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The behavioral immune system and use of transportation services during the COVID-19 pandemic

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ABSTRACT

Introduction: A primary means of reducing the spread of COVID-19 is avoidance of close contact with other people, particularly in closed areas. Transportation services generally require being in closed spaces with other people, which has resulted in a significant reduction in use during the COVID-19 pandemic. Understanding individual differences associated with likelihood of using transportation services may help in targeting individuals that are hesitant to use these services. Specifically, psychological processes that encourage disease avoidance (e.g., disgust sensitivity, germ aversion) may play a key role in people’s hesitancy to use transportation services. The aim of this study was to identify demographic groups that were hesitant to use transportation services during the COVID-19 pandemic and determine the extent to which individual differences in disease avoidance processes are associated with the likelihood of using transportation services during the COVID-19 pandemic.

Method: A national sample of U.S. adults (N = 947) completed an online survey about the likelihood of using transportation services (i.e., public transportation, rental car, ride share, intercity trains, intercity buses, and commercial flight), germ aversion, disgust sensitivity, demographics, and control variables (e.g., COVID-19 concern).

Results: Regression analyses indicated that greater germ aversion was associated with lower likelihood of transportation use for all measured transportation services, controlling for disgust sensitivity, demographics, and control variables. Older age and higher COVID-19 concern were associated with lower likelihood of using most of the transportation services, while town size was associated with greater likelihood of using public transportation and ride share.

Discussion: Overall, germ aversion was consistently uniquely associated with lower likelihood of transportation service use. In the process of getting back to normal after the COVID-19 threat is reduced, structuring messages that target hesitant populations and use malleable psychological mechanisms like disease avoidance may aid in encouraging behavior change and increase transportation service use.

1. Introduction

The novel coronavirus disease 2019 (COVID-19) is an infectious disease caused by a coronavirus (SARS-CoV-2) and was declared a pandemic by the World Health Organization on March 11, 2020 (WHO, 2020). The virus mainly spreads between people who are in
close contact with each other through the inhalation of respiratory droplets expelled into the air when coughing, talking, or breathing (CDC, 2020). Although less common, the virus can also spread through touching a contaminated surface and then touching the nose, mouth, or eyes (CDC, 2020). As means to prevent the spread of COVID-19, vaccination, wearing masks, social distancing, and avoidance of crowds and poorly ventilated spaces are advised (CDC, 2020).

Use of public or commercial transportation services can expose individuals to the risk of virus transmission through being in close contact with other people, sharing a closed space, and contact with common surfaces (Zhen et al., 2020). As such, many states took measures to decrease the possible contamination risk, such as restricting public and commercial transportation, decreasing maximum capacity in vehicles, and enforcing face-mask use (Bandyopadhyay, 2020; Drisi and Dei, 2020; Tirachini and Cats, 2020). With the combination of the new public transportation restrictions and the risk of contamination, the use of transportation services decreased substantially (Laverty et al., 2020; Liu et al., 2020). For example, Australia, Brazil, and United Kingdom all saw a 40% decrease in public transportation hub activity (Tirachini and Cats, 2020). Ride share platforms lost more than half of their activity (BBC, 2020; Goldstein, 2020), the passenger totals for international flights dropped 60% (ICAO, 2021), and U.S. railroad Amtrak had a 70% decrease in travel (Shepardson, 2020).

More than a year into the COVID-19 pandemic, there are some signs of recovery in transportation numbers, but demand is still lower than pre-pandemic levels. As of May 2021, Eurostar high-speed train that connects European cities doubled train services to two trains per day, but this pales in comparison to sixty trains per day in its peak before the COVID-19 pandemic (Alderman, 2021). The New York City subway has reported more than two million riders a day and returning to 24-h operations, but the number of riders is still less than half of the pre-pandemic levels (i.e., over five million riders per day; Linton, 2021). Hesitancy towards the use of transportation services is still evident, and there is further indication that some people may never go back to using these services even after the COVID-19 pandemic ends. In a sample of individuals who regularly used public transportation from Gdańsk, Poland, 25% of respondents indicated that they would not return to using public transportation after the COVID-19 pandemic (Przybylowski et al., 2021). Another study from Greece investigated the reinforcement time participants would take before using public transport again after the lockdowns ended (Kopsidas et al., 2021). Although 13% of the participants reported that they would use public transportation the next day, most reported waiting for some period of time (e.g., 31% reported they would wait one week to one month, 15% reported they would refrain from using public transport for at least six months). These findings show that, although many people are ready to return to using public and commercial transportation services, there is substantial variability and some people are hesitant to return at all.

With the decrease in riders and lack of revenue during the COVID-19 pandemic, many transportation services received assistance from governments and other sources (Paget, 2021; Shepardson and Rucinski, 2020). However, regaining and retaining users is essential for transportation services to be sustainable and survive after the COVID-19 pandemic (Topham, 2021; Yen et al., 2021). Returning use to pre-pandemic levels is important as public transportation services provide transportation opportunities for all income groups and decrease the harm towards the environment. In order to encourage the use of transportation services, it is necessary to identify who is most hesitant to use transportation services and, thus, target messaging campaigns to these groups. It may also be beneficial to identify psychological processes that are related to transportation use and can be utilized in messaging to encourage behavior change.

### 1.1. The behavioral immune system

Humans have dealt with infectious diseases throughout their history (Curtis, 2007) and COVID-19 is not the first or the last infectious disease that poses a threat to human health. To serve the function of avoiding diseases, the behavioral immune system (BIS) evolved (Schaller and Park, 2011). The BIS involves affective and cognitive processes (e.g., germ aversion and disgust sensitivity) that facilitate the identification of potential pathogen sources (e.g., feces) and encourage avoidance behavior, thus reducing the likelihood of contamination (Shook et al., 2020). The BIS can be used to potentially modify behavior. Lab studies have shown that the BIS can be manipulated and activated through different procedures (e.g., visual cues, odor) to encourage health behaviors like hand washing and condom use (Porzig-Drummond et al., 2009; Tybur et al., 2011). Accordingly, if they are related, the BIS can be used in attempts to encourage the use of transportation services. Examining the individual differences in BIS would help in understanding if the BIS is at play in the use of transportation services during the COVID-19 pandemic.

Individuals reliably differ in BIS reactivity (Schaller and Park, 2011). For example, people vary in disgust sensitivity (aroused intensity of disgust towards disgust cues; Tybur and Karinen, 2018) and germ aversion (dislike of situations involving pathogen transmission risk; Duncan et al., 2009). Individuals with a more reactive BIS are expected to be more sensitive towards pathogen threats and risks of contamination. Accordingly, a wide range of studies report that a more reactive BIS is associated to higher COVID-19 concern (Shook et al., 2020), higher COVID-19 anxiety (Cox et al., 2020; Makhanaova and Shepherd, 2020), and higher fear of COVID-19 (Ahorsu et al., 2020). Moreover, a more reactive BIS is associated with higher belief that public health measures are necessary to protect the population (De Coninck, 2020), higher belief that engaging in health behaviors are important (Makhanaova and Shepherd, 2020) and report higher frequencies of preventative health behaviors (e.g. handwashing; Cox et al., 2020; Shook et al., 2020). These findings suggest that individual differences in the BIS are associated with an individuals’ perception of the COVID-19 pandemic and their reaction towards it.

A recent study indicated that individual differences in the BIS were associated with transportation service use during the COVID-19 pandemic (Prawira et al., 2021). Individuals with a more reactive BIS (i.e., germ aversion) reported less use of public transportation and app-based ridesharing services during the COVID-19 pandemic (Prawira et al., 2021). This finding provides initial support that the BIS is associated with transportation service use during the COVID-19 pandemic. However, there are different types of transportation
services, and different methods of transportation services bring differing levels of potential risks. For example, using a public bus involves sharing a vehicle with other people where new people can come in and go out at every stop, whereas when using a rental car, the vehicle is shared with different people at different times and the users does not share a closed space with an unknown person. Therefore, further examination is needed to see the possible differences the BIS may have with the use of different transportation service types.

1.2. Present study

The aim of this study was to determine the extent to which individual differences in BIS reactivity (i.e., germ aversion, disgust sensitivity), as well as demographic factors, are associated with the likelihood of using public and commercial transportation services during the COVID-19 pandemic. To be able to examine possible differences in associations between services, we assessed use of six different public or commercial transportation services: public transportation (e.g., bus, subway), rental car, ride share (e.g., Uber, Lyft), intercity trains (e.g., Amtrak), intercity buses (e.g., Greyhound), and commercial flight. We expected that greater disgust sensitivity and germ aversion would be associated with lower likelihood of using all transportation services. We did not have specific hypotheses regarding demographics or specific types of transportation services. These analyses were exploratory.

2. Method

2.1. Participants

Participants were recruited through the panel provider Qualtrics for a larger longitudinal study consisting of 29 waves, about the effects of COVID-19. Sample size for the original project was determined based on Monte Carlo simulations (N = 10,000) of the most conservative models for the data analysis plan associated with the larger longitudinal project. Assuming α = 0.05, a minimum sample of 500 was estimated to provide sufficient power (>95%) to detect anticipated effects (β = 0.15 to 0.20) based on previous BIS research (Terrizzi et al., 2013). To account for missing or unusable data, we aimed to recruit a panel of at least 1000 U.S. residing individuals.

For the current study, data collected in Wave 17 (July 20 to 27, 2020) of the longitudinal study was used (N = 961). Fourteen participants were excluded from analyses due to problematic response patterns (e.g., giberish open-ended responses, straight line responses to close-ended measures). The final sample was comprised of 947 participants (485 Women; M.age = 55.33 years, SD.age = 16.57, range: 19-88 years; 83.7% White; M.education = College graduate; M.income = $70,000–$79,999).

Before starting their first online survey, participants provided electronic consent to participate in the longitudinal study. After electronically agreeing to be part of the study, participants completed self-administered online surveys on a weekly to monthly basis. Demographic information was collected in Wave 1 (March 20 to 25, 2020) and Wave 8 (May 13 to 14, 2020) surveys. The Wave 17 survey was administered from July 20, 2020 to July 27, 2020 and contained the measures of interest. The measures were presented in a random order. Participants were given monetary compensation in an amount established by the panel provider. This project was approved by the University of Connecticut IRB (Protocol #L20-0018).

2.2. Measures

2.2.1. Transportation use

Participants were asked to indicate their likelihood of using six transportation services: public transportation (e.g., bus, subway), rental car, ride share (e.g., Uber, Lyft), intercity trains (e.g., Amtrak), intercity buses (e.g., Greyhound), and commercial flight at that moment. In the case that participants did not have access to any type of transportation, they were instructed to imagine that they found themselves in a position to use that type of transportation. Participants indicated their likelihood to use the transportation services on a 7-point scale from 1 (“Extremely unlikely”) to 7 (“Extremely likely”).

2.2.2. BIS indicators

The Germ Aversion subscale of the Perceived Vulnerability to Disease Scale (Duncan et al., 2009) measures a discomfort with situations that impose high likelihood of pathogen transmission (e.g., “I prefer to wash my hands pretty soon after shaking someone’s hand”). Participants rated eight items on a scale ranging from 1 (“Strongly Disagree”) to 7 (“Strongly Agree”). A composite score was created by taking the average of the items. Higher scores reflect greater germ aversion (α = 0.80).

The Pathogen Disgust subscale of the Three Domain Disgust Scale (Tybur et al., 2009) measures disgust sensitivity specifically related to pathogens (e.g., “stepping on dog poop”). Participants rated seven items on a scale ranging from 0 (“not disgusting at all”) to 6 (“extremely disgusting”). A composite score was created by taking the average of the items. Higher scores reflect higher pathogen disgust sensitivity (α = 0.91).

2.2.3. Demographic information

Participants reported their age, race, gender, education level, annual family income, size of town they lived in, and employment status.

2.2.4. Control variables

Participants responded to single-item measures to be used as control variables in the analyses, as these items may have influenced
| 1. Public Transportation | 2. Rental Car | 3. Ride Share | 4. Intercity Trains | 5. Intercity Buses | 6. Commercial Flight | 7. Germ Aversion | 8. Pathogen Disgust | 9. Perceived Health | 10. COVID-19 Concern | 11. Self-Quarantine | 12. Gender | 13. Age | 14. Income | 15. Town Size | 16. Employed |
|--------------------------|--------------|--------------|-------------------|------------------|-------------------|------------------|------------------|------------------|-------------------|-------------------|-----------|---------|--------|----------|----------|
| r                        | .72**        | .72**        | .82**             | .77**            | .84**             | -.27**           | -.33, -.21      | -.11**           | -.26**            | -.23, -.10      | -.07     | -.22**  | -.04   | -.03    | -.13**  |
| 95% CI                   | .66-.61      | .66-.71      | .66-.77           | .58-.67          | .79-.87           | -.30, -.15      | -.34, -.22      | -.16, -.02       | -.21, -.16      | -.23, -.11     | -.06     | -.12**  | -.07   | -.02    | -.13**  |
| CV                      | .08, .06     | .09, .08     | .06, -.09**       | .03, -.15        | .07-.11           | -.06, .02       | -.06, .02       | -.08, -.01       | .04, -.06       | -.06, .13     | .01      | -.04    | -.04   | -.03    | .00     |
| Notes                    | The confidence intervals are bias corrected. Gender coded as Men = 1, Women = 2; *p < .05, **p < .01.
Table 2
Bootstrap-based linear regression analyses for the likelihood to use public and commercial transportation services.

|                       | Public Transportation | Rental Car | Ride Share |
|-----------------------|-----------------------|------------|------------|
|                       | β         | B     | SE     | %95 CI | β         | B     | SE     | %95 CI | β         | B     | SE     | %95 CI |
| Germ Aversion         | −0.21    | −0.30** | 0.06  | −0.43, −0.18 | −0.14   | −0.25** | 0.07  | −0.38, −0.14 | −0.16   | −0.24** | 0.07  | −0.38, −0.11 |
| Pathogen Disgust      | 0.04    | 0.05    | 0.05  | −0.03, 0.15 | −0.04   | −0.06    | 0.06  | −0.18, 0.07 | 0.04    | 0.05    | 0.05  | −0.05, 0.16 |
| Perceived Health      | 0.00    | 0.00    | 0.05  | −0.10, 0.10 | 0.09    | 0.19    | 0.08  | 0.04, 0.33 | 0.06    | 0.11    | 0.06  | −0.01, 0.23 |
| COVID-19 Concern      | −0.17   | −0.25** | 0.06  | −0.37, −0.12 | −0.14   | −0.26** | 0.07  | −0.39, −0.11 | −0.13   | −0.20*  | 0.06  | −0.32, −0.08 |
| Self-Quarantine      | −0.07   | −0.21    | 0.11  | −0.42, 0.02 | −0.06   | −0.23    | 0.14  | −0.49, 0.07 | −0.06   | −0.21    | 0.11  | −0.44, 0.04 |
| Gender                | −0.07   | −0.23    | 0.11  | −0.43, −0.01 | −0.10   | −0.40    | 0.14  | −0.67, −0.11 | −0.10   | −0.35*  | 0.11  | −0.58, −0.15 |
| Age                   | −0.17   | −0.02** | 0.00  | −0.03, −0.01 | −0.05   | −0.01    | 0.01  | −0.02, 0.00 | −0.19   | −0.02** | 0.00  | −0.03, −0.01 |
| Income                | −0.03   | −0.01    | 0.02  | −0.05, 0.02 | 0.04    | 0.03    | 0.02  | −0.01, 0.07 | 0.01    | 0.00    | 0.02  | −0.03, 0.04 |
| Town Size             | 0.13    | 0.13**   | 0.04  | 0.06, 0.21 | 0.08    | 0.10    | 0.04  | 0.01, 0.18 | 0.15    | 0.17**  | 0.04  | 0.09, 0.24 |
| Employed              | 0.01    | 0.04    | 0.12  | −0.19, 0.29 | 0.06    | 0.22    | 0.16  | −0.08, 0.54 | 0.05    | 0.17    | 0.14  | −0.11, 0.45 |
| Adj. R²               | .17**   |          |       |          | .11**   |          |       |          | .16**   |          |       |          |

|                       | Intercity Trains | Intercity Buses | Commercial Flight |
|-----------------------|-----------------|-----------------|-------------------|
|                       | β         | B     | SE     | %95 CI | β         | B     | SE     | %95 CI | β         | B     | SE     | %95 CI |
| Germ Aversion         | −0.22   | −0.31** | 0.06  | −0.42, −0.20 | −0.24   | −0.32** | 0.05  | −0.43, −0.23 | −0.18   | −0.29** | 0.07  | −0.44, −0.16 |
| Pathogen Disgust      | 0.05    | 0.07    | 0.05  | −0.04, 0.17 | 0.06    | 0.06    | 0.05  | −0.04, 0.17 | 0.03    | 0.05    | 0.06  | −0.07, 0.16 |
| Perceived Health      | 0.02    | 0.04    | 0.06  | −0.08, 0.14 | −0.04   | −0.06    | 0.05  | −0.17, 0.04 | 0.03    | 0.05    | 0.07  | −0.09, 0.19 |
| COVID-19 Concern      | −0.20   | −0.29** | 0.06  | −0.41, −0.18 | −0.18   | −0.25** | 0.06  | −0.38, −0.11 | −0.23   | −0.38** | 0.07  | −0.51, −0.25 |
| Self-Quarantine      | −0.06   | −0.18    | 0.10  | −0.38, 0.01 | −0.06   | −0.18    | 0.10  | −0.39, 0.03 | −0.12   | −0.45** | 0.13  | −0.71, −0.20 |
| Gender                | −0.09   | −0.28    | 0.11  | −0.48, −0.08 | −0.06   | −0.18    | 0.10  | −0.37, 0.01 | −0.07   | −0.25    | 0.12  | −0.49, −0.01 |
| Age                   | −0.17   | −0.02** | 0.00  | −0.03, −0.01 | −0.17   | −0.02** | 0.00  | −0.02, −0.01 | −0.09   | −0.01    | 0.01  | −0.02, 0.00 |
| Income                | −0.01   | −0.01    | 0.02  | −0.04, 0.03 | −0.02   | −0.01    | 0.02  | −0.04, 0.02 | 0.06    | 0.03    | 0.02  | 0.00, 0.07 |
| Town Size             | 0.09    | 0.09    | 0.03  | 0.02, 0.16 | 0.08    | 0.08    | 0.03  | 0.02, 0.14 | 0.08    | 0.10    | 0.04  | 0.02, 0.19 |
| Employed              | 0.04    | 0.11    | 0.13  | −0.13, 0.38 | 0.03    | 0.10    | 0.12  | −0.12, 0.33 | 0.08    | 0.31    | 0.15  | 0.02, 0.59 |
| Adj. R²               | .18**   |          |       |          | .17**   |          |       |          | .19**   |          |       |          |

Notes. The confidence intervals are bias corrected. Gender coded as Men = 1, Women = 2; *p < .005, **p < .001.
responses to the transportation use questions. Participants rated their overall health in general on a scale from 1 (“Poor”) to 5 (“Excellent”). Participants indicated how concerned they were about COVID-19 on a 5-point scale from 1 (“Not at all concerned”) to 5 (“Very concerned”). Participants indicated if they engaged in self-quarantine in the past week by indicating "yes" or “no”.

3. Results

3.1. Descriptive statistics

Means, standard deviations, and bivariate correlations for all the study variables are reported in Table 1. For all six transportation services, the means of likelihood to use transportation services indicated that the participants were not likely to use transportation services (i.e., means were below the mid-point on the scale, ps < .05). The transportation service that was the least likely to be used was intercity busses and the service with the highest likelihood of use was rental cars. The distribution of the responses indicated that, except for the likelihood to use a rental car, the likelihood of use was skewed for not likely to use transportation services (skewness > 1).

Due to the non-normal distribution of likelihood of use for majority of transportation services, bootstrapping with 1000 resamples was utilized with the correlation analyses (Pek et al., 2018). The sample bias was close to 0 (range: −0.002 to 0.002). The likelihood of using transportation was positively correlated between all six transportation types. Higher germ aversion, greater disgust sensitivity, more concern about COVID-19, engaging in self-quarantine, identifying as a woman, and older age were associated with lower likelihood of using most (at least five) of the transportation types. Living in a larger town and being employed were associated with greater likelihood of using all six transportation types.

3.2. Regression analyses

To determine the unique association of individual differences in BIS reactivity (i.e. germ aversion, pathogen disgust) and demographic factors with likelihood of public and commercial transportation use, regression analyses were conducted for each type of transportation. As used with the bivariate correlations bootstrapping with 1000 resamples was utilized. In six separate regressions, one for each transportation type, likelihood of using transportation types (i.e. public transportation, rental car, ride share, intercity trains, intercity buses, and commercial flight) were regressed on the BIS indicators (i.e., germ aversion, pathogen disgust sensitivity), demographics, and control variables.

The regressions models examining the likelihood to use of the transportation types were all significant (p < .001): public transportation (F(10, 860) = 18.16), rental car (F(10, 860) = 12.12), ride share (F(10, 860) = 17.04), intercity trains (F(10, 860) = 19.78), intercity buses (F(10, 860) = 19.08), and commercial flight (F(10, 859) = 20.94). Multicollinearity was checked and found not to be a problem (all VIF < 5, Tolerance > 0.20). The total variance explained for the likelihood of use for each transportation type and the effect sizes of the predictors are reported in Table 2.

Given the number of analyses, Bonferroni correction was used to set the significance threshold (α = 0.05/10 = 0.005). Higher concern for COVID-19 was significantly associated with lower likelihood to use all six of the measured transportation types. Self-quarantining in the past week was significantly associated with lower likelihood to use commercial flight. Identifying as women was significantly associated with lower likelihood to use ride share. Older age was significantly associated with lower likelihood to use public transport, ride share, intercity trains, and intercity buses. Bigger town size was significantly associated with higher likelihood to use public transport and ride share. After accounting for control variables, greater germ aversion was significantly related to lower likelihood of using all six measured transportation types.

4. Discussion

The aim of this study was to examine the associations of demographic differences and individual differences in BIS reactivity (i.e., germ aversion, pathogen disgust sensitivity) with the likelihood to use different transportation services (i.e., public transportation, rental car, ride share, intercity trains, intercity buses, and commercial flight) during the COVID-19 pandemic. Our findings showed that overall participants were not likely to use transportation services during the COVID-19 pandemic, and people who had higher germ aversion, were older, and had higher concerns towards COVID-19 were less likely to use most transportation services (minimum of 4).

For all of the transportation services (i.e., public transportation, rental car, ride share, intercity trains, intercity buses, and commercial flight), participants were unlikely to use them. Among the studied transportation services, renting a car was the service with the highest likelihood of use and the only one that did not have skewed responses. Although people were still unlikely to rent cars, the likelihood of use was higher than the other sectors. This higher likelihood in renting a car may be due to the fact that vehicles can be used by only the renter alone. Although rental cars are shared by different people in different times, compared to the other methods, they do not involve other individuals in the same vehicle. This indicates the emphasis people may have on avoiding other people as possible sources of contamination.

Both germ aversion and disgust sensitivity were negatively related with the likelihood of use for six transportation services at a bivariate level. As people reported a more reactive BIS, they were less likely to use public or commercial transportation services. When BIS variables, demographics, and covariates (i.e., perceived health, concern about COVID-19, and engaging in self-quarantine) were considered simultaneously, germ aversion turned out to be consistently associated with the likelihood of using all transportation services, while pathogen disgust was not significantly associated with any of the transportation services. The effects sizes of the unique
association with germ aversion has on the likelihood of use for six transportation types were between the range of small to moderate ($\beta_s = -0.14$ to $-0.24$). The weakest relationship was seen with rental cars and the strongest relationship was seen with the use of intercity busses.

The variance in effect size is consistent with BIS theory. Rental cars involve the risk of previous users leaving residue of possible pathogens behind and do not involve being present in the same vehicle with other people. Considering the major way COVID-19 spreads is through respiratory droplets, the risk of contamination is relatively low compared to other public transportation services. In contrast, use of intercity busses involves being together with multiple people possibly from different areas. The number of people and variety of places these fellow passengers may be coming from increases the contamination risk with novel pathogens. Accordingly, it would be expected for germ aversion to be strongly associated with transportation services that involve a higher contamination risk, which is in line with our findings.

The present study also provided a test of the unique associations of demographic variables and control variables on the likelihood to use transportation services during the COVID-19 pandemic. Older age and higher COVID-19 concern were associated with lower likelihood of using most of the transportation services (minimum of 4), while town size was associated with greater likelihood to use public transportation and ride share. COVID-19 presents greater risk for the health of older adults (Shahid et al., 2020) and people with higher concern towards COVID-19 would be expected to acknowledge the risks of the disease more. Accordingly, the findings are in line with the expectations that older adults and people with higher concern towards COVID-19 would be avoidant of any behaviors that include the risk of transmission. Different than the other demographic factors, town size was positively associated with the likelihood of using public transportation. Compared to rural areas, urban areas include access to more methods of public transportation with higher frequency. Further, public transportation is a major factor for the sustainability of urban areas (Miller et al., 2016) and can be considered as a part of the lifestyle. Consequently, living in larger areas could have been associated with the higher likelihood to use public transportation during COVID-19.

4.1. Implications

Although this study was conducted in the earlier phases of the pandemic only four months after COVID-19 was declared as a pandemic (WHO, 2020), the findings are still relevant given the continued prevalence of COVID-19. In the time that has passed since data collection, various measures were taken in the transportation sector to improve the quality and safety of rides (e.g., increased social distancing, facemask requirement), but many of these measures are coming to an end in the “reopening” phase of the pandemic (Stuart et al., 2022). However, COVID-19 is still a risk and there are individuals who are not eligible for a vaccine (e.g., children). Many people are not comfortable about these safety measures coming to an end (Kim, 2022; Stuart et al., 2022). People with high BIS reactivity are more likely to be uncomfortable about the preventative measures ending and be more reluctant to use transportation services without the preventative measures in action. In the transition period to getting back to the normal, continued encouragement of preventative measures (e.g., mask wearing) by patrons of transportation services and emphasis on hygiene practices (e.g., disinfecting transportation vehicles) may encourage those high in BIS reactivity to use transportation services.

Use of transportation services includes the risk of disease transmission and the perception of disease cues can activate the BIS, which can be even more amplified for individuals with a more reactive BIS (Schaller, 2011; Sawada et al., 2018). In attempts to increase the likelihood of transportation service use, practitioners should be careful in using messages and advertisements that activate the BIS. Further, continuation of disease protection measures in transportation services and messaging of these measures can be helpful in encouraging use of transportation services. It is proposed that exposure to disease protection can decrease the influence of the BIS (Aarøe et al., 2017). Engaging in disease protection behavior (i.e., wiping hands) or even reading about someone who is engaging in disease protection behavior (i.e., washing hands) can remove the need for the BIS to be activated (Aarøe et al., 2017; Huang et al., 2011). Continuation of measures like having disinfecting wipes and hand sanitizers ready in vehicles and waiting areas, and messaging the availability of these services to users can be helpful in increasing the transportation use likelihood of the individuals with a reactive BIS.

4.2. Limitations

The findings of this study should be interpreted in light of its limitations. The assessment of the variables used self-report measurements that can raise the concerns for social desirability and response bias. Also, the generalizability of the findings may be limited. The COVID-19 pandemic has been going on for more than a year with different infection and death rates depending on time and geography. This study used a national sample residing in the U.S. one week after a new peak was seen with 75,600 cases (AJMC, 2021). Therefore, these findings may show differences depending on the timepoint during the COVID-19 pandemic. Replication of our findings in the context of “getting back to normal” and later periods of the pandemic is necessary.

The sample was not representative of the U.S. population and the generalizability in different populations may be limited. In particular, racial and ethnic minority groups were underrepresented. Black and Hispanic/Latinx Americans are more likely to use public transportation than their White American counterparts (Anderson, 2016). Also, occupation types of the participants was not assessed, which may be factor that influences the present findings during the COVID-19 pandemic. Many occupations were able to move to remote or distance work (e.g., technology services), but some occupations required that employees work in person (e.g., health care; Molla, 2021; OECD, 2021). The ability to work remotely versus in person undoubtedly influenced use of transportation services. Future research is needed to investigate the generalizability of these findings in different groups.
4.3. Conclusion

Overall, the findings of this study reiterated the low intentions to use transportation services during the COVID-19 pandemic and showed that older age and concern towards COVID-19 were associated with lower likelihood of use. The findings also put forward that a psychological individual difference BIS reactivity is associated with the likelihood to use transportation services during the COVID-19 pandemic. These findings can have translational value in the process of getting back to normal after the COVID-19 threat is reduced. If the right measures are taken and communicated via structured and consistent messaging campaigns to the right groups of people it can be easier to encourage the willingness to transportation services.

CRediT author statement

Barış Sevi: Conceptualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing. Natalie J. Shook: Conceptualization, Formal analysis, Writing - Original Draft, Writing - Review & Editing, Supervision, Funding acquisition.

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Declaration of competing interest

None.

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