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Article

The Rise of the 'Technological Motorcyclist': Exploring the Predictors of Digital Distractions in Motorcycle Commuting

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ABSTRACT

Background/aim: The increasing integration of digital technology into daily life has introduced new challenges for road safety, particularly for groups of interest, such as motorcycle commuters. This study examines individual, road safety-related, and psychosocial work factors as predictors of technology-induced distractions among motorcyclists. **Method:** Using a sample of 736 Powered Two-Wheeler (PTW) commuters, gender-specific pathways of digital distractions were analyzed through Structural Equation Modeling (SEM) and Multi-Group Structural Equation Modeling (MGSEM). **Results:** The results suggest that younger riders, those with higher sensation-seeking tendencies, and those involved in other risk-related behaviors outside the technological sphere report higher levels of distraction. Work-related stress, particularly job strain, was a strong predictor of digital distractions, while a better work-life balance served as a mitigating factor. Regarding gender differences, sensation seeking and risk perception played a significant role among males, whereas commuting trip length was a stronger predictor of distractions for female riders. **Conclusions:** These findings highlight the need for gender-sensitive interventions to reduce technological distractions, considering both individual and work-related factors.

El Auge del 'Motorista Tecnológico': Explorando los Predictores de las Distracciones Digitales en la Conducción de Motocicletas

RESUMEN

Antecedentes/objetivos: La creciente integración de la tecnología digital en la vida cotidiana ha introducido nuevos desafíos para la seguridad vial, particularmente en grupos de interés como los motociclistas. Este estudio examina los factores individuales, relacionados con la seguridad vial y psicosociales del trabajo como predictores de las distracciones inducidas por la tecnología en motoristas. **Método:** Utilizando una muestra de 736 motoristas, se analizaron las trayectorias específicas de distracción tecnológica mediante Ecuaciones Estructurales (SEM) y Ecuaciones Estructurales Multigrupo (MGSEM). **Resultados:** Los resultados sugieren que los motociclistas más jóvenes, aquellos con mayores tendencias a la búsqueda de sensaciones y aquellos involucrados en otros comportamientos de riesgo fuera del ámbito tecnológico reportan niveles más altos de distracción. El estrés laboral fue un predictor significativo de distracciones digitales, mientras que el equilibrio entre la vida laboral y personal actúa como factor protector. En cuanto a las diferencias de género, la búsqueda de sensaciones y la percepción del riesgo fueron predictores significativos entre los hombres, mientras que la duración media del trayecto fue un predictor más fuerte de distracciones en las mujeres. **Conclusiones:** Estos hallazgos subrayan la necesidad de intervenciones sensibles al género para reducir las distracciones tecnológicas, considerando tanto factores individuales como laborales.

Palabras clave:
Conductas relacionadas con el riesgo
Estrés laboral
Percepción del riesgo
Búsqueda de sensaciones
Equilibrio entre la vida laboral
Diferencias de género
Seguridad vial

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Introduction

Over the past four decades, the use of Powered Two-Wheelers (PTWs) for daily commuting has grown steadily across most regions of the world, largely driven by their convenience and efficiency in urban mobility (Rodriguez-Valencia et al., 2024). This trend is particularly pronounced in regions with a high motorcycle share, such as Latin America and Southeast Asia (Aritenang, 2024; De Sá et al., 2017; Delpino-Chamy et al., 2024; Oxley et al., 2013).

However, given that motorcycles remain the most dangerous mode of road travel (Directorate-General for Mobility and Transport, 2024), an ongoing debate persists over whether the benefits of motorcycle commuting outweigh the risks, as extensive research continues to document both health and safety concerns associated with their use for intensive activities such as work or daily commuting (Honda et al., 2022; Kiwango et al., 2024; Lin et al., 2017; Wu & Loo, 2016).

Moreover, due to the distinctive risk-related characteristics of motorcycle commuting in high-use regions, multiple studies have suggested that improving road safety for motorbike commuters requires structured interventions at various levels, including mandatory training programs, stricter licensing processes, and regular vehicle inspections (Chouhan et al., 2024; Directorate-General for Mobility and Transport, 2024; Fadaei et al., 2021). However, more recent findings have expanded this discussion, highlighting not only safety risks but also the broader health and well-being implications for motorcycle commuters (Roberts et al., 2011; Rose & Delbosc, 2016; Yousif et al., 2020). Among these, research suggests that occupational factors such as work-related stress, insufficient work-life balance, and demanding job dynamics can significantly affect commuting safety outcomes, particularly among individuals who rely on their vehicles for work-related travel (Anggraini et al., 2024; Cendales et al., 2023).

At the same time, an emerging concern is the growing reliance on connected technological devices such as mobile phones, GPS systems, and in-helmet communication tools during motorcycle trips (Nguyen-Phuoc et al., 2020). In this regard, most studies consistently suggest that increased interaction with technology heightens safety risks, mirroring patterns observed among drivers, cyclists, and other road users worldwide (Nguyen-Phuoc et al., 2020; O'Hern & St. Louis, 2023; Oviedo-Trespalacios et al., 2016). While road distraction has been extensively studied in relation to car driving (Okati-Aliabad et al., 2024; Rahmillah et al., 2023; Useche et al., 2024a), recent research highlights that motorcyclists face even greater risks when engaging with digital devices due to their increased exposure to environmental hazards, performance impairments, and reduced physical protection (Boulagouas et al., 2024; Lemonakis et al., 2021; Nurul-Huda & Radot, 2024; Truong et al., 2018).

Motorcycle Commuting in South European Cities

While these trends have been thoroughly examined in several regions worldwide, the figures, motives, and specific risks associated with commuting via Powered Two-Wheelers (PTWs) in Central and South Europe remain underexplored, despite their frequent use in many major cities (Kraft et al., 2024; Marquet & Miralles-Guasch, 2016; Navarro-Moreno et al., 2023).

Put differently, empirical evidence is significantly lacking in countries where motorcycles are widely used for daily commuting but do not report the exceptionally high accident rates observed in many developing regions. This does not necessarily indicate an absence of latent risks that could compromise the safety and well-being of these road users, whose accident figures remain alarming at a regional level (European Commission, 2020). Rather, it suggests that unique urban planning policies, infrastructure adaptations, and possibly differing rider behaviors or safety regulations may contribute to lower crash rates (Chouhan et al., 2024).

Moreover, motorcycle commuting in Europe, particularly in Spain, presents a complex landscape influenced by factors such as urban congestion, environmental policies, and economic considerations (Dorantes-Argandar et al., 2024; Useche et al., 2023). According to the latest EU Transport Report, motorcycles play a significant role in urban mobility, especially in Southern European countries, where favorable weather conditions, urban density, road infrastructure, and commuting habits favor powered two-wheeled transport (Directorate-General for Mobility and Transport, 2024).

In Spain, motorcycles constitute a notable share of the vehicle fleet, and the existing data support that motorcycle commuting is a common alternative to cars, particularly for short to medium-distance trips (Díez-Navarro et al., 2024; Marquet & Miralles-Guasch, 2016). However, despite their efficiency and ease of use, Spanish epidemiological data highlight that motorcycles remain associated with a higher crash risk than other transport modes.

Among other figures, it is worth noting that in 2023 alone, 485 Powered Two-Wheeler users died in traffic crashes, accounting for 25.13% of all fatal victims. Unusually, this number even exceeds pedestrian fatalities (353; 19.54% of total), despite pedestrians typically being considered the most vulnerable road users (Dirección General de Tráfico [DGT], 2024). Moreover, while PTW riders only represent approximately 10% of the vehicle fleet, they are involved in 25-30% of severe crashes annually (DGT, 2024). Furthermore, due to their limited passive safety features, motorcycle riders face a 20-fold higher risk of fatality per kilometer traveled compared to car occupants – especially among frequent users, whose greater exposure increases their vulnerability (Díez-Navarro et al., 2024; Perez-Fuster et al., 2013).

Individual Factors and Road Distraction

While more evidence is needed to categorically affirm this across all possible groups, certain sociodemographic and psychological characteristics have been shown to play a significant role in explaining why some road users are more prone to technological distractions, which, in turn, can increase their risk of road crashes. Previous studies have shown that individual factors, such as age, gender, and personality traits, are strong predictors of users' likelihood to engage in riskier behaviors, including those technology-related (Nurul-Huda & Radot, 2024; Tinella et al., 2021 & 2024). For instance, younger individuals, who tend to score higher on sensation-seeking scales, seem more likely to engage with their smartphones, GPS systems, or other connected devices while driving or riding vehicles, thus increasing their exposure to distractions (Useche, 2025; Zhang et al., 2019).

Sensation seeking, in particular, has been closely linked to impulsivity and the tendency to engage in high-risk behaviors. Recent studies show that two-wheeler riders with higher sensation-seeking tendencies are often more willing to take risks, such as interacting with technology while riding, due to a greater predisposition to seek excitement and novelty (Gianfranchi et al., 2017; Useche et al., 2025). This impulsivity, combined with a lower level of self-regulation, can lead to distractions that impair road performance, increasing the likelihood of crashes, as shown in studies with drivers (see Tinella et al., 2021; Traficante et al., 2024).

Moreover, personal trip features, such as longer trip durations, have been associated with an increased likelihood of engaging in technological distractions among road users. For instance, recent research indicates that longer commutes (which imply greater exposure to risk) provide more opportunities for distractions, such as using mobile devices or in-vehicle technologies, especially among individuals with low risk awareness. In this regard, recent evidence consistently show that these distractions can impair road safety performance and increase the risk of crashes (Arevalo-Tamara et al., 2022; Useche et al., 2024a).

Psychosocial Work Factors and Commuting Safety

Work-related psychosocial factors have been increasingly recognized as key determinants of commuter safety, with stress, time pressure, and work-related fatigue being key issues influencing risky behavioral and low-performance road outcomes (Alonso et al., 2020; Cendales et al., 2023; Hoang et al., 2025; Legrain et al., 2015). From a theoretical perspective, studies such as Costa et al. (1988) and Burch & Barnes-Farrell (2020) have highlighted a significant link between job-related stress and impaired driving/riding performance, as it impacts cognitive functioning, enhances impulsivity, and increases the likelihood of engaging in risk-taking behaviors. Additionally, studies by Milner et al. (2017) and Useche et al. (2023) have explored the connection between commuting time and mental health outcomes, suggesting that extra-occupational factors, such as the time spent commuting, may act as an additional source of job-related time stress.

In the specific case of motorcycle commuters, who frequently encounter both job-related pressures (e.g., time constraints) and mobility restraints (e.g., inadequate infrastructure), some studies suggest that prolonged exposure to these conditions, especially when commuting under time pressure and using mixed lanes, may contribute to elevated stress levels, leading to increased crash risks (Clabaux et al., 2014; Gupta et al., 2022; Theofilatos & Yannis, 2015). Interestingly, some studies suggest that these factors not only affect physical riding performance but also contribute to the increased use of technology during both job and commuting time (Mai et al., 2025; Nguyen et al., 2024; Umair et al., 2023). For instance, work-related stress and pressure may lead working population to use digital devices more frequently, either to stay connected to work or manage tasks on the go. This reliance on technology as a coping mechanism can result in distractions, further compromising working riders' road safety (Choudhary & Velaga, 2017; Umair et al., 2023; Useche et al., 2024b).

Moreover, the growing blurring of boundaries between work and personal life, driven by technological progress and enhanced connectivity, has led to an increase in work-related cognitive distractions during commuting. This phenomenon is largely linked to the fact that workers are now more accessible outside regular work hours, extending work-related demands into commuting time and resulting in task interferences (Anttila et al., 2015; Lachmann et al., 2017).

Are Technological Distractions Worsening?

The increasing integration of technology into daily life has raised concerns about its role in traffic safety, particularly regarding distractions among road users (Kun et al., 2024). While much research has focused on technological distractions in the context of car drivers (Arevalo-Tamara et al., 2022; Boulagouas et al., 2024; Oviedo-Trespalacios et al., 2016), with some attention to cyclists (Useche et al., 2018; Wu et al., 2024; De Waard et al., 2010; Oviedo-Trespalacios & Useche, 2024), comparatively fewer studies have explored their implications for motorcyclists (Stavrinos et al., 2018). Additionally, technological distractions in motorcycle commuting may differ from those affecting other road users, due to the particular ergonomic characteristics of motorcycle riding, such as the need for constant balance, greater exposure to external factors, and distinct patterns of visual scanning (Gupta et al., 2022; Ledesma et al., 2023).

In this regard, one key emerging concern is the growing use of mobile phones and wearable devices while riding despite existing regulations. In other words, while most European countries have developed legal frameworks regarding onboard technology distractions (European Commission, 2018), factors such as low enforcement and lack of user adherence practically explain a considerably frequent use across all transport modalities (European Commission, 2024). This phenomenon has been documented among groups of both drivers and riders, showing consistent associations with individual psychosocial factors, such as personality traits –especially sensation seeking–, technological affinity, and attentional outcomes (Albert et al., 2018; Karrer-Gauß et al., 2024; Oviedo-Trespalacios & Useche, 2024; Tinella et al., 2022; Useche, 2025; Useche et al., 2025).

In the specific case of powered two-wheelers, previous studies indicate that some motorcyclists engage in phone use through hands-free systems, voice commands, or even glancing at screens while stopped at traffic lights (Nguyen et al., 2020). However, even seemingly minor interactions can affect cognitive load and situational awareness, delaying reactions to sudden hazards. Additionally, the increasing prevalence of smart helmets and head-up display (HUD) technology, designed to improve navigation and connectivity, raises questions about their potential to distract riders rather than enhance safety (Rahmillah et al., 2023; Useche et al., 2024b).

In Spain, where motorcycles represent a substantial share of urban mobility, the intersection of commuting, work-related demands, and technological distractions remains underexamined. However, the blurring of work-life boundaries is already known to be linked to higher fatigue levels and reduced attentional capacity, which can negatively impact road safety (Gupta et al., 2022; Kim et al., 2024). In other words, it is hypothesized that many commuters may feel compelled to stay connected during their trips, responding to work messages or notifications while riding.

Moreover, given that technological distractions have been growingly documented for other specific types of road users but remain underexplored among motorcycle commuters, and non-conventional individual risk factors and solutions remain underexplored, further research is needed to understand how these factors influence commuting motorcyclists' safety and health.

Study Aim and Hypotheses

This study aimed to examine the predictors of technology-induced distractions among motorcycle/PTW commuters, considering individual characteristics, road safety-related factors, and psychosocial work variables. Given the increasing reliance on digital devices and the occupational demands influencing commuting experiences, this research sought to determine how these factors contribute to self-reported technological distractions while riding. Based on insights from the existing literature, two theory-driven hypotheses were formulated:

Hypothesis 1 (H1): Individual, road safety-related, and psychosocial work factors will present significant and predictive associations with technology-induced distractions among motorcycle commuters.

Hypothesis 2 (H2): Gender differences will emerge in the structural relationships between predictors and technology-induced distractions, with distinct patterns of influence for male and female riders.

Method

Participants

For this cross-sectional research, we used the data retrieved using a full sample of n = 736 daily commuting motorcyclists, with a mean age of M = 47.72 (SD = 10.89), ranging between 18 and 80 years. Among them, 242 (33%) identified themselves as women, and 494 as men (67%). While the option was available in the questionnaire, none of the participants identified themselves as non-binary.

As for their commuting data, the average daily commuting time (measured in minutes per single trip) was M = 26.49 minutes, with a standard deviation of SD = 23.78 minutes. Additional demographic details and commuting-related information about the motorcycle commuters included in the study are summarized in Table 1.

Regarding the representativeness of the study sample (obtained through a pseudo-probabilistic approach due to its specificity), it is important to note that while the sample does not perfectly reflect all demographic characteristics of motorcycle commuters in Spain, certain key similarities exist. First, the mean age of the Spanish population is M = 45.34 years (Instituto Nacional de Estadística [INE], 2024), while the sample average was M = 47.72. Second, while females are estimated to constitute 16–26% of the motorcyclist population, they accounted for 33% of our sample. Moreover, although specific demographic data on motorcycle commuters is unavailable, national statistics from the most recent census (INE, 2024) indicate that approximately 41% of adults have completed secondary/technical education, and 44.7% hold a university degree. In this study, 45.5% of participants had secondary/technical education, and 42% held a university degree.

Study Setting

The data collection for this study was conducted across the different Autonomous Communities (Regions) of Spain. Participants were recruited through pre-existing research email lists maintained by the study authors. Electronic invitations were distributed to a broad audience, containing a link to the questionnaire and an introductory letter. The letter explained the study objectives, emphasized its scientific purpose, detailed the inclusion and exclusion criteria, and described the participation process, which involved completing an anonymous online survey.

The inclusion and exclusion criteria, presented before survey participation, required participants to meet the following conditions: (*i*) being a licensed motorcyclist of legal age, (*ii*) being currently employed and using a PTW/motorcycle for commuting at least three times per week, (*iii*) possessing a minimum of five years of motorcycling experience, and (*iv*) having access to a smartphone, tablet, or computer with an internet connection, which was technically necessary to complete the survey.

The electronic survey began with an introduction outlining its objectives and participation details, presented through an informed consent form that participants were required to acknowledge before continuing. During the pilot phase, completing the questionnaire took approximately 10–15 minutes.

Based on the statistical power analysis, assuming a study with 10 predictors in a two-group comparison, the minimum sample size for each of the two sub-samples (male and female riders) was set at approximately 110-120 participants per group to achieve a statistical power of .800, with a medium effect size (f^2 = 0.15) and an alpha level of .05.

A total of 753 responses were collected, of which 736 were deemed complete and valid, while other 17 were excluded due to incompleteness or failure to meet the exclusion criteria detailed in Section "2.4 Description of the questionnaire". The effective response rate was 48.41%, calculated as 736 valid questionnaires out of about 1,500 invitations sent (736/1500 × 100).

Ethical Issues

Regarding institutional ethical procedures, this study received approval from the Research Ethics Committee at the Research Institute on Traffic and Road Safety (IRB approval number HE00011270324), endorsing its compliance with the general ethical principles outlined in the Declaration of Helsinki. The study was categorized as 'very low risk' since no sensitive personal data were collected beyond basic demographics, commuting habits, and the scales appended in the questionnaire. Participants' anonymity was rigorously maintained throughout, and unnecessary information (e.g., name, place of residence, phone number) was not collected.

Additionally, as recommended by the IRB, only individuals who voluntarily agreed to partake were included in the study after reading and agreeing with the participation conditions.

For this purpose, explicit informed consent was obtained from all participants. This information was presented in the survey homepage, outlining the study's objectives, the scientific nature of the data collection, and the procedures for data management.

Description of the Questionnaire

The electronic questionnaire used in this study was conducted in Spanish, which is spoken across all regions of the country. It was organized into three main sections or thematic blocks:

Individual factors

The first section aimed at collecting commuters' demographic and trip-related data. Participants were initially asked to provide personal details, including age, gender, educational background, income range (in intervals), and current occupation. Following this, they were questioned about their daily travel behaviors, such as the usual length of their trips, and how often they use their motorcycle for commuting, with the latter serving as a filter question, as previously mentioned.

Participants' attitudes towards technology were evaluated using the Technology Affinity Scale (TAEG) (Karrer-Gauß et al., 2024). This self-report questionnaire was used to score of motorcycle riders' technology affinity through a set of 19 items rated on a 5-point Likert scale, ranging from [1 = *totally disagree* to 5 = *totally agree*], with higher scores indicating a greater affinity for technology. The scale's unidimensional internal consistency scores (**α** = .742; ω = .735) indicated satisfactory reliability.

Sensation seeking was measured through the Brief Sensation Seeking Scale, BSSS4 (Stephenson et al., 2003). This is a unidimensional self-report instrument (**α** = .780; ω = .781) consisting of 4 items, each rated on a 5-point Likert scale ranging from [1 = *totally disagree* to 7 = *totally agree*]. The scale aims to measure an individual's attraction to sensations or experiences that provide heightened excitement or arousal, including risky behaviors and the use of technology.

Road safety skills, dynamics, behaviors, and distractions

The Risk Perception and Regulation Scale (RPRS) was used to evaluate motorcycle commuters' perceptions of risk and self-reported knowledge of traffic regulations. Previously adapted and applied to different types of road users (see Arevalo-Tamara et al., 2022; McIlroy et al., 2022; O'Hern et al., 2022), the RPRS comprises 12 items divided into two subscales: (1) risk perception and (2) knowledge of traffic rules. The risk perception subscale (7 items; α = .812; ω = .810) assesses individual awareness of safety-related risks, such as identifying hazardous road conditions or recognizing potential obstacles in their environment. Meanwhile, the knowledge subscale (5 items; α = .745; ω = .748) measures their familiarity with fundamental traffic regulations, including the recognition of standard road conventions and practices.

Self-reported non-technological (N-T) risky riding behaviors were measured using a 9-item version of the Motorcycle Riding Behavior Questionnaire (MRBQ) (Elliott et al., 2007), which has been systematically endorsed as a suitable measure for motorbike riders' self-reported behaviors and predictive value (Chouhan et al., 2023). This five-point Likert-based scale (1 = *never*; 5 = *always*) was used to assess the frequency with which riders engage in a set of self-reported risky behaviors (e.g., running a red light that has just turned red). The scale was scored in its unifactorial version, (α = .782; ω = .778) to obtain a risky behavioral indicator, covering both errors and traffic violations, but excluding technology-related behaviors which could create endogeneity with the dependent variable of the study.

Regarding technological distractions (dependent variable), a 7-item literature-based scale was employed (α = .834; ω = .831). This five-point Likert scale (1 = *not at all*; 5 = *highly distracting*) aimed to evaluate the extent to which motorcycle riders are distracted by various generic technological inputs commonly associated with distractions during commuting trips. The items included: 'Phone calls, using hands-free or helmet communication systems'; 'App notifications, chat messages, or SMSs'; 'Mobile phones, handled by you'; 'Technological devices other than mobile phones, handled by you'; 'Auditory information from earbuds or integrated systems'; 'Electronic information sources present in the city environment'; and 'Advanced Riders' Assistance Systems (ARAS)'.

Psychosocial work factors

Job strain was assessed using the 20-item Job Content Questionnaire (JCQ), following Karasek's JDC model (Karasek et al., 1998), which has been endorsed in several occupational contexts (Santos et al., 2017). The Spanish version of this instrument was initially validated by Gómez (2011) and subsequently psychometrically refined and adapted for Spanish workers by Useche et al. (2021). The reference value of the Job Strain indicator it provides is 1.0; i.e., values exceeding the threshold of 1.0 are interpreted as indicating job strain, suggesting a significant imbalance between work demands and perceived control over them.

Our participants' work-life balance was measured using the Brough's Work-life Balance Scale (WLBS) (Brough et al., 2017). This is a unidimensional (α = .822; ω = .824) Likert-based four-item measure using a five-point scale [1 = *strongly disagree* to 5 = *strongly agree*], whose structure, reliability and validity have been extensively tested and endorsed in several samples of workers of different countries (see Brough et al., 2014 & 2017 for a reference).

Data Analysis

Following the careful preparation of the dataset, which implied deleting incomplete and doubtful responses, we conducted basic descriptive analyses to generate dimensional scores and key statistical measures, such as means, standard deviations, and standard errors, for the scales, based on each test's scoring guidelines. Additionally, to the full sample descriptives, gender-specific descriptive statistics, including 95% confidence intervals, were calculated to enhance the accuracy and reliability of subsequent analyses, reduce potential errors, provide precise variable measurements, and enable meaningful comparisons between gender groups.

After establishing the necessary parameters, such as weighting the samples by gender for comparative purposes, an Analysis of

Covariance (ANCOVA) was performed to investigate gender differences in the study factors, accounting for participants' age and commuting trip length. ANCOVA was selected because it allows for the simultaneous analysis of multiple dependent variables while using covariates to minimize the impact of confounding variables. This approach provides a thorough examination of group differences across outcomes derived from self-reported data. To supplement the statistical results, a tabular representation of the data was created, offering a clear visualization of gender-specific variations and similarities, along with the outcomes corresponding to the full sample.

For the structural analyses, we applied Structural Equation Modeling (SEM) and Multi-Group Structural Equation Modeling (MGSEM) to investigate the multivariate relationships between commuters' demographic, road safety-related, and psychosocial factors –used as predictors– and their technology-induced distractions, which served as the dependent variable. This literature-informed approach offers greater precision than treating gender groups as independent samples. Apart from encompassing both models with latent and/or observed variables, MGSEM allows for the integration of full sample parameters when fitting the models, permits error covariances between exogenous factors, and accounts for third variables (e.g., controlling demographics). From a statistical standpoint, this approach minimizes the influence of demographic confounders, providing more robust and reliable insights into the relationships under study.

To enhance the precision of the model and to account for the influence of other predictors, standardized beta (β) coefficients (representing the magnitude and directionality of each SEM path) were complemented by covarying the error terms of highly correlated exogenous variables. This strategy addresses systematic associations between variables while avoiding unsupported causal inferences. Given that this is a confirmatory procedure, and to avoid model overfitting, structural parameters were freely estimated across groups, and only theoretically justified modification indices were applied. The thresholds for statistical significance were set as follows: $p < .050$ (*), $p < .01$ (**), and $p < .001$ (***), for clarity and consistency in the interpretation of results.

To assess the goodness-of-fit of the structural models, we employed a robust set of indices widely endorsed in the literature. These included the chi-square to degrees of freedom ratio (χ^2/df), also known as the minimum discrepancy ratio (CMIN/df), alongside the Normed Fit Index (NFI), Confirmatory Fit Index (CFI), Incremental Fit Index (IFI), and Root Mean Square Error of Approximation (RMSEA). The evaluation criteria adhered to established benchmarks: a CMIN/df ratio below 5.000, NFI/CFI/IFI values exceeding .900, and RMSEA values under .080 (Hair & Alamer, 2022; Hair & Sarstedt, 2019). To assess the distributions of the employed variables, we evaluated skewness and kurtosis, ensuring that they remained within the ±2 range, which is generally considered acceptable in behavioral sciences. Additionally, bootstrapping procedures were applied to mitigate potential distortions due to non-normality or issues with homoscedasticity (Andrews & Buckinsky, 2000; Efron & Tibshirani, 1994).

Descriptive statistical analyses were performed using IBM SPSS Statistics, version 29.0, while both Structural (SEM) and Multi-Group Structural Equation Modeling (MGSEM) were conducted using IBM AMOS (Analysis of Moment Structures) software, version 29.0.

Results

Descriptive Data

The sample for this study comprised a total of 736 Spanish motorcycle commuters, with a mean age of 47.72 years (*SD* = 10.89; range: 18–80 years). In terms of individual psychological and behavioral attributes, the mean score for sensation seeking levels averaged *M* = 3.16 (*SD* = .83) on a [1 – 7] scale. Participants' technology affinity was *M* = 3.41 (*SD* = 1.09) on a five-point scale. Risk perception was relatively high (*M* = 4.44; *SD* = .52) on a [1–5] scale, while self-reported rule knowledge also presented scores (*M* = 4.37; *SD* = .58). However, the mean score for risky riding behaviors was *M* = 2.15 (*SD* = .90), suggesting a greater degree of variability in self-reported violations and errors.

Regarding work-related psychosocial factors, the job strain index had a mean value of *M* = 1.06 (*SD* = .73), with values exceeding 1.0 generally indicating job-related stress exposure. Additionally, work-life balance received a moderate score (*M*=2.95; *M*=1.16) on a [1–5] scale, suggesting slightly high values compared to previous studies conducted in other countries.

Lastly, the technology-induced distraction scores averaged *M* = 1.49 (*SD* = 1.05). The complete set of descriptive statistics, including means and standard deviations for all study variables, is summarized in Table 1.

Bivariate Tests

The bivariate analyses showed several associations among the study variables. Overall, these findings suggest that both individual (e.g., age, sensation seeking, technology affinity) and occupational (e.g., job strain, work-life balance) factors have significant relationships to technological distractions and risky behaviors among motorcycle commuters.

Age was negatively correlated with both technology-induced distractions ($\rho = -.245$; $p < .001$) and risky riding behaviors ($\rho = -.171$; $p < .001$), suggesting that younger riders remain more susceptible to both technological distractions and non-technological (N-T) risky behaviors. Conversely, age was positively associated with risk perception ($\rho = .095$; $p < .01$), albeit not with rule knowledge ($\rho = .070$; $p = .056$). Additionally, higher technology affinity was linked to greater technology-induced distractions ($\rho = .138$; $p < .001$), suggesting that individuals with stronger inclinations toward technology remain also more prone to its use while riding.

Regarding work-related factors, job strain was positively correlated with technology-induced distractions ($\rho = .477$; $p < .001$) and risky riding behaviors ($\rho = .593$; $p < .001$), suggesting that higher occupational stress is associated with more frequent technological distractions and unsafe riding practices. Additionally, work-life balance showed a negative association with job strain ($\rho = -.263$; $p < .001$) and technology-induced distractions ($\rho = -.263$; $p < .001$). The full set of correlations is presented in Table 1.

Mean Comparison Analyses

After ensuring the adequacy of statistical assumptions and controlling for key covariates, ANCOVA tests were conducted to compare the key study variables across male and female motorcycle commuters. The descriptive statistics, including means, standard deviations, and standard errors for each group, are shown in the left columns of Table 2, with gender-specific scores and full-sample scores provided for reference.

Among the significant ANCOVA results, technology-induced distractions did not differ by gender (F = 2.747; p = .098; non-significant difference), with female motorcycle commuters reporting just slightly higher distraction scores than males. Similarly, risky riding behaviors showed consistently non-significant gender-based differences (F = .002; p = .968).

Regarding significant differences, female riders reported significantly higher risk perception scores than males (F = 5.689; p < .0). This trend aligns with findings on rule knowledge, where women also scored significantly higher than male commuters (F = 6.327; p < .05). On the other hand, female motorcyclists remained significantly more technology-affine than their male counterparts (F = 4.730; p < .05).

Regarding work-related factors, similar job strain (F =.267; p = .606) and work-life balance scores (F = .006; p = .939; non-significant differences) were found between male and female motorcycle commuters. A graphical summary of these differences, illustrating gender-specific trends across key study variables, is provided in Figure 1.

To examine the relationships between individual, road safety-related, and psychosocial work factors in predicting technology-induced distractions among motorcycle commuters, Structural Equation Modeling (SEM) was applied. Additionally, a Multi-Group Structural Equation Modeling (MGSEM) analysis was conducted to explore potential gender-based differences in these relationships.

SEM and MGSEM: Single and Multi-group Structural Equation Modeling

This approach offers key advantages over traditional regression models, as it accounts for interdependencies among predictor variables and provides a more comprehensive examination of latent constructs. Unlike standard analyses that treat gender as a simple covariate, MGSEM allows for the simultaneous estimation of model paths within each gender group, enabling a comparative assessment of structural differences. To mitigate potential demographic biases, all relationships were adjusted for age and educational attainment. Figure 2 summarizes the bootstrap distributions of the SEM and MGSEM models, derived from N = 200 iterative samples, contributing to enhance the robustness of parameter estimates.

Table 1

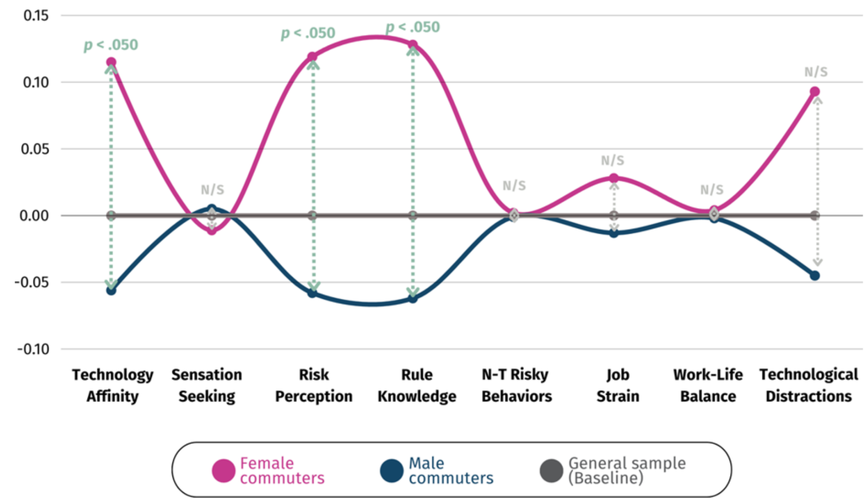
Descriptive data (means and standard deviations) and bivariate parametric correlations (Spearman's ρ) among the study variables.

	Variable	*M*	*SD*	Coeff.	2	3	4	5	6	7	8	9	10	11
1	Age (years)	47.50	10.89	ρ	-.211**	.061	-.019	-.078*	.070	.095**	-.171**	-.131**	.096**	-.245**
				Sig.	<.001	.099	.609	.034	.056	.010	<.001	<.001	.009	<.001
2	Educational attainment [a]	--	--	ρ	--	-.025	.046	-.039	-.075*	-.005	.144**	.076*	.014	.098**
				Sig.		.493	.214	.285	.042	.900	<.001	.038	.700	.008
3	Commuting Trip Length [b]	26.49	23.78	ρ		--	-.062	.027	.007	-.074*	-.054	-.004	-.019	.006
				Sig.			.091	.459	.848	.044	.141	.915	.598	.879
4	Technology Affinity [c]	3.41	1.09	ρ			--	.210**	.158**	.059	.171**	.144**	-.113**	.138**
				Sig.				<.001	<.001	.110	<.001	<.001	.002	<.001
5	Sensation Seeking [d]	3.16	.83	ρ				--	.113**	.151**	.215**	.285**	-.305**	.250**
				Sig.					.002	<.001	<.001	<.001	<.001	<.001
6	Risk Perception [c]	4.44	.52	ρ					--	.594**	-.127**	-.107**	-.056	-.123**
				Sig.						<.001	.001	.004	.127	.001
7	Rule Knowledge [c]	4.37	.58	ρ						--	-.123**	-.057	-.109**	-.082*
				Sig.							.001	.123	.003	.027
8	N-T Risky Behaviors [c]	2.15	.90	ρ							--	.593**	-.183**	.488**
				Sig.								<.001	<.001	<.001
9	Job Strain Index [e]	1.06	.73	ρ								--	-.263**	.477**
				Sig.									<.001	<.001
10	Work-Life Balance [c]	2.95	1.16	ρ									--	-.263**
				Sig.										<.001
11	Technology-induced Distractions [c]	1.49	1.05	ρ										--
				Sig.										

Note. *M* = Arithmetic mean; *SD* = Standard Deviation; [a] Categorical (ordinal) variable; [b] Round trip (minutes); [c] Measured in a [1 to 5] scale; [d] Measured in a [1 to 7] scale; [e] The Job Strain (JS) reference value is 1.0; * Correlation is significant at the .05 level (2-tailed); ** Correlation is significant at the .01 level (2-tailed).

Figure 1

Mean differences in the study variables by commuters' gender.



Notes. Axis Y (left column) is graphically scaled in terms of standardized (Z) scores to favor fair comparability; Axis X (0.0) represents the full sample average.

Table 2

Descriptive values and gender-based ANCOVA comparisons.

Factor	Group	*M*	*SD*	*SE*	95% CI[a]		Comparative Tests		Effect Sizes[b]		95% CI[a]	
					Lower	Upper	Test value[c]	Sig.[d]	Parameter	Estimate	Lower	Upper
Individual factors												
Commuting Trip Length	Female	26.06	23.765	1.528	23.053	29.071			η^2	.000	.000	.007
	Male	26.71	23.820	1.072	24.601	28.812	.119	.730	ε^2	.001	.001	.005
	Total	26.49	23.788	.877	24.773	28.216			Ω^2_F	.001	.001	.005
Technology Affinity	Female	3.54	1.110	.071	3.399	3.680			η^2	.007	.000	.023
	Male	3.35	1.085	.049	3.255	3.447	4.730	*	ε^2	.005	.001	.022
	Total	3.41	1.096	.040	3.334	3.492			Ω^2_F	.005	.001	.022
Sensation Seeking	Female	3.15	.919	.059	3.037	3.269			η^2	.006	.004	.008
	Male	3.17	.788	.035	3.097	3.236	.041	.840	ε^2	.005	.003	.007
	Total	3.16	.832	.031	3.102	3.222			Ω^2_F	.005	.003	.007
Road safety skills and behaviors factors												
Risk Perception	Female	4.51	.468	.030	4.453	4.571			η^2	.007	.000	.024
	Male	4.42	.543	.024	4.371	4.467	5.689	*	ε^2	.006	.001	.022
	Total	4.45	.521	.019	4.412	4.487			Ω^2_F	.006	.001	.022
Rule Knowledge	Female	4.45	.547	.035	4.379	4.517			η^2	.008	.000	.026
	Male	4.34	.594	.027	4.284	4.389	6.327	*	ε^2	.007	.001	.024
	Total	4.37	.581	.021	4.331	4.415			Ω^2_F	.007	.001	.024
N-T Risky Behaviors	Female	2.16	.990	.064	2.030	2.281			η^2	.001	.001	.001
	Male	2.15	.855	.038	2.077	2.228	.002	.968	ε^2	.001	.001	.001
	Total	2.15	.901	.033	2.089	2.219			Ω^2_F	.001	.001	.001
Psychosocial Work factors												
Job Strain Index	Female	1.09	.787	.051	.986	1.185			η^2	.002	.000	.004
	Male	1.05	.710	.032	.992	1.117	.267	.606	ε^2	.001	.001	.007
	Total	1.06	.736	.027	1.012	1.118			Ω^2_F	.001	.001	.007
Work-Life Balance	Female	2.96	1.252	.080	2.800	3.117			η^2	.003	.001	.005
	Male	2.95	1.126	.051	2.852	3.051	.006	.939	ε^2	.003	.001	.005
	Total	2.95	1.168	.043	2.869	3.038			Ω^2_F	.003	.001	.005
Dependent Variable												
Technology-induced Distractions	Female	1.59	1.196	.077	1.442	1.744			η^2	.004	.000	.019
	Male	1.45	.973	.044	1.360	1.532	2.747	.098	ε^2	.003	.001	.017
	Total	1.49	1.053	.039	1.418	1.571			Ω^2_F	.003	.001	.017

Notes. M = Arithmetic mean; *SD* = Standard Deviation; *SE*= Standard Error; [a] Confidence Interval at the level 95%; [b] Estimated based on the fixed-effect model; [c] Test value; controlling for commuters' age and educational attainment; [d] Significance levels: $**p < .01$; $*p < .05$; η^2= Eta-squared; ε^2= Epsilon-squared; Ω^2_F Omega-squared (Fixed-effect).

Models' Goodness-of-Fit (GoF)

The general Structural Equation Model (SEM), comprising the full study sample data showed suitable goodness of fit (GoF) coefficients, with $\chi^2_{(27)}$ = 133.165, p < .001; CMIN/df = 4.932; NFI = .940; CFI = .951; IFI = .952; RMSEA = .073, 95% CI [.061-.086]. All the model features, pathways, and relevant indexes are fully described in Table 3, and graphically illustrated in Figure 3.

In a second step, the MGSEM analysis was subsequently carried out. For this purpose, the combined sample was divided into two gender-based groups (reference categories), each with an appropriate minimum sample size (more than 200 subjects per group) for comparative purposes. The resulting Multi-Group Structural Equation Model, simultaneously fitted for both gender groups ($\chi^2_{(45)}$ = 171.973, p < .001; CMIN/df = 3.185; NFI = .947; CFI = .946; IFI = .947; RMSEA = .055, 95% CI [.046-.064]). The full set of MGSEM coefficients is appended in Table 3.

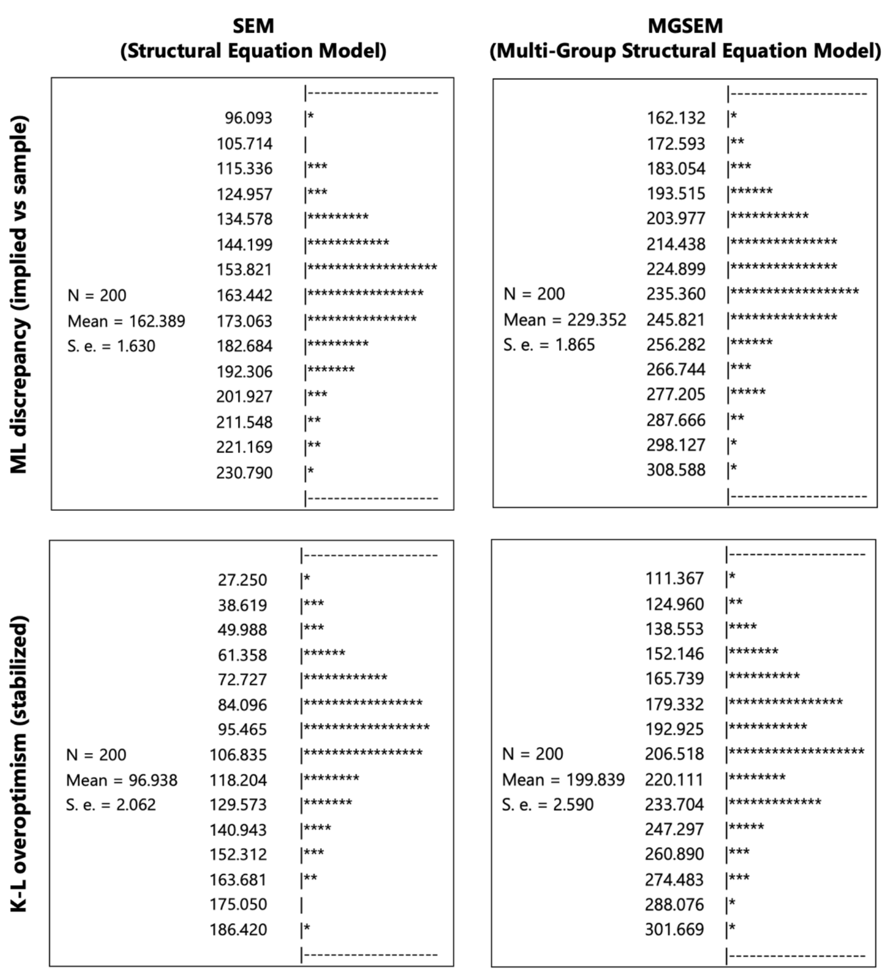
Model outcomes

The general SEM model identified significant associations between age, work-related factors, road safety behaviors, and technology-induced distractions. For this purpose, the Standardized Path Coefficients (SPCs) in Table 3 can be used to interpret the directionality and magnitude of each SEM path. Notably, age was a negative predictor of technological distractions (bootstrapped β = -.119; p < .01), suggesting that younger riders reported higher engagement in them. Job strain scores positively predicted motorcyclists' involvement in technology-induced distractions (β=.230; p < .01), while work-life balance had a negative effect (β = -.065; p < .05).

Regarding gender-based structural differences, the primary outcomes of the MGSEM models (A and B) suggest that the relationships between exogenous variables and self-reported technological distractions differ between male and female motorcycle commuters. The standardized β path coefficients (see Table 3 and the significant paths marked with continuous lines/arrows in Figure 3) highlight key structural differences and specific patterns based on gender, as follows:

Figure 2

Summary of SEM and MGSEM models' Bootstrap distributions, using N= 200 iterative samples.



Model A: Male motorcycle commuters

Among male commuters, job strain showed a strong positive association with technology-induced distractions (β = .275; $p < .01$), similar in direction and significance to its effect on non-technological risky behaviors (β = .449; $p < .01$). Additionally, males' sensation-seeking tendencies were positively related to distractions (β = .063; $p < .05$), suggesting that individuals who seek thrill are more likely to engage with distracting technology while riding, although the strength of this relationship was moderate. Both risk perception (β=-.106; $p < .05$) and work-life balance (β = -.063; $p < .05$) were negative predictors of technological distractions, supporting the idea that greater awareness of road risks and better work-life balance may help reduce distractions while riding.

Model B: Female motorcycle commuters

Similar to male riders, job strain (β = .121; $p < .05$) and non-technological risky behaviors (β = .673; $p < .01$) were significant predictors of technology-induced distractions. Another notable similarity was that work-life balance was also a negative and significant predictor of the dependent variable (β = -.082; $p < .05$).

However, unlike male riders, commuting trip length had a significant effect (β = .128; $p < .01$), suggesting that longer commutes may increase exposure to distractions among female riders. Additionally, neither sensation seeking (β = .027; $p = .518$) nor risk perception (β = .073; $p = .089$) were significant predictors of distractions in this group, differing from the patterns observed among male motorcyclists.

Overall, the MGSEM results indicate that, despite some shared patterns, technology-induced distractions are influenced by distinct factors depending on gender. Male riders show stronger associations between sensation seeking, risk perception, and distractions, whereas commuting trip length is a significant predictor among female riders, as shown in detail in Figure 3.

Table 3

SEM and MGSEM modeling outcomes to predict motorcycle commuters' technology-induced distractions.

Study variable			UPC[a]	*SE*[b]	C.R.[c]	*p*[d]	Bootstrap Bias-Corrected Values[e]				
							SPC[f]	Bias[g]	95% CI[h]		*p*[d]
General SEM Model: Full motorcycle commuters' sample											
Age	→		-.011	.002	-4.854	***	-.115	.002	-.163	-.056	**
Education	→		.012	.022	.577	.564	.014	-.001	-.028	.062	.633
Commuting Trip Length	→		.003	.001	2.784	**	.065	.001	.027	.112	**
Sensation Seeking	→		.061	.032	1.906	.057	.049	-.001	-.012	.103	.098
Technology Affinity	→	Technology-Induced	.030	.022	1.368	.171	.032	.002	-.01	.086	.128
Risk Perception	→	Distractions	-.070	.061	-1.143	.253	-.035	.000	-.093	.034	.233
Rule Knowledge	→		.027	.055	.485	.627	.015	.002	-.043	.079	.644
N-T Risky Behaviors	→		.608	.04	15.251	***	.525	.001	.451	.583	**
Job Strain	→		.324	.048	6.711	***	.230	.002	.167	.305	**
Work-Life Balance	→		-.058	.022	-2.617	**	-.065	.001	-.117	-.005	*
Model A: Male motorcycle commuters											
Age	→		-.011	.003	-4.057	***	-.124	.002	-.180	-.051	**
Education	→		.004	.025	.153	.878	.005	-.001	-.060	.064	.944
Commuting Trip Length	→		.001	.001	1.040	.298	.032	.001	-.021	.088	.282
Sensation Seeking	→		.077	.039	1.970	*	.063	-.002	-.002	.134	*
Technology Affinity	→	Technology-Induced	.027	.026	1.035	.301	.031	.003	-.037	.093	.338
Risk Perception	→	Distractions	-.185	.073	-2.549	**	-.106	.000	-.192	-.015	*
Rule Knowledge	→		.076	.066	1.156	.248	.048	.002	-.040	.130	.234
N-T Risky Behaviors	→		.503	.048	10.518	***	.449	.002	.358	.514	**
Job Strain	→		.371	.057	6.497	***	.275	.001	.193	.359	**
Work-Life Balance	→		-.053	.026	-2.015	*	-.063	.001	-.130	.000	*
Model B: Female motorcycle commuters											
Age	→		-.009	.004	-2.313	*	-.084	.001	-.159	-.010	*
Education	→		.008	.041	.204	.838	.008	.000	-.067	.081	.807
Commuting Trip Length	→		.006	.002	3.618	***	.128	.003	.061	.200	**
Sensation Seeking	→		.035	.055	.646	.518	.027	.001	-.062	.124	.573
Technology Affinity	→	Technology-Induced	.026	.038	.674	.500	.024	.002	-.055	.112	.514
Risk Perception	→	Distractions	.184	.108	1.702	.089	.073	-.002	-.019	.154	.108
Rule Knowledge	→		-.097	.092	-1.053	.292	-.045	.002	-.134	.058	.381
N-T Risky Behaviors	→		.809	.069	11.777	***	.673	-.003	.572	.774	**
Job Strain	→		.179	.085	2.100	*	.121	.002	.017	.220	**
Work-Life Balance	→		-.077	.038	-2.037	*	-.082	-.001	-.171	.001	*

Note. [a] UPC= Unstandardized (raw) Path Coefficients; [b] *SE*= Standard Error; [c] CR= Critical Ratio; [d] p-value: *Significant at the level $p < .05$; **Significant at the level $p < .01$; ***Significant at the level $p < .001$; [e] Bootstrapped (bias-corrected) model; [f] Bootstrapped bias- standardized estimates (corrected UPC values that can be interpreted as Beta-linear regression weights); [g] Corrected Bias; [h] Confidence Interval at the level 95% (lower bound – left; upper bound – right).

Discussion

The objective of this study was to examine the predictors of technology-induced distractions among PTW/motorcycle commuters, considering individual characteristics, road safety-related factors, and psychosocial work variables. The findings, aligned with the analytical framework designed to test the study hypotheses, suggest that multiple factors contribute to technological distractions while riding, with distinct patterns observed between genders. This discussion contextualizes the study results within the existing literature addressing two central questions, accordingly.

What Predicts Motorcycle Commuters' Technology-Induced Distractions?

The first of our literature-based hypotheses anticipated significant associations between individual, road safety-related, and psychosocial work factors and technology-induced distractions. With some exceptions, our results broadly support this premise, highlighting key variables within these domains.

Regarding individual characteristics, and consistently with the existing literature, riders' age emerged as a significant one. Specifically, younger commuters were found to be more prone to engaging in technological distractions, a trend that aligns with previous findings on risk-taking behaviors in motorcyclists (Oviedo-Trespalacios et al., 2016; Truong et al., 2017 & 2018). Additionally, technology affinity was positively associated with self-reported distractions, reinforcing the idea that frequent digital engagement extends into commuting contexts (Jiang et al., 2018).

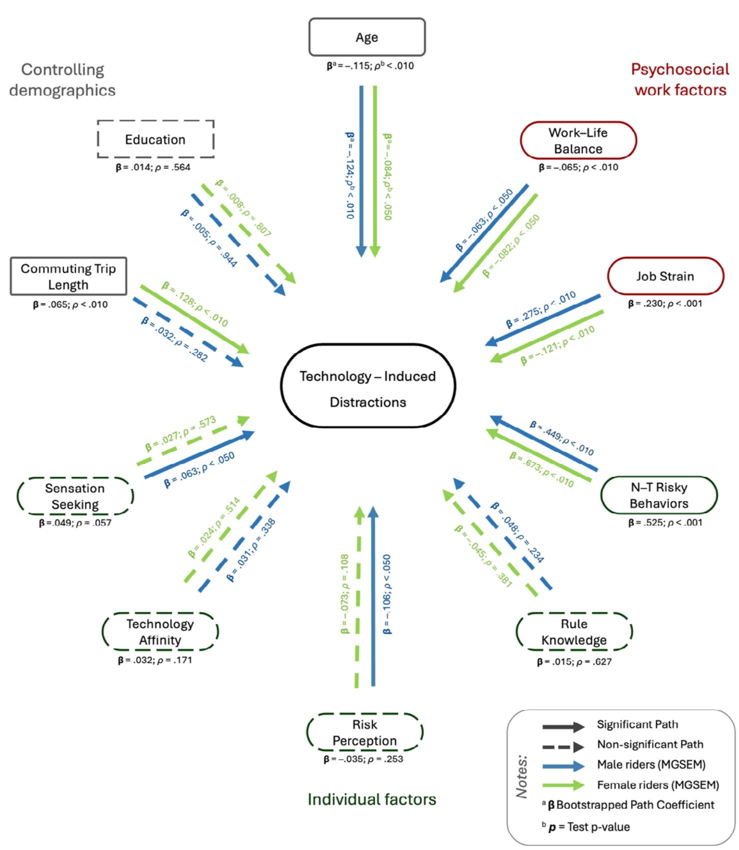
Moreover, as expected, sensation seeking also played a predictive role, though its influence was significant only among male riders, similar to what has been reported in previous studies with other groups of two-wheeled users, particularly moped riders and cyclists (Gianfranchi et al., 2017; Useche, 2025; Useche et al., 2025). Moreover, consistent with our results, a recent gender-comparative study on sensation seeking among motorcyclists found that this trait might be more significant in understanding risky behaviors among male riders (Romero et al., 2019).

Concerning road safety-related factors, risk perception had a protective effect, particularly among male motorcyclists, with higher scores significantly predicting lower engagement in distracting technology (Nguyen-Phuoc et al., 2020). Conversely, rule knowledge did not significantly predict distraction levels, suggesting that familiarity with traffic regulations does not necessarily translate into safer behavioral patterns in this domain (Alonso et al., 2017; Hoang et al., 2025).

Work-related factors also showed notable associations. Job strain was a strong predictor of technological distractions, indicating

Figure 3

Graphical representation of the SEM and MGSEM outcomes, with the dependent variable being motorcycle commuters' technology-induced distractions. Ellipses represent latent constructs, while squares represent observed variables.



that occupational stress may contribute to increased engagement with digital devices during commuting trips. This aligns with research suggesting that work pressure can lead to compensatory behaviors, including heightened digital engagement while on the road (Choudhary & Velaga, 2017; Fitch et al., 2014; Oviedo-Trespalacios & Useche, 2024). Conversely, work-life balance had a mitigating effect, reducing the likelihood of distractions, possibly by allowing riders to disengage from professional demands during their commutes.

Do Gender Differences Exist in the Predictors of Technological Distractions?

The second hypothesis anticipated gender differences in the structural relationships between predictors and technology-induced distractions. Overall, the results support this expectation, showing distinct patterns in the influence of individual, road safety, and work-related factors across male and female motorcycle commuters.

Among male riders, sensation seeking was significantly associated with increased distractions, suggesting that those who seek thrill and stimulation are more likely to engage with digital technology while riding. Risk perception, in turn, played a protective role by reducing distraction rates. Although only in the case of males –among which the clearest trends have been consistently observed in preceding literature– (see Bates et al., 2024; Useche et al., 2025), these findings align with prior research highlighting the influence of personality traits and safety awareness on road behaviors (Gupta et al., 2022).

In contrast, among female riders, commuting trip length emerged as a notable predictor, with longer trips correlating with greater exposure to distractions. This suggests that extended commuting durations may increase the likelihood of engaging with digital devices, potentially as a coping mechanism for monotony or fatigue (Iseland et al., 2018; Okati-Aliabad et al., 2024). Unlike male riders, neither sensation seeking nor risk perception significantly predicted technological distractions, indicating that other contextual factors may be more relevant for female motorcyclists. In this regard, studies such as Hsieh et al. (2017) and Siebert et al. (2024) have shown that their risk-related patterns and outcomes remain distinct in areas such as alcohol consumption, helmet use, and overall safety behavior.

In sum, these gender differences highlight the complexity of technology-induced distractions in motorcycle commuting, highlighting the need for targeted interventions considering travel-specific factors (Alfaro et al., 2025; Rojas-Quezada et al., 2024). However, while intervention programs for traffic offenses and deliberate risky behaviors have shown positive results, their efficacy remains limited and should be further evaluated in the context of technological risk behaviors, given the positive but sometimes limited effectiveness of these programs in preventing specific types of behaviors (Elliott et al., 2021; Escamilla-Robla et al., 2024).

Limitations of the Study and Further Research

Despite its contributions, this study has several limitations. First, the reliance on self-reported data introduces the possibility of memory biases and social desirability effects, particularly given the sensitivity of technology use while riding (Althubaiti, 2016; Sarwar et al., 2014). Moreover, participants may have underreported their engagement in distracting behaviors due to safety concerns or legal implications, as claimed in previous studies addressing other sensitive topics (Arrojo et al., 2024; Leal et al., 2023). Furthermore, the cross-sectional design limits the scope of these results (Hunziker & Blankenagel, 2021).

Secondly, although some of the significant ANCOVA differences are significant, they show small effect sizes. This should be considered alongside statistical significance when evaluating the practical relevance of the study outcomes (Hair & Alamer, 2022). While these effects suggest associations, the small magnitudes of some require careful consideration when interpreting the results and their implications for intervention design or policy.

Future research should move beyond self-reported awareness and explore the behavioral implications of technological distractions through objective measures, such as naturalistic riding studies or simulator-based experiments (Gianfranchi et al., 2017; Nguyen-Phuoc et al., 2020; Siebert et al., 2024).

Finally, further investigation into the role of both commuting and work-related stressors (see Useche et al., 2023), incorporating physiological indicators and systematic measurement, may provide deeper insights into how occupational demands influence distraction patterns (see Quy Nguyen-Phuoc et al., 2023), which also would help assess the generalizability of these findings.

Conclusion

The core conclusions of this study, aligned with the previously tested literature-based hypotheses, can be summarized as follows:

Overall, the findings suggest that 'gender matters' in technology-induced distractions during motorcycle commuting. While some patterns were consistent across male and female riders, others showed relevant differences, particularly in how risk perception, sensation seeking, and commuting trip length influence levels of technological distraction.

Beyond gender differences, the results prompt a critical examination of the role of individual characteristics, road safety awareness, and work-related factors in shaping technological distractions among motorcycle commuters. Specifically, younger age, higher sensation-seeking tendencies, and greater involvement in other types of (i.e., non-technological) risky behaviors were linked to increased technology distractions, whereas stronger risk perception served as a protective factor.

Regarding work-related factors, motorcyclists experiencing higher job strain reported greater technology-induced distractions, while better work-life balance was associated with lower distraction levels.

Practical Implications

From a practical standpoint, this study provides valuable insights for road safety interventions targeting motorcycle commuters, particularly regarding gender differences in technological distractions. These takeaways highlight the importance of considering riding commuters' dynamics when addressing distracted riding.

Given the described specificities, interventions could focus on raising awareness about the specific risks of distracted riding from a gender-sensitive approach. Additionally, addressing work-related stressors and improving commuting conditions could contribute to safer outcomes. In this regard, workplace policies that promote a healthier work-life balance may indirectly enhance commuting safety.

Based on our theoretical foundations, it would be expected that educational programs could promote safer technology use by encouraging riders to limit device interaction while riding. Moreover, road safety policies could enhance road safety by reducing distractions and supporting safer riding practices.

However, and given the limited setting of this study and the need for further evidence supporting these practical points, these implications should be seen as complementary suggestions that align with the study's findings, rather than definitive conclusions. Thus, further research on this topic is definitely needed (and encouraged) to establish new policy directions and achievements in this regard.

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