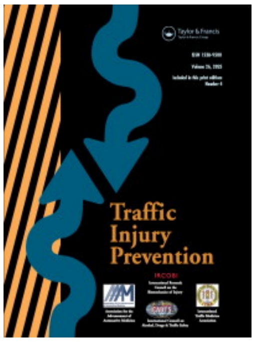

Traffic Injury Prevention

ISSN: 1538-9588 (Print) 1538-957X (Online) Journal homepage: www.tandfonline.com/journals/gcpi20

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To cite this article: Steve O'Hern, Amanda N. Stephens, Felix Wilhelm Siebert & Sergio A. Useche (03 Jun 2025): Is our growing affinity for technology a challenge for preventing distracted cycling? An Australian study, Traffic Injury Prevention, DOI: 10.1080/15389588.2025.2489649

To link to this article: https://doi.org/10.1080/15389588.2025.2489649

TRAFFIC INJURY PREVENTION
https://doi.org/10.1080/15389588.2025.2489649

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Is our growing affinity for technology a challenge for preventing distracted cycling? An Australian study

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ABSTRACT

Objectives: The core aim of this study was to assess secondary task engagement among Australian cyclists, considering demographic, behavioral, and psychosocial factors as potential contributors.

Methods: This study used the information provided by a sample of 1,240 Australian cyclists (24% females; 74% males; 2% non-binary) aged $M = 53.6$ (SD 12.9) years. They responded to an online survey on cycling-related affairs, including demographic, psychosocial (Risk Perception and Regulation Scale, RPRS), behavioral (Cycling Behavior Questionnaire, CBQ), and technology-related (Affinity for Technology Questionnaire, TAEG) factors.

Results: After analyzing the TAEG properties and outcomes in this Australian sample, it was found that engagement in secondary tasks while riding varies significantly according to demographic and cycling behavioral profiles. For instance, older cyclists were less likely to report engaging in secondary tasks while riding. In terms of cycling behavior, respondents who reported higher rates of violations were more likely to report high engagement with technology while riding. Moreover, the results from a multilinear regression model predicting secondary task engagement indicated associations between self-reported cycling behavior and engagement in secondary tasks, as well as a strong relationship between traffic violations and the latter. Additionally, knowledge of traffic rules and self-reported positive behaviors showed a significant negative relationship with secondary task engagement, suggesting that these respondents were less inclined to use mobile devices while riding.

Conclusion: Overall, the findings of this study support the hypothesis that secondary task engagement can be statistically explained by demographic factors (such as age and gender), attitudinal factors, and cycling behavior. These findings highlight several challenges and implications for cycling safety practices, particularly considering the increasing normalization of technology-related secondary tasks in transport activities such as cycling.

ARTICLE HISTORY
Received 16 July 2024
Accepted 2 April 2025

KEYWORDS
Cycling; technological trends; secondary tasks; road safety

Introduction

Road user distraction is globally recognized as a major challenge to achieving a safer road environment (World Health Organization 2020). In 2021, driver distraction was identified as a contributing factor in 8% of fatal crashes and 14% of injury crashes in the United States (NHTSA 2021). In addition to increased risk of crash involvement (Young et al. 2007; Regan et al. 2011; Dingus et al. 2016), distraction decreases driver performance, which can include impairing the driver's ability to maintain speed, throttle control, and lateral position. Driving distracted can also reduce driver's visual search patterns, reaction times, and decision-making processes (Young et al. 2007).

Regan et al. (2011, p. 1776) defined driver distraction as "the diversion of attention away from activities critical for safe driving toward a competing activity, which may result in insufficient or no attention to activities critical for safe driving." This definition can be extrapolated to consider all road users by replacing "driving" with another road user activity, such as "cycling." For example, cyclist distraction could be defined by the diversion and subsequent removal of attention away from cycling safety critical activities toward a competing activity. Young et al. (2007) further considered distraction across 4 key classifications that include visual, auditory, biomechanical (physical/manual), and cognitive distraction. A road user can engage in more than one of these types of distractions simultaneously; for example, holding and dialing a phone (visual and manual) while trying to remember the phone number (cognitive). One of the most common sources of distraction arises from engagement in secondary tasks unrelated to the safety of the primary task.

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Associate editor Richard Frampton oversaw the review of this article.
Supplemental data for this article can be accessed online at https://doi.org/10.1080/15389588.2025.2489649

A frequent secondary task that road users perform is engaging with smartphones. These can be used in a variety of ways, such as to make calls, read or write text messages, listen to music, route find, or access the internet or social media. The widespread prevalence of smartphones has led to road authorities implementing restrictions on mobile phone usage while driving (Kaviani et al. 2020; O'Hern and Stephens 2022). Nonetheless, elevated daily usage and a problematic dependence are contributing to a higher probability of using such devices in unsafe situations when engaging with the road environment (Kaviani et al. 2020). High rates of smartphone use while driving have been reported across European countries (Ross et al. 2018) as well as in Australia (Young, Osbourne et al. 2020).

There are many factors associated with smartphone use while operating a motor vehicle. These factors include driver characteristics (e.g., age, gender, reliance on smartphones, or nomophobia), perceptions and attitudes toward risk, and perceived likelihood of receiving a fine or being charged with an offense (Young et al. 2007; Kaviani et al. 2021). These factors can be mediated by views of the individual toward technology, their technical competencies, and their general inclinations toward technology (Lansdown 2012; Chen and Donmez 2016; Sutanto et al. 2022). Though considerable research has been undertaken to address these issues, less is known about the engagement in secondary tasks when riding bicycles, particularly outside of a European context.

At a transport planning level, there is a global political desire to increase bicycle riding as a form of transport. This is because of the recognized health, environmental, and congestion-alleviating benefits that can be achieved when transitioning from car-based trips to bicycling (Banister 2011; Deenihan and Caulfield 2014). However, this is a process that requires considering people's decision making. In other words, in addition to its health benefits, invigorating cycling implies achieving a reasonable balance between these benefits and the actual risks for both current and potential users. One of the key deterrents to riding a bicycle, however, is the increased risk of a crash (Useche, Montoro et al. 2019) and subsequently potentially serious injuries (Garrard et al. 2006). This risk can be further compounded when the person riding a bicycle engages in a secondary task that causes distraction, augmenting the potential for rider error and crashes (De Waard et al. 2010; Terzano 2013; Young, Stephens et al. 2020).

This increased risk for cyclists when engaging in secondary tasks has been demonstrated in multiple scientific studies. Researchers from the Netherlands found that when listening to music, using a mobile phone, or conversing with other riders, cyclists demonstrated significantly more unsafe behaviors (Terzano 2013). When engaging in secondary tasks, riders showed reductions in performance, similar to motor vehicle drivers, with reduced situational awareness, reduced perception of traffic sounds, increased subjective workload, and greater variability in lateral position (De Waard et al. 2010; Young, Stephens et al. 2020). However, Møller et al. (2024) did not observe similar reductions in performance in simulator studies and suggested that secondary tasks that require only cognitive resources were capable of being performed without adverse effects on behavior in simple environments.

Goldenbeld et al. (2012) endorsed a hypothesized association between secondary tasks and crash risk. They identified that Dutch riders' crash risk increased by a factor of 1.4 when using a mobile phone while cycling. Likewise, studies conducted by Useche et al. (2018) showed that secondary task engagement played a significant role in predicting crashes through the mediation of risky behaviors among Spanish-speaking riders in the Americas and Europe. Many riders report engaging in compensatory strategies such as riding at slower speeds when engaging in secondary tasks, and this has also been found in observational studies with riders either stopping or adapting their speed when using a phone (Kircher et al. 2015). Notwithstanding, the findings highlight that safety for cyclists could effectively be improved by reducing the rate of engagement in secondary tasks while cycling.

The rates of secondary task engagement when riding a bicycle are high. In their study, Goldenbeld et al. (2012), identified that over 70% of Dutch cyclists reported occasionally using a phone while riding. Similar rates of mobile phone engagement were found in Japan among high school students (Ichikawa and Nakahara 2008). In Australia, Young, Stephens et al. (2020) found that roughly half of surveyed participants reported technology engagement when cycling, with using headphones the most common behavior. However, though riders commonly report secondary task engagement, observational studies suggest the rates of usage are low, with 19% of riders in Sweden (Adell et al. 2014) and only 2% of riders in Germany observed to be using a mobile phone while riding (Huemer et al. 2019).

Overall, the previous studies conducted in different countries provide valuable context regarding the risks, prevalence, and behaviors exhibited by people when engaging with secondary tasks while riding. However, to date the majority of research considering secondary task engagement has been focused in Europe (Young, Stephens et al. 2020), with limited research considering the specificities of other regions, such as Australia, which has differing infrastructure, cycling culture, and mode share (Pucher et al. 2011). Furthermore, compared to research considering secondary task engagement among motor vehicle drivers, there has been a paucity of research on cyclists, and there is a need to further understand the factors that contribute to secondary task engagement in this domain.

Study aim and hypothesis

Given the above, this study aimed to quantify the rate of secondary task engagement among Australian cyclists, taking into account demographic, behavioral, and personal factors that could influence such engagement. Furthermore, this study sought to explore the relationship between technology affinity and engagement with secondary tasks while cycling. Based on previous findings in the empirical literature, it was anticipated that there would be significant and consistent relationships among cyclists' demographic characteristics and their technological affinity, self-reported cycling behavior, and engagement in secondary tasks while riding.

Methodology

Procedure

An online survey was conducted to collect data on cyclists' self-reported secondary task engagement, as well as their demographic backgrounds and behavioral and personal factors. Participants were eligible to take part in the study if they lived in Australia, were aged 18 years or older, rode a bicycle at least once a week, and were proficient in English. Data were collected using the Qualtrics (2024) online survey platform. The survey took approximately 20 min to complete. Ethical approval was granted from the University Human Research Ethics Committee. The study recruited participants via a paid advertisement on Facebook and through the university's social media pages.

A total of 1,866 people began the survey, and 1,240 complete responses were recorded, representing a completion rate of 66.4%. Only complete responses were included in the analysis. Upon completion of the survey, participants could provide their email address using a separate link to enter the draw to win 1 of 5 AU$100 gift vouchers.

Material

Participants

Participants provided information about their demographic characteristics, cycling exposure, and habits. Participants ranged in age from 18 to 84 years ($M = 53.6$; SD 12.9), 24.0% were female, 74.0% were male, and 2.0% were non-binary or chose not to provide their gender. This profile reflects statistics reported in the Australian National Walking and Cycling Participation Survey, which showed that 18.9% of Australian males cycle in a typical week compared to 11.2% of females, and the highest participation rates for adults are among those aged between 30 and 49 (Munro 2023). Most participants were in full-time employment (69.5%) and had attained an undergraduate degree or higher (75.7%).

On average during a typical week participants rode their bicycle for 11.0 h (SD 4.3 h) and most cycling trips lasted for 1 h or less (58.6%). The most commonly reported reasons for riding were leisure trips (91.8%), commuting (58.4%), and cycling while working (e.g., couriers; 8.7%). In the past 5 years 65.9% of participants reported being involved in a crash while cycling.

Affinity for technology questionnaire

Views toward technology of participants were assessed using the Affinity for Technology Questionnaire (TAEG) developed by Karrer et al. (2009). The TAEG includes 4 subscales representing enthusiasm for technology, competence in dealing with technology, positive consequences of technology, and negative consequences of technology (Karrer et al. (2009). The 4 scales include a total of 19 items measured on a Likert scale from 1 (*totally disagree*) to 5 (*totally agree*). Therefore, higher scores represent higher affinity for technology. Cronbach's alphas ranging from .73 to .86 have previously been reported for TAEG factors (Karrer et al. 2009). The introduction to the TAEG and wording of items was updated in accordance with Karrer-Gauß et al. (2024).

Cyclist Behavior Questionnaire

Self-reported behaviors while riding a bicycle were measured using the 29-item version of the Cycling Behavior Questionnaire (CBQ; Useche et al. 2022; Useche, Alonso, Boyko et al. 2024). The CBQ measures behaviors across 3 factors: Errors, violations, and positive behaviors. Each item is answered on a 5-point Likert Scale (1 = *never*, 3 = *sometimes*, 5 = *almost always*). Participants report how often they perform each behavior while riding a bicycle. The CBQ has been previously validated across an international sample of cyclists and has demonstrated good internal consistency and reliability of factors, with Cronbach's alphas ranging from .76 to .91 (Useche et al. 2022).

Cyclist Risk Perception and Regulation Scale

Risk perception and knowledge of traffic regulations while cycling was measured using the Cyclist Risk Perception and Regulation Scale (RPRS). The RPRS includes 12 items, measuring 2 factors: Risk perception and knowledge of traffic rules. Responses were provided on a 5-point Likert scale (1 = *strongly disagree*, 3 = *neither agree nor disagree*, and 5 = *strongly agree*). Previous applications of the RPRS demonstrated acceptable internal consistency, with Cronbach's alphas ranging from .62 to .72 (Useche, Alonso et al. 2019; O'Hern et al. 2021).

Engagement in Secondary Tasks

Participants were asked to indicate how often they engage with technology while riding a bicycle. Eight scenarios were included; for example, answering phone calls, performing visual manual tasks on their phone (e.g., texting, browsing, or emailing), posting on social media, listening to music, and using navigation functions. Participants were asked to indicate how often they engage in each task when cycling using a 5-point scale (1 = *never*, 5 = *very frequently*). Mean scores for each item are presented in Table 1.

Analysis

Summary statistics are presented for items on the TAEG, CBQ, RPRS and the secondary tasks. Factor analysis was performed on the TAEG to confirm the 4-factor structure. The number of factors was decided by visual inspection of the scree plot and using eigenvalues >1. The adequacy of the

Table 1. Self-reported engagement in secondary tasks (α = .73).

Secondary task items	*M* (SD)
You looked continually at the phone for more than 2 s.	1.57 (0.83)
You reacted without delay (e.g., searched for, reached for, or picked up mobile phone) to a ringing phone (audio or vibration).	1.44 (.074)
You performed a visual–manual task on your mobile phone (e.g., texting, browsing, or emailing).	1.36 (0.69)
You posted on social media apps (e.g., Facebook, Twitter, Snapchat, etc.).	1.11 (0.45)
You listened to music using a hands-free device/earphones.	2.09 (1.47)
You had a phone conversation without using your hands (hands-free device, earphones, etc.).	1.60 (0.95)
You had a phone conversation using your hands.	1.20 (0.50)
You used your phone as a GPS/maps device.	2.29 (1.34)

data for extraction was assessed using a Kaiser-Meyer-Olkin measure of sampling adequacy greater than 0.80 and a significant Bartlett's test of sphericity. The reliability of the extracted factors was assessed using Cronbach's alphas to confirm internal consistency. Cronbach's alphas were also calculated for factors in the CBQ and RPRS to assess internal consistency for the sample of participants. To understand their bivariate associations, Pearson correlations were assessed between demographic characteristics; factors on the TAEG, CBQ, and RPRS; and self-reported engagement with secondary tasks. Finally, a multilinear regression accounting for basic demographic characteristics (i.e., age and gender) was conducted to examine the factors that influence self-reported engagement with secondary tasks while cycling. The statistical analyses presented in this article were performed using IBM SPSS v29 (IBM Corp 2023).

Results

Secondary tasks

Overall, self-reported engagement in secondary tasks was relatively low. The most frequently performed tasks included using a GPS or map application on the phone while riding or listening to music using a hands-free device.

Factor analysis and internal consistency indexes

Factor analysis of TAEG items indicated that a 4-factor solution was appropriate based on the components with eigenvalues >1 and a visual inspection of the scree plot. For the 4-factor solution the Kaiser-Meyer-Olkin measure of sampling adequacy was .914 and Bartlett's test of sphericity was significant, indicating that the data were suitable for factor analysis. Factor loadings and mean scores for the TAEG items are presented in Table A1 (see online supplement). The structure included factors for enthusiasm for technology, competence with technology, and positive and negative impact of the technology. The highest mean scores were for the positive impact factor, with participants generally feeling that technology made life easier and that technology provided easier access to information. Participants also reported positive mean scores for competence, indicating that they enjoyed new electronic devices and knew how to operate the devices they owned. The means scores were neutral for enthusiasm. The lowest mean scores were reported for the negative impact factor.

Table 2 presents the Cronbach's alpha, mean, and standard deviation for each factor of the CBQ, RTRS, TAEG. The previously validated factor structure for the CBQ and RPRS were used in this study (Useche, Alonso et al. 2019; Useche et al. 2022). Mean scores for errors, violations, and positive behaviors were similar to previously reported results from samples in Australia, whereas the values for Cronbach's alpha were slightly higher (O'Hern et al. 2021; Useche, Alonso, Boyko et al. 2024). Similarly, mean results for the RPRS were comparable to previous applications of the questionnaire in Australia (O'Hern et al. 2021).

Correlation analysis

Table 3 presents the bivariate correlations between the factors of the TAEG, CBQ, and RPRS; secondary task engagement; and participants' age. Significant negative relationships were identified between age and factors on the TAEG, CBQ, and RPRS and engagement in secondary tasks. Notably, older cyclists tended to report less engagement in secondary tasks while riding. Enthusiasm toward technology was associated with more secondary task engagement while cycling,

Table 2. Factor scores for TAEG, CBQ, and RTRS.

	Factor	*M*	SD	α
TAEG	Enthusiasm	3.08	0.85	.862
	Competence	3.64	0.80	.842
	Positive impact	3.69	0.62	.805
	Negative impact	2.74	0.67	.730
CBQ	Violations	1.63	0.45	.693
	Errors	1.50	0.35	.852
	Positive behaviors	4.18	0.45	.663
RPRS	Knowledge of traffic rules	4.41	0.46	.658
	Risk perception	4.49	0.46	.627

Table 3. Relationships between secondary task engagement while cycling with self-reported errors, violations, risk perceptions, and regulations, as well as affinity for technology.

Factor	1	2	3	4	5	6	7	8	9	10
Age (1)	1									
Enthusiasm (2)	−0.055*	1								
Competence (3)	−0.305**	.544**	1							
Positive impacts (4)	−0.097**	.523**	.353**	1						
Negative impacts (5)	−0.093**	−0.352**	−0.275**	−0.473**	1					
Violations (6)	−0.173**	.082**	.096**	.023	.083**	1				
Errors (7)	.023	.051	−0.097**	.019	.078**	.451**	1			
Positive behaviors (8)	.104**	.066*	−0.054	.129**	−0.124**	−0.342**	−0.177**	1		
Knowledge of traffic rules (9)	.109**	.076**	.024	.108**	−0.041	−0.171**	−0.076**	.233**	1	
Risk perception (10)	.048	.113**	.180**	.097**	−0.095**	−0.118**	−0.151**	.139**	.503**	1
Secondary tasks (11)	−0.281**	.165**	.153**	.173**	−0.052	.351**	.184**	−0.170**	−0.188**	−0.057*

*Significant at $P<0.050$ level (2-tailed), **Significant at $P<.001$ level (2-tailed).

Table 4. Multilinear regression analysis of self-reported secondary task engagement.

Parameter	B	SE	95% Confidence interval		Sig.
			Lower	Upper	
Age	−0.009	0.0012	−0.011	−0.006	<0.001
Non-binary	−0.059	0.1023	−0.259	0.142	0.567
Female	−0.042	0.0369	−0.114	0.030	0.255
Male (ref)	–				
Enthusiasm	0.066	0.0225	0.022	0.110	0.003
Competence	−0.022	0.0237	−0.068	0.025	0.361
Positive impacts	0.108	0.0291	0.051	0.165	<0.001
Negative impacts	−0.007	0.0254	−0.057	0.042	0.771
Violations	0.303	0.0382	0.228	0.378	<0.001
Errors	0.099	0.0461	0.009	0.189	0.032
Positive behaviors	−0.059	0.0297	−0.117	−0.001	0.047
Knowledge of traffic rules	−0.187	0.0357	−0.257	−0.117	<0.001
Risk perception	0.077	0.0368	0.005	0.149	0.037

as were increased self-reported competence and positive views toward technology. Respondents who reported higher rates of violations while cycling also tended to report higher levels of engagement with technology while cycling. This was somewhat expected given that violations represent a deliberate action to contravene the road rules. A weak positive relationship was also found between self-reported errors while cycling and engagement with technology while cycling.

More frequent positive behaviors while riding were related to reduced rates of secondary task engagement. Similarly, having greater knowledge of traffic rules and higher risk perception were associated with reduced engagement with technology while riding.

Regression analysis

Finally, a multilinear regression was performed to examine whether the TAEG, CBQ, RPRS, and demographic variables predicted secondary task engagement for cyclists (Table 4). When controlling for the other variables, enthusiasm and positive impacts were the only TAEG factors that significantly predicted secondary task engagement. Both factors had a positive relationship, indicating that those who viewed technology positively or felt enthusiastic about using technology were more likely to engage in secondary tasks while riding.

Regarding the CBQ and RTRS, knowledge of traffic rules and self-reported positive behaviors had a significant negative relationship with secondary task engagement, indicating that these respondents were less likely to use their mobile devices while riding. This general relationship was expected given that previous research has demonstrated that positive behaviors and knowledge of traffic rules have a protective effect when considering crash involvement, and the same was expected to be true for engagement in secondary tasks.

When considering the other factors of the CBQ, both violations and errors were found to have a significant positive relationship with secondary task engagement. This is an interesting finding, because though both errors and violations represent aberrant behaviors, they have unique psychological origins and underlying motivations. Notably, the relationship between violations and secondary task engagement was much stronger, endorsing the assumption that the nature of secondary task engagement might correspond to a deliberate aberrant behavior, as opposed to an unintentional error.

When considering demographic variables, age had a negative relationship with secondary task engagement. This was somewhat expected and indicates that younger cyclists are more likely to engage with technology while riding. No significant gender differences were identified.

Discussion

The core aim of this study was to assess secondary task engagement among Australian cyclists, considering demographic, behavioral, and personal factors as potential contributors. Overall, our findings support the hypothesis that secondary task engagement can be statistically explained by demographic factors (such as age and gender), attitudinal factors, and cycling behavior. These findings suggest several challenges and implications for the practice of cycling safety.

Though extensive research has explored distraction among drivers, less research has been focused on vulnerable road users, such as cyclists, particularly in Australia. Our findings demonstrate that secondary task engagement is also an issue for cyclists because it is associated with riskier behavior. Moreover, previous research has demonstrated that engagement in secondary tasks can lead to distraction, which is a serious road safety concern. This is because, when distracted, attention is drawn away from critical safety tasks, and this can reduce the ability of road users to identify, react to and avoid hazardous situations (Young et al. 2007). Indeed, distraction due to technology use contributes to a substantial number of collisions, emphasizing the need to understand and address this issue (Young, Osbourne et al. 2020).

With the increasing reliance on mobile devices to facilitate daily life, it is imperative to delve deeper into factors contributing to secondary task engagement. An important contribution of our study is the significant association between technical affinity and engagement with devices while riding. The threat related to potential distraction from phones while riding may be exacerbated through the normalization of technological devices in road users' daily life (Useche, Alonso, Boyko et al. 2024). The more common this becomes and the more comfortable people are, the greater the issue may become. This is evidenced in the driving literature that demonstrates that individuals struggle to disengage from technology even when performing critical tasks, such as operating a vehicle (Kaviani et al. 2020). With a global push to promote cycling, coupled with the rise in e-bike usage, this problem is likely to arise in cycling. Further understanding of the issue of secondary task engagement while cycling, and factors that underly it, is warranted to support cyclist safety.

Our study also aimed to further an understanding of the rate of secondary task engagement among Australian cyclists, with a focus on technology use. The findings revealed that accessing GPS or maps on mobile phones was the most common task reported by cyclists, though rather infrequently. It may be that this type of engagement with technology is not seen by riders as a secondary task but rather as a task directly associated with cycling. This rather subtle difference may influence risk perceptions around the behavior. Interestingly, this may impose additional constraints for discouraging phone use among current road users who are already engaged in secondary tasks while riding (Okati-Aliabad et al. 2024; Useche, Alonso, Faus et al. 2024). Further, it remains unclear whether this behavior was done while cycling or while stationary. Understanding when cyclists use the navigation features of their phones, as well as determining the perceived and actual crash risk associated with this behavior, is an important avenue for further research. This is especially important given the propensity to use navigation devices among gig economy workers to complete tasks. The second most reported behavior was listening to music and using headphones. Studies from the United States and Europe have previously reported that using headphones while riding is the most common technology-based secondary task among cyclists (Goldenbeld et al. 2012; Adell et al. 2014; Ethan et al. 2016). In their observational study in Sweden, Adell et al. (2014) identified that when cyclists were observed using phones, 90% were using headphones. In the Netherlands, Goldenbeld et al. (2012) identified that three-quarters of teenagers and half of young adults listen to music while cycling, and in New York, Ethan et al. (2016) observed lower rates of technology usage but also identified using headphones as the most common form of technology engagement. Cycling while using headphones has also been associated with less safe behaviors (Terzano 2013). However, based on findings from a recent simulator study, Møller et al. (2024) suggested that purely cognitive tasks that use hands-free technology do not affect performance when undertaking simple cycling tasks, although they noted that their study did not consider more complex environments. Further research regarding cyclists' engagement in these secondary tasks is needed because listening to headphones has the potential to mask ambient noise and traffic sounds, which could reduce cyclists' situational awareness. Recommendations of safer alternatives, such as bone conduction headphones, and safer volume levels may be warranted.

There is a need to understand the behaviors noted in this study through observational and naturalistic research. This would provide more in-depth information on the ways in which people engage with technology, the frequency of engagement, and the context in which this happens. Though these behaviors provide some indication of the frequency of use of technology, it is likely that there are more nuanced behaviors performed by cyclists not captured in the survey. There is also the potential of bias in recollection of the frequency of the behaviors or a social desirability bias, with respondents choosing to downplay their engagement with technology, especially considering that the questions addressed "sensitive" topics related to normative behavior, which tends to increase the likelihood of omission of modification of answers (Leal et al. 2023).

As noted earlier, an innovation in this study was the use of the TAEG. The TAEG measured cyclists' views toward technology across 4 relevant subscales representing enthusiasm for technology, competence in dealing with technology, positive consequences of technology, and negative consequences of technology (Karrer et al. (2009). Because the TAEG had not previously been used to assess technology affinity among a cohort of Australian cyclists, we first confirmed the factor structure of the scale. Overall, participants in this study reported positive views toward technology and that they were competent technology users. A key finding is that enthusiasm for and positive views toward technology were significant predictors of technology use. It may be that these positive views overshadow potential risk perceptions in using the technology. This is a further avenue worthy of investigation.

Competence with technology was not identified as a significant predictor of engagement. This may reflect the overall high levels of competence among the sample of cyclists. Given the generally positive views toward technology, competence in using technology, and the general enthusiasm for technology among the cohort of cyclists, technology-based solutions may be an appropriate measure to reduce engagement in technology-based secondary tasks while riding.

There are a number of ways in which smartphone technology may be used to support safer riding. Avenues that have been suggested previously include self-tracking, social tracking, goal setting, blocking, gamification, and simplification (Rahmillah et al. 2023). For instance, most mobile devices also have a driving mode that can be enabled that restricts the range of applications that can be used, though these features may need to be recalibrated to cyclist travel speeds. Similar phenomena can be also observed in the motor vehicle–related industry, where car insurance companies have also explored gamified schemes to improve driver behavior (Ambrey and Yen 2018), with drivers rewarded with lower premiums for "safe" driving. Translating these techniques to cycling could be a means for reducing or limiting technology engagement. When considering the growing number of bicycle users working in the gig economy, there is potential to incorporate road safety solutions into company applications. These features could limit functionality when the phone's sensors detect motion above thresholds. Geofencing is another option that has been utilized by e-scooter companies (Dibaj et al. 2024), and similar functionality could be added to other applications, with limited application or interaction options available while in motion or within proximity to locations.

The findings of this study should be considered with an awareness of several limitations. First, the study relies on a nonrepresentative convenience sample of cyclists aged 18 years and older. Both the sampling approach and the exclusion of younger cyclists (younger than 18 years) restricts the generalizability of the findings to adult cyclists who ride regularly. Furthermore, there is a skew toward respondents with a high education level and male respondents, though this does reflect the profile of cyclists in Australia (Munro 2023), and further research is warranted to investigate cyclist behaviors among a nationally representative sample to confirm these findings.

The use of self-reported surveys can also introduce both recall bias and social desirability effects. The anonymous nature of the study may have mitigated these concerns. However, further research using naturalistic or observational techniques is needed to gain a better understanding of cyclists' engagement with technology. There is also a need to understand the nuances of when cyclists engage with technology, in which road environments, or under what traffic conditions. Furthermore, because the TAEG has seen limited applications to date, there is a need for further validation of the questionnaire among representative populations.

In conclusion, this study provides insight into self-reported secondary task engagement with technology among Australian cyclists. Overall, self-reported engagement in secondary tasks was relatively low in this sample. However, there is the potential for this to increase with technology being increasingly integrated into the gig economy and shared micromobility schemes. An important aspect of the study was the inclusion of a measure for technology affinity (TAEG). This highlighted the associations between positive views and enthusiasm toward technology and the likelihood of engaging with technology while cycling. This presents an avenue for intervention, where the same device that provides a source of distraction could be harnessed to improve cyclist safety.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The author(s) reported there is no funding associated with the work featured in this article.

References

Adell E, Nilsson A, Kircher K. 2014. Cyclists' use of mobile IT in Sweden—usage and self-reported behavioural compensation. In: International Cycling Safety Conference.

Ambrey CL, Yen BTH. 2018. How perceptions influence young drivers' intentions to participate in gamified schemes. Transport Res Part F Traffic Psychol Behav. 58:708–718. doi:10.1016/j.trf.2018.06.047.

Banister D. 2011. Cities, mobility and climate change. J Transp Geogr. 19(6):1538–1546. doi:10.1016/j.jtrangeo.2011.03.009.

Chen H-YW, Donmez B. 2016. What drives technology-based distractions? A structural equation model on social-psychological factors of technology-based driver distraction engagement. Accid Anal Prev. 91:166–174. doi:10.1016/j.aap.2015.08.015.

De Waard D, Schepers P, Ormel W, Brookhuis K. 2010. Mobile phone use while cycling: incidence and effects on behaviour and safety. Ergonomics. 53(1):30–42. doi:10.1080/00140130903381180.

Deenihan G, Caulfield B. 2014. Estimating the health economic benefits of cycling. J Transp Health. 1(2):141–149. doi:10.1016/j.jth.2014.02.001.

Dibaj S, Vosough S, Kazemzadeh K, O'hern S, Mladenović M. 2024. Investigating e-scooter injury and severity before and after the restriction policies in Helsinki, Finland. In: Transportation Research Board Annual Meeting.

Dingus TA, Guo F, Lee S, Antin JF, Perez M, Buchanan-King M, Hankey J. 2016. Driver crash risk factors and prevalence evaluation using naturalistic driving data. Proc Natl Acad Sci U S A. 113(10): 2636–2641. doi:10.1073/pnas.1513271113.

Ethan D, Basch CH, Johnson GD, Hammond R, Chow CM, Varsos V. 2016. An analysis of technology-related distracted biking behaviors and helmet use among cyclists in New York City. J Community Health. 41(1):138–145. doi:10.1007/s10900-015-0079-0.

Garrard J ,Crawford S, Hakman N, editors. 2006. Revolutions for Women: Increasing women's participation in cycling. Department for Victorian Communities Sport and Recreation 78.

Goldenbeld C, Houtenbos M, Ehlers E, De Waard D. 2012. The use and risk of portable electronic devices while cycling among different age groups. J Safety Res. 43(1):1–8. doi:10.1016/j.jsr.2011.08.007.

Huemer AK, Gercek S, Vollrath M. 2019. Secondary task engagement in German cyclists–An observational study. Saf Sci. 120:290–298. doi:10.1016/j.ssci.2019.07.016.

IBM Corp. 2023. IBM SPSS Statistics for Windows, Version 29.0.2.0 [software]. Armonk (NY): IBM Corp.

Ichikawa M, Nakahara S. 2008. Japanese high school students' usage of mobile phones while cycling. Traffic Inj Prev. 9(1):42–47. doi:10.1080/15389580701718389.

Karrer K, Glaser C, Clemens C, Bruder C. 2009. Technikaffinität erfassen–der Fragebogen TA-EG. Der Mensch Im Mittelpunkt Technischer Systeme. 8(2009):196–201.

Karrer-Gauß K, Roesler E, Siebert FW. 2024. Neuauflage des TAEG Fragebogens: technikaffinität valide und multidimensional mit einer Kurz-oder Langversion erfassen. Zeitschrift Für Arbeitswissenschaft. 78:387–406.

Kaviani F, Benier K, Robards B, Young KL, Koppel S. 2021. "Does that mean I can't use my phone to pay when I'm in the Maccas drive thru?": Younger drivers' uncertainty and attitude toward smartphone law and punishment. Accid Anal Prev. 160:106314. doi:10.1016/j.aap.2021.106314.

Kaviani F, Young KL, Robards B, Koppel S. 2020. Understanding the deterrent impact formal and informal sanctions have on illegal smartphone use while driving. Accid Anal Prev. 145:105706. doi:10.1016/j.aap.2020.105706.

Kircher K, Ahlstrom C, Palmqvist L, Adell E. 2015. Bicyclists' speed adaptation strategies when conducting self-paced vs. system-paced smartphone tasks in traffic. Transp Res Part F Traffic Psychol Behav. 28:55–64. doi:10.1016/j.trf.2014.11.006.

Lansdown TC. 2012. Individual differences and propensity to engage with in-vehicle distractions–A self-report survey. Transp Res Part F Traffic Psychol Behav. 15(1):1–8. doi:10.1016/j.trf.2011.09.001.

Leal S, Vrij A, Deeb H, Burkhardt J, Dabrowna O, Fisher RP. 2023. Verbal cues to deceit when lying through omitting information: examining the effect of a model statement interview protocol. Europ J Psychol Appl Legal Context. 15(1):1–8. doi:10.5093/ejpalc2023a1.

Møller M, Berghoefer FL, Vollrath M. 2024. How does hands-free cognitive distraction influence cycling behaviour and perceived safety? Transp Res Part F Traffic Psychol Behav. 104:522–531. doi:10.1016/j.trf.2024.06.026.

Munro C. 2023. National walking and cycling participation survey 2023.

NHTSA. 2021. Distracted driving. https://www.nhtsa.gov/risky-driving/distracted-driving.

O'Hern S, Estgfaeller N, Stephens AN, Useche SA. 2021. Bicycle rider behavior and crash involvement in Australia. Int J Environ Res Public Health. 18(5):2378. doi:10.3390/ijerph18052378.

O'Hern S, Stephens AN. 2022. Mobile phone use while driving in Finland. Transp Res Part F Traffic Psychol Behav. 90:220–228. doi:10.1016/j.trf.2022.08.018.

Okati-Aliabad H, Hashemi Habybabady R, Sabouri M, Mohammadi M. 2024. Different types of mobile phone use while driving and influencing factors on intention and behavior: insights from an expanded theory of planned behavior. PLoS One. 19(3):e0300158. doi:10.1371/journal.pone.0300158.

Pucher J, Garrard J, Greaves S. 2011. Cycling down under: a comparative analysis of bicycling trends and policies in Sydney and Melbourne. J Transp Geogr. 19(2):332–345. doi:10.1016/j.jtrangeo.2010.02.007.

Qualtrics. 2024. Version 2024 [software]. Provo (UT). https://www.qualtrics.com.

Rahmillah FI, Tariq A, King M, Oviedo-Trespalacios O. 2023. Evaluating the effectiveness of apps designed to reduce mobile phone use and prevent maladaptive mobile phone use: multimethod Study. J Med Internet Res. 25:e42541. doi:10.2196/42541.

Regan MA, Hallett C, Gordon CP. 2011. Driver distraction and driver inattention: definition, relationship and taxonomy. Accid Anal Prev. 43(5):1771–1781. doi:10.1016/j.aap.2011.04.008.

Ross V, Brijs K, Torfs K, Khattak MW, Meesmann U. 2018. ESRA: e -survey of road users' attitudes: analysis of safety indicators and predictors of distracted Driving behaviour. In: 6th International Humanist Conference.

Sutanto K, Widyanti A, Pratama GB, Soetisna HR. 2022. Technology for reducing distracted driving in developing countries: the level of usage and intention to use in Indonesia. Heliyon. 8(11):e11709. doi:10.1016/j.heliyon.2022.e11709.

Terzano K. 2013. Bicycling safety and distracted behavior in The Hague, the Netherlands. Accid Anal Prev. 57:87–90. doi:10.1016/j.aap.2013.04.007.

Useche SA, Alonso F, Boyko A, Buyvol P, Castañeda I, Cendales B, Cervantes A, Echiburu T, Faus M, Feitosa Z, et al. 2022. Cross-culturally approaching the cycling behaviour questionnaire (CBQ): evidence from 19 countries. Transportation Research Part F: Traffic Psychology and Behaviour. 91:386–400. doi:10.1016/j.trf.2022.10.025.

Useche SA, Alonso F, Boyko A, Buyvol P, Castañeda I, Cendales B, Cervantes A, Echiburu T, Faus M, Feitosa Z, et al. 2024. Using demographic, psychosocial, behavioural and safety-related factors to assess cyclists' behaviour: a comparative approach across 19 countries. Data Brief. 54:110278. doi:10.1016/j.dib.2024.110278.

Useche SA, Alonso F, Faus M, Trejo AC, Castaneda I, Oviedo-Trespalacios O. 2024. "It's okay because I'm just driving": an exploration of self-reported mobile phone use among Mexican drivers. PeerJ. 12:e16899. doi:10.7717/peerj.16899.

Useche SA, Alonso F, Montoro L, Esteban C. 2018. Distraction of cyclists: how does it influence their risky behaviors and traffic crashes? PeerJ. 6:e5616. doi:10.7717/peerj.5616.

Useche SA, Alonso F, Sanmartin J, Montoro LV, Cendales B. 2019. Well-being, behavioral patterns and cycling crashes of different age groups in Latin America: are aging adults the safest cyclists? PLoS One. 14(8):e0221864. doi:10.1371/journal.pone.0221864.

Useche SA, Montoro L, Sanmartin J, Alonso F. 2019. Healthy but risky: a descriptive study on cyclists' encouraging and discouraging factors for using bicycles, habits and safety outcomes. Transp Res Part F Traffic Psychol Behav. 62:587–598. doi:10.1016/j.trf.2019.02.014.

World Health Organization. 2020. Health at a glance: Asia/Pacific 2020 measuring progress towards universal health coverage: Measuring progress towards universal health coverage. Paris, France: OECD publishing.

Young KL, Osborne R, Grzebieta R, Williamson A, Haworth N, Senserrick T, Stephan KL, Charlton JL. 2020. Using naturalistic driving data to examine how drivers share attention when engaging in secondary tasks. Saf Sci. 129:104841. doi:10.1016/j.ssci.2020.104841.

Young KL, Regan M, Hammer M. 2007. Driver distraction: a review of the literature. Distract Driv. 2007:379–405.

Young KL, Stephens AN, O'Hern S, Koppel S. 2020. Australian cyclists' engagement in secondary tasks. J Transp Health. 16:100793. doi:10.1016/j.jth.2019.100793.