External and internal influences on mobile phone use while driving
Combining the theories of deterrence and self-determination

Truelove, Verity; Watson-Brown, Natalie; Oviedo-Trespalacios, Oscar

DOI
10.1016/j.trf.2023.01.019

Publication date
2023

Document Version
Final published version

Published in
Transportation Research Part F: Traffic Psychology and Behaviour

Transportation Research Part F: Psychology and Behaviour 93 (2023) 280–293

Contents lists available at ScienceDirect

Transportation Research Part F: Psychology and Behaviour

journal homepage: www.elsevier.com/locate/trf

External and internal influences on mobile phone use while driving: Combining the theories of deterrence and self-determination

Verity Truelove [a,*], Natalie Watson-Brown [b], Oscar Oviedo-Trespalacios [c]

[a] Road Safety Research Collaboration, School of Law and Society, University of the Sunshine Coast, 90 Sippy Downs Dr, Sippy Downs, Queensland 4556, Australia

[b] Queensland University of Technology (QUT), Centre for Accident Research and Road Safety – Queensland (CARRS-Q), 130 Victoria Park Road, Kelvin Grove 4059, Australia

[c] Delft University of Technology, Faculty of Technology, Policy and Management, Section of Safety and Security Science, Jaffalaan 5, 2628 BX Delft, The Netherlands

ARTICLE INFO

Keywords:
Distracted driving
Driver behaviour
Human factors
Self-regulation
Road safety
Enforcement

ABSTRACT

Objectives: Various legal countermeasures have been introduced in numerous jurisdictions worldwide to reduce the risky behaviour of phone use while driving. However, external factors do not influence behaviour alone; internal factors may also play a large role in influencing behaviour. Therefore, the aim of this study was to examine the impact of both external and internal influences on hand-held phone use while driving.

Methods and analysis: The influence of external factors was examined after a higher penalty and a trial for mobile phone detection cameras was introduced in Queensland, Australia, utilising deterrence-theory related constructs. Meanwhile, internal factors were examined through the lens of self-determination theory to determine the relevance of self-regulation to phone use while driving, over and above the effect of deterrence factors.

Findings: A total of 866 participants (M age = 37.51 years, SD = 17.23) completed a survey examining these variables. Despite the changes to the penalty and enforcement, the legal factors did not significantly deter drivers from phone use while driving. Instead, participants reported avoiding punishment, which influenced further engagement in the behaviour. Meanwhile, indicators of self-regulation including effort/importance, perceived pressure, and relatedness were found to have a more salient impact on the behaviour, whereby drivers who reported high levels of internalised regulatory processes were less likely to use a hand-held phone while driving.

Novelty and improvement: These results provide a novel contribution to understanding road rule compliance and have important implications for both theory and practice. For example, it can be suggested that legal countermeasures need to be improved, while non-legal countermeasures that target internalisation is a promising avenue for future research.

* Corresponding author.
E-mail address: vtruelove@usc.edu.au (V. Truelove).

https://doi.org/10.1016/j.trf.2023.01.019
Received 7 October 2022; Received in revised form 11 January 2023; Accepted 25 January 2023
Available online 4 February 2023

1. Introduction

1.1. Background

Mobile phones have become increasingly integrated into everyday lives and subsequently, the use of a mobile phone has become more common while driving. Despite efforts to reduce the use of a hand-held phone while driving, this behaviour remains a pervasive problem worldwide. Fatalities and injuries as a result of distracted driving have been increasing in driving jurisdictions, such as Australia (Queensland Government, 2021a), the United States (U.S. Department of Transport, 2020) and India (Government of India, 2020). Using a hand-held phone for activities such as texting while driving has been demonstrated to significantly deteriorate driving performance, resulting in a higher crash risk (Oviedo-Trespalacios, Haque, King, & Washington, 2016; Dingus et al., 2016). Further, hand-held phone use while driving has also been shown to increase variations in lane position, increase reaction time and result in poorer speed control (Oviedo-Trespalacios et al., 2016, Ortiz-Peregrina et al., 2020). The risk and prevalence of hand-held use while driving highlights the need to continue working towards the prevention of this risky behaviour.

An important psychological factor to consider in the prevention of phone use while driving is how drivers regulate their behaviour. Recent research has identified that self-regulation can contribute to reduced engagement in risky and non-compliant driving behaviours (Mills, Watson-Brown, Freeman, Truelove, & Davey, 2021; Watson-Brown, Scott-Parker, & Senserrick, 2019, Watson-Brown, Senserrick, et al., 2021), with self-regulating behaviour suggested to be specifically influential in engagement in phone use while driving (Onate-Vega, Oviedo-Trespalacios, & King, 2020; Oviedo-Trespalacios et al., 2019a; Senserrick, Oviedo-Trespalacios, & McDonald, 2021). Self-regulation is defined as having the capacity to control one's emotions, motivations, and behaviours in response to changes in the environment and in pursuit of personal goals (Vink et al., 2020). Those who have higher levels of self-regulation can be considered to be more internally regulated, which is a central construct of self-determination theory. Specifically, internalisation of regulatory processes, as informed by self-determination theory, is linked to engagement in positive behaviours that can be sustained long-term (Deci & Ryan, 2012; Ng et al., 2012). Considering the ongoing issue of engagement in the risky behaviour of phone use while driving, it can be suggested that the application of self-determination theory to phone use while driving is an important area to examine, especially as internal regulation is connected to long term, as opposed to short term behaviour change. However, when considering the application of internal regulation to phone use while driving, it is important to acknowledge that this behaviour also occurs in the context of external forces of legal sanctions, which can lead to individuals' engagement in this behaviour being externally regulated (i.e., where behaviour is contingent on an external punishment). Indeed, external regulation concerns any form of perceived punishment or reward, such as feelings of guilt for engaging in non-compliant behaviour or a vehicle alert tone when, for example, speeding or not wearing a seatbelt. When examining the impact of the external factors of legal sanctions on phone use while driving, deterrence theory can be considered the most appropriate way to measure this, as this well-established theory is based on the idea that an individual will not commit an offence when they perceive that the costs associated with offending (i.e., the legal sanction) outweighs the benefits of doing so (Becker, 1968; Zimring & Hawkins, 1973).

Importantly, regulation exists on a continuum. As such, it is possible that some drivers may be primarily externally regulated (e.g., influenced by legal sanctions), some may be primarily internally regulated (e.g., influenced by their internalisation of self-regulatory processes for safe driving behaviour, regardless of the legal sanctions), and some may be regulated by a mixture of both internal and external regulation for phone use while driving. Indeed, previous research has suggested that driving behaviours, given the necessity to follow road rules (external regulation when the safety value is not understood) are most likely guided by a combination of external and internal regulatory processes (Watson-Brown, Senserrick, et al., 2021). In recent updates to self-determination theory, Ryan and Deci (2020) acknowledge the co-existence of external and internal regulation given individuals are influenced by multiple factors that change over time, which is particularly relevant to driving. This suggests that context (personal and road environment) is influential and, only when perceived by the driver to be autonomy-supportive, the key element of self-determination theory (Deci & Ryan, 2012), internal regulation will ensue. Research has suggested that learner driver training that focuses on the value of road rules via teaching techniques suggested by self-determination theory could develop internal regulation prior to independent driving (Watson-Brown, Scott-Parker, et al., 2021). Notably, external regulation has been demonstrated to only lead to short-term behaviour change. This study will examine the impact of both internal regulation (via self-determination theory) and external regulation within the current environment of existing legal sanctions (via deterrence theory) for phone use while driving, as this has the potential to increase our understanding of what contributes to this behaviour and may be used to guide future countermeasures. The following sections outline the application of these theories to phone use while driving in more detail.

2. Internal regulation and phone use while driving guided by self-determination theory

Self-determination theory guides an understanding of external and internal regulatory processes that are associated with behaviours. Indeed, internal regulatory processes are associated with positive behaviour that can be sustained in the long-term (Ng et al., 2012). Internalisation, or self-regulation associated with specific behaviours, signifies positive behaviours that are aligned with an individual's personal goals and values. For example, research has shown that individuals who engage in occasional drug use refrained from drug driving when they valued compliant driving behaviours (Mills et al., 2021). Self-determination theory (SDT) guides an understanding of the development of internalisation that can influence specific behaviours with recent research applying SDT to engagement in safe and compliant driving behaviours (e.g., Reeve, Ryan, Deci, & Jang, 2008; Watson-Brown et al., 2019; Watson-Brown, Senserrick, et al., 2021). Given that SDT suggests a framework for developing positive behaviours, the research that has applied SDT to driving behaviours has examined safe driving as both compliant driving behaviour and safe driving choices. SDT

suggests internalisation of self-regulatory processes associated with engagement in safe driving behaviours, such as refraining from using a mobile phone while driving, is determined by personal values of safety.

Specifically, SDT suggests internalisation of self-regulatory processes is developed when three basic psychological needs are perceived to be satisfied within a specific context: autonomy (perception of free will in decision making), competence (perceived ability to engage in a targeted behaviour), and relatedness (a sense of connectedness to others while engaging in the behaviour) (Deci & Ryan, 2012). In the context of mobile phone use while driving, an individual refrains when the safe choice is perceived to be free from pressure, is valued by others, and the driver feels capable of driving without using their phone. Pressure thwarts autonomy and an individual who is pressured feels their behaviour is controlled (Deci & Ryan, 2012). Pressure while driving can be attributed to multiple sources, however, given the construct is *perceived pressure*, feelings of tension and anxiety represent this construct (Center for Self-Determination Theory, 2022). Previous research has shown that the predominant factors influencing engagement in safe driving practices is the lack of pressure and a high level of importance placed on safe driving (Watson-Brown et al., 2019, Watson-Brown, Senserrick, et al., 2021). An important facet of SDT is that when an individual perceives these needs as met, internalisation ensues.

Internalised regulation will be more likely when a) compliance is perceived to be important and encourages effortful good and safe driving, b) compliance and safety are perceived as a choice, c) the individual's social networks value safety and road rule compliance, and d) the driver is content to comply with road rules and make safe driving decisions regardless of pressures from other drivers, police presence, community opinions etcetera. Limited driving research has applied SDT, yet there is preliminary support that 'internalisation' is important to safe driving behaviours and a lack of internalisation contributes to a large proportion of engagement in risky and non-compliant driving behaviours (Watson-Brown et al., 2019, Watson-Brown, Senserrick, et al., 2021). Consequently, it can be suggested that self-determination theory has predictive utility for phone use while driving.

3. External regulation and phone use while driving guided by deterrence theory

In the current driving environment, legal sanctions for phone use while driving exist in most jurisdictions worldwide. When considering the impact of internalised regulation on phone use while driving, it can be considered an oversight to ignore this context, as drivers may also be externally regulated by this external threat of punishment. To understand the impact of these sanctions on phone use while driving, it is important to consider deterrence theory (that legal enforcement and punishment is based on), which states that a potential offender will only be deterred if there is a high perceived certainty of being apprehended for the offence, and if the penalty is perceived to be severe and delivered swiftly (Beccaria, 1764/2007; Bentham, 1780/1970). It is the objective of police forces to deter the public from engaging in offending behaviour. Importantly, the effectiveness of deterrence is dependent on how people perceive the certainty of apprehension and severity and swiftness of punishment, therefore, individuals need to be aware of the threat of punishment in order to be effectively deterred (Andenaes, 1974; Piquero, Paternoster, Pogarsky, & Loughran, 2011). In the case of the present research, we believe that knowledge about the road rules and punishment concerning mobile phone use while driving is well known in the Australian community as it is one of the risky driving behaviours that has been the focus of extensive educational campaigns and policy initiatives. Previous research by Oviedo-Trespalacios et al. (2017) also suggests that Australian drivers have high awareness of the road rules targeting mobile phone use while driving. Initial investigations that have applied classical deterrence theory to phone use while driving have found that the perceived certainty of apprehension, and the severity and swiftness of punishment were not significant deterrents for illegal phone use while driving in both Victoria, Australia (Kaviani, Young, Robards, & Koppel, 2020) and for Snapchat while driving in Queensland, Australia (Truelove, Freeman, & Davey, 2019). Similarly, certainty of apprehension was not a significant predictor of engagement in reading messages while driving (both general and concealed engagement in the behaviour) in Queensland, Australia (Truelove et al., 2021a). These results suggest that at the time of those studies, drivers' perceptions of being caught and punished for using their phone while driving were low and ultimately had limited effectiveness in creating a salient deterrent effect. Meanwhile, the non-significant swiftness of punishment result is consistent in road safety research (e.g., Fleiter, Lennon, & Watson, 2010; Freeman, Szogi, Truelove, & Vingilis, 2016), most likely due to the large time period (usually a couple of weeks) between receiving an infringement notice and being required to pay the fine. However, it should be acknowledged that non-significant deterrence results do not mean that deterrence does prevent behaviour. Instead, non-significant results signify that the legal sanctions being examined in the studies are not at a sufficient level to be a significant deterrent for the behaviour and need improvement (Homel, 1988; Gibbs, 1979; Piquero et al., 2011; Zimring & Hawkins, 1973). Notably, the chances of being caught using a phone while driving and the severity of punishment have increased recently. In Queensland, Australia, (where this study took place), trials for cameras that capture phone use while driving were implemented in July 2020 and the punishment increased from a $400 fine and 3 demerit points to a $1000 fine and 4 demerit points. During the trial period, drivers caught by a camera for phone use while driving only received a warning, while drivers caught by police officers may have still received the penalty, based on the police officer's discretion. Preliminary research suggested that self-reported phone use while driving decreased after these cameras were implemented (Truelove, Watson-Brown, Parker, Freeman, & Davey, 2021b). However, this finding was suggested as a result of a decrease in phone use while driving behaviour and cannot be definitively attributed to the implementation of the cameras. Notably, deterrence theory has yet to be applied to these changes in the legal countermeasures.

Importantly, the non-significant certainty of apprehension and severity of punishment results for phone use while driving may be explained by variables within the reconceptualised deterrence theory by Stafford and Warr (1993). This theory includes four variables (direct punishment, direct punishment avoidance, indirect punishment and indirect punishment avoidance) and states that experiences with punishment and the avoidance of punishment influences offending behaviour. For example, if a driver engages in phone use while driving yet avoids being caught and punished, they are more likely to continue engaging in this behaviour (direct punishment avoidance). Similarly, if a driver knows of friends or family who use their phone while driving and are not caught and punished for that

behaviour, based on the reconceptualised deterrence theory it can be suggested that the driver is more likely to engage in phone use while driving themselves (indirect punishment avoidance). Meanwhile, if a driver is caught and punished for illegally using their phone while driving (direct punishment), or they know of someone who has been caught and punished for this behaviour (indirect punishment), it is suggested that they will be less likely to engage in that behaviour. In relation to phone use while driving, this theory has only been applied to the use of Snapchat while driving (Truelove et al., 2019) and the individual variable of punishment avoidance has been applied to concealed and general reading messages while driving (Truelove et al., 2021a). It was found that experiencing direct punishment avoidance had the most prominent impact on engagement in these phone use while driving behaviours, whereby drivers who experienced more punishment avoidance were significantly more likely to continue engaging in the behaviour. In relation to the non-significant certainty of apprehension result for phone use while driving in previous research, it can be suggested that drivers were engaging in the behaviour and avoiding being detected (i.e., experiencing punishment avoidance) which resulted in the lower perceptions of certainty of apprehension and consequently, the non-significant result for certainty. The non-significant severity of punishment result in previous research may also be related to low perceptions of certainty of apprehension. Deterrence literature has suggested that the perceived severity of punishment may only be an effective deterrent if there is a high perceived certainty of being caught (Homel, 1988; Nagin, Solow, & Lum, 2015; Piquero et al., 2011). For example, if a driver does not believe they will be caught if they were to use their phone while driving, then the punishment is unlikely to be a deterrent, regardless of how severe it is.

Recent research has also shown that legal countermeasures alone do not necessarily create a sustained or effective deterrent effect due to issues such as concealed phone use (Truelove et al., 2021a) and difficulties enforcing penalties experienced by police (Rudisill, Baus, & Jarrett, 2019). Indeed, legal countermeasures in deterring drivers from illegally using their phone while driving have limited effectiveness (Truelove et al., 2021a). However, there is a gap in the research on the effectiveness of legal countermeasures applied to phone use while driving behaviour more generally (especially the application of the reconceptualised deterrence theory), and after the increase of both the severity of the punishment (the $1000 fine and 4 demerit points) and certainty of being apprehended (the implementation of cameras that capture phone use while driving).

4. The present study

This research examines mobile phone use while driving through the lens of SDT to determine the relevance of self-regulation to engagement in phone use while driving, over and above the effect of deterrence factors. Without this information, our knowledge on factors influencing mobile phone distracted driving will be limited to external regulation such as police enforcement and legal sanctions, with no consideration for personal factors such as self-regulation. Importantly, the integration of deterrence and self-determination theories provides an innovative examination of phone use while driving, allowing an understanding of internal and external influences. Research on prevention of mobile phone use while driving lacks a more theoretically informed investigation of the role of self-regulation at a cognitive level.

To address the gap in the literature, this research aimed to examine the impact of both external and internal influences on engagement in hand-held phone use while driving. Classical deterrence theory and Stafford and Warr (1993) reconceptualised deterrence theory will be used to obtain a comprehensive understanding of the external influences, while self-determination theory informs a measure of perceived needs satisfaction to understand the impact of internal influences on mobile phone use while driving. Two research questions were developed to address this aim:

1) How do legal sanctions influence engagement in phone use while driving?
2) Does internalisation of self-regulatory processes at a cognitive level influence engagement in phone use while driving?

5. Method

5.1. Participants

A sample of 1,138 Queensland drivers took part in the online survey. A total of 272 responses were deleted due to missing data on key variables, leaving a sample size of 866. Participants were aged between 17 and 82 years (M = 37.51 years, SD = 17.23). Participants included 392 (45.3%) males and 472 (54.4%) females. Further, 35 participants (4.04%) had received at least one infringement (Range = 0–5) for using a mobile phone while driving. Due to the small number of participants who had received an infringement, this variable was not included in subsequent analyses.

5.2. Materials

The study formed part of a larger project examining self-regulation and deterrence factors that influence road rule compliance for both speeding and phone use while driving, with this study focussing on phone use while driving. A survey was designed to capture self-regulation variables, deterrence variables and engagement in the offending behaviours, as outlined below.

5.2.1. Demographics

Demographic information regarding age, gender, previous infringement history was included in the survey.

5.2.2. Engagement in phone use while driving

Rule compliance for hand-held phone use while driving was measured with the average of 6 items tapping into the most prominent components of phone use while driving behaviours, including reading text messages, sending text messages, talking on a hand-held phone, using social media and general hand-held phone use while driving. Including this range of phone use while driving behaviours is more comprehensive in capturing engagement in the behaviour. The full set of questions are included in the appendix. Responses were recorded on a 6-point Likert scale (1 = never, 6 = daily) and had good reliability, $\alpha = 0.89$. The measurement was based on previous research (Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). Further, as additional items on engagement in phone use while driving were developed for this study, an exploratory factor analysis (EFA) using principal components with a VARIMAX rotation was conducted. The Kaiser-Meyer-Olkin measure of sampling adequacy was 0.896, indicating good factorability, and Bartlett's test of sphericity was significant at $p < .001$. The diagonals of the anti-image correlation matrix were all above 0.5 and the communalities were all over 0.3, suggesting each item shared some common variance with other items. The EFA produced a one-factor structure explaining 63.18% of the variance in engagement in mobile phone use while driving via the seven items, with factor loadings ranging from 0.345 to 0.812.

5.2.3. Internalisation of self-regulatory processes for reduced engagement in mobile phone use while driving

A 10-item adapted version of the Intrinsic Motivation Inventory (IMI; Center for Self-Determination Theory, 2022.), based on self-determination theory, was used to measure the internalisation of regulatory processes in the context of engagement in mobile phone use while driving. The scale assesses four indicators of internalisation; effort/importance (e.g., I make an effort not to use my mobile phone while driving; $\alpha = 0.728$), perceived choice (e.g., I believe I have a choice whether I use my mobile phone while driving; one item variable), relatedness (e.g., The people I value don't use their mobile phone while driving; $\alpha = 0.701$) and pressure/tension (e.g., I feel tense when I can't use my mobile phone while driving; $\alpha = 0.737$). Effort/importance is an overarching indicator of internalisation suggesting value of the behaviour, whereas perceived choice (positive predictor of internalisation), relatedness, and pressure/tension (negative predictor of internalisation) are indicators that have been shown to predict internalisation (Center for Self-Determination Theory, 2022). Participants rated how true each statement was on a 7-point scale (1 = not true at all, 7 = very true). These measures have been adapted to phone use while driving based on previous research that has applied the IMI to driving behaviour (Mills et al., 2021; Watson-Brown et al., 2019; Watson-Brown, Senserrick, et al., 2021).

A higher score indicated greater internalisation for all predictors except pressure/tension which is a negative predictor, and a lower score indicated greater internalisation.

5.2.4. Deterrence related variables

The classical deterrence variables were measured using items based on previous road safety deterrence research (Armstrong, Watling, & Davey, 2018; Freeman & Watson, 2009; Truelove et al., 2019), measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree). Two items were averaged to measure the perceived certainty of apprehension for phone use while driving, with good internal reliability, $\alpha = 0.922$. One item measured general certainty (The chances of getting caught for using a hand-held phone while driving are high) and the other measuring personal certainty (If **I** were to use a hand-held phone while driving, I think the chance **I** would be caught is high). Severity of punishment was also measured with the average of two items, consisting of *"I won't use a hand-held phone while driving because I don't want to get a fine"* and *"I won't use a hand-held phone while driving because I don't want to lose points from my licence"*. This variable had good internal reliability, $\alpha = 0.946$.

For the reconceptualised deterrence theory factors, each variable was determined by a single item measure based on previous road safety research (Freeman, Kaye, Truelove, & Davey, 2017; Truelove et al., 2019). Direct punishment was measured using an open-ended question; *"How many times have you received an infringement(s) notice (*e.g. *ticket) for using a hand-held phone while driving?"* Direct and indirect punishment avoidance, and indirect punishment were measured on a 7-point Likert scale (1 = strongly disagree, 7 = strongly agree) using statements such as *"My friends or family have been caught and punished for using a hand-held phone while driving"*.

5.3. Procedure

Ethical approval was obtained from University of the Sunshine Coast Human Research Ethics Committee (approval number: A201408). Participants were recruited via social media advertising and university recruitment. Participants provided responses to the measures described above, which took an average of 20 min to complete. Following the completion of the survey, participants were given the option to enter a prize draw to win one of ten $50 gift cards. Data was collected between August 2020 and February 2021.

5.4. Data analysis

First, means and standard deviation were reported to understand the extent of engagement in phone use while driving behaviour, as well as perceptions towards the external and internal variables of interest. For a more in-depth understanding of the participants, the frequency of phone use while driving for the demographic variables (age and gender) was also analysed via cross-tabulation. To address the research aim, correlations and a hierarchical linear regression were conducted. Correlations (using Pearson's *r*) were examined to understand the linear relationship between variables. A hierarchical linear regression analysis was conducted in order to determine the contribution of both external influences (based on deterrence theory) and internal factors (based on SDT's indicators of internalisation) on engagement in mobile phone use while driving. As the demographic variables age and gender were significantly correlated to mobile phone use while driving, they were entered in Step 1 as control variables. The deterrence variables (from classical

Table 1
Cross-tabulation between age, gender and self-reported engagement in illegal phone use while driving.

		Frequency of phone use while driving % (n)						
		Never (1)	Never to Once (1.14 to 1.86)	Once to a couple or a few times a year (2 to 2.86)	A couple or a few times a year to monthly (3–3.86)	Monthly to weekly (4–4.86)	Weekly to daily (5–5.71)	Daily (6)
Gender	Male	45.41% (178)	28.32% (111)	13.52% (53)	6.12% (24)	3.83% (15)	2.3% (9)	0.51% (2)
	Female	43.86% (207)	31.36% (148)	13.35% (63)	8.47% (40)	2.33% (11)	0.64% (3)	0% (0)
Age group (years)	17–25	39.02% (119)	33.77% (103)	12.46% (38)	10.16% (31)	2.95% (9)	1.31% (4)	0.33% (1)
	26–39	32.56% (70)	30.7% (66)	20.47% (44)	10.7% (23)	3.72% (8)	1.86% (4)	0% (0)
	40–59	47.51% (105)	28.51% (63)	14.03% (31)	3.62% (8)	4.07% (9)	1.81% (4)	0.45% (1)
	60+	73.39% (91)	22.58% (28)	2.42% (3)	1.61% (2)	0% (0)	0% (0)	0% (0)

Note. Age was grouped into categories for ease of interpretation of this table based on previous research (Kaviani et al., 2020). As the variable for frequency of engagement in phone use while driving was the average of 7 items, the scores reported in this table for this variable is the sum of scores in the range reported in each heading. Separate groups were created for scores of 1 (never) and 1.14 to 1.86 (never to once) to distinguish between participants who reported never engaging in the behaviour compared to those who reported engaging in the behaviour at some point.

Table 2
Means, standard deviations, and correlations.

Variable	M (SD)	1	2	3	4	5	6	7	8	9	10	11	12
1. Phone Use	1.67 (0.98)	–											
2. Age	37.51 (17.23)	−0.19**	–										
3. Gender	N/A	−0.03	−0.19**	–									
4. Certainty of Apprehension	4.79 (1.74)	−0.16**	−0.02	0.22**	–								
5. Severity of Punishment	5.83 (1.49)	−0.17**	−0.04	0.09*	0.39**	–							
6. Direct Punishment Avoidance	2.04 (1.69)	0.67**	−0.24**	−0.01	−0.14**	−0.15**	–						
7. Indirect Punishment	2.31 (1.71)	0.16**	0.00	−0.00	0.01	−0.04	0.19**	–					
8. Indirect Punishment Avoidance	2.98 (1.94)	0.27**	−0.09*	0.06	−0.16**	−0.08*	0.40**	0.46**	–				
9. Perceived Pressure	1.66 (1.06)	0.52**	−0.13**	0.06	−0.06*	−0.07*	0.46**	0.11*	0.22**	–			
10. Effort & Importance	5.80 (1.45)	−0.40**	0.10*	0.17**	0.17**	0.25**	−0.38**	−0.11**	−0.11*	−0.22**	–		
11. Relatedness	3.28 (1.68)	−0.28**	−0.03	0.13**	0.25**	0.29**	−0.20**	−0.11*	−0.20**	−0.12**	0.30**	–	
12. Perceived Choice	5.59 (1.76)	0.07*	−0.08*	0.01	−0.05	0.00	0.09*	−0.01	0.10*	−0.01	0.07*	−0.11**	–

Note. Gender was dummy coded such that 0 = males and 1 = females. *$p < .05$. ** $p < .01$.

Table 3
Summary of hierarchical regression analysis for variables predicting mobile phone use while driving (n = 827)[1].

Variable	Step 1					Step 2						Step 3					
	β	B	SE	sr^2	Adj. R^2	β	B	SE	sr^2	Adj. R^2	R^2 Change	β	B	SE	sr^2	Adj. R^2	R^2 Change
Demographic																	
Age	−0.202**	−0.011	0.002	0.039		−0.041	−0.002	0.002	0.002			−0.035	−0.002	0.001	0.001		
Gender	−0.077*	−0.152	0.068	0.058		−0.018	−0.036	0.054	0.000			−0.013	−0.025	0.050	0.000		
Deterrence Factors																	
Certainty of Apprehension						−0.038	−0.021	0.016	0.001			−0.019	−0.011	0.015	0.000		
Severity of punishment						−0.048	−0.032	0.019	0.002			−0.007	−0.004	0.018	0.000		
Direct Punishment Avoidance						0.637**	0.371	0.017	0.317			0.465**	0.271	0.018	0.130		
Indirect Punishment						0.046	0.027	0.017	0.002			0.034	0.019	0.016	0.001		
Indirect Punishment Avoidance						−0.016	−0.008	0.016	0.000			−0.032	−0.016	0.015	0.001		
Internalisation Factors																	
Perceived Pressure												0.274**	0.259	0.025	0.059		
Effort & Importance												−0.112**	−0.076	0.019	0.009		
Relatedness												−0.107**	−0.063	0.016	0.009		
Perceived Choice												0.036	0.020	0.014	0.001		
					0.038**					0.443**	0.407					0.531**	0.090

*p <.05. ** p <. 001.

[1] When the internalisation factors were instead entered in step 2 and the deterrence variables were entered in step 3, the R^2 change for step 2 was 0.359 while the R^2 change for step 3 was 0.147. The only individual predictor that changed in significance when internalisation was entered in step 2 (as opposed to step 3) was perceived choice, which became a significant predictor. All remaining significant and non-significant predictors remained the same.

deterrence theory and the reconceptualised deterrence theory) were entered into step 2, as this theory is more well-established in relation to phone use while driving. Finally, the internalisation factors were entered into step 3. Entering the internalisation factors into step 3 also allows an understanding of the impact of these variables on behaviour after controlling for the impact of the external legal factors in the current driving environment. All statistical assumptions were met.

6. Results

6.1. Self-reported mobile phone use

Results from self-reported mobile phone use indicated 56% of the sample have previously engaged in mobile phone use while driving. The average mobile phone use while driving was 1.67 ($SD = 0.98$), representing "never" to "once" on a 7-point Likert scale. Table 1 presents the frequency of engagement in phone use while driving by age and gender.

6.2. Correlations

Table 2 presents the means, standard deviations and correlations of the demographic variables, external and internal variables, and engagement in phone use while driving.

6.3. Predictors of mobile phone use while driving

A hierarchical multiple linear regression was conducted to analyse the impact of demographic variables, external influences (based on deterrence theory) and internal factors (based on SDT's indicators of internalisation) on engagement in mobile phone use while driving (see Table 3). Step 1 included the demographic variables of age and gender and was statistically significant, $F(2, 827) = 17.57$, $p < .001$ with an adjusted R^2 of 0.038. Age was a significant negative predictor, indicating that younger drivers were more likely to engage in illegal hand-held phone use while driving, $\beta = -0.202$, $p < 0.001$, $sr^2 = 0.039$. Gender was also a significant predictor. Gender was dummy coded such that 0 = males and 1 = females. Therefore, this result means that males were significantly more likely to engage in illegal phone use while driving compared to females.

Step 2, with the inclusion of the deterrence variables, was also statistically significant, $F(7, 822) = 95.05$, $p < .001$, with an R^2 of 0.447 and adjusted R^2 of 0.443. Only direct punishment avoidance was a significant predictor in step 2, $\beta = 0.637$, $p < 0.001$, $sr^2 = 0.371$, indicating that avoiding being caught for phone use while driving significantly reinforces the continued engagement in the behaviour. The deterrence factors were able to explain an additional 40.7% of the variance, adjusted $R^2 = 0.443$.

Step 3, with the additional inclusion of the internalisation factors, was also statistically significant, $F(11, 818) = 86.39$, $p < .001$, $R^2 = 0.537$, adjusted $R^2 = 0.531$. For the internalisation factors, perceived pressure was a significant predictor of mobile phone use while driving, $\beta = 0.274$, $p < .001$, $sr^2 = 0.059$, suggesting that social pressures to access the phone while driving influences engagement in mobile phone use while driving. Both effort/importance ($\beta = -0.112$, $p < .001$, $sr^2 = 0.009$) and relatedness ($\beta = -0.107$, $p < .001$, $sr^2 = 0.009$) were significant negative predictors of mobile phone use while driving. Effort and importance is an overarching indicator of internalised regulatory processes and the significance of this variable suggests the value of compliant behavioural choices is a positive influence on mobile phone use while driving. Similarly, relatedness, or the values and behaviours of friends and important others also reinforces compliance. Perceived choice was not a significant predictor of mobile phone use while driving. The internalisation factors explained an additional 9 % of the variance, adjusted $R^2 = 0.531$.

7. Discussion

This study is the first to examine how both external and internal factors influence engagement in hand-held phone use while driving, utilising measures of 1) deterrence and 2) internalisation of regulatory processes based on self-determination theory. The demographic variables showed that young drivers were more likely to engage in phone use while driving, consistent with previous research (Ismeik, Al-Kaisy, & Al-Ansari, 2015; Oviedo-Trespalacios et al., 2016). It was also found that males were more likely to use their phone while driving. Previous research has found females were more likely to use their phone while driving (Kaviani et al., 2020; Truelove et al., 2021a), therefore it may be suggested that the rates of this behaviour are increasing among males.

Overall, the findings illustrate there is an absence in external influences (legal enforcement and sanctions) that is impacting engagement in phone use while driving. Specifically, the variable direct punishment avoidance was a significant predictor, demonstrating that engaging in the behaviour and not being caught encouraged *more* frequent offending behaviour. Meanwhile, the perceived certainty of apprehension and severity of punishment were not significant deterrents for phone use while driving. This demonstrates that it is the absence of legal sanctions, as opposed to their presence, that is impacting offending behaviour. Considering avoiding punishment has such a large impact on illegal phone use while driving, it can be suggested that lowering drivers experiences with avoiding punishment through increased enforcement practices may enable external factors to have a larger impact on influencing *less* frequent engagement in the behaviour. Meanwhile, internal influences were found to have an additional impact on phone use while driving behaviour. Drivers who reported high levels of internalisation in the context of mobile phone use were less likely to engage in hand-held phone use while driving. Given that it has been suggested internalisation of self-regulatory factors can promote long-term behaviour change (Ng et al., 2012; in this case, more sustained road rule compliance), this can be considered an encouraging result for road safety. The finding that participants have found ways to avoid being penalised for phone use while driving reflects the

importance of interventions that target the development of internalisation of regulatory processes for phone use while driving. That is, internal factors are salient in the absence of perceived enforcement. A challenge from targeting self-regulatory factors is that the development of internalised regulatory processes for phone use while driving may be difficult across different groups of drivers as there has been limited research on effective interventions targeting internalised regulatory processes. This poses an opportunity to intervene, employing innovative approaches to reach the diversity of those who use their phone while driving. Importantly, continued research is suggested to investigate whether internalisation fluctuates in response to the dynamic driving environment. Given these circumstances, enforcement as an external regulating force remains an important element in reducing non-compliant driving behaviours, but further research should explore the possibility of an interaction between legal and personal factors for mobile phone use while driving prevention.

During the time in which this study was conducted, a mobile phone detection camera trial was in place. As this was a trial period, those who were caught using a hand-held phone by the camera would receive a warning, rather than an infringement notice (those caught by police officers could still receive an infringement notice; Queensland Government, 2021b). This study demonstrated that both drivers' perceived certainty of being apprehended and perceived severity of punishment were not significant deterrents for phone use while driving during this time. These non-significant results are consistent with previous research that has applied classical deterrence theory to phone use while driving (Kaviani et al., 2020; Truelove et al., 2019). However, in the previous studies, drivers could only be caught by police enforcement, while in this study, the mobile phone detection cameras were also in place. It may be suggested that the non-significant results are due to the trial period. In particular, the non-significant severity of punishment result can be explained by drivers not receiving a punishment if they are caught via the cameras. Further, as the mobile phone detection cameras were in a trial period, it is possible that not as many people would be aware that they could be caught by them, in comparison to when the cameras have been in place for a longer period of time. Future research is required to examine the deterrent impact of the mobile phone detection cameras after the trial period has ended and drivers receive an infringement notice when they are caught for the offence. Notably, it should also be acknowledged that preliminary research has suggested that engagement in phone use while driving has decreased since the mobile phone detection cameras and higher fines were implemented in Queensland (Truelove, Watson-Brown, Parker, Freeman, & Davey, 2021b). Therefore, this may indicate that, despite the non-significance of legal deterrents in this study, phone use while driving may still be decreasing. Future research is needed to explore this in more detail. Importantly, the long-term impact of increasing fines on the development of a self-regulated safety orientation towards phone use while driving will be key.

The only significant predictor of phone use while driving from Stafford and Warr's reconceptualised deterrence variables was punishment avoidance, where drivers who had previously used their phone while driving and had not been caught were more likely to continue engaging in the behaviour. This result can also help explain the non-significant certainty of apprehension result, as drivers may be frequently avoiding punishment, resulting in low perceptions of certainty of being caught. It may be suggested that there needs to be more mobile phone detection cameras and increased police enforcement to maximise the impact of legal countermeasures, especially as the perceived certainty of being apprehended for an offence has been demonstrated to be the most important component of deterrence (Homel, 1988; Nagin et al., 2015; Piquero et al., 2011). Self-determination theory posits that for some behaviours, both internal and external regulation is important. For driving behaviours in general, this is being realised (e.g., Watson-Brown, Senserrick, et al., 2021). Previous research has also identified that drivers frequently engage in concealed phone use while driving (Gauld, Lewis, & White, 2014; (Truelove et al., 2021a), which can limit the effectiveness of police enforcement and contribute to their experiences with punishment avoidance. Specifically, it has been suggested that high penalties have counteractively influenced more drivers to conceal this behaviour in an effort to avoid being caught and punished for the offence (Truelove et al., 2021a). Further, this highlights the complexity of this driving behaviour and suggests that mobile phone use, without the complication of the driving context, can be a problem for some individuals. Research has shown younger people are more likely to misuse their phone (in line with the findings of this study), with younger participants reporting greater engagement in phone use while driving (e.g., Thomée, Härenstam, & Hagberg, 2011). Concealed mobile phone use has been found to increase handheld mobile phone use while driving (Oviedo-Trespalacios, 2018). It has been suggested that phone detection cameras may be able to capture drivers' efforts to conceal their phone while driving (Truelove et al., 2021a), however drivers may be engaging in this behaviour in areas where the cameras are not located. Nowadays drivers can also have real time access to locations of police enforcement cameras and other forms of road policing operations through their mapping applications and/or social media (Mills, Truelove, Freeman, & Davey, 2022).

It is also noteworthy that indirect punishment (i.e. knowing others who have been caught and punished for phone use while driving) was not a significant deterrent in this study, yet was a significant deterrent in a previous study for Snapchat use while driving (Truelove et al., 2019). It is important to note that the study by Truelove et al. (2019) only looked at young drivers aged between 17 and 25 years, while this study looked at drivers across all age ranges. Therefore, it may be suggested that 1) young drivers discuss their experiences with receiving a phone use while driving penalty more so than older drivers, or 2) other drivers' experiences of punishment are less influential on drivers of a wider age than for younger drivers, resulting in the non-significant indirect punishment result for this study. It may also highlight the importance of individual elements in phone use while driving as more critical than the outcomes of others' behaviours.

While legal sanctions were demonstrated to have limited impact on hand-held phone use while driving, this study identified that after controlling for demographics and external influences (via deterrence theory), internal influences were able to predict less frequent engagement in phone use while driving. It should be acknowledged that the internal influences may have a lower variance in the model because the deterrence factors were entered first. Specifically, three of the four factors from the measure of internalisation based on SDT, significantly predicted engagement in the behaviour. The small variance explained by the SDT factors also reinforces that there are additional personal elements that need to be explored in future research that contribute to the complexity of phone use while driving. Although the variance accounted for over and above deterrence was limited, these findings suggest the importance of

the social context of driving and the need to develop countermeasures that support individual drivers' perceived autonomy, competence, and relatedness. This means that drivers who are faced with the opportunity to engage in phone use while driving are more likely to engage in the safe option when their social context values the choice not to use a phone while driving. Driver training and media campaigns can influence the social context targeting distinct groups of phone users to develop the perceived support for individuals' autonomy, competence, and relatedness (e.g., Watson-Brown, Scott-Parker, et al., 2021). Furthermore, the small increment in variance accounted for over deterrence factors supports the need for continued deterrence countermeasures. However, improvements to these countermeasures could be better aligned to the ideas of SDT that focus on drivers' goals and values around compliance and safety.

Perceived pressure or tension was the largest contributing factor of the internalisation variables to engagement in mobile phone use while driving, suggesting that this behaviour is complex. Social pressures to engage in phone use are presented as overarching to the engagement in phone use while driving. This has been confirmed in prior research that identified that individuals that have developed maladaptive relationships with their phones such as nomophobia, addiction or fear-of-missing-out also tend to use their phone more while driving (Oviedo-Trespalacios et al., 2019; Nguyen-Phuoc, Oviedo-Trespalacios, Su, Gruyter, & Nguyen, 2020; Rahmillah, Tariq, King, & Oviedo-Trespalacios, 2023). Indeed, the influence of peers and the 'fear of missing out', irrespective of the drivers' age, can influence the temptation to use a phone while driving (e.g., Elhai, Levine, Dvorak, & Hall, 2016). As with many risky and non-compliant driving behaviours, it is most likely that mobile phone use while driving is influenced by elements beyond the vehicle and immediate road environment. Similar to learner driver training that suggests the importance of self-reflection, particularly for young novice drivers (Hatakka, Keskinen, Gregersen, Glad, & Hernetkoski, 2002; Watson-Brown, 2020), and having insight into emotions that arise prior to and during a trip, so too is it critical that training addresses self-identification of the maladaptive attachments to the mobile that may lead to risky phone use while driving.

Relatedness and the perceived values of close contacts was also found to influence engagement in phone use while driving. There is accumulating evidence regarding the impact of close contacts on driving behaviours (e.g., Mills et al., 2021), irrespective of age, albeit youth driving behaviours are known to be more vulnerable to the influence of their peers (e.g., Scott-Parker, Watson, King, & Hyde, 2014). The results reinforce this knowledge with younger participant drivers found to be more likely to engage in mobile phone use while driving. This finding may in turn impact on the results that pressure and relatedness were most influential to engagement in phone use while driving. However, these internalisation indicators were still significant when age was controlled for. An important finding was that effort/importance was a significant predictor of phone use while driving. This factor is a key indicator of internalisation of regulatory processes for phone use while driving. This finding suggests that a driver who tries not to use their phone while driving and values this as a safe behaviour is more likely to be compliant in the long-term (Ng et al., 2012). This also means that, regardless of police officer or detection camera presence, it is most likely that a driver with internalised regulatory processes for phone use while driving would not be concerned with the level of enforcement.

Perceived choice as an internalisation indicator that intends to measure the level of autonomy in deciding to use a phone while driving was not a significant predictor of engagement in phone use while driving. A potential explanation for this finding is that not all phone use activities are self-initiated by the drivers and in some cases phone interactions are initiated externally (Oviedo-Trespalacios et al., 2020ab). For example, some drivers can be reacting by impulse to unexpected notifications or an in-coming call that interrupts the driving task. Arguably, this lack of choice could explain the lack of association between perceived choice construct and mobile phone use while driving. Additionally, another potential reason for this could be the validity and reliability of the perceived choice construct. Despite changes made to items to improve the reliability of the self-regulation scale, future work is needed to improve the psychometric properties of the scale (Watson-Brown et al., 2019, Watson-Brown, Senserrick, et al., 2021). In future application of the items developed to measure perceived choice, it is recommended that there is a clear delineation of the meaning of 'choice' in phone use while driving, with items reflecting this understanding. Additional items could also be a solution to the ambiguity of the current measure. Moreover, this finding may correspond to the notion of drivers perceived pressure to use their phone due to maladaptive relationships (Rahmillah et al., 2023), meaning the interpretation of choice could have been that there is a lack of autonomy in the decision to engage when mobile phone use represents pressure to engage.

Regardless of certainty and severity not being significant predictors of phone use while driving, effort and importance was correlated with severity, suggesting the perception of the form of punishment for non-compliance may be important to the effort and/or value placed on phone use. Relatedness was also found to be associated with severity and certainty, with this finding possibly explained by close contacts having verbalised their opinion on policing and punishment. This may influence drivers' perception of what is valued by close contacts. Importantly, pressure (+), relatedness (-) and effort (-) were all found to correlate with direct punishment avoidance which reflects the idea that greater external regulation discounts the level of internalisation. It is necessary for further research to examine this potentially important finding that concerns understanding regulatory processes in the context of enforcement and driving.

8. Limitations and future directions

While this study provides a unique contribution to the phone use while driving literature, there are limitations that need to be acknowledged. First, this study consisted of a self-report survey, therefore factors such as reporting or recall bias need to be considered. Social desirability bias needs to be acknowledged, whereby participants may answer questions in a way to look more favourable (Rosenman, Tennekoon, & Hill, 2011), such as reporting using their phone while driving less frequently than their actual engagement in the behaviour. However, a study by Taubman–Ben-Ari et al. (2016) identified similar results in risky driving behaviour between a self-report survey and a driving simulator, suggesting that self-report surveys may be a reliable measure of risky driving behaviour.

Nevertheless, self-report measures are not completely flawless in regard to bias. Further, participants were recruited primarily from regional and metropolitan areas in Queensland, Australia and may not be representative of the whole population. Queensland have one of the toughest road rules on driver distraction in the country. Future research is needed to apply these internal and external factors to phone use while driving internationally. Given the increasing use of technology in vehicles, such as the use of Apple CarPlay and Android Auto, there is a need to focus on the development of a self-regulated safety orientation more generally that will apply to in-vehicle technology use. Drivers can take advantage of many vehicles features to engage in risky driving behaviours and distracted driving (Oviedo-Trespalacios and Scott-Parker, 2018, Oviedo-Trespalacios et al., 2019c). The application of internal regulatory processes via self-determination theory used in this study provides a starting point for future research in this area. Future research should also consider the application of perceived legitimacy of the law and more broadly, procedural justice theory (Bates, Hassan, Soderlind, & McLean, 2022) to this model, as how drivers perceive the law and the way in which they are treated by authorities may also impact the way they regulate their behaviour. In addition, future research should also consider factors such as using a phone for work purposes while driving (Costantini, Ceschi, & Oviedo-Trespalacios, 2022, 2020b) and other psychosocial variables such as difficulty disconnecting from the phone or addiction (Rahmillah et al., 2023).

9. Conclusion

The present manuscript investigates external and internal influences on mobile phone use while driving. The overall findings suggested that mobile phone use while driving is a complex behaviour requiring countermeasures that focus on a whole system rather than one solution in isolation. Specifically, external and internal influences on the driver should be considered to reduce dangerous mobile phone use (e.g., police-based deterrence and self-regulation). The effectiveness of police-based countermeasures for mobile phone use while driving appears to be limited yet have potential to prevent phone use while driving through external regulation by decreasing experiences with punishment avoidance and increasing individual's perceived chances of being caught for the offence. Meanwhile, higher internal regulation was demonstrated to impact less frequent phone use while driving. As such, it suggested that countermeasures that further promote this type of regulation is a promising avenue to consider. This is a crucial finding as policy-based approaches have been one of the main countermeasures for mobile phone use while driving. This research also provides support that both external and internal regulation can exist together. Notably, it is suggested that regulation in the driving environment is context dependent. Both types of regulation need to be considered to prevent phone use while driving, especially considering that regulation exits on a continuum, rather than being simply external or internal. To conclude, it is recommended from these findings that a combination of person-centred factors and enforcement are considered for greater effectiveness in improving drivers' non-compliant mobile phone use while driving behaviours. Thus, the key implication of this manuscript for policy and practice is that a human-centred approach should be considered for road safety, where road policing should be part of multi-faceted intervention with inputs of both law enforcement and the psychosocial environment of a driver.

Funding

This project was supported by the Motor Accident Insurance Commission (MAIC) Queensland. The views expressed herein are those of the authors and are not necessarily those of the MAIC.

Dr Oscar Oviedo-Trespalacios was supported by an Australian Research Council Discovery Early Career Researcher Award Fellowship (DE200101079). The funders did not have any role in the study design, data collection and analysis, decision to publish, or preparation of the manuscript.

CRediT authorship contribution statement

Verity Truelove: Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Natalie Watson-Brown:** Conceptualization, Data curation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Oscar Oviedo-Trespalacios:** Writing – original draft, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to

Table A1
Items used to Measure Engagement in Phone use while Driving.

Items	
How often do you use a mobile phone while driving that is not hands-free?	
How often do you use your mobile phone to read a message while driving?	$\alpha = 0.89$
How often would you check your mobile phone if you receive an alert while driving?	
How often do you send text messages while driving?	
How often do you use social media on your phone while driving?	
How often would continually look at the phone for more than two seconds while driving?	
How often do you talk on a hand-held phone while driving?	

influence the work reported in this paper.

Data availability

Data will be made available on request.

Appendix A

See Table A1.

References

Andenaes, J. (1974). *Punishment and deterrence*. United States of America: University of Michigan Press.

Armstrong, K. A., Watling, C. N., & Davey, J. D. (2018). Deterrence of drug driving: The impact of the ACT drug driving legislation and detection techniques. *Transportation Research Part F: Traffic Psychology and Behaviour, 54*, 138–147. https://doi.org/10.1016/j.trf.2018.01.014

Bates, L., Hassan, E. H., Soderlind, D., & McLean, R. (2022). Does procedural justice predict intentions to speed? Evidence from a sample of young drivers. *Transportation Research Interdisciplinary Perspectives, 16*, Article 100709.

Beccaria, C. (1764/2007). In R. Bellamy (Ed.), R. Davies, & V. Cox (Trans.). *On Crimes and Punishments and Other Writings*. New York: Cambridge University Press.

Becker, G. S. (1968). Crime and punishment: An economic approach. In *The economic dimensions of crime* (pp. 13-68): Springer.

Bentham, J. (1780/1970). In J.H. Burns & H. L. Hart (Eds.). *An Introduction to the Principles of Morals and Legislation*. London: The Athlone Press.

Center for Self-Determination Theory. (2022). Intrinsic Motivation Inventory (IMI). Intrinsic Motivation Inventory (IMI) – selfdeterminationtheory.org.

Costantini, A., Ceschi, A., & Oviedo-Trespalacios, O. (2022). Eyes on the road, hands upon the wheel? Reciprocal dynamics between smartphone use while driving and job crafting. *Transportation research part F: traffic psychology and behaviour, 89*, 129–142. https://doi.org/10.1016/j.trf.2022.05.020

Dingus, T. A., Guo, F., Lee, S., Antin, J. F., Perez, M., Buchanan-King, M., & Hankey, J. (2016). Driver crash risk factors and prevalence evaluation using naturalistic driving data. *Proceedings of the National Academy of Sciences, 113*(10), 2636–2641.

Deci, E., & Ryan, R. (2012). Motivation, personality, and development within embedded social contexts: An overview of self-determination theory. In R. M. Ryan (Ed.), *The Oxford handbook of human motivation* (pp. 85-107). New York: NY: Oxford University Press. doi: 10.1016/B978-0-08-097086-8.26036-4.

Elhai, J. D., Levine, J. C., Dvorak, R. D., & Hall, B. J. (2016). Fear of missing out, need for touch, anxiety and depression are related to problematic smartphone use. *Computers in Human Behavior, 63*, 509–516. https://doi.org/10.1016/j.chb.2016.05.079

Fleiter, J. J., Lennon, A., & Watson, B. (2010). How do other people influence your driving speed? Exploring the 'who' and the 'how' of social influences on speeding from a qualitative perspective. *Transportation Research Part F: Traffic Psychology and Behaviour, 13*(1), 49–62. https://doi.org/10.1016/j.trf.2009.10.002

Freeman, J., Kaye, S., Truelove, V., & Davey, J. (2017). Is there an observational effect? An exploratory study into speed cameras and self-reported offending behaviour. *Accident Analysis & Prevent, 108*, 201–208. https://doi.org/10.1016/j.aap.2017.08.020

Freeman, J., Szogi, E., Truelove, V., & Vingilis, E. (2016). The law isn't everything: The impact of legal and non-legal sanctions on motorists' drink driving behaviours. *Journal of Safety Research, 59*, 53–60. https://doi.org/10.1016/j.jsr.2016.10.001

Freeman, J., & Watson, B. (2009). Drink driving deterrents and self-reported offending behaviours among a sample of Queensland motorists. *Journal of Safety Research, 40*(2), 113–120. https://doi.org/10.1016/j.jsr.2008.12.009

Gauld, C., Lewis, I., & White, K. M. (2014). Concealed texting while driving: What are young people's beliefs about this risky behaviour? *Safety Science, 65*, 63–69. https://doi.org/10.1016/j.ssci.2013.12.017

Gibbs, J. P. (1979). Assessing the deterrence doctrine: A challenge for the social and behavioural sciences. *American Behavioral Scientist, 22*(6), 653–677. https://doi.org/10.1177/000276427902200604

Government of India (2020). *Road accidents in India 2019*. https://morth.nic.in/sites/default/files/RA_Uploading.pdf.

Hatakka, M., Keskinen, E., Gregersen, N. P., Glad, A., & Hernetkoski, K. (2002). From control of the vehicle to personal self-control; broadening the perspectives to driver education. *Transportation Research Part F: Traffic Psychology and Behaviour, 5*(3), 201–215. https://doi.org/10.1016/S1369-8478(02)00018-9

Homel (1988). *Policing and punishing the drinking driver. A study of specific and general deterrence*. Springer. 10.1007/978-1-4684-7077-2.

Ismeik, M., Al-Kaisy, A. F., & Al-Ansari, K. (2015). Perceived risk of phoning while driving: A case study from Jordan. *Safety Science, 78*, 1–10. https://doi.org/10.1016/j.ssci.2015.02.011

Kaviani, F., Young, K. L., Robards, B., & Koppel, S. (2020). Understanding the deterrent impact formal and informal sanctions have on illegal smartphone use while driving. *Accident Analysis & Prevention, 145*, 1–10. https://doi.org/10.1016/j.aap.2020.105706

Mills, L., Truelove, V., Freeman, J., & Davey, J. (2022). Police location pages and groups on Facebook: Does knowing where the police are influence perceptions of certainty and drug driving behaviour? *Safety science, 147*, Article 105601.

Mills, L., Watson-Brown, N., Freeman, J., Truelove, V., & Davey, J. (2021). An exploratory investigation into the self-regulatory processes influencing drug driving: Are young drivers more externally regulated? *Transportation Research Part F: Traffic Psychology and Behaviour, 80*, 237–249. https://doi.org/10.1016/j.trf.2021.04.011

Nagin, D. S., Solow, R. M., & Lum, C. (2015). Deterrence, criminal opportunities, and police. *Criminology: An Interdisciplinary Journal, 53*(1), 74–100. https://doi.org/10.1111/1745-9125.12057

Ng, J. Y. Y., Ntoumanis, N., Thøgersen-Ntoumani, C., Deci, E. L., Ryan, R. M., Duda, J. L., & Williams, G. C. (2012). Self-Determination Theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science, 7*(4), 325–340. https://doi.org/10.1177/1745691612447309

Nguyen-Phuoc, D. Q., Oviedo-Trespalacios, O., Su, D., Gruyter, C. D., & Nguyen, T. (2020). Mobile phone use among car drivers and motorcycle riders: The effect of problematic mobile phone use, attitudes, beliefs and perceived risk. *Accident Analysis & Prevention, 143*, Article 105592. https://doi.org/10.1016/j.aap.2020.105592

Onate-Vega, D., Oviedo-Trespalacios, O., & King, M. J. (2020). How drivers adapt their behaviour to changes in task complexity: The role of secondary task demands and road environment factors. *Transportation research part F: Traffic psychology and behaviour, 71*, 145–156. https://doi.org/10.1016/j.trf.2020.03.015

Oviedo-Trespalacios, O., Haque, M. M., King, M., & Washington, S. (2016). Understanding the impacts of mobile phone distraction on driving performance: A systematic review. *Transportation research part C: Emerging technologies, 72*, 360–380. https://doi.org/10.1016/j.trc.2016.10.006

Oviedo-Trespalacios, O., Haque, M. M., King, M., & Washington, S. (2019). "Mate! I'm running 10min late": An investigation into the self-regulation of mobile phone tasks while driving. *Accident Analysis & Prevention, 122*, 134–142. https://doi.org/10.1016/j.aap.2018.09.020

Oviedo-Trespalacios, O., Nandavar, S., Newton, J. D. A., Demant, D., & Phillips, J. G. (2019). Problematic use of mobile phones in Australia… is it getting worse? *Frontiers in Psychiatry, 10*, 105. https://doi.org/10.3389/fpsyt.2019.00105

Oviedo-Trespalacios, O., Nandavar, S., & Haworth, N. (2019). How do perceptions of risk and other psychological factors influence the use of in-vehicle information systems (IVIS)? *Transportation research part F: traffic psychology and behaviour, 67*, 113–122. https://doi.org/10.1016/j.trf.2019.10.011

Oviedo-Trespalacios, O., & Scott-Parker, B. (2018). Young drivers and their cars: Safe and sound or the perfect storm? *Accident Analysis & Prevention, 110*, 18–28. https://doi.org/10.1016/j.aap.2017.09.008

Oviedo-Trespalacios, O., Truelove, V., & King, M. (2020). "It is frustrating to not have control even though I know it's not legal!": A mixed-methods investigation on applications to prevent mobile phone use while driving. *Accident Analysis & Prevention, 137*, Article 105412. https://doi.org/10.1016/j.aap.2019.105412

Oviedo-Trespalacios, O., Vaezipour, A., Truelove, V., Kaye, S. A., & King, M. (2020). "They would call me, and I would need to know because it is like life and death": A qualitative examination of the acceptability of smartphone applications designed to reduce mobile phone use while driving. *Transportation research part F: Traffic psychology and behaviour, 73*, 499–513. https://doi.org/10.1016/j.trf.2020.06.007

Oviedo-Trespalacios, O. (2018). Getting away with texting: Behavioural adaptation of drivers engaging in visual-manual tasks while driving. *Transportation Research Part A: Policy and Practice, 116*, 112–121. https://doi.org/10.1016/j.tra.2018.05.006

Ortiz-Peregrina, S., Oviedo-Trespalacios, O., Ortiz, C., Casares-López, M., Salas, C., & Anera, R. G. (2020). Factors determining speed management during distracted driving (WhatsApp messaging). *Scientific Reports, 10*(1), 1–10. https://doi.org/10.1038/s41598-020-70288-4

Piquero, A. R., Paternoster, R., Pogarsky, G., & Loughran, T. (2011). Elaborating the individual difference component in deterrence theory. *Annual Review of Law and Social Science, 7*(1), 335–360. https://doi.org/10.1146/annurev-lawsocsci-102510-105404

Queensland Government. (2021a). *Queensland road crash weekly report.* (Report No. 1248). https://www.webcrash.transport.qld.gov.au/webcrash2/external/daupage/weekly/roadsense.pdf.

Queensland Government (2021b). *Mobile Phone and Seatbelt Cameras.* https://www.qld.gov.au/transport/safety/fines/cameras.

Rahmillah, F. I., Tariq, A., King, M., & Oviedo-Trespalacios, O. (2023). Is distraction on the road associated with maladaptive mobile phone use? A systematic review. *Accident Analysis and Prevention, 181*. https://doi.org/10.1016/j.aap.2022.106900

Reeve, J., Ryan, R., Deci, E. L., & Jang, H. (2008). Understanding and promoting autonomous self-regulation: A self-determination theory perspective. In D. H. Schunk & B. J. Zimmerman (Eds.), *Motivation and self-regulated learning: Theory, research, and applications* (pp. 223–244). Lawrence Erlbaum Associates Publishers.

Rosenman, R., Tennekoon, V., & Hill, L. G. (2011). Measuring bias in self-reported data. *International journal of behavioural & healthcare research, 2*(4), 320–332. https://doi.org/10.1504/IJBHR.2011.043414

Rudisill, T. M., Baus, A. D., & Jarrett, T. (2019). Challenges of enforcing cell phone use while driving laws among police: A qualitative study. *Injury Prevention, 25*(6), 494–500. https://doi.org/10.1136/injuryprev-2018-042931

Ryan, R. M., & Deci, E. L. (2020). Intrinsic and extrinsic motivation from a self-determination theory perspective: Definitions, theory, practices, and future directions. *Contemporary educational psychology, 61*, Article 101860.

Saunders, J. B., Aasland, O. G., Babor, T. F., de la Fuente, J. R., & Grant, M. (1993). Development of the Alcohol Use Disorders Identification Test (AUDIT): WHO collaborative project on early detection of persons with harmful alcohol consumption: II. *Addiction, 88*(6), 791–804. https://doi.org/10.1111/j.1360-0443.1993.tb02093.x

Senserrick, T., Oviedo-Trespalacios, O., & McDonald, C. (2021). Is it time to apply a harm reduction approach to young driver education? *Journal of Transport & Health, 23*, Article 101263. https://doi.org/10.1016/j.jth.2021.101263

Scott-Parker, B., Watson, B., King, M. J., & Hyde, M. K. (2014). Young novice drivers and the risky behaviours of parents and friends during the Provisional (intermediate) licence phase: A brief report. *Accident Analysis & Prevention, 69*, 51–55.

Stafford, M. C., & Warr, M. (1993). A reconceptualization of general and specific deterrence. *Journal of Research in Crime and Delinquency, 30*(2), 123-135. 10.1177%2F0022427893030002001.

Taubman – Ben-Ari, O., Eherenfreund – Hager, A., & Prato, C. G. (2016). The value of self- report measures as indicators of driving behaviors among young drivers. *Transportation Research Part F: Traffic Psychology and Behaviour, 39*, 33-42. doi:10.1016/j.trf.2016.03.005.

Thomée, S., Härenstam, A., & Hagberg, M. (2011). Mobile phone use and stress, sleep disturbances, and symptoms of depression among young adults - a prospective cohort study. *BMC Public Health, 11*(1), 66. https://doi.org/10.1186/1471-2458-11-66

Truelove, V., Freeman, J., & Davey, J. (2019). "I snapchat and drive!" A mixed methods approach examining snapchat use while driving and deterrence perceptions among young adults. *Accident Analysis & Prevention, 131*, 146–156. https://doi.org/10.1016/j.aap.2019.06.008

U.S. Department of Transport. (2020). *Overview of motor vehicle crashes in 2019.* https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/813060.

Truelove, V., Oviedo-Trespalacios, O., Freeman, J., & Davey, J. (2021a). Sanctions or crashes? A mixed-method study of factors influencing general and concealed mobile phone use while driving. *Safety Science, 135*, 1–9. https://doi.org/10.1016/j.ssci.2020.105119

Truelove, V., Watson-Brown, N., Parker, E., Freeman, J., & Davey, J. (2021b). Driving through a pandemic: A study of speeding and phone use while driving during COVID-19 restrictions. *Traffic injury prevention, 22*(8), 605–610. https://doi.org/10.1080/15389588.2021.1980213

Vink, M., Gladwin, T. E., Geeraerts, S., Pas, P., Bos, D., Hofstee, M., Durston, S., & Vollebergh, W. (2020). Towards an integrated account of the development of self-regulation from a neurocognitive perspective: A framework for current and future longitudinal muti-model investigations. *Developmental Cognitive Neuroscience, 45*. https://doi.org/10.1016/j.dcn.2020.100829

Watson-Brown, N., Scott-Parker, B., & Senserrick, T. (2019). Association between higher- order driving instruction and risky driving behaviours: Exploring the mediating effects of a self-regulated safety orientation. *Accident Analysis & Prevention, 131*, 275–283. https://doi.org/10.1016/j.aap.2019.07.005

Watson-Brown, N., Scott-Parker, B., & Senserrick, T. (2021). Higher order training supporting competence, autonomy, relatedness (HOT-CAR): A model to improve learner drivers' higher order skills. *Transportation Research Part F: Traffic Psychology and Behaviour, 80*, 79–89. https://doi.org/10.1016/j.trf.2021.03.013

Watson-Brown, N., Senserrick, T., Freeman, J., Davey, J., & Scott-Parker, B. (2021). Self-regulation differences across learner and probationary drivers: The impact on risky driving behaviours. *Accident Analysis & Prevention, 154*. https://doi.org/10.1016/j.aap.2021.106064

Watson-Brown, N. (2020). *Operationalising theoretical frameworks for a best-practice model of higher-order driving instruction for Learner drivers* [University of the Sunshine Coast]. https://research.usc.edu.au/discovery/delivery/61USC_INST:ResearchRepository/121 30109710002621?l#13130109700002621.

Zimring, F., & Hawkins, G. (1973). *Deterrence: The legal threat in crime control.* Chicago and London: The University of Chicago Press.