
Vehicles with reduced maximum capacities	6.0	1.6
Level of Worry of Infection on Transit	**%**	
1 = Not Worried	7	
2	22	
3	19	
4	14	
5	21	
6	9	
7 = Very Worried	8	

Further Survey Analysis

The results of the ANOVA test on the perceived safety ratings between participants with zero, one, and two (1,1) coordinates, are shown in Table 5. Participants who had zero (1,1) coordinates had an average perceived safety of 4.4, participants with one had an average perceived safety of 4.0, and participants with two had an average perceived safety of 4.4. The p-value for the test was .24, indicating that the differences between the groups were not significant.

Table 5
Differences in Perceived Safety Between Coordinate Groups

# of (1,1) Coordinates	# of Respondents	Perceived Safety*
0	76	4.4
1	83	4.0
2	23	4.4

*p=.24

The plot of participants' perceived safety and SISs is shown in Figure 1. Most scores are negative, indicating that most participants thought many measures were important but did not frequently see them. There is a moderate and significant positive correlation ($R=.41$, $p<.0001$) between the variables.

The plots of perceived safety against the visibility and efficacy ratings are shown in Figure 2 and Figure 3 respectively. There is a weak but significant positive correlation ($R=.19$, $p<.025$) between perceived safety and visibility. Lastly, there is a negative correlation between perceived safety and believed efficacy of identical strength and significance as the SIS ($R=.41$, $p<.0001$).

Figure 1: Perceived Safety vs. Safety Index Scores

Figure 2: Perceived Safety vs. Visibility of Safety Measures

Figure 3: Perceived Safety vs. Believed Efficacy of Safety Measures

Age and Gender

Females were slightly more worried about infection than males, with a mean safety rating of 4.0 compared to 3.5. Worry of infection also increased with age, with mean safety ratings of 3.4, 3.9, and 4.4 for the respective age groups of 18-24, 25-34, and 35-44. ANOVA tests were conducted on both variables to determine if the differences in perceived safety between genders and among age groups were significant. People who reported their gender as 'non-binary or other' and age groups of 45-54 and older were not tested due to the small fraction of respondents in each category. The difference in perceived safety between genders and among age groups were both found to be significant at a 95% confidence level. The results of the tests are shown below in Tables 6 and 7.

Table 6
Differences in Perceived Safety Between Genders

Groups	Count	Average*
Male	87	3.5
Female	99	4.0

*p=.04

Table 7
Differences in Perceived Safety Between Age Groups

Groups	Count	Average*
18-24	71	3.4
25-34	84	3.9
35-44	31	4.4

*p=.02

Interviews

Although there were only four interview participants, there were some common themes in their answers. The general consensus among the participants was that the transit operators' methods of responding to the pandemic were mediocre. Three of them mentioned how rare it was to see mask enforcement and lamented that ticket checkers would often ignore people who were wearing their mask improperly or not wearing one at all. They observed that windows in transit vehicles were open more frequently than before the pandemic, but one participant noted that people often shut the windows when it was cold and recommended that windows be fixed open instead of merely placing signs asking people to leave them open. Most of them felt more comfortable riding transit at the time of the interview than the beginning of the pandemic, primarily because of vaccinations, overall increased compliance with mask mandates despite the lack of enforcement, and personal efforts to avoid crowded vehicles.

Observations

Table 8 displays some of the results from the transit vehicle observations, broken down by transit type. Additionally, hand sanitizing stations were observed in two stations, social distancing signs/floor markings were observed in two vehicles and twelve stations, and police were enforcing masks in one station. Overall, windows were open in half of transit vehicles, though this differed significantly by transit type. Despite that both the U-Bahn and tram are both operated by the BVG, the U-Bahn's windows were almost always open, and the tram's windows were always closed. Vehicles tended to be about half full, though the U-Bahn was typically more crowded (median: 70% capacity) and buses were generally sparse (median: 20% capacity). Mask usage on vehicles was quite prevalent. The S-Bahn was the only transit mode that did not have a median number of zero maskless people. The U-Bahn, trams, and buses all had a median of zero (0) maskless people, despite only one recorded instance of mask enforcement. Lastly, transit vehicles in Berlin were generally very clean. The overall average cleanliness score (1=very clean, 7=very dirty) was 1.7 with the highest rating being a 4. The rating scale was based on the amount of litter on the floor and the visible cleanliness of surfaces (not taking into account graffiti, which was ubiquitous).

Table 7 shows the average visibility rating of a safety measure compared to the actual rate it was observed at. Generally, the average visibility rating corresponded well with how often the safety measures were observed. Participants most frequently noticed open windows and social distancing signage, which were also frequently observed in stations and occasionally in vehicles.

Table 8
Observation Results

	Mean	Median	S.D.	Low	High	Yes (%)	n
Windows Open						**50**	**40**
U-Bahn						93	15
S-Bahn						40	10
Tram						0	8
Bus						29	7
Approx % Full[1]	**49%**	**45%**	**0.36**	**10**	**110**		
U-Bahn	65%	70%	0.40	10	110		
S-Bahn	45%	40%	0.36	10	110		
Tram	44%	40%	0.32	10	100		
Bus	23%	20%	0.16	10	50		
Number of People not Wearing Masks	**0.7**	**0.0**	**1.00**	**0**	**4**		
U-Bahn	0.6	0.0	0.83	0	3		
S-Bahn	1.1	1.0	1.29	0	4		
Tram	0.1	0.0	0.35	0	1		
Bus	0.7	0.0	1.25	0	3		
Vehicle Dirtiness[2]	**1.7**	**2.0**	**0.68**	**1**	**4**		
U-Bahn	1.6	2.0	0.51	1	2		
S-Bahn	1.9	2.0	0.88	1	4		
Tram	1.5	1.5	0.53	1	2		
Bus	1.9	2.0	0.90	1	3		

[1]Values recorded between 10-110% at 10% intervals. Any vehicle with more passengers than seats was recorded at 110%
[2]Values based on Likert Scale where 1=very clean and 7=very dirty

Table 9
Safety Measure Visibility and Observation Rates

Measure	Average Visibility Rating	Vehicles (%)	Stations (%)
Guards or police enforcing mask requirements	1.8	0	3
Open windows on transit vehicles	4.3	50	NA
Hand sanitizing station	1.7	0	5
Signs or floor markings encouraging social distancing	4.4	5	32
Cleaning and sanitization of vehicles	2.4	0	NA
Vehicles with reduced maximum capacities	1.4	0	NA

CHAPTER 5

DISCUSSION

The results of this survey corroborate some previous research findings and contradict others. In this section, I discuss my results in the context of each research question and discuss whether they support or refute my hypotheses. I also discuss the potential implications of my results for transit agencies and make recommendations for future research.

Discussion of Results

How do safety measures affect passengers' perception of safety during the pandemic?

H1: Study participants who frequently notice pandemic safety measures they believe to be effective will have higher perceived safety than those who do not meet both criteria.

The results of the ANOVA test in Table 5 do not support H1. Specifically, there was no significant difference between participants who had (1,1) coordinates for zero, one, and two safety measures. However, the only two safety measures that participants frequently noticed were open windows and social distancing signage. The other four safety measures were rarely seen or observed and only eight participants frequently saw three or more measures they believed to be important, and the ANOVA test could only compare participants who had (1,1) coordinates for less than half of the safety measures. It is possible that a greater diversity of safety measures within Berlin's transit system would have yielded more significant results.

The correlations between perceived safety and the SIS, the visibility variable, and the efficacy variable yielded more interesting results. Perceived safety and the SIS had a

positive correlation with a moderately good fit (R=.41, p<.0001), which at first glance would indicate that the more safety measures people noticed and found important, the safer they would feel. However, isolating the variables showed that perceived safety had only a very minor correlation with measure visibility (R=.19, P<.025), but had a much stronger correlation with efficacy (R=.41, p<.0001).

One interpretation of this finding is that perceived safety increased with the SIS not because people felt safer with the more measures they saw, but because people who did not think measures were important were less worried about infection. This interpretation is supported by the fact that there were 573 (0,1) coordinates (negative SIS impact), 402 (0,0) or (1,0) coordinates (neutral SIS impact) and only 153 (1,1) coordinates (positive SIS impact), indicating that increasing SIS scores were better attributed to participants believing less measures to be important rather than noticing more measures they believed were important.

It is possible that people who place more importance in safety measures are more anxiety about the pandemic in general, and that safety measures have a limited ability to change that. This reasoning is supported by Kapatsila & Grise's (2021) finding that "the more concerned a person is with the rules around limited occupancy and coming in contact with people who take transit, the lower their likelihood to feel safe using public transit is." That is not to say perception of safety is immutable; factors unrelated to the transit environment, such as vaccination status or personal beliefs about the pandemic, may have a larger influence on perceived safety. The interviews and survey data support this notion, as interviewees cited vaccines as one of the most important drivers for their improved perception of safety over the course of the pandemic, and survey results showed that people

placed a higher importance on all safety measures in the hypothetical scenario where all passengers were unvaccinated. If these conclusions are supported by future research, it would suggest that investments in pandemic safety measures may have a limited effect on ridership.

How do gender and age relate to perceived safety on transit during the pandemic?

H2: Study participants who are female will have lower perceived safety on transit than male participants.

The results found that female respondents were significantly more likely to have lower perceived safety on transit than male respondents, supporting H2. The results in this study do not make it clear why this is the case, but the finding is consistent with previous research. Rahimi et al. (2021) postulate that the traditional role of females as care providers within households might cause them to perceive a greater threat from COVID-19. Future research could untangle the 'why' of the gender discrepancy better by incorporating qualitative interview data.

H3: There will be either no difference in perceived safety between age groups, or older age groups will have lower perceived safety than younger age groups.

The results also supported H3. There proved to be a larger difference in perceived safety between age groups than between genders. Because of the increased risk of COVID-19 with age, it makes sense that older age groups would perceive a lower level of safety on transit. However, literature has not always reported similar findings. It may be the case that because the participants in this study are more educated than the average citizen, they may be more aware of the increased risks of COVID-19 with age.

Limitations and Future Research

All results in the study were related to COVID-19 specific safety measures and perceptions and may not be generalizable to future pandemics. For example, age may not be associated with lower perceived safety in a pandemic that does not share the same age-related health risks. This limitation is not necessarily a flaw with the research design, but something that should be considered when applying this study's findings.

Some additional limitations arose from the data used in this research. As the survey was implemented entirely through a school email list and social media groups that primarily use English, the study participants were much younger and more educated than the general population of Berlin. I did not try to weight answers to correct for the demographic discrepancies for two reasons. First, there was a lack of representation in certain demographic groups. It would have been impossible to correct for education as there were zero respondents in the lowest two education categories, even though those categories account for 21% of Berlin's population. Age would have been nearly as difficult to correct for, as only one respondent was 65 years or older. Secondly, there were other biases present in the sample population that are not accounted for in the survey data. Participants recruited from the email list were almost certainly limited to university students and faculty, who are not necessarily representative of even the portion of the general population who share a similar age and level of education. Additionally, it is likely that participants recruited from the English-speaking social media groups were more likely to be international residents, who also do not necessarily reflect the general population.

Additional survey data limitations arose from being unable to separate responses based on how the participants were recruited because of the differences between the groups

not reflected in the survey data. Furthermore, the observations revealed differences among transit modes in which safety measures were present. For example, the U-Bahn almost always had open windows while the tram never did. Future research could correct for these data limitations by using a different recruitment method that would yield more representative demographics (e.g., survey panels), adding a mechanism to differentiate responses by recruitment method (if using more than one), and, if the research is conducted in a context where safety measures differ by transit mode, adding one or more questions that differentiate the participants' perception of safety by transit mode.

Future research could further improve upon this study by using a longitudinal or multiple cross-sectional study design rather than cross-sectional. The cross-sectional nature of the data used in this research makes it difficult to establish any causal relationship between safety measures and perceived safety. A practical example of this would be surveying passengers before and after a safety measure is implemented.

As a final note, this study only focused on six safety measures that were relatively easily implementable by transit agencies. There are many other safety measures that could affect perceived safety differently, such as live crowd tracking apps, fare waiving, and provision of free personal protective equipment such as masks and gloves. It may be beneficial to include some of these additional measures in future research.

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APPENDIX A

SURVEY INSTRUMENT (ENGLISH VERSION)

Hello. Thank you for your participation in my survey about your perception of safety on public transportation in Berlin during the pandemic. The purpose of the survey is to gather information about how Covid-19 has affected people's perception of safety on public transportation and how we can make transit be and feel safer.
Your participation in this survey is voluntary, but important. The survey will take about 5-10 minutes to complete and your responses are completely anonymous.
This study is being conducted by Noah Katt from Arizona State University in Phoenix, Arizona, United States. He is conducting his research at Humboldt Universität zu Berlin. If you have any questions regarding this research, please contact Noah Katt at nkatt@asu.edu

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You must be 18 years or older to take this survey. There are no foreseeable risks or discomforts to your participation. The results of this study may be used in reports, presentations, or publications but your name will not be used. De-identified data collected as a part of current study may be shared with others (e.g., investigators or industry partners) for future research purposes or other uses. Deborah Salon from Arizona State University is the Principal Investigator for this research project and may be reached at dsalon@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at +1 (480) 965-6788.

1. How often do you typically ride public transportation in Berlin, Germany?
    a. Daily
    b. 5-6 days per week
    c. 3-4 days per week
    d. 1-2 days per week
    e. Less than once a week
    f. Never

Option (f) ends the survey.

2. How worried are you about getting infected with COVID-19 while using public transportation in Berlin? (1) Not worried at all, , , , , , (7) Very worried
3. Please rate how safe you would feel in the following scenarios on public transportation vehicles in Berlin ((1) Very unsafe, , , (4) Neutral, , , (7) Very safe)
    a. Passengers are not social distancing
    b. The vehicle is poorly ventilated
    c. The vehicle is visibly dirty
    d. You are unable to clean your hands
    e. Passengers are not wearing masks
4. (Optional) Are there any other situations you have experienced on public transportation in Berlin where you felt unsafe (in regards to COVID-19)?
5. Please indicate how often you have noticed the following COVID-19 safety measures on public transportation in Berlin within the past month. ((1)Never, , , , , , (7)Always)

    a. Guards or police enforcing mask requirements
    b. Open windows on transit vehicles
    c. Hand sanitizing stations
    d. Signs or floor markings encouraging social distancing
    e. Cleaning and sanitization of vehicles
    f. Vehicles with reduced maximum capacities
6. (Optional) Are there any COVID-19 safety measures not mentioned that you have noticed in transit vehicles or stations in Berlin?
7. Please indicate how important you believe the following COVID-19 safety measures are in preventing the spread of disease on public transportation in Berlin. ((1)Not important, , , , ,(7)Very important)
    a. Guards or police enforcing mask requirements
    b. Open windows on transit vehicles
    c. Hand sanitizing stations
    d. Signs or floor markings encouraging social distancing
    e. Cleaning and sanitization of vehicles
    f. Vehicles with reduced maximum capacities
8. **If the entire population was unvaccinated**, please indicate how important you believe the following COVID-19 safety measures **would be** in preventing the spread of disease on public transportation in Berlin**.** ((1)Not important, , , , , (7)Very important)
    a. Guards or police enforcing mask requirements
    b. Open windows on transit vehicles
    c. Hand sanitizing stations
    d. Signs or floor markings encouraging social distancing
    e. Cleaning and sanitization of vehicles
    f. Vehicles with reduced maximum capacities
9. (Optional) Are there any COVID-19 safety measures not mentioned that you believe would assist in preventing the spread of COVID-19 on public transportation in Berlin?
10. What is your age?
    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54
    e. 55-64
    f. 65 & over
11. What is your gender?
    a. Male
    b. Female
    c. Non-binary
    d. Other:

12. Please check the highest level of education you have attained
    a. Less than high school (Ohne Abschluss)
    b. Some high school (Hauptschulabschluss oder mittlere Reife)
    c. Vocational or technical training (Ausbildung)
    d. High school diploma (Abitur)
    e. Bachelor or Master degree (Studium)
    f. PhD (Promotion)
    g. Other: ___
13. What is your vaccination status?
    a. Fully vaccinated + booster
    b. Fully vaccinated
    c. Half vaccinated
    d. Unvaccinated
    e. Prefer not to answer
14. **Optional:** If you would like to participate in a ~20 minute interview **in English** in which you can elaborate on your perception of safety on transit during COVID-19, please leave your email address and I (Noah Katt) will contact you within a week.

APPENDIX B

SURVEY INSTRUMENT (GERMAN VERSION)

Hallo. Vielen Dank für Ihre Teilnahme an meiner Umfrage bezüglich Ihrer Wahrnehmung des Gesundheitsschutzes in öffentlichen Verkehrsmitteln während der Pandemie. Ziel der Umfrage ist es, Informationen darüber zu sammeln, wie sich Covid-19 auf das Gesundheitsempfinden der Menschen in öffentlichen Verkehrsmitteln ausgewirkt hat. Darüber hinaus ist es mir ein Anliegen herauszufinden wie wir dafür sorgen können, dass sich sowohl der effektive als auch wahrgenommene Gesundheitsschutz in öffentlichen Verkehrsmitteln erhöht werden kann.

Ihre Teilnahme an dieser Umfrage ist freiwillig, aber dennoch wichtig. Das Bearbeiten der Umfrage dauert etwa 5-10 Minuten, wobei Ihre Antworten völlig anonym bleiben.

Durchgeführt wird die Studie von Noah Katt von der Arizona State University in Phoenix, Arizona, Vereinigte Staaten von Amerik. Derzeit führt er seine Forschung an der Humboldt Universität zu Berlin durch. Falls Sie Fragen zu dieser Studie haben sollten, wenden Sie sich bitte an Noah Katt unter nkatt@asu.edu

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Um an dieser Umfrage teilnehmen zu können müssen Sie 18 Jahre oder älter sein. Es gibt keine vorhersehbaren Risiken oder Unannehmlichkeiten bei Ihrer Teilnahme, wobei die Ergebnisse dieser Studie in Berichten, Präsentationen oder Veröffentlichungen verwendet werden können. Ihr Name wird jedoch dabei jedoch unter keinen Umständen genannt. Anonymisierte Daten, die im Rahmen dieser Studie gesammelt wurden, können für zukünftige Forschungszwecke oder andere Zwecke an andere weitergegeben werden (z. B. an Forscher oder Industriepartner). Weiterhin wird darauf aufmerksam gemacht, dass Deborah Salon von der Arizona State University die Hauptforscherin für dieses Forschungsprojekt ist und unter dsalon@asu.edu erreicht werden kann. Wenn Sie Fragen weitere Fragen zu der Verwendung Ihrer Daten haben sollten, können Sie sich gerne an das ASU Office of Research Integrity and Assurance unter folgender Nummer: +1 (480) 965-6788 wenden.

1. Wie oft fahren Sie normalerweise mit den öffentlichen Verkehrsmitteln in Berlin?
    a. Täglich
    b. 5-6 Tage pro Woche
    c. 3-4 Tage pro Woche
    d. 1-2 Tage pro Woche
    e. Weniger als einmal pro Woche
    f. Niemals

Option (f) ends the survey

2. Wie groß ist Ihre Sorge, sich bei der Benutzung öffentlicher Verkehrsmittel in Berlin mit COVID-19 zu infizieren?
    a. (1) Überhaupt nicht besorgt
    b.
    c.

d.
e.
f.
g. (7) Sehr besorgt

3. Bitte bewerten Sie, wie sicher Sie sich in den folgenden Szenarien in öffentlichen Verkehrsmitteln in Berlin fühlen würden ((1) Sehr unsicher, , , (4) Neutral, , , (7) Sehr sicher)
    a. Die Passagiere halten die Abstandsregeln nicht ein
    b. Das Fahrzeug ist schlecht belüftet
    c. Das Fahrzeug ist sichtlich verschmutzt
    d. Es gibt keine Möglichkeit sich die Hände zu reinigen
    e. Die Fahrgäste tragen keine Masken
4. (Optional) Gibt es andere Situationen, die Sie im öffentlichen Personennahverkehr in Berlin erlebt haben, in denen Sie sich unsicher gefühlt haben (in Bezug auf COVID-19)?
5. Bitte geben Sie an, wie oft Sie die folgenden COVID-19 Sicherheitsmaßnahmen in öffentlichen Verkehrsmitteln in Berlin im letzten Monat wahrgenommen haben. ((1) Niemals, , , , , ,(7)Immer)
    a. Wachpersonal oder Polizei zur Durchsetzung der Maskenpflicht
    b. Offene Fenster in Fahrzeugen öffentlicher Verkehrsmittel
    c. Stationen zur Händedesinfektion
    d. Schilder oder Bodenmarkierungen, die zur Wahrung eines Mindestabstandes auffordern
    e. Reinigung und Desinfizierung von Fahrzeugen
    f. Fahrzeuge mit reduzierter maximaler Kapazität
6. (Optional) Gibt es COVID-19-Sicherheitsmaßnahmen, die nicht aufgezählt wurden und die Ihnen in den öffentlichen Verkehrsmitteln oder an den Bahnhöfen in Berlin aufgefallen sind?
7. Bitte geben Sie an, wie wichtig Ihrer Meinung nach die folgenden COVID-19-Sicherheitsmaßnahmen sind, um die Verbreitung der Krankheit in öffentlichen Verkehrsmitteln in Berlin zu verhindern. ((1)Nicht wichtig, , , , , ,(7)Sehr Wichtig)
    a. Wachpersonal oder Polizei zur Durchsetzung der Maskenpflicht
    b. Offene Fenster in Fahrzeugen öffentlicher Verkehrsmittel
    c. Stationen zur Händedesinfektion
    d. Schilder oder Bodenmarkierungen, die zur Wahrung eines Mindestabstandes auffordern
    e. Reinigung und Desinfizierung von Fahrzeugen
    f. Fahrzeuge mit reduzierter maximaler Kapazität
8. Angenommen die gesamte Bevölkerung wäre ungeimpft, wie wichtig wären Ihrer Meinung nach die folgenden COVID-19-Sicherheitsmaßnahmen zur

Verhinderung der Ausbreitung der Krankheit in öffentlichen Verkehrsmitteln in Berlin. ((1)Nicht wichtig, , , , , ,(7)Sehr Wichtig)

   a. Wachpersonal oder Polizei zur Durchsetzung der Maskenpflicht
   b. Offene Fenster in Fahrzeugen des öffentlichen Verkehrsmittel
   c. Stationen zur Händedesinfektion
   d. Schilder oder Bodenmarkierungen, die zur Wahrung eines Mindestabstandes auffordern
   e. Reinigung und Desinfizierung von Fahrzeugen
   f. Fahrzeuge mit reduzierter maximaler Kapazität

9. (Optional) Gibt es weitere, nicht erwähnte COVID-19-Sicherheitsmaßnahmen, die Ihrer Meinung nach dazu beitragen würden, die Verbreitung von COVID-19 in öffentlichen Verkehrsmitteln in Berlin zu verhindern?
10. Wie alt sind Sie?
    a. 18-24
    b. 25-34
    c. 35-44
    d. 45-54
    e. 55-64
    f. >65
11. Welchem Geschlecht ordnen Sie sich zu?
    a. Männlich
    b. Weiblich
    c. Divers
    d. Sonstiges:
12. Welches ist Ihr letzter absolvierter Bildungsabschluss?
    a. Ohne Abschluss (Less than high school)
    b. Hauptschulabschluss oder mittlere Reife (Some high school)
    c. Ausbildung (Vocational or technical training)
    d. Abitur (High school diploma)
    e. Studium (Bachelor or Master degree)
    f. Promotion (PhD or Professional degree)
    g. Sonstiges:
13. Wie ist Ihr gegenwärtiger Impfstatus?
    a. Doppelt Geimpft + Booster Impfung
    b. Doppelt Geimpft
    c. Einfach Geimpft
    d. Nicht Geimpft
    e. Ich möchte nicht antworten

Optional: Vielen Dank für die Teilnahme an meiner Umfrage! Da mich Ihre Meinung zum Thema Gesundheitsschutz im Berliner öffentlichen Personennahverkehr im Zuge der COVID-19 Pandemie interessiert, würde ich mich freuen, wenn Sie sich zu einem ca. 20-minütigen Interview **auf Englisch** bereit erklären würden. Falls dem so ist, dann tragen

Sie bitte ihre E-Mail-Adresse im nachfolgendem Feld ein. Ich (Noah Katt) werde Sie dann umgehend kontaktieren, um alles Weitere zu klären.

APPENDIX C

INTERVIEW INSTRUMENT

Email Consent Form (Prior to Interview)

Hello,

My name is Noah Katt, I'm a researcher from Arizona State University in the USA. I'm contacting you because you indicated that you would like to take part in an interview regarding your perception of safety on public transportation during the pandemic. First of all, I would like to thank you for taking my survey and volunteering to participate in this interview. Your input is vital to my research.

The interview will take about 20 minutes, will be conducted in English, and is completely anonymous. The focus of the survey will be your experiences while using public transportation during the pandemic. I ask that if you did **not** use public transportation in Berlin between March 2020 and January 2021, to please let me know. The survey is designed for people who used public transportation during this time period. The interview will take place via phone, Zoom, Skype, or Microsoft Teams.

Your participation is voluntary. If, at any time, you wish to opt out of the interview, please let me know and I will delete your contact information and will not contact you again.

Here is the list of available times. Please respond to this email indicating what time you would like to do the interview and how you would like to do it (phone, Zoom, Skype, or Microsoft Teams). If you choose a phone call, please provide your phone number as well. I will delete it after the interview.

(Insert times)

Best Regards,

Noah Katt

By agreeing to participate in this interview you acknowledge that you are 18+ years old. The results of this study may be used in reports, presentations, or publications but your name will not be used. There are no foreseeable risks or discomforts to your participation. Data collected as a part of this interview will not be shared with others (e.g., investigators or industry partners) for future research purposes or other uses. Your contact information will not be shared under any circumstances. Deborah Salon is the Principal Investigator for this research project, you may contact her at dsalon@asu.edu. If you have any questions about your rights as a subject/participant in this research, or if you feel you have been placed at risk, you can contact the Chair of the Human Subjects Institutional Review Board, through the ASU Office of Research Integrity and Assurance, at +1 (480) 965-6788.

The following text is required by the General Data Protection Regulation (GDPR).

This research will collect data about you that can identify you, referred to as Study Data. The General Data Protection Regulation ("GDPR") requires researchers to provide this Notice to you when we collect and use Study Data about people who are located in a State that belongs to the European Union or in the European Economic Area. If you reside in the European Union or European Economic Area during your participation in the Study, your Study Data will be protected by the GDPR, in addition to any other laws that might apply.

We will obtain and create Study Data directly from you so we can properly conduct this research. As we conduct research procedures with your Study Data, new Study Data may be created.
The Research Team will collect and use the following types of Study Data for this research:

- Contact Information

This research will keep your Study Data until the research project is completed, at which point it will be deleted.
The following categories of individuals may receive Study Data collected or created about you:

- Members of the research team so they properly conduct the research
- ASU study team members will oversee the research to see if it is conducted correctly and to protect your safety and rights

The research team will transfer your Study Data to our research site in the United States. The United States does not have the same laws to protect your Study Data as States in the EU/EEA. However, the research team is committed to protecting the confidentiality of your Study Data. Additional information about the protections we will use is included in the consent document.
If you reside in the European Union or European Economic Area during your participation in the Study, the GDPR gives you rights relating to your Study Data, including the right to:

- Access, correct or withdraw your Study Data; however, the research team may need to keep Study Data as long as it is necessary to achieve the purpose of this research
- Restrict the types of activities the research team can do with your Study Data
- Object to using your Study Data for specific types of activities
- Withdraw your consent to use your Study Data for the purposes outlined in the consent form and in this document (Please understand that you may withdraw your consent to use new Study Data but Study Data already collected will continue to be used as outlined in the consent document and in this Notice)

Arizona State University is responsible for the use of your Study Data for this research. The ASU Privacy Officer is Debra Murphy. You can contact Ms. Murphy by phone at (480) 965-2179 or by email at debra.murphy@asu.edu if you have:

- Questions about this Notice
- Complaints about the use of your Study Data
- If you want to make a request relating to the rights listed above.

Verbal consent during interview:
Hi, my name is Noah Katt, with Arizona State University in the United States. I'm calling to conduct our scheduled phone interview about the perception of safety on public transportation during the pandemic. First, I'd like to thank you for your time, and

agreeing to participate in this interview. The purpose of the study is to find out how people perceived safety on public transportation during the pandemic, and what steps can be taken to mitigate fear of public transportation. Your participation is voluntary and you will not be paid for participating in this interview. I am recording this phone call so I don't miss any of your comments, and the interview is completely anonymous. May I proceed with the interview?

Interview:
The first question is just a multiple choice question. I'm going to read off answers, stop me when I reach the correct answer

1. How often did you use public transportation before the pandemic?
    a. Daily
    b. 5-6 days per week
    c. 3-4 days per week
    d. 1-2 days per week
    e. Less than once a week
2. How did the pandemic affect your use of public transportation?
    a. Was there a period of time during the pandemic where you did not use public transportation at all?
        i. (If yes) When was this?
    b. How often do you use it now?
3. Can you describe a typical experience using public transportation during the pandemic?
    a. What emotions did you feel while riding public transit?
    b. Did people act differently than before the pandemic? (if yes, elaborate)
        i. Did people, for the most part, act responsibly regarding COVID?
    c. Were there any physical changes about the setting? (if yes, elaborate)
    d. Were you ever worried about getting infected? *(OR)* You mentioned before that you were worried about getting infected.
        i. (If yes) What kind of situations caused you to worry?
        ii. What kind of situations caused you to feel safer?
4. What is your general impression of how public transportation operators, such as the BVG and Deutsch-Bahn, responded to the pandemic?
    a. Were the safety measures adequate in preventing infection?
    b. Do you think any additional safety measures should have been added?
5. How has your perception of safety on public transportation changed over the course of the pandemic

APPENDIX D

OBSERVATION FORMS

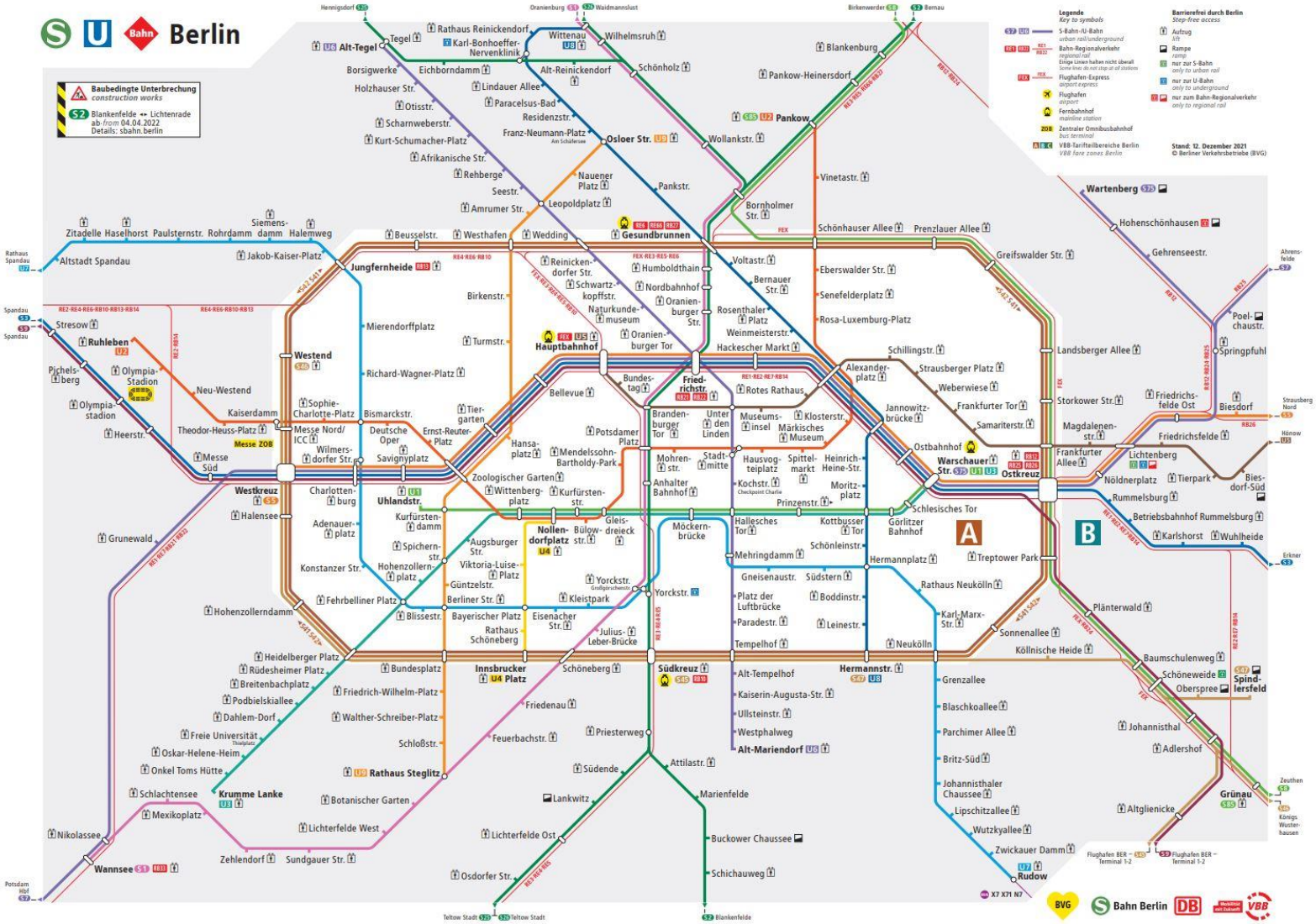
Transit Station			
Station		Anyone enforcing masks?	
Date		Hand sanitizing station?	
Time		Floor markings?	
Enclosed or open air?		Station visibly dirty?	
# of people not wearing masks		*Remarks*	
General remarks			

Transit Vehicle			
Date		Start station	
Time		End station	
Transit Type		# of stops	
Line #		Above or underground	
Approx % full		Signs/Floor markings/seats marked off?	
# of people not wearing masks		Anyone enforcing masks?	
Windows open		Vehicle visibly dirty?	
Rear Door Boarding Only?		Maximum Capacity?	
Hand sanitizing station?		*Remarks*	
General remarks			

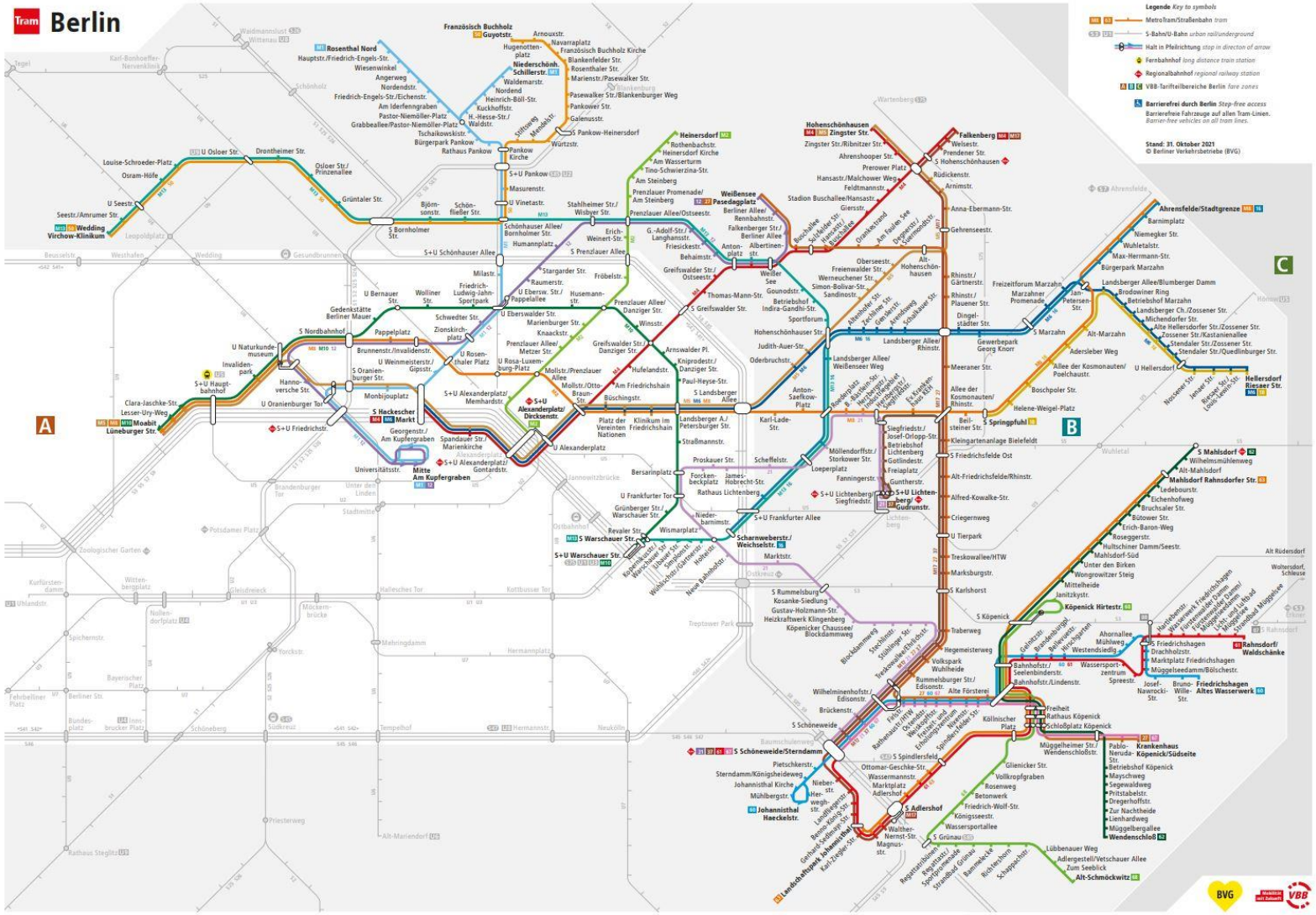
APPENDIX E

TRANSIT MAPS

S-Bahn and U-Bahn (source: Berliner Verkehrsbetriebe, n.d.-b)



Tram (source: Berliner Verkehrsbetriebe, n.d.-



APPENDIX F

IRB APPROVAL

EXEMPTION
GRANTED

Deborah Salon
CLAS-SS: Geographical Sciences and Urban Planning, School of (SGSUP) 480/965-7475
Deborah.Salon@asu.edu

Dear Deborah Salon:

On 10/15/2021 the ASU IRB reviewed the following protocol:

Type of Review:	Initial Study
Title:	Perception of Safety on Public Transportation During COVID-19: A Case Study of Berlin, Germany
Investigator:	Deborah Salon
IRB ID:	STUDY00014657
Funding:	None
Grant Title:	None
Grant ID:	None
Documents Reviewed:	• German IRB Requirements per Clarification Request, Category: Off-site authorizations (school permission, other IRB approvals, Tribal permission etc); • IRB Social Behavior Protocol, Category: IRB Protocol; • Survey Consent Form.pdf, Category: Consent Form; • Survey Draft 10.12.pdf, Category: Measures (Survey questions/Interview questions /interview guides/focus group questions); • Survey Recruitment Materials.pdf, Category: Recruitment Materials;

The IRB determined that the protocol is considered exempt pursuant to Federal Regulations 45CFR46 (2) Tests, surveys, interviews, or observation on 10/11/2021.

In conducting this protocol you are required to follow the requirements listed in the INVESTIGATOR MANUAL (HRP-103).

If any changes are made to the study, the IRB must be notified at research.integrity@asu.edu to determine if additional reviews/approvals are required. Changes may include but not limited to revisions to data collection, survey and/or interview questions, and vulnerable populations, etc.

REMINDER - All in-person interactions with human subjects require the completion of the ASU Daily Health Check by the ASU members prior to the interaction and the use of face coverings by researchers, research teams and research participants during the interaction. These requirements will minimize risk, protect health and support a safe research environment. These requirements apply both on- and off-campus.

The above change is effective as of July 29th 2021 until further notice and replaces all previously published guidance. Thank you for your continued commitment to ensuring a healthy and productive ASU community.

Sincerely,

IRB

Administrator

cc:

Noah Katt
David King
Sara Meerow