

Young Adult Perceptions of Public Transport After Exposure to Mode-Specific Images

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Abstract

Prior work suggests that perceptions, rather than infrastructure alone, drive public transit ridership decisions. The "psychological rail factor" literature has argued that rail modes carry image advantages over buses, but findings have been mixed and have rarely distinguished between rail subtypes. Drawing on cognitive priming theory, the present study tested whether brief exposure to mode-specific transit imagery would elicit differential evaluations of public transportation among non-rider young adults, consistent with a general rail preference. In a cluster-randomized design, 22 classrooms at a St. Louis university ($N = 227$) were each assigned one of four six-minute silent videos (Bus, Subway, Tram, or Control) before completing a 44-item survey that referred generically to "public transportation." An exploratory factor analysis yielded five factors: Ride Intentions/Access, Cleanliness/Comfort/Safety, Environmental/Civic Benefits, Stigmatization, and Reliability/Convenience. Contrary to predictions, there were no significant differences between conditions on the Total Attitude Score or on four of the five factors. A single significant condition effect emerged on Factor 5 (Reliability/Convenience), $F(3, 220) = 3.77, p = .011, \eta^2 = .049$. However, the pattern did not conform to a rail-versus-bus dichotomy: subway imagery was associated with lower reliability ratings than both control and tram, where tram and control did not differ. Taken together, the results provide little support for a uniform psychological rail factor and raise the possibility that "rail" may be too coarse a psychological category, with tram and subway potentially activating distinct schemas.

Introduction

If someone had a heart attack today, it would be unlikely that they would take a bus, tram or subway to the hospital. However, the ambulance that would take them to the hospital is certainly affected by the density of traffic on the highway. In this way, and countless others, public transit is not just for the benefit of those who ride. Robustly used public transit networks benefit the entire community they serve, including those who do not choose to utilize it (Weyrich & Lind, 2003). Public transportation often utilizes existing roads in more effective ways, reducing air pollution, noise, traffic congestion, and increasing accessibility (Abdulrazzaq et al., 2020). Improving overall living conditions and accessibility for a city naturally seems to benefit its population. Further, it has been found that increased infrastructure of public transport has correlated to strong economic growth in several European nations (Cigu et al., 2019).

However, increased availability of public transit infrastructure does not always equate to increased ridership of public transit. In fact, several cities (Barcelona, Berlin, Lisbon, Rome) have seen spikes in available public transportation with stagnant results on usership (Land Transport Authority Academy, 2011). A particularly astounding example of this exists in Lisbon, Portugal. Despite efforts to implement and improve public transportation continually from 1991 to 2011, these 20 years saw a 29% increase in automotive use in juxtaposition to a 23% drop in public transit usage by overall population (Ramos et al., 2019). In the United States, Erhardt et al. (2022) found that, across 215 metropolitan areas, bus ridership fell 15% and rail ridership fell 3% between 2012 and 2018, as gains associated with expanded transit service and land-use changes were offset by other factors.

The greater St. Louis metropolitan area offers a stark illustration of the infrastructure/use gap. The average Saint Louisan rides public transit just 8.6 trips a year; yearly ridership has declined steeply from 56.5 million in 2007 to as low as 19.7 million in 2024 (Metro Transit, 2025). This decline happened

despite the presence of MetroLink, a 46-mile off-road rail system with 38 stations, and Metrobus, which operates 59 fixed routes across the bi-state region. At the inception of this study, St. Louis was considering a \$1.1 billion expansion of its Metro system with a street-level tram line which would travel a 5.6-mile stretch through a well-used street within the city limits. It was canceled during the course of this research due to budgetary setbacks. This proposed investment raises a fundamental question that psychology is uniquely positioned to address. Would this project, or others like it, change perceptions of public transit and increase ridership? If not, what project would meet this goal?

The importance of perceptions in actual ridership (not simply quality or quantity of infrastructure) has been increasingly recognized in transportation literature. In a Federal Transit Administration report on bus rapid transit, Cain et al. (2009) found that transit decisions are shaped primarily by intangible, image-based factors rather than direct experience with service characteristics. Their analysis revealed that brand identity and perceived image could account for up to one-third of ridership gains. This is much greater than any quantifiable service improvements. Their findings suggest that how people perceive a transit system may matter just as much, if not more, than how that system actually performs.

One particularly relevant concept in transit perception literature is outlined by Scherer and Dziekan (2012) in their study published in *Journal of Public Transportation* on the “psychological rail factor.” They used a cognitive schemata framework to investigate the transport bias across German and Swiss samples. When participants were asked to imagine bus and rail transit under identical conditions of travel time, convenience, and frequency, 63% of German respondents preferred regional trains and 75% of Swiss respondents preferred trams. Furthermore, Scherer and Dziekan attributed 20-50% of the variance in these findings to emotional and social factors. Emotional factors alone explained 38% of the preference in the German sample.

Subsequent research has replicated this pattern. In Australia, Hensher and Mulley (2015) found that modern light rail transit was preferred over modern bus rapid transit by a margin of 55% to 17%. Utsunomiya and Shibayama (2021), in an Austrian replication study modeled after their earlier research in Japan, used computer-assisted telephone interviews and a contingent valuation design to show that residents along two regional railways valued rail service at about a 10% premium over equivalent bus service.

However, the psychological rail factor is not universally accepted. Cain and Flynn (2013) provided strong counterevidence to these claims through their analysis of the Los Angeles's Orange Line bus rapid transit system. They showed that a high-quality bus system could replicate both the functionality and image qualities traditionally associated with rail transit. Further, their findings suggest that the urban context through which a transit line runs had a larger impact on public perceptions than whether the vehicle ran on rails or rubber.

Whether rail factors reflect a psychological preference or if they are a proxy for correlated differences has important practical implications. If people genuinely do have a psychological preference for rail travel, then cities like St. Louis may be better off embracing it and investing heavily in rail travel rather than attempting to change the public perceptions of the bus. If this preference does not exist, but instead is representative of correlative differences, other avenues to increase ridership should be explored.

Our hypothesis that brief visual exposure to transit mode imagery can affect self-reported attitudes draws on a well-established body of research on cognitive priming. The accessibility model, outlined by Higgins (1996), states that priming works by temporarily increasing the activation potential of stored constructs. This increased activation potential is then used to interpret and evaluate subsequent stimuli. According to this model, viewing images of a specific transit mode would activate or

“prime” associated schemas with that transit mode. These primes would then color the subsequent evaluative judgments of public transportation in general, even when these judgments are not explicitly associated with those individual modes. In other words, by showing images of a specific mode of public transit and then proceeding to give a generic transportation survey we sought to get individuals’ implicit schematic perceptions of the public transit they were primed for (their experimental condition) by comparing their explicit answers to those in other experimental groups. Thus, we do not explicitly ask “Do you think bus travel is safe?” but instead seek to understand how the priming of bus imagery versus rail imagery changes the answer to the question “do you think public transportation is safe?”

Media priming research has demonstrated that visual exposure activates not just individual concepts but entire mental models that frame subsequent perceptions and evaluation (Roskos-Ewoldsen et al., 2002). In a study methodologically relevant to the present design, Coates et al. (2025) found that exposure to negative environmental imagery reduced participants’ preference for eco-friendly transportation options on a subsequent choice task, suggesting that brief visual primes can influence later transportation-related judgments.

The present study investigates whether brief exposure to mode-specific transit imagery can shift non-rider young adults' self-reported perceptions of public transportation. Using a between-subjects experimental design, 22 classrooms at Webster University in St. Louis, Missouri were randomly assigned to view one of four 6-minute silent video conditions: bus, tram, subway, or a neutral control. These groups then completed a 44-item transportation perceptions survey. The survey items refer generically to "public transportation" without specifying any particular mode. Thus, any between-group differences in responses can be attributed to the mode-specific video priming and the schematic perceptions that are tied to the images the participants are primed with. Based on the psychological rail factor literature, we hypothesized:

H1: Participants exposed to rail imagery (tram and subway conditions) will produce higher Total Attitude Scores than participants exposed to non-rail imagery (bus and control conditions).

H2: Across both factor scores and individual items, tram and subway prime conditions will produce higher ratings than bus and control conditions.

We additionally conducted exploratory analyses examining the role of demographic variables including political orientation, race, and international student status as predictors of transit attitudes.

Method

Participants

All participants in the study were Webster University students on the Webster Groves campus in St. Louis County, Missouri. Professors were contacted via email from every department in the University requesting approximately 20 minutes of class time to conduct the experiment. Professors were given the option to schedule the session at the beginning of class, during a break, or at the end of class. Both undergraduate and graduate classrooms were included. Of the 100 professors contacted, 17 professors granted class time over 22 classes with some professors allowing multiple classes to participate.

A total of 251 students participated in the study. After applying exclusion criteria (described below), the final analytic sample was $N = 227$. The targeted age range was 18 to 35; the actual range of participants included was 18 to 46 ($M = 22.2$, $SD = 4.87$). Two participants did not report their age; all participants confirmed being at least 18 during the consent process. The sample included 112 women (49.3%), 100 men (44.1%), 10 non-binary (4.4%), 2 who preferred to self-describe (0.9%), 2 who preferred not to answer (0.9%) and 1 who did not respond (0.4%). Self-reported race of participants was 136 White (59.9%), 35 Asian (15.4%), 21 Multiracial (9.3%), 20 Black or African American (8.8%), 7 Other (3.1%), 2 Middle Eastern or North African (0.9%), 2 American Indian or Alaskan Native (0.9%), 1

Hispanic/Latino (0.4%) and 3 who preferred not to answer (1.3%). Fifty-four participants (23.8%) identified as international students. The majority of participants reported middle-class household socioeconomic background ($n = 112$, 49.3%), followed by upper-middle ($n = 56$, 24.7%), working class ($n = 38$, 16.7%), lower ($n = 11$, 4.8%), and 10 who preferred not to answer (4.4%).

Regarding transportation behavior, 173 participants (76.2%) had never used public transit in St. Louis, 29 (12.8%) used public transit less than once per month, 15 (6.6%) used public transit 1-3 times per month and 10 (4.4%) used public transit 1-3 times per week in the St. Louis area. An additional 16 participants who reported using public transit 4 or more times per week in St. Louis were excluded prior to analysis (see Data Cleaning). In their home cities, 160 participants (70.5%) reported never using public transit, while 66 (29.1%) reported some level of use. One hundred eighty-one participants (79.7%) held a driver's license, and 144 (63.4%) reported owning a car.

This study was approved by the Webster University Institutional Review Board prior to data collection. All participants were read aloud an informed consent form, given a copy of the consent form with contact information, and consented prior to the start of research. Participation was voluntary and had no effect on students' academic standing.

Design

The study employed a between-subjects experimental design with four conditions. The unit of randomization was the classroom: each of the 22 classrooms was assigned to a single experimental condition so that all participants within a given classroom received the same treatment. Students who had already participated in a previous session were not permitted to participate again in a different classroom. Condition assignment was determined by a random number generator that selected one of four numbers corresponding to the Bus, Control, Subway, or Tram video. This cluster randomization yielded the following post-exclusion cell sizes: Bus ($n = 61$), Control ($n = 45$), Subway ($n = 68$), and Tram (n

= 53). Prior to exclusions, cell sizes were more balanced: Bus ($n = 71$), Control ($n = 53$), Subway ($n = 70$), and Tram ($n = 57$). The unequal post-exclusion cell sizes reflect the classroom-level randomization and the differential application of exclusion criteria across groups (see Data Cleaning), rather than systematic attrition. The study was completed over the course of 3 weeks.

Materials

Experimental Stimuli

Four 6-minute silent videos were created using Adobe Premiere Pro, one for each experimental condition (Bus, Tram, Subway, and Control). Each of the three transportation condition videos alternated between 30-second segments of still images (one image every 3 seconds, 10 images per segment) and 30-second segments of video footage depicting the respective transit mode. For example, the Bus condition video displayed 10 still photographs of buses over 30 seconds, followed by 30 seconds of bus video footage, then another set of 10 bus photographs, continuing this pattern for the full 6-minute duration. Care was taken to ensure consistency across the three transportation videos. The content of each image and video segment was matched thematically. For example, when a photograph of a bus driver appeared in a given segment of the Bus video, a photograph of a driver also appeared in the corresponding segment of the Subway and Tram videos. Equal proportions of interior and exterior imagery were used across all three transportation conditions. Images and video footage depicted transit stations, ride-along perspectives, and vehicles moving through urban environments. The visual content was sourced from public domain photographs and videos of transit systems from cities around the world, representing varying ages and conditions of vehicles and infrastructure. We were intentional in not selecting any images or video footage that portrayed any of the three transportation modes in a disproportionately negative or positive light. Images of nature were avoided. Images and videos did not depict crowded or visibly dirty environments. Care was also taken to avoid depicting riders of a single

age, race, or apparent socioeconomic class. We avoided depicting children or the elderly. The Control condition video followed the same alternating still-image/video structure but depicted mundane everyday objects and activities unrelated to transportation. This included footage and images of things like a person flicking a lighter, sweeping a floor, opening a pack of batteries, pictures of doors and rooftops, pictures of rocks, toasting bread in a toaster, and a video of a person restocking a toilet paper roll. These stimuli were selected to be emotionally neutral and free of any depictions of specific gender, race, socioeconomic class, or age. No audio was included in any of the four experimental videos. The only text was at the completion of the video, indicating that the manila envelope could be opened and the transportation survey started.

Demographics and Background Questionnaire

A 19-item demographics and background questionnaire (hereafter referred to as DSQ) collected information on participants' age, gender, race/ethnicity, year in school, city of birth, city where they grew up, current city of residence, car access, frequency of public transit use in St. Louis, frequency of public transit use in their home city, household socioeconomic status (self-perceived), current personal socioeconomic status (self-perceived), political orientation, international student status, and whether they held a driver's license. The questionnaire also included four items assessing personal values on a 1–10 Likert-type scale: "I value personal safety," "I value privacy," "Timeliness is important to me," and "I am concerned about becoming a victim of theft or assault in public spaces." Critically, the demographics questionnaire made no reference to specific modes of public transportation, ensuring that it did not contaminate the subsequent mode-specific prime.

Transportation Survey Questionnaire

The transportation survey questionnaire (hereafter referred to as TSQ) consisted of 44 items, all rated on a 1–10 Likert-type scale with anchors varying by item (e.g., 1 = Negative to 10 = Positive; 1 =

Strongly Disagree to 10 = Strongly Agree; 1 = Never to 10 = Always). Items were compiled by the principal investigator based on informal interviews conducted while riding public transit in cities across the United States, supplemented by a review of prior research on transit perception and ridership. The survey covered several domains including safety, reliability, convenience, behavioral intentions to ride, comfort, cleanliness, social stigma, environmental benefits, civic duty, and accessibility. Seven items were reverse-coded (TSQ27, TSQ29, TSQ30, TSQ33, TSQ34, TSQ38, TSQ43). All items referred to "public transportation" generically without specifying any particular transportation mode; no mention of bus, tram, subway, or any other specific transit type appeared anywhere in the survey. This generic wording was essential to the experimental design: because all four conditions received identical surveys, any between-group differences in responses could be attributed to the mode-specific video prime rather than to differences in the questions themselves. The transportation survey was enclosed in a sealed manila envelope that participants were instructed not to open until after the experimental video had concluded.

Procedure

The principal investigator coordinated with each participating professor to determine the optimal time for conducting the experiment within their class period. The PI wore the same outfit (brown pants, tan jacket, and green sweater) to every data collection session to minimize potential confounding effects of appearance. A professional demeanor was maintained throughout all sessions to encourage participant engagement. Most sessions were conducted at the beginning of the class period. For these sessions, the PI waited 10 to 15 minutes after the scheduled class start time to allow for late arrivals before distributing materials. For other classes, the session took place at the end of class or during a scheduled break. Each participant received three items: a paper informed consent form, the demographics and background questionnaire, and the manila envelope containing the TSQ. The PI read the informed consent form out loud to the class and asked if there were any questions. Students who

arrived after the informed consent had been read were not permitted to participate. Participants were informed that their participation was entirely voluntary, that declining would have no effect on their academic standing, that they did not have to answer any questions they did not want to, and that they could withdraw at any point during the session. They were also informed that by participating they would be given the opportunity to enter into a drawing for a \$50 prize to be awarded to one participant at the conclusion of the study. Participants who consented were instructed to complete the demographics questionnaire first. All participants were reminded not to open the sealed manila envelope. When it appeared that all participants had finished the demographics survey, the PI verbally confirmed that no one needed additional time. The PI then reminded participants to pay attention to the best of their ability, to close their laptops, and to put away their phones. The PI then played the experimental video, which had been randomly assigned to that classroom via a random number generator prior to the session. All videos were displayed silently on the classroom's projector.

During the 6-minute video, the PI monitored the room by scanning the participants to encourage sustained attention and to note any individuals who appeared disengaged. When the video concluded, a message on the screen instructed participants to open their envelopes and begin the TSQ. The PI verbally repeated this along with the phrase "Please take your time answering the questions and please take this seriously." If participants had questions about survey items, the PI responded uniformly with "answer to the best of your ability." Participants were asked not to talk or converse with one another during the survey.

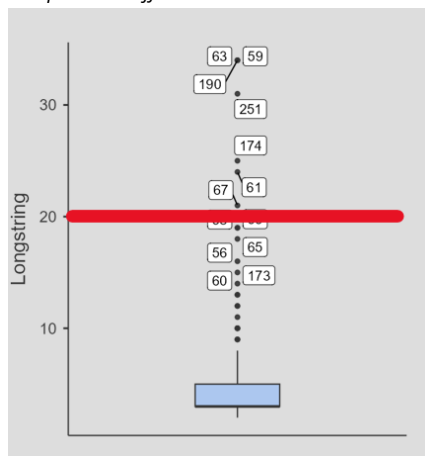
Upon completing the survey, participants placed both the demographics questionnaire and the TSQ into the manila envelope, sealed it, and returned it. Participants were invited to keep the informed consent form for their records. They were also given the option to enter the \$50 drawing via a separate digital form accessed through a QR code; this form collected only contact information and was not linked to survey data in any way. Sealed envelopes were labeled with the class identifier and experimental

condition and secured in the PI's locked vehicle. At the end of each data collection day, all paper materials were batch-scanned onto a password-protected encrypted drive and immediately shredded. No physical copies of participant data were retained. Scanned responses were then hand-entered into a Microsoft Excel spreadsheet and coded according to a pre-established codebook. All entered values were triple checked for accuracy. The coded data were imported into Jamovi (version 2.6.44) for analysis.

Data Cleaning and Exclusion Criteria

Two a priori exclusion criteria were applied sequentially. First, participants who reported using public transportation in St. Louis four or more times per week ($DSQ9 \geq 5$) were excluded, as the study targeted non-riders and infrequent users. This removed 16 participants, reducing the sample from 251 to 235. Second, a Longstring analysis (Figure 1) was conducted on the 44-item TSQ to identify careless or inattentive responding. Participants who provided 20 or more consecutive identical responses were flagged as unreliable reporters and excluded. This threshold is conservative relative to standards in the careless responding literature, which typically recommends cutoffs closer to the length of a single subscale (Meade & Craig, 2012); the higher threshold of 20 was adopted to minimize false exclusions while removing only the most clearly disengaged respondents. This removed an additional 8 participants, yielding a final analytic sample of $N = 227$. No participant was flagged by both criteria. The 24 excluded participants were not evenly distributed across conditions: 10 were from the Bus condition, 8 from Control, 4 from Tram, and 2 from Subway. The exclusion criteria were applied uniformly and without regard to condition assignment; the uneven distribution reflects natural variation in the composition of the 22 participating classrooms. Missing responses on individual survey items were coded as 99 and treated as missing data in analyses. Responses exceeding the scale maximum (i.e., values above 10) were recoded to 10. Upon review of the data, everyone who was noted for being disengaged or talking during the session had been excluded by the Longstring analysis; no additional exclusions were necessary.

Figure 1
Longstring Analysis with Maximum Sequential Response Cutoff



Analytic Strategy

Analyses proceeded in several stages. First, an exploratory factor analysis (EFA) was conducted on the 44-item TSQ using maximum likelihood extraction with oblimin rotation to identify the underlying factor structure. The Kaiser-Meyer-Olkin measure of sampling adequacy ($KMO = .900$) and Bartlett's test of sphericity ($\chi^2 = 5526$, $df = 946$, $p < .001$) confirmed that the data were suitable for factor analysis. The number of factors retained was determined by inspection of the scree plot in conjunction with parallel analysis.

Second, because classrooms rather than individuals were the unit of randomization, intraclass correlation coefficients (ICCs) were computed for each factor to assess the degree of variance attributable to classroom-level clustering. Factors with ICCs exceeding .05 were analyzed using linear mixed models (LMMs) with classroom as a random intercept to account for the non-independence of observations within classrooms. Factors with negligible ICCs were analyzed using standard one-way analyses of variance (ANOVA).

Third, the experimental hypotheses were tested by examining the effect of condition (Bus, Control, Subway, Tram) on each factor score. Levene's test for homogeneity of variances was non-significant for all factors, so Fisher's F-test is reported as the omnibus test throughout. Significant omnibus effects were followed by Tukey's Honestly Significant Difference (HSD) post-hoc comparisons.

Fourth, to address the uneven distribution of international students across conditions (51% of the Control group vs. 11–18% in other groups), an analysis of covariance (ANCOVA) was conducted on Factor 5 with international student status (DSQ18) as a covariate.

Fifth, individual one-way ANOVAs were conducted for each of the 44 TSQ to identify item-level condition effects. Given the exploratory nature of these 44 tests and the associated inflation of family-wise Type I error rate, these results are interpreted cautiously and are presented as supplementary to the factor-level analyses. Under a Bonferroni correction ($\alpha = .05/44 = .001$), only the most robust effects would survive; uncorrected results are reported with this caveat noted.

Sixth, exploratory analyses examined the role of demographic variables as predictors of transit attitudes. Separate one-way ANOVAs examined the effect of political orientation on each factor score and the Total Attitude Score (excluding those who answered moderate/centrist and prefer not to answer). Independent-samples t-tests compared international and domestic students on each factor score and the Total Attitude Score. All primary analyses were conducted using Jamovi statistical software. Effect sizes are reported as eta squared (η^2) for ANOVAs and partial eta-squared (η^2p) for ANCOVAs, with omega-squared (ω^2) provided as a less biased estimate where available.

Results

Exploratory Factor Analysis

Prior to testing the experimental hypotheses, an exploratory factor analysis (EFA) was conducted on the 44-item TSQ to identify the underlying dimensionality of the survey items. The Kaiser-Meyer-Olkin measure of sampling adequacy was .900, exceeding the recommended threshold of .60, and Bartlett's test of sphericity was significant ($\chi^2 = 5526$, $df = 946$, $p < .001$), confirming that the data were suitable for factor analysis. Maximum likelihood extraction with oblimin rotation was employed. Inspection of the scree plot (Figure 2) in conjunction with parallel analysis supported the retention of five factors. The five-factor solution accounted for 48.1% of the total variance. Factors 1 through 5 explained 11.89%, 10.48%, 9.52%, 8.36%, and 7.81% of the variance, respectively, and had initial eigenvalues of 12.69, 3.38, 1.87, 1.40, and 1.17. Thirty-one of the 44 items loaded onto one of the five factors with a primary loading of at least .40. Thirteen items did not meet the loading threshold or cross-loaded and were not included in factor composites: TSQ1, TSQ2, TSQ7, TSQ8, TSQ10, TSQ20, TSQ24, TSQ29, TSQ31, TSQ36, TSQ39, TSQ42, and TSQ43. Factor loadings are presented in Table 1.

Factor composites were computed as the mean of constituent items for each participant. Factor 1, labeled "Ride Intentions and Access", consisted of eight items (TSQ5, TSQ13, TSQ14, TSQ15, TSQ16, TSQ17, TSQ19, TSQ32) capturing respondents' willingness to use public transportation across a range of common situations (e.g., commuting to work, school, sporting events, the airport) and desire for better transit access and affordability ($\alpha = .881$). Factor 2, labeled "Cleanliness, Comfort, and Safety", consisted of eight items (TSQ11, TSQ12, TSQ18, TSQ21, TSQ22, TSQ25, TSQ26, TSQ28) reflecting perceptions of how clean, safe, comfortable, and pleasant respondents believed the transit experience to be ($\alpha = .885$). Factor 3, labeled "Environmental and Civic Benefits", consisted of 6 items (TSQ6, TSQ35, TSQ37, TSQ40, TSQ41, TSQ44) capturing beliefs about the broader environmental, civic, and community-level benefits

of public transportation, including sustainability, urban prestige, and community connectivity ($\alpha = .880$). Factor 4, labeled “Stigmatization”, consisted of five reverse-coded items (TSQ27, TSQ30, TSQ33, TSQ34, TSQ38) capturing stigma, fear, and concerns about the types of people who ride public transportation and the perceived risk of crime or victimization. After reverse coding, higher composite scores indicate lower stigma and less fear ($\alpha = .865$). Factor 5, labeled “Reliability and Convenience”, consisted of four items (TSQ3, TSQ4, TSQ9, TSQ23) reflecting perceptions of whether transit runs on schedule, is reliable, is convenient, and gets riders where they want to go ($\alpha = .731$). Internal consistency was acceptable to good across all five factors (α s ranging from .731 to .885), with Factor 5 showing the lowest reliability, consistent with its smaller number of constituent items.

Figure 2

Scree Plot and Parallel Analysis

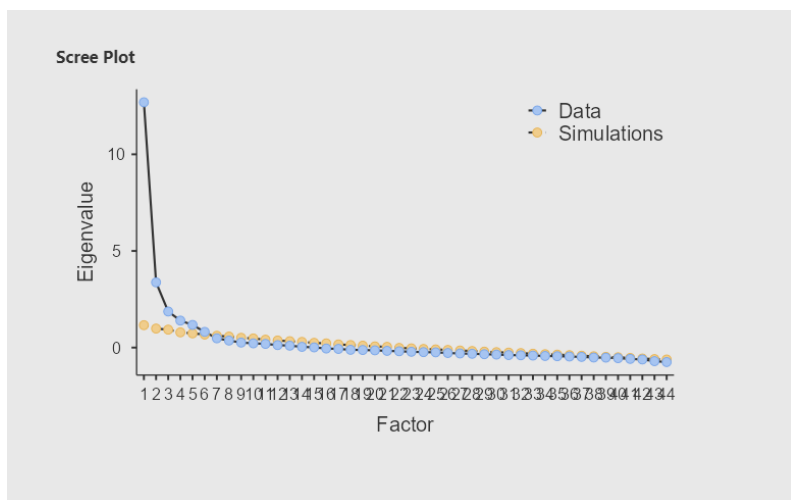


Table 1

Exploratory Factor Analysis Factor Loadings

Factor Loadings	Factor					Uniqueness
	1	2	3	4	5	
TSQ14	0.851					0.304
TSQ15	0.755					0.429
TSQ17	0.739					0.509
TSQ5	0.650					0.360
TSQ32	0.596					0.571
TSQ19	0.566					0.428
TSQ16	0.564					0.625
TSQ20	0.507					0.647
TSQ7	0.506					0.568
TSQ13	0.471					0.627
TSQ36	0.418					0.613
TSQ39	0.411					0.613
TSQ21		0.884				0.259
TSQ18		0.877				0.226
TSQ25		0.507				0.373
TSQ22		0.496				0.490
TSQ28		0.463				0.583
TSQ26		0.444				0.610
TSQ12		0.429				0.570
TSQ11						0.488
TSQ8						0.769
TSQ10						0.705
TSQ41			0.911			0.178
TSQ37			0.911			0.184
TSQ40			0.534			0.460
TSQ35			0.512			0.480
TSQ44			0.443			0.440
TSQ6						0.522
TSQ42						0.697
TSQ31						0.777
TSQ33 - Reverse				0.892		0.202
TSQ34 - Reverse				0.873		0.230
TSQ30 - Reverse				0.841		0.326
TSQ38 - Reverse				0.614		0.554
TSQ27 - Reverse				0.500		0.639
TSQ2						0.472
TSQ43 - Reverse						0.822
TSQ4					0.755	0.417
TSQ9					0.633	0.512
TSQ3					0.612	0.625
TSQ23					0.444	0.709
TSQ24						0.573
TSQ29 - Reverse						0.751
TSQ1						0.470

Note: "Maximum likelihood" extraction method was used in combination with a "oblimin" rotation

Classroom Clustering and Analytic Approach

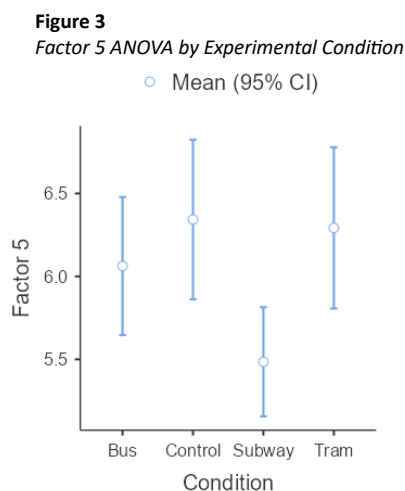
Because classrooms rather than individuals were the unit of randomization, intraclass correlation coefficients (ICCs) were computed for each factor to assess the proportion of variance attributable to classroom-level clustering. ICCs for Factor 1 (ICC = .107), Factor 2 (ICC = .092), and Factor 3 (ICC = .185) indicated that 9% to 19% of the variance in these scores was attributable to differences between classrooms. These ICCs justified the use of linear mixed models (LMMs) with classroom as a random intercept for Factors 1 through 3. For Factor 4 (ICC = .004) and Factor 5 (ICC < .001), ICCs were negligible, indicating minimal classroom clustering; standard one-way ANOVAs were therefore used for these two factors. The Total Attitude Score (the mean of all 44 items) showed a moderate ICC of .132. The LMM results for Factors 1, 2, and 3 revealed no significant main effect of experimental condition on any of these factors (Factor 1: $F(3, 18.0) = 0.359, p = .783$; Factor 2: $F(3, 18.7) = 0.683, p = .574$; Factor 3: $F(3, 17.2) = 0.136, p = .937$). The marginal R^2 values for the condition effect alone ranged from 0.5% to 1.9% across all factors, indicating that the video manipulation explained very little variance in transit attitudes when considered in isolation. By contrast, the full models including classroom clustering explained more variance, with conditional R^2 values of .116 for Factor 1, .109 for Factor 2, and .189 for Factor 3, suggesting that classroom context accounted for more variance in these factor scores than the experimental manipulation itself.

Effect of Condition on Factors 4 and 5

One-way ANOVAs were conducted to examine the effect of experimental condition on Factor 4 and 5. The one-way ANOVA on Factor 4 (Stigmatization) yielded no significant effect of condition, $F(3, 213) = 0.853, p = .467, \eta^2 = .012$. However, the Factor 5 (Reliability/Convenience) ANOVA did find a significant effect of condition, $F(3, 220) = 3.774, p = .011, \eta^2 = .049$; Levene's test for homogeneity of

variances was non-significant, $F(3, 220) = 1.143, p = .333$, and the Shapiro-Wilk test of normality for the residuals was non-significant, $W = .995, p = .637$, indicating that both assumptions were adequately met.

For Factor 5, group means and standard deviations were as follows: Bus ($M = 6.06, SD = 1.61, n = 60$), Control ($M = 6.34, SD = 1.56, n = 43$), Subway ($M = 5.49, SD = 1.36, n = 68$), and Tram ($M = 6.29, SD = 1.76, n = 53$). Tukey's HSD post-hoc comparisons revealed that the Control condition scored significantly higher than the Subway condition ($MD = 0.86, p = .028$) and the Tram condition scored significantly higher than the Subway condition ($MD = 0.81, p = .028$). There was no significant difference between Control and Tram ($p = .999$), and the Bus condition did not differ significantly from any other group (all $ps \geq .163$). This pattern indicates that exposure to subway imagery specifically depressed perceptions of transit reliability and convenience relative to the control and tram conditions, while bus imagery did not meaningfully alter these perceptions (see Figure 3).



Sensitivity Analysis: Controlling for International Student Status

International students comprised 23.8% of the sample ($n = 54$) but were unevenly distributed across conditions. Notably, 51.1% of the Control group consisted of international students, compared to 11.5% of the Bus group, 17.6% of the Subway group, and 22.6% of the Tram group. Because international students may bring fundamentally different transit experiences and baseline attitudes (many coming

from cities with well-developed transit systems), this uneven distribution represented a potential confound. To address this, an analysis of covariance (ANCOVA) was conducted on Factor 5 with experimental condition as the independent variable and international student status (DSQ18) as a covariate. The effect of condition remained significant after controlling for international student status, $F(3, 219) = 3.31, p = .021, \eta^2p = .043, \omega^2 = .030$. International student status itself was not a significant predictor of Factor 5 scores once condition was in the model, $F(1, 219) = 1.48, p = .226, \eta^2p = .007$. This indicates that the condition effect on perceived reliability and convenience is not an artifact of the uneven distribution of international students across groups. A supplementary ANOVA analysis of Factor 5 restricted to domestic students ($n = 173$) showed the same directional pattern as the full sample Factor 5 ANOVA but fell to marginal significance ($p = .057$), consistent with reduced statistical power from the 24% reduction in sample size.

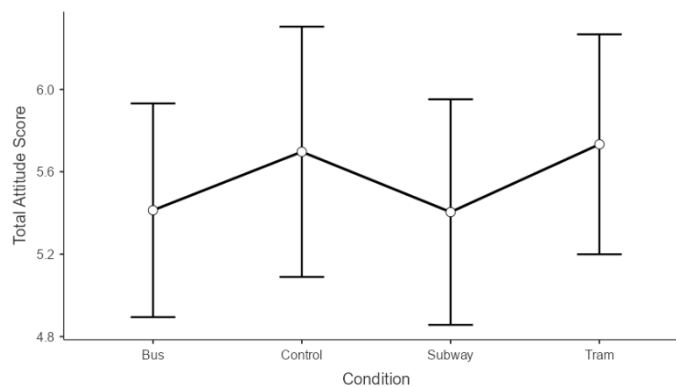
Total Attitude Score

A Total Attitude Score was computed as the mean of all 44 TSQ for each participant, with the reverse-coded items reversed. Sixteen participants were excluded for incomplete TSQ, yielding $n = 211$. Group means were as follows: Bus ($M = 5.43, SD = 1.31, n = 56$), Control ($M = 5.72, SD = 0.99, n = 38$), Subway ($M = 5.35, SD = 1.18, n = 68$), and Tram ($M = 5.66, SD = 1.43, n = 49$). The pattern was directionally consistent with the Factor 5 finding (Subway scored lowest and Control and Tram scored highest) but a one-way ANOVA (Fisher's) was not significant, $F(3, 207) = 1.016, p = .387$. Levene's test for homogeneity of variances was non-significant, $F(3, 207) = 1.783, p = .152$. Given the moderate classroom-level ICC for the Total Attitude Score ($ICC = .132$), a linear mixed model was also conducted with condition as a fixed effect and classroom as a random intercept. The LMM similarly yielded no significant effect of condition (see Figure 4). The marginal R^2 (variance explained by condition alone) was less than 2%, while the conditional R^2 (variance explained by condition plus classroom clustering) was

substantially higher, indicating that the classroom social context accounted for more variance in overall transit attitudes than the experimental manipulation.

This result indicates a rejection of H1: the experimental manipulation did not produce a broad, uniform shift in overall transit attitudes. The significant effect isolated to Factor 5 suggests that the priming manipulation operated selectively on perceptions of reliability and convenience rather than on attitudes as a whole. The Total Attitude Score aggregates across all 44 items, including 13 that did not load cleanly onto any retained factor, and as a broad omnibus index it may be less sensitive than factor-level analyses to selective schematic priming effects. Item noise from conceptually distant constructs may have clouded any mode-specific signal. The small differences between group means on the Total Attitude Score (ranging from 5.35 to 5.72, a spread of less than 0.4 points on a 10-point scale) suggest that any priming effect was too subtle to shift the aggregate when diluted across all 44 items, many of which tap constructs (e.g., environmental beliefs, ride intentions) that may be more resistant to brief visual priming than perceptions of reliability.

Figure 4
Total Attitude Score by Experimental Condition (Linear Mixed Model)



Individual Item Analyses

To further explore condition effects, one-way ANOVAs were conducted for each of the 44 TSQ items. Fisher's F-test is reported as the primary omnibus test, as Levene's test for homogeneity of

variances was non-significant for all items. Several items showed violations of normality (Shapiro-Wilk); however, ANOVA is robust to normality violations at the sample sizes employed ($ns = 45-68$ per group). Nine items showed effects worth examining: eight reached significance at $p < .05$ on the omnibus test, and TSQ1 ($p = .056$) showed a significant Tukey post-hoc Tram-Subway contrast despite a marginal omnibus. Given the exploratory nature of 44 simultaneous tests and the associated inflation of the family-wise Type I error rate, these results should be interpreted with caution. Under a Bonferroni correction ($\alpha = .05/44 = .001$), only TSQ31 ($p < .001$) would survive; uncorrected results are reported and the nine items showing condition effects are organized into five interpretable patterns to characterize the pattern of effects.

Pattern A: Subway Depression Effect

Four items showed the consistent pattern of the Subway condition scoring lower than the Control condition mirroring the Factor 5 finding:

TSQ7: "Do you feel like public transportation is set up for you?" $F(3, 223) = 2.87, p = .037, \eta^2 = .037$. Subway participants ($M = 3.93, SD = 2.01$) rated this item significantly lower than Control participants ($M = 5.16, SD = 2.67$; Tukey $MD = 1.229, p = .038$). No other pairwise differences reached significance (see Figure 5).

TSQ9: "Is public transportation convenient?" $F(3, 222) = 3.57, p = .015, \eta^2 = .046$. Control ($M = 6.27, SD = 2.26$) scored significantly higher than Subway ($M = 5.09, SD = 1.89$; Tukey $MD = 1.184, p = .029$). The Subway-Tram difference approached but did not reach significance ($MD = -1.025, p = .055$) (see Figure 6).

TSQ10: "Is public transportation for everyone?" $F(3, 223) = 3.63, p = .014, \eta^2 = .047$. Control ($M = 6.62, SD = 2.92$) scored significantly higher than Subway ($M = 4.91, SD = 2.68$; Tukey $MD = 1.710, p = .010$). This was the largest mean difference observed on any individual item (see Figure 7).

TSQ18: "Public transportation is clean." $F(3, 221) = 2.65, p = .049, \eta^2 = .035$. Control ($M = 4.43, SD = 2.28$) scored significantly higher than Subway ($M = 3.49, SD = 1.69$; Tukey $MD = 0.947, p = .048$) (see Figure 8).

Figure 5
TSQ7 ANOVA by Condition

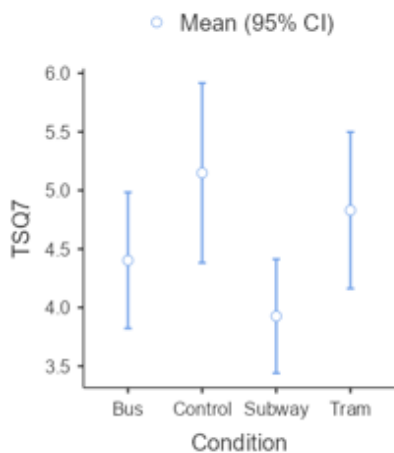


Figure 6
TSQ9 ANOVA by Condition

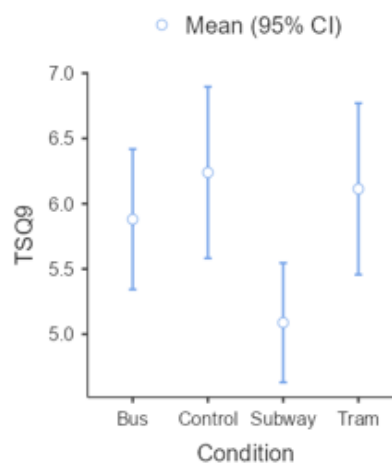


Figure 7
TSQ10 ANOVA by Condition

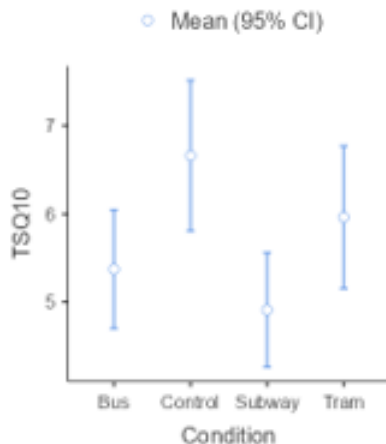
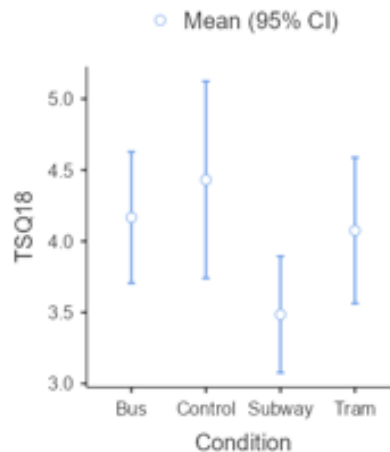


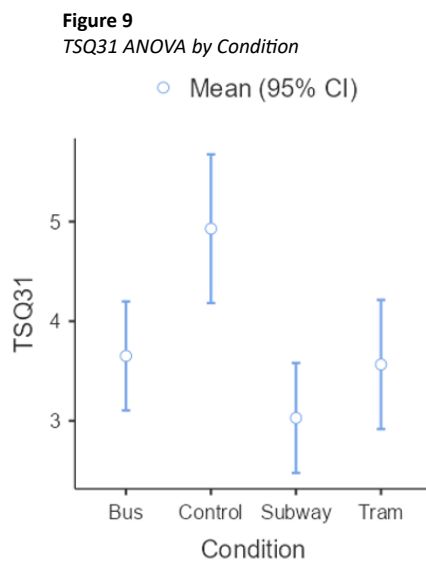
Figure 8
TSQ18 ANOVA by Condition



Pattern B: Any Public Transit Imagery Depresses Civic Duty

TSQ31: "People have a duty to ride public transportation." $F(3, 217) = 5.68, p < .001, \eta^2 = .073$. This item showed the strongest statistical effect of any individual item and a distinctive pattern. Control participants ($M = 4.92, SD = 2.45, n = 40$) scored significantly higher than Subway ($M = 3.03, SD = 2.28, n$

= 68; $MD = 1.90, p < .001$), Tram ($M = 3.57, SD = 2.35, n = 53; MD = 1.36, p = .030$), and Bus ($M = 3.52, SD = 2.29, n = 60; MD = 1.41, p = .018$). No transit-primed group differed significantly from any other transit-primed group (all $ps \geq .59$). This is the only item on which the Control group outperformed all three transit conditions, rather than just Subway (see Figure 9).



Pattern C: Tram vs. Subway

TSQ1: "How do you feel about public transportation?" $F(3, 223) = 2.55, p = .056, \eta^2 = .033$; the omnibus F was marginal, but Tukey post-hoc comparisons revealed a significant Tram-Subway difference ($MD = -1.097, p = .031$). Tram participants ($M = 7.04, SD = 2.39$) reported significantly more positive feelings than Subway participants ($M = 5.94, SD = 1.95$) (see Figure 10).

TSQ23: "Public transportation gets me where I want to go" $F(3, 220) = 2.68, p = .048, \eta^2 = .035$. Tram participants ($M = 5.94, SD = 2.57$) scored significantly higher than Subway participants ($M = 4.76, SD = 2.39$; Tukey $MD = 1.179, p = .048$) (see Figure 11).

Figure 10
TSQ1 ANOVA by Condition

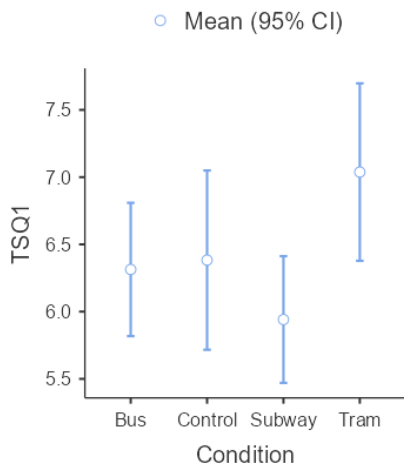
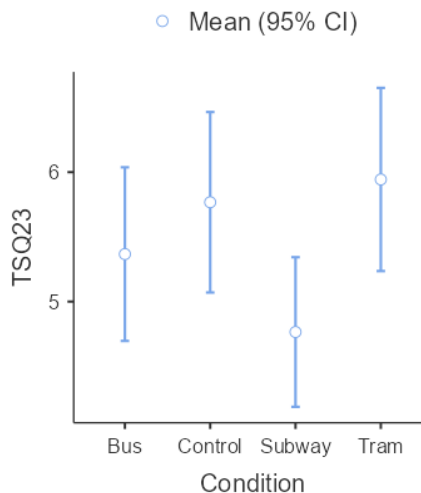


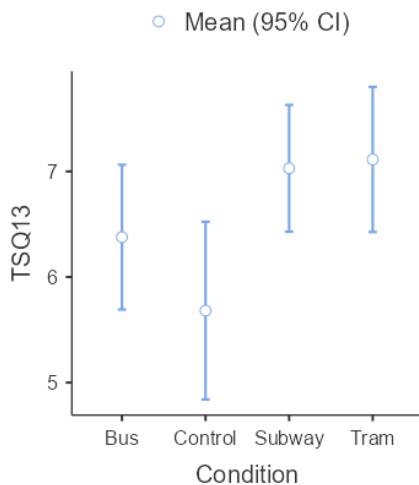
Figure 11
TSQ23 ANOVA by Condition



Pattern D: Rail Advantage for Airport Travel

TSQ13: “Would you ride public transportation to the airport?” $F(3, 222) = 3.29, p = .021, \eta^2 = .043$. This was the only item on which both rail conditions outperformed the Control group. Both Subway ($M = 7.03, SD = 2.48$; Tukey $MD = -1.348, p = .039$) and Tram ($M = 7.11, SD = 2.49$; Tukey $MD = -1.431, p = .037$) scored significantly higher than Control ($M = 5.68, SD = 2.77$). Bus ($M = 6.38, SD = 2.68$) did not differ from any group. This pattern is unique among all 44 items in that it is consistent with the psychological rail factor hypothesis specifically for airport-related travel (see Figure 12).

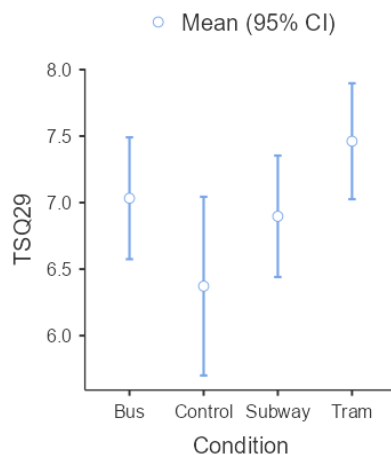
Figure 12
TSQ13 ANOVA by Condition



Pattern E: Tram Crowding Perception

TSQ29: "Public transportation can be overcrowded." $F(3, 220) = 2.77, p = .042, \eta^2 = .036$. This reverse-coded item (higher raw scores = more perceived crowding) showed that Tram participants ($M = 7.46, SD = 1.57$) perceived significantly more crowding than Control participants ($M = 6.37, SD = 2.18$; Tukey $MD = -1.089, p = .024$). No other comparisons were significant. This suggests the tram video prime may have activated associations with passenger density or enclosed spaces (see Figure 13).

Figure 13
TSQ29 ANOVA by Condition



Demographic Predictors of Transit Attitudes

Political Orientation

Political orientation emerged as the strongest and most consistent demographic predictor of transit attitudes outside of experimental conditions. One-way ANOVAs comparing participants ($n = 113$) who identified as very conservative, somewhat conservative, somewhat liberal, and very liberal revealed significant effects on four of the five factors and the Total Attitude Score: Factor 1 (Ride Intentions/Access), $F(3, 107) = 5.31, p = .002$; Factor 2 (Cleanliness/Comfort/Safety), $F(3, 108) = 3.13, p = .029$; Factor 3 (Environmental/Civic Benefits), $F(3, 107) = 7.47, p < .001$; Factor 4 (Stigmatization), $F(3,$

105) = 5.07, $p = .003$; and Total Attitude Score, $F(3, 103) = 7.71$, $p < .001$. Factor 5

(Reliability/Convenience) was not significant, $F(3, 108) = 0.79$, $p = .501$. Levene's test for homogeneity of variances and the Shapiro-Wilk test of normality were non-significant for all factors (all $ps > .05$). In all cases, more liberal political orientation was associated with more favorable transit attitudes.

Tukey HSD post-hoc comparisons indicated that very liberal participants consistently reported the most favorable attitudes. For Factor 1, very liberal participants scored significantly higher than very conservative participants ($MD = 2.31$, $p = .008$) (see Figure 14). For Factor 2, very liberal participants scored significantly higher than somewhat conservative participants ($MD = 1.11$, $p = .049$) (see Figure 15). For Factor 3, very liberal participants scored significantly higher than somewhat conservative ($MD = 1.98$, $p < .001$), somewhat liberal ($MD = 1.27$, $p = .014$), and very conservative participants ($MD = 1.74$, $p = .042$) (see Figure 16). For Factor 4, very liberal participants scored significantly higher than somewhat conservative participants ($MD = 1.81$, $p = .005$); the difference with very conservative participants approached significance ($MD = 1.74$, $p = .065$) (see Figure 17). For the Total Attitude Score, very liberal participants scored significantly higher than both very conservative ($MD = 1.51$, $p = .005$) and somewhat conservative participants ($MD = 1.28$, $p = .002$); the difference with somewhat liberal participants approached significance ($MD = 0.73$, $p = .058$) (see Figure 18).

Figure 14
Factor 1 ANOVA by Political Orientation

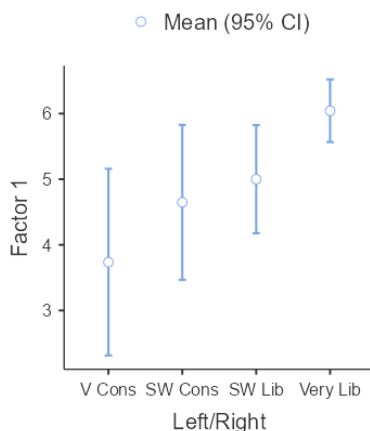


Figure 15
Factor 2 ANOVA by Political Orientation

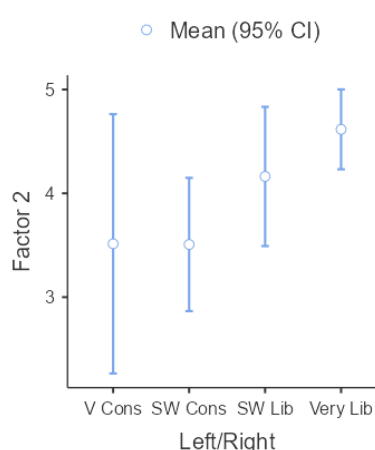


Figure 16
Factor 3 ANOVA by Political Orientation

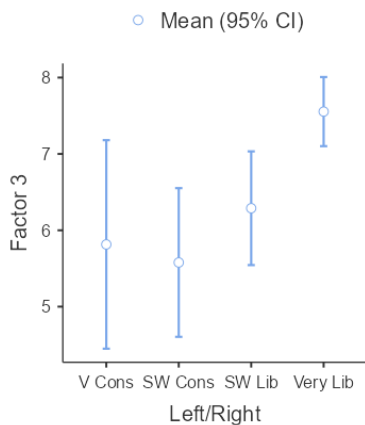


Figure 17
Factor 4 ANOVA by Political Orientation

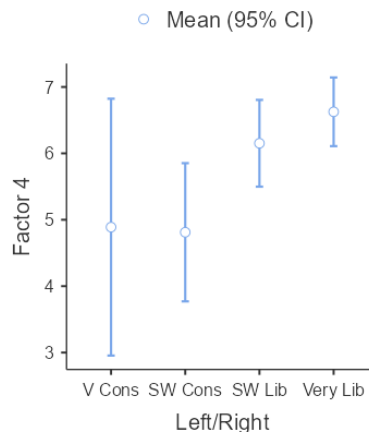
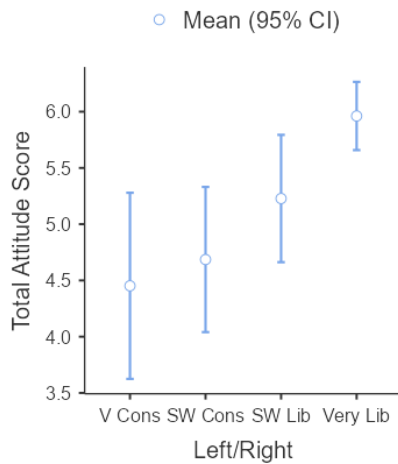


Figure 18
Total Attitude Score ANOVA by Political Orientation



Race

Racial identity did not reach statistical significance as a predictor for any factor (all $ps > .05$). This may be due to the wide range of answers to the racial identity question, and the low number of participants for each racial group.

International Students

Independent-samples t-tests were conducted to compare international ($n = 54$) and domestic ($n = 173$) participants on each factor score and the Total Attitude Score. Student's t-test was used unless Levene's test indicated unequal variances, in which case Welch's t-test was reported.

International students ($M = 5.97, SD = 1.00$) reported significantly more favorable attitudes on the Total Attitude Score than domestic students ($M = 5.38, SD = 1.28$), $t(209) = 2.88, p = .004$ (see Figure 23). For Factor 1, international students ($M = 6.39, SD = 1.63$) scored significantly higher than domestic students did ($M = 5.33, SD = 2.09$), Welch's $t(110.0) = 3.85, p < .001$ (see Figure 19). For Factor 2, international students ($M = 5.03, SD = 1.70$) scored significantly higher than domestic students ($M = 4.27, SD = 1.48$), $t(220) = 3.07, p = .002$ (see Figure 20). For Factor 3, International students ($M = 7.06, SD = 1.47$) scored significantly higher than domestic students ($M = 6.42, SD = 1.88$), $t(220) = 2.23, p = .027$ (see Figure 21). This positive perception reversed on Factor 4, where international students ($M = 5.32, SD = 1.52$) reported significantly higher stigmatization than domestic students ($M = 6.18, SD = 1.95$), $t(215) = -2.83, p = .005$ (see Figure 22). Factor 5 (Reliability/Convenience) did not differ significantly by international student status, $t(222) = 1.68, p = .095$.

Figure 19
Factor 1 T-test International vs. Domestic

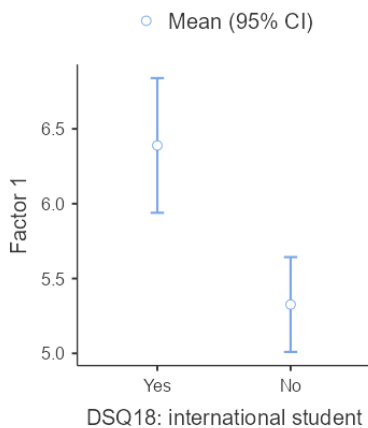


Figure 20
Factor 2 T-test International vs. Domestic

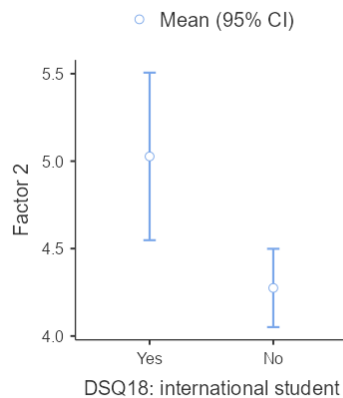


Figure 21
Factor 3 T-test International vs. Domestic

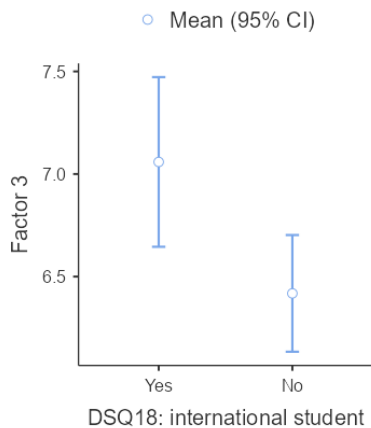


Figure 22
Factor 4 T-test International vs. Domestic

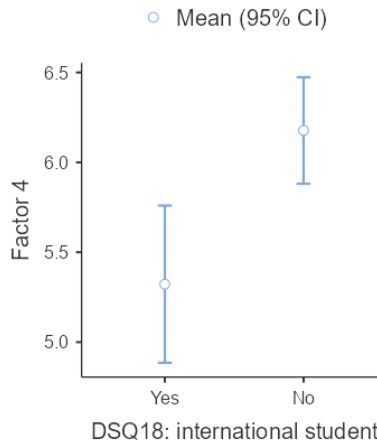
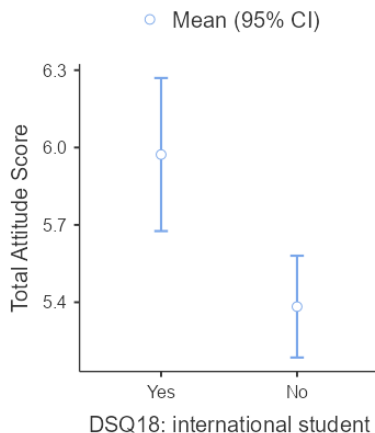


Figure 23
Total Attitude Score T-test International vs. Domestic



Summary of Hypothesis Testing

H1 predicted that rail conditions (tram and subway) would produce higher overall ratings on the Total Attitude Score than non-rail conditions (bus and control). This hypothesis was rejected; the Total Attitude Score showed no significant condition effect across the four conditions, and the directional pattern (Subway lowest, Control and Tram highest) did not survive statistical testing.

H2 predicted that both tram and subway conditions would rate higher than bus and control across factor domains. This hypothesis was also rejected. At the factor level, no condition differences

emerged for Factors 1 through 4. On Factor 5, tram rated comparably to control and significantly higher than subway, while bus did not differ from any group. The Factor 5 pattern did not conform to a simple rail-versus-non-rail dichotomy: subway diverged from tram, undermining the prediction that rail modes would behave similarly relative to non-rail modes. The individual item analysis revealed a more nuanced picture: of the nine items showing condition effects, four showed the control condition outperforming the subway condition, one showed the control outperforming everything, two showed the tram condition outperforming the subway condition, one showed tram-primed participants perceiving more crowding than control and one showed both rail modes outperforming control (the only finding consistent with the psychological rail factor). The overarching pattern was not "rails better than wheels" but rather "subway worse than everything else."

Discussion

The present study investigated whether a brief 6-minute video prime using mode specific transit imagery could activate schematic representations of different transit modes among non-rider young adults and whether those activated schemas would produce differential evaluations of public transportation consistent with the psychological rail factor. Using a between-subjects design, 22 classrooms were randomly assigned one of the four transportation prime conditions (bus, tram, subway, and control). Thus, the differences in the 44-item TSQ survey, which only generically referred to public transportation, reflected differences in the primed schematics of whichever of the four experimental videos that classroom was exposed to. In this way we used visual priming as a diagnostic tool, not with the intention of changing participants' attitudes but to reveal the implicit schemas they already carry for these different transit modes.

Based on the preestablished psychological rail factor literature (Scherer & Dziekan, 2012; Hensher & Mulley, 2015; Utsunomiya & Shibayama, 2021) we predicted that activating rail-associated

schemas would produce more favorable survey responses than activating bus schemas or no transit schemas at all (control group). This prediction was largely not supported by the results. Both H1 and H2 were rejected; we did not find support for the rail factor in the Total Attitude Score or on the factor level.

The rejection of H1 and H2 should be interpreted with the implicit design this study employed in mind. Prior work supporting the psychological rail factor almost exclusively used explicit methods to gauge perceptions of public transportation. The present study deliberately did not. Rather than explicitly asking participants what they thought about trams, subways, or buses, we primed them with imagery of one mode and then measured their responses to a generically worded survey, treating any between-condition differences as a window onto the implicit schemas these modes activate. Under this design, the absence of a uniform rail advantage on the Total Attitude Score does not necessarily mean non-riders hold no rail preference when asked explicitly.

The priming design did appear to successfully activate mode-specific schematic differences. Most clearly, the subway condition produced the only significant factor-level effect. Additionally, nine individual survey items showed condition effects, revealing interpretable patterns that extended and qualified the factor-level findings. Taken together, the manipulation functioned as a diagnostic tool even though it did not support our hypotheses, and the specific patterns it revealed are examined in detail in the sections that follow.

The Subway Depression Effect

The most consistent finding across the factor-level and item-level analyses was that subway imagery depressed perceptions of public transportation. On Factor 5, participants primed with subway imagery rated public transportation as significantly less convenient, less reliable, and less accessible than participants in the control and tram conditions ($\eta^2 = .049$). This effect remained significant after controlling for international student status via ANCOVA ($F(3, 219) = 3.31, p = .021$), and a supplementary

analysis restricted to domestic students showed the same directional pattern, though it fell to marginal significance consistent with the reduced statistical power from a 24% smaller sample. This finding departed from the expectation, drawn from the rail factor literature, that *all* rail imagery would be associated with more favorable evaluations. We do not interpret this finding as evidence that the video changed participants' attitudes. Rather, we suggest that the priming activated a pre-existing subway schema that colored their subsequent responses in the generic public transportation survey. This interpretation is consistent with Higgins' (1996) accessibility model, which holds that priming temporarily increases the activation potential of stored constructs (transport mode schemas) which are then used to interpret and evaluate subsequent stimuli (the transportation survey).

It is possible that subway imagery activated existing schematic constructs that associate subways with navigational complexity, unfamiliar underground infrastructure, and systems that appear difficult to access or use. These associations are consistent with the Reliability and Convenience dimension (Factor 5) where we observed the strongest condition effects, rather than with safety or social stigma (Factors 2 and 4), neither of which showed significant condition effects. Participants primed with subway imagery may have rated public transportation less favorably than control and tram conditions on these dimensions because their activated schemas framed transit as harder to figure out and less likely to get them where they want to go. By contrast, tram imagery may have activated schemas of above-ground, street-level systems with visible routes and stops. These schemas may convey accessibility and navigational transparency, which align with positive reliability and convenience perceptions. However, the present design can detect that schemas differ by mode but cannot directly measure the content of those schemas. These interpretations are speculative and would require qualitative methods or semantic differential measures to confirm.

Item-Level Analysis

Pattern A of the individual item analyses provided converging evidence of the subway depression effect. Four items showed a consistent pattern of the control condition significantly outperforming the subway condition: TSQ7 ("Do you feel like public transportation is set up for you?"), TSQ9 ("Is public transportation convenient?"), TSQ10 ("Is public transportation for everyone?"), and TSQ18 ("Public transportation is clean"). TSQ9 is a Factor 5 item, providing convergent validity between the factor-level and item-level findings; the composite score was not merely an artifact of aggregation but is reflected in the behavior of its individual items. TSQ7 and TSQ10 did not load onto Factor 5 or any other factor in the EFA, which may suggest that the activated subway schema colors evaluations beyond the strict reliability and convenience dimension, extending into adjacent perceptual territory around system inclusivity and personal fit. It is possible that these other factors could not be measured because of small sample size and a small effect being measured. It is also possible that our factors are simply not well constructed enough to fully capture these concepts. TSQ10 produced the largest mean difference of any individual item on the survey (Control $M = 6.62$ vs. Subway $M = 4.91$), indicating that after subway priming, participants were notably less likely to endorse the idea that public transit serves everyone.

Pattern C provided further evidence that subway and tram activate distinct schemas. On TSQ1 ("How do you feel about public transportation?") and TSQ23 ("Public transportation gets me where I want to go"), tram-primed participants scored significantly higher than subway-primed participants, while neither differed significantly from control or bus. TSQ1 is the broadest evaluative item on the survey. It asks for an overall affective reaction to public transportation without targeting any specific dimension. In other words, the core overall concept of what we sought to study. It is also the first item on the survey, meaning it was answered closest in time to the priming exposure, when schema activation should theoretically be at its strongest (Higgins, 1996). The tram-subway divergence on this item suggests that the schematic difference between these two modes may extend beyond narrow

perceptions of reliability to a more general evaluative level. TSQ23, a Factor 5 item, replicates the factor-level tram-over-subway pattern at the individual item level.

It is important to note that these 44 individual item analyses were exploratory and subject to inflated familywise error rates. Under a Bonferroni correction ($\alpha = .001$), none of the Pattern A or Pattern C items would survive. The consistency of the pattern across multiple items provides some reassurance, but these findings should be interpreted as suggestive rather than definitive.

Implications for the Psychological Rail Factor

Together, the Factor 5 finding and the item-level patterns raise questions about the psychological rail factor's core assumption that "rail" functions as a unitary psychological category. Scherer and Dziekan (2012), Hensher and Mulley (2015), and Utsunomiya and Shibayama (2021) frame the rail preference as a general tendency to prefer rail over bus. Our data suggest that this framing may be incomplete. Subway and tram are both rail modes, yet they activate opposite schematic patterns on the Reliability and Convenience dimension we have outlined as well as within several individual analyses. This finding may support Cain and Flynn's (2013) argument that the observed rail premium is a proxy for correlation between urban context, modernity, and system legibility rather than a genuine preference for rail technology.

It may, however, simply mean that the psychological rail factor is more nuanced than prior reporting has characterized. Rather than rail being perceived as uniformly superior, there may be meaningful psychological distinctions between types of rail that the existing literature has not adequately differentiated. Different populations in different urban contexts may hold different modal schemas, and the rail factor documented in European and Australian samples may not map cleanly onto the schemas held by non-rider young adults in a car-dependent American city. At minimum, the present

findings suggest that a subway extension and a new tram line are not the same psychological proposition, even though both run on rails.

Additional Item-Level Patterns

While the majority of findings challenged the psychological rail factor, one result was consistent with its predictions. On TSQ13 ("Would you ride public transportation to the airport?"), both subway and tram conditions scored significantly higher than the control condition. This was the only item on which both rail modes outperformed the non-rail baseline (Pattern D). This may reflect a domain-specific schema linking rail transit to airport connectivity that exists even among non-riders. For the present sample, MetroLink's airport connection is one of the most visible functions of St. Louis's rail system, which could contribute to a pre-existing rail-airport association. However, it would be premature to interpret one significant item out of 44 as strong evidence for a generalized rail factor, particularly given that the bus condition did not differ from any group on this item. What the TSQ13 finding does suggest is that our priming design was capable of detecting positive rail associations where they exist, providing some methodological reassurance that the subway depression effect is not an artifact of a design which systematically favors negative detection.

TSQ31 ("People have a duty to ride public transportation") produced the strongest single-item effect in the study ($F(3, 217) = 5.68, p < .001, \eta^2 = .073$) and is the only item that would survive a Bonferroni correction. Uniquely, the control condition within this item scored significantly higher than all three transit-primed groups, while no transit-primed group differed from any other (Pattern B). This pattern is not mode-specific. Any exposure to transit imagery was associated with reduced endorsement of civic duty to ride public transit relative to the control group. One possible interpretation draws on cognitive dissonance theory (Festinger, 1957): participants in the transit conditions had transit-related schemas activated, making public transportation salient in a way it was not for control participants.

When subsequently asked whether people have a duty to ride, transit-primed non-riders may have experienced tension between the salience of public transit in their minds and the reality of their own non-ridership. Rejecting the duty premise could serve to reduce that tension. This is speculative and cannot be tested with the present data, but the magnitude of the effect and its distinctiveness from all other patterns suggest it may warrant further investigation.

Pattern E revealed that the tram schema is not uniformly neutral. On TSQ29 ("Public transportation can be overcrowded"), tram-primed participants perceived significantly more crowding than control participants. This suggests that tram imagery may have activated a specific association with passenger density, complicating the otherwise neutral-to-positive tram profile. The reason tram imagery uniquely activated this association is unclear from the present data. As with all individual item findings, this result should be interpreted cautiously given the multiple comparisons involved.

Demographic Predictors of Transit Attitudes

Political orientation emerged as the strongest and most consistent predictor of transit attitudes overall, with significant effects on four of five factors and the Total Attitude Score. More liberal political orientation was associated with more favorable transit attitudes across Factor 1 (Ride Intentions/Access), Factor 2 (Cleanliness/Comfort/Safety), Factor 3 (Environmental/Civic Benefits), Factor 4 (Stigmatization), and the Total Attitude Score. Factor 5 (Reliability/Convenience) was the sole exception, showing no significant relationship with political identity. Tukey HSD comparisons indicated that very liberal participants consistently reported the most favorable attitudes, with the largest differences emerging between very liberal and conservative subgroups. This pattern converges with Klein et al.'s (2022) documentation of growing partisan polarization around transportation policy, which outlines that support for transit investment has become increasingly associated with liberal political identity. It is also consistent with a social identity framework (Tajfel & Turner, 1979) in which attitudes toward public

transit function partly as expressions of political group membership rather than purely as evaluations of transit service quality.

Independent samples t-tests comparing international and domestic students revealed that international students reported significantly more favorable attitudes on the Total Attitude Score and on Factors 1 through 3, consistent with the possibility that students from countries with established transit systems bring different baseline expectations to their evaluations of public transportation. However, this positive orientation reversed on Factor 4 (Stigmatization), where international students reported significantly higher levels of stigma and safety concerns than domestic students. Factor 5 did not differ by international student status. The Factor 4 reversal may suggest that international students who are accustomed to using transit are more attuned to the social dynamics and safety concerns associated with American public transit specifically, or it may reflect cultural differences in baseline safety expectations. The cross-sectional design of the present study cannot distinguish between these accounts.

One observation that emerges from the demographic analyses, when considered alongside the experimental findings, is worth noting. Political orientation and international student status appeared to predict the factors that the experimental manipulation did not have a measurable effect on (Factors 1 through 4 and the Total Attitude Score). The experimental manipulation moved the one factor that political orientation could not predict (Factor 5). This complementary pattern is suggestive: it is possible that the dimensions of transit attitudes most susceptible to mode-specific schema activation are those least tied to stable identity commitments, while the dimensions most tied to identity are those most resistant to brief visual priming. A third strand of evidence converges on this same split: the intraclass correlations. Factors 1 through 3, dimensions predicted by political orientation and international student status, also show classroom-level clustering (ICCs of .09 to .19). This is consistent with attitudes that vary systematically across the social contexts students inhabit, especially on a diverse campus where many

pools of students were used. Factor 5, the only factor moved by the experimental manipulation, showed essentially zero clustering ($ICC < .001$). This is consistent with perceptions of how well transit systems function being more individually variable and less tied to the identity-level commitments that may have grouped students into classrooms in the first place. However, this interpretation is based on the conjunction of separately analyzed effects rather than on a formal test of interaction and should be treated as a hypothesis for future research rather than a confirmed finding.

Limitations

Several limitations constrain the interpretation of these findings. First, the sample consisted exclusively of students at a single university in the St. Louis metropolitan area, a car-dependent region with limited public transit infrastructure. The schemas held by non-riders in this context may not generalize to populations in transit-rich cities, to older adults, or to individuals with different levels of transit experience.

Second, the priming stimulus was a 6-minute silent video. This was an intentionally minimal manipulation designed to test whether even brief exposure could activate mode-specific schemas. It is possible that a more sustained or multimodal prime would produce effects on a broader range of attitudinal dimensions. The narrow scope of significant findings may reflect the limitations of the prime rather than the absence of broader schematic differences. While a considerable amount of effort was put into making these videos non-biased and as consistent as possible, it is not out of the question that experimenter bias in selecting and arranging videos or pictures may have somehow affected the stimuli and results.

Third, the study used classroom-level randomization, which introduces clustering effects. While ICCs were computed and linear mixed models were used where appropriate, the effective sample size for between-condition comparisons is constrained by the number of classrooms (22) rather than the

number of individual participants (227). This limits statistical power for detecting small effects. The participating classrooms varied considerably, and the type of professor willing to host such a study may have affected the results. Similarly, courses with the schedule flexibility to accommodate a 20-minute session may differ from those without, introducing additional unknown bias.

Fourth, the 44 individual item analyses were exploratory and subject to inflated familywise error rates. Only TSQ31 would survive a Bonferroni correction. The item-level patterns were identified post hoc based on interpretive coherence rather than on a priori predictions. Although the broad concepts these items were designed to capture also emerged in the factor structure, the item-level findings should be regarded as hypothesis-generating rather than confirmatory.

Fifth, the TSQ was constructed for this study and has not been validated as a standalone instrument. Of the 44 items, 13 did not load cleanly onto any retained factor in the EFA. Factor 5, the dimension on which the only significant condition effect emerged, had only four items and the lowest internal consistency of any factor ($\alpha = .731$). Several of the non-loading items (TSQ7, TSQ10, TSQ31) nonetheless produced significant condition effects, suggesting the existing five-factor structure may not capture all of the meaningful dimensions of transit perceptions. The Total Attitude Score, which aggregates all 44 items including those that did not load, may be a noisier index of overall attitudes than is ideal. A refined version of the scale would provide a more sensitive test of the effects observed here.

Sixth, the present design can detect that schemas differ by transit mode but cannot directly measure what those schemas contain. The inferences about navigational complexity and underground infrastructure are drawn from the pattern of significant items, not from direct assessment of schema content.

Seventh, all measures were self-report and administered on paper in a classroom setting, introducing the possibility of demand characteristics and social context effects that would not be present in individual testing.

Eighth, the study was conducted at a single time point, so we cannot assess whether the observed priming effects were transient or reflect more durable cognitive representations. No baseline measures were taken prior to the priming condition, and all comparisons are between-groups only.

Future Research

Several directions for future research emerge from these findings. First, the subway depression effect should be replicated in samples with different levels of transit experience and in different urban contexts. Populations in transit-rich cities may carry qualitatively different subway schemas than the non-rider sample studied here.

Second, future studies should attempt to decompose the content of mode-specific transit schemas using qualitative methods. Semantic differential measures, free-association tasks, or think-aloud protocols administered after mode-specific priming could identify the specific associations that drive the evaluative differences observed here.

Third, the present study could be complemented by a direct comparison design in which participants are explicitly asked about specific transit modes without any priming. Comparing explicit mode evaluations against the priming-based evaluations from the present paradigm would clarify the added value of the priming methodology.

Fourth, the TSQ31 finding regarding civic duty warrants replication with a design that compares riders and non-riders, which would allow a direct test of the cognitive dissonance interpretation.

Fifth, the role of political orientation as a predictor of transit attitudes could be investigated within an experimental framework. A design that crosses political orientation with priming conditions as factorial variables could test whether political identity moderates susceptibility to mode-specific priming.

Sixth, the practical implications of the subway-tram distinction could be investigated through applied research. If transit agencies considering new rail investments are choosing between subway-style and tram-style systems, understanding how each activates different public schemas could inform public engagement strategies.

Seventh, the stigma paradox observed among international students (more favorable overall attitudes but higher stigma concerns) could be explored through qualitative interviews to understand what specific safety and social concerns this population associates with American transit systems.

Eighth, the TSQ should be refined into a validated instrument before further use. A refined scale would retain the items that loaded cleanly onto the five-factor structure observed here and would also expand the factor structure to capture the signal from items that produced significant condition effects despite not loading on any retained factor, such as items measuring system inclusivity and civic duty. Factor 5 could be broadened as it was the dimension with the strongest factor-level condition effects yet had the fewest items and lowest internal consistency. Confirmatory factor analysis on a new sample could then test whether this expanded structure replicates. A cleaner and more comprehensive instrument would reduce the item noise that may have masked priming effects in the present study and would allow more sensitive tests of mode-specific schema activation in future replications. The study itself could also be replicated on a larger scale, with more universities in St. Louis, other cities, and non-university young adults, to see if a more sensitive instrument paired with a larger sample reveals nuances the current design could not.

Conclusion

The present study used a video prime to examine the schemas that young adult non-riders hold for bus, tram, and subway transit. We expected a blanket rail preference, but our hypothesis was rejected; we did not find an overall preference for rail over bus. What the design did reveal was a meaningful divergence between rail subtypes: subway imagery depressed perceptions of reliability and convenience, while tram imagery did not, and converging item-level patterns reinforced this subway-tram split.

At the outset of this study, St. Louis was considering a \$1.1 billion light rail expansion. In contrast to the current subway style MetroLink, this would have been a tram style system that would run at street level through a well-traveled urban corridor. The project was canceled during the course of this research. The findings reported here offer a limited but empirically grounded perspective on the psychological dimension of such investments. Our priming methodology suggested that tram imagery does not broadly activate negative schemas among non-rider young adults; it either improves perceptions or leaves them largely undisturbed (with the exception of Pattern E). Subway imagery, however, was associated with reduced perceptions of reliability and convenience. St. Louis's existing MetroLink system (akin to the subway imagery used in this study) may carry negative schematic associations that the proposed tram-style Green Line would not have evoked.

Our findings suggest these two types of rail investment may not be interchangeable in the minds of potential riders. As discussed in the demographic analyses above, the present findings suggest that transit attitudes among non-rider young adults may be influenced by at least two distinguishable sources. One is mode specific and schema-driven, captured here primarily by Factor 5, in which visual associations with different transit modes color perceptions of how well transit systems function. This dimension responded to the brief priming manipulation and was not

significantly related to political identity. The other is demographic and identity-driven, captured by the remaining factors and the Total Attitude Score, in which transit attitudes are shaped by political orientation, international experience, and cultural context. This dimension was resistant to brief visual priming but powerfully predicted by who the participant was. For cities seeking to increase transit ridership among young adults, both dimensions may warrant attention: not only the functional characteristics of the system being built, but also the broader identity-level associations that shape how non-riders think about public transportation.

Finally, the psychological rail factor as it is currently defined may require refinement. Rather than treating rail as a single psychological category, the present finding suggests that different rail modes may evoke meaningfully different associations. Tram and subway may not be interchangeable in how they are perceived, and future work should distinguish between them rather than assuming a uniform rail advantage. The present study does not reject the psychological rail factor outright, but it does suggest that “rail” may be too broad a category to be used analytically without distinction.

References

- Abdulrazzaq, L. R., Abdulkareem, M. N., Mat Yazid, M. R., Borhan, M. N., & Mahdi, M. S. (2020). Traffic congestion: Shift from private car to public transportation. *Civil Engineering Journal*, 6(8), 1547-1554. <https://doi.org/10.28991/cej-2020-03091566>
- Cain, A., & Flynn, J. (2013). Examining the ridership attraction potential of bus rapid transit: A quantitative analysis of image and perception. *Journal of Public Transportation*, 16(4), 63-82. <https://doi.org/10.5038/2375-0901.16.4.4>
- Cain, A., Flynn, J., McCourt, M., & Reyes, T. (2009). Quantifying the importance of image and perception to bus rapid transit (Project No. FTA-FL-26.7109.1009.3). Center for Urban Transportation Research, University of South Florida.
- Cigu, E., Agheorghiesei, D. T., Gavriliuță, A. F., & Toader, E. A. (2019). Transport infrastructure development, public performance and long-run economic growth: A case study for the EU-28 countries. *Sustainability*, 11(1), 67. <https://doi.org/10.3390/su11010067>
- Coates, Z., Brown, S., & Kelly, M. (2025). Exploring impacts of environmentally focused imagery on pro-environment behaviours and climate anxiety. *Climate*, 13(6), 128. <https://doi.org/10.3390/cli13060128>
- Erhardt, G. D., Hoque, J. M., Goyal, V., Berrebi, S., Brakewood, C., & Watkins, K. E. (2022). Why has public transit ridership declined in the United States? *Transportation Research Part A: Policy and Practice*, 161, 68–87. <https://doi.org/10.1016/j.tra.2022.04.012>
- Festinger, L. (1957). *A theory of cognitive dissonance*. Stanford University Press.
- Hensher, D. A., & Mulley, C. (2015). Modal image: Candidate drivers of preference differences for BRT and LRT. *Transportation*, 42(1), 7-23. <https://doi.org/10.1007/s11116-014-9516-7>
- Higgins, E. T. (1996). Knowledge activation: Accessibility, applicability, and salience. In E. T. Higgins & A. W. Kruglanski (Eds.), *Social psychology: Handbook of basic principles* (pp. 133-168). Guilford Press.
- Klein, N. J., Ralph, K., Thigpen, C., & Brown, A. (2022). Political partisanship and transportation reform. *Journal of the American Planning Association*, 88(2), 163-178. <https://doi.org/10.1080/01944363.2021.1965495>
- Land Transport Authority Academy. (2011). Passenger transport mode shares in world cities. *Journeys*, 11, 54-64.
- Meade, A. W., & Craig, S. B. (2012). Identifying careless responses in survey data. *Psychological Methods*, 17(3), 437-455. <https://doi.org/10.1037/a0028085>
- Metro Transit. (2025). System profile: Statistics and information from fiscal year 2024. <https://www.metrostlouis.org/metro-transit-system-profile/>
- Ramos, S., Vicente, P., Passos, A. M., Costa, P., & Reis, E. (2019). Perceptions of the public transport service as a barrier to the adoption of public transport: A qualitative study. *Social Sciences*, 8(5), 150. <https://doi.org/10.3390/socsci8050150>
- Roskos-Ewoldsen, D. R., Roskos-Ewoldsen, B., & Dillman Carpentier, F. R. (2002). Media priming: A synthesis. In J. Bryant & D. Zillmann (Eds.), *Media effects: Advances in theory and research* (2nd ed., pp. 97-120). Lawrence Erlbaum Associates.
- Scherer, M., & Dziekan, K. (2012). Bus or rail: An approach to explain the psychological rail factor. *Journal of Public Transportation*, 15(1), 75-93. <https://doi.org/10.5038/2375-0901.15.1.5>
- Tajfel, H., & Turner, J. C. (1979). An integrative theory of intergroup conflict. In W. G. Austin & S. Worchel (Eds.), *The social psychology of intergroup relations* (pp. 33-47). Brooks/Cole.

Utsunomiya, K., & Shibayama, T. (2021). Rail bonus: An empirical study onto relative valuation of railways in Austria. *Transport Policy*, 113, 37-45. <https://doi.org/10.1016/j.tranpol.2020.04.005>

Weyrich, P. M., & Lind, W. S. (2003). How transit benefits people who do not ride it: A conservative inquiry. *Free Congress Foundation*. https://www.apta.com/wp-content/uploads/Resources/resources/reportsandpublications/Documents/how_transit_benefits.pdf