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Measuring how harassment type and experiences impacts personal safety perceptions of women on urban rail

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1 Introduction

There are a range of congestion relief, economic productivity and environment benefits which growing cities can generate by increasing urban rail ridership (Currie, 2021). However personal safety concerns on public transport remain a major barrier to increased rail use, particularly for women (Currie et al., 2013). Harassment of women on public transport is widely recognised as a major factor influencing personal safety and placing a 'personal burden' on women (Gekoski et al., 2015). There is little research on how past harassment experience can be empirically measured to determine its influence on perceived safety.

This research paper aims to explore how the harassment experience of women urban rail passengers acts to influence their perceived safety. It explores past experience of harassment during their adolescence as well as recent experience (in the last year of travel) including personal and observational experience. Data was collected by administrating an online survey of women rail users in Melbourne, Australia. Structural equation modelling (SEM) from 526 responses is developed to explore factors influencing perceived safety including verbal and physical harassment and mitigating factors such as ethnicity and personality traits. The contribution of the present study is two-fold; first, experience with physical and verbal harassment is measured for its influence on perceived safety with the adoption of precautionary measures, termed precautionary perceived safety (PPS). Second, the study examines past experience during adolescence on PPS.

The paper is structured as follows; the next section provides a description of the research approach, including a description of the online survey and an outline of the analytical theory behind the research. Results are then presented. The paper concludes with a summary of key findings and an outline of the implications for practice and future research.

2 Methodology

The research aims to measure the links between harassment experiences and perceptions of personal safety for women rail users. The research hypothesis and proposed theoretical model are firstly described, followed by an outline of the analytical approach adopted to test these hypotheses. The online survey tool used to collect data from women rail users is also outlined.

2.1 Conceptual framework

Figure 1 illustrates the conceptual framework proposed. This framework posits that Perceived Precautionary Safety (PPS) is a coping response to past harassment on transit. PPS involves precautionary behaviours such as hypervigilance, rerouting, or avoiding travel after dark. Harassment experiences, particularly during adolescence, can shape personality traits and lead to long-term adaptive coping behaviours in adulthood. The framework also accounts for

travel (e.g., mode, frequency, time of day) and socio-demographic characteristics as control variables to assess their influence on PPS. The conceptual framework integrates the "Stranger Harassment Index" (Fairchild & Rudman, 2008) and modified Physical Aggression Scale-PHYSAGG" (Huesmann, 1977) to understand the harassment experience. Moreover, the "State-Trait Anxiety Inventory (STAI)" (Spielberger et al., 1971) is applied to measure individual's general anxiety level and its effect on the PPS.

The following research hypotheses are tested in this study:

H1: PPS is directly related to the harassment experience on transit

H2. Harassments negatively influences the safety perception on transit

H3: Harassment experience influences individual's personality traits (e.g., anxious, secure)

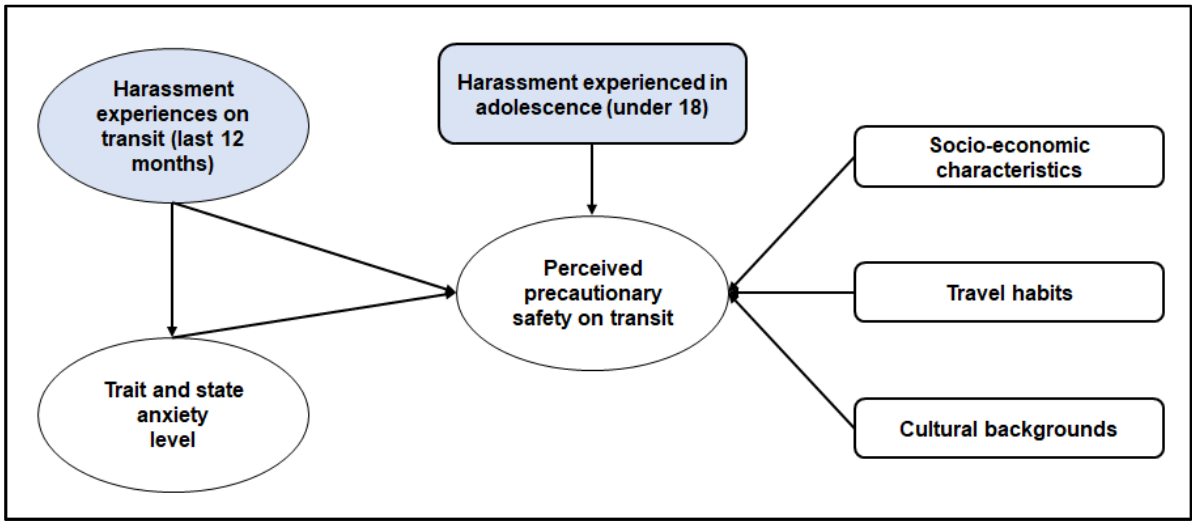
H4. PPS is negatively associated with individuals with higher anxiety traits

H5. PPS is positively associated with individuals with secure traits

H6. Past harassment experience in adolescence is negatively associated with PPS

H7. Individuals from different cultural and linguistic backgrounds perceive transit as less safe even with precautionary measures

Figure 1: Conceptual framework



2.2 Rail passenger survey design and administration

Questions in the survey were designed to understand harassment experience of women rail users, their perceptions of personal safety and collect data on a range of potential explanatory factors that may also influence perceived safety.

The verbal and non-verbal harassment experience on transit in the last 12 months were measured adopting the Stranger Harassment Index and physical harassment were measured adopting the PHYSAGG scale in the transit context; using a 7-point Likert scale ranging from *strongly disagree (1) to strongly agree (7).*

The questionnaire included both personal and observed experience of **non-verbal** (e.g., intimidation, staring etc.), **verbal** (e.g., catcalls, crude & offensive sexual remarks etc.), and **physical** assaults (e.g., physical harm not involving weapon & hospitalisation, threatening with a weapon etc.) while travelling with transit.

Harassment experiences during adolescence were measured using the same items as above but not on a Likert scale or frequency-based format due to potential recall bias. Given the time elapsed, respondents may have difficulty accurately recalling the number of incidents. To

reduce cognitive burden and enhance data reliability, a binary (yes/no) response format was used to indicate whether such experiences occurred.

Another critical issue explored in this survey is to understand the impact of harassment experience on individuals state and trait and its subsequent impact on PPS. Spielberger's (1971) 20-item State-Trait Anxiety Inventory (STAI) were applied to measure the general state and trait of any individual, which is hypothesised to be impacted by harassment experience on transit. The respondents were asked to reflect on their daily life and rate their general feelings (e.g., I feel calm, I feel tense etc.) based on a 5-point Likert scale ranging from *never (1) to always (5).* In addition to ethnicity, this study also explored the affinity with culturally and linguistically diverse (CALD) communities. Australia's population includes many people who were born overseas, have a parent born overseas or speak a variety of languages. Together, these groups of people are known as culturally and linguistically diverse (CALD) populations (Government, 2018) . A potential transit market exists across CALD communities, and hence their coping behaviour while travelling on transit is explored in this study (ABS, 2021).

A primary online survey was administered in Melbourne, Australia, using a market research panel. The survey was approved by the Monash University Human Research Ethics Committee. This targeted Melbourne rail users who identify themselves as women and used metro trains at least once a year, aged over 18.

2.3 Analytical approach

Data analysis involved Exploratory Factor Analysis (EFA) using Principal Axis Factoring with Varimax rotation, followed by Confirmatory Factor Analysis (CFA) and Structural Equation Modelling (SEM). Reliability and validity were confirmed with Cronbach's Alpha and KMO tests, and no multicollinearity issues were found as all VIF values were below 5. Normality was assessed, and due to skewness beyond +2, bootstrapping was applied. SEM was then used to examine the relationship between harassment experiences, PPS, and coping behaviours, linking latent motivational factors to observed indicators. Models were estimated in SPSS-AMOS (v26) with robust Maximum Likelihood, and the goodness-of-fit was evaluated using Comparative-Fit-Index (CFI), Tucker-Lewis-Index (TLI) and Root Mean Square Error of Approximation (RMSEA).

3 Results

The survey yielded 528 valid responses from women rail users. Rail frequency included 25% commuting 3–4 days per week, 21% commuting 5 days per week, and another 21% using it 1–2 days per week. Additionally, 37% reported travelling by rail after dark up to 3 days a week. Most participants (62%) had regular access to a private car, while only 5% could be classified as captive riders. While the average commute time by rail in Melbourne (including walking, waiting, and travel) is 47 minutes (Saunokonoko & Blancato, 2021), more than half of the sample (65.9%) travel up to 50 minutes with metro trains. Over 20% of participants use the train as their primary mode of transport, while another 23% combine train and tram for their daily travel. The sample includes relatively few bus users, as the survey primarily targeted metro rail users in Melbourne.

Nearly half of the sample (49.6%) are full-time employees, and 42.8% hold an undergraduate university degree. In terms of race and ethnicity, 36% identified as European, 30% as Pacific Islander, and 20% as Asian, while 6.7% identified as First Nations people. Additionally, 13% of participants self-identified as part of the CALD (Culturally and Linguistically Diverse) community, and 11% as members of the LGBTIQA+ community.

Harassment on transit was measured using the Street Harassment Index, which captured both personal and witnessed experiences. The frequency of harassment was categorised as: i) Never, ii) Low frequency – once in the past 12 months, iii) Medium frequency – once a month or less, and iv) High frequency – 2 to 4 times per month or more. Results indicate that non-verbal forms of harassment, such as intimidation and persistent staring, were the most commonly reported experiences among women rail users in the past year. One in 25 women

reported experiencing direct or explicit pressure for sex. While most participants did not report serious physical assaults, at least 16% had experienced some form of physical harm on transit, and a small number had been hospitalised as a result. The results regarding witnessing harassment on transit showed similar patterns, with frequent observations of intimidation, catcalling, and discriminatory remarks. Notably, the frequency of witnessing harassment and assault was slightly higher than that of personally experiencing it.

The self-reported frequency of harassment in adolescence indicates that most participants experienced harassment. Common experiences included frequent intimidation (50%), catcalling (42%), unwanted attention (38%), and discriminatory remarks (31%) while using transit. Participants were also asked whether their overall experience or perception of harassment had affected their rail use in Melbourne. Nearly half (47%) reported that it had influenced their travel behaviour, with 24% stating they regularly travel significantly less and another 25% reporting they travel somewhat less.

Participants also self-reported their overall perceived personal safety on transit in Melbourne, including concerns about crime and anti-social behaviour. The results indicate a strong tendency to adopt precautionary or coping behaviours to feel safer such as being hyper-vigilant even during the day or avoiding travel after dark. This is in line with a recent Australian study where women discussed the “safety work” or precautionary measures that they undertook to mitigate risk on public transport, which is also perceived as a personal safety burden on five dimensions - cognitive, temporal, emotional, financial and social (King et al., 2025).

3.1 Model estimation

The sample validity, reliability and adequacy were tested in exploratory factor analysis (EFA) with Cronbach’s Alpha = 0.941>0.90 and KMO = 0.925>0.90, confirming its suitability for CFA and SEM estimation (as per (Miller, 1995; Sofroniou & Hutcheson, 1999). The standardized loadings in CFA analysis for this sample were mostly between 0.60 and 0.86, as shown in Table 6. Initially, 49 items were used in the EFA, which resulted into 5 factors: i) *verbal harassment, ii) physical harassment, iii) anxious trait, iv) secure trait, and v) perceived precautionary safety (PPS)*. Items with factor loadings less than 0.40 in the EFA was not included in the final CFA analysis as these have lower influence/significance. The measurement model confirmed that all observed variables were valid indicators of their latent constructs, with critical ratios exceeding 1.96. The structural model (Table 1) shows the strength of the relationship between different latent and observed variables.

The SEM analysis identified harassment experiences as significant determinants of perceived precautionary safety (PPS), with effects varying by harassment type and personality traits. Standardized coefficients from Table 1 highlight the following **key findings:**

- **Harassment and PPS**
  - Verbal harassment (+0.41) and physical harassment (–0.32) are the strongest predictors of PPS.
  - Hypothesis 1 confirmed; PPS is directly related to harassment, though direction differs by type.
- **Verbal vs. physical Harassment**
  - Verbal harassment is more frequent and widespread among women rail users.
  - Women with verbal harassment history adopt precautionary behaviours and feel relatively safer; rejects Hypothesis 2.
  - Physical harassment is less frequent but severely undermines feelings of safety, even with coping behaviours; confirms Hypothesis 2.
- **Personality traits and PPS**
  - Verbal harassment linked with anxiety traits (tense, worried, strained, jittery).
  - Physical harassment linked with both secure and anxious traits, with anxiety stronger.
  - Hypotheses 4 & 5 confirmed: both secure and anxious traits relate to PPS.

- Secure traits enhance perceived safety when using precautionary measures; anxiety was not significant but negatively associated, consistent with theory.

Table 1: Structural model

Hypothesised relationships	Estimate (Std. Error)	Std. coefficients	Critical Ratio	Hypothesis
Verbal harassment → PPS	.492 (0.106)	0.41	4.631***	Supported
Physical harassment → PPS	-.402 (0.120)	-0.32	-3.342***	Supported
CALD → PPS	-.531 (0.165)	-0.15	-3.227***	Supported
Intimidation experience in adolescence → PPS	-.332 (0.122)	-0.14	-2.733**	Supported
Tram → PPS	-1.146(0.190)	-0.32	-6.023***	Supported
All PT mode → PPS	-.384(0.160)	-0.11	-2.405*	Supported
Trip duration (up to 50minutes → PPS	-.294 (0.153)	-0.12	-1.925*	Supported
Aboriginal origin → PPS	.777(.237)	0.18	3.279***	Supported
After dark PT use frequency (medium) → PPS	-.471(0.154)	-0.20	-3.054***	Supported
After dark PT use frequency (high) → PPS	-.423(0.188)	-0.17	-2.242*	Supported
Anxious trait → PPS	-.033(0.166)	-0.02	-.282 N.S.	Not supported
Secure trait → PPS	.315(0.094)	0.17	3.366***	Supported
Verbal harassment → Anxious	.082(0.042)	0.13	1.966*	Supported
Physical harassment → Anxious	.313(0.045)	0.47	6.982***	Supported
Intimidation experience in adolescence → Anxious	.009(0.054)	0.01	.169 N.S.	Not supported
Verbal harassment → Secure	-.084(0.049)	-0.13	-1.720 N.S.	Not supported
Physical harassment → Secure	.133 (0.049)	0.19	2.704**	Supported
Intimidation experience in adolescence → Secure	-.193(0.064)	-0.14	-3.010***	Supported
Significance level, P at <0.001***, <0.01**, and <0.05*; N.S.=Not Significant; Model fit: $\chi 2 = 4683.45$, df = 2269, p < 0.001, CFI = 0.917≥0.90; TLI = 0.904 ≥0.90; SRMR= 0.069≤ .08; RMSEA = 0.045 ≤ .08				

4 Discussion and conclusions

This study offers new insights into the factors shaping women's perceived precautionary safety (PPS) on transit in Melbourne. The findings highlight the need for policy intervention that includes trauma-informed, intersectional approaches to transit personal safety. Addressing harassment requires early prevention, beginning with education and awareness campaigns in schools and among young transit users to reduce risks during adolescence. Safer after-dark travel should be prioritised through improved lighting, visibility, and proactive staff presence at stations and stops, supported by digital solutions such as real-time emergency reporting apps that allow users to seek immediate assistance. Importantly, transport planning must incorporate the lived experiences of diverse groups, including CALD and Indigenous women, to ensure that interventions reflect varied safety perceptions and coping behaviours. Beyond infrastructure, behavioural and emotional safety measures are critical, including bystander intervention training, enhanced reporting support systems, and gender-sensitive staff

responses. Finally, participatory co-design processes that directly involve women riders in shaping policies and environments can create more inclusive and trusted transit systems, embedding safety as both a practical and perceived outcome of everyday travel.

A holistic focus on both physical and psychological safety is essential for equitable transit. This study advances knowledge by linking adolescent harassment and personality traits to coping behaviours, though its focus on Melbourne rail users limits broader applicability and intersectional depth. Future research should draw on more diverse samples and longitudinal designs to capture how harassment shapes safety perceptions over time.

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