The association of self-regulation, habit, and mindfulness with texting while driving

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ABSTRACT

The saturation of mobile phones throughout Australia has led to some individuals being unable to regulate their use within situations that are inappropriate or risky. One of the most prevalent risky mobile phone use behaviours is texting while driving. Attempts to explain texting while driving suggest cognitive variables and personality characteristics are key factors. This study explored relationships between trait self-regulation, habitual text messaging, trait mindfulness, and texting while driving. One hundred and seventy participants comprising Australian undergraduate psychology students and members of the public completed an online survey measuring trait self-regulation, habitual text messaging behaviour, trait mindfulness, and frequency of texting while driving. It was found that habitual texting behaviour mediated the relationship between trait self-regulation and frequency of texting while driving. Additionally, trait mindfulness moderated the relationship between habit and texting while driving, such that habitual texting was significantly, positively related to texting while driving, but only for individuals with low to moderate trait mindfulness. These results suggest personality constructs related to attention, awareness, and control of behaviour play a significant role in counteracting the association that habitual texting behaviour has with the frequency of texting while driving. As these traits are considered malleable, this association may be applicable in future development of intervention programs aimed at increasing control over mobile phone use and reducing the frequency with which people text while driving.

1. Introduction

Mobile phone ownership in Australia is at an all-time high. At December 2017, it was estimated 19.4 million Australians owned a mobile phone, with these estimates increasing to 19.7 million in 2018, and 20 million by 2019 (Statista, 2017). Despite benefits to both individuals and society arising from mobile phone technology such as text message reminders for health prevention and management (Car et al., 2008), some negative behaviour has also arisen. One such example is when individuals are unable to regulate their mobile phone use in situations that are inappropriate, dangerous, or illegal. A well-documented example within the literature is using one's mobile phone while driving (Bayer and Campbell, 2012; Nemme and White, 2010).

Using a mobile phone while driving affects nearly every aspect of driving ability and performance (Caird et al., 2014). The distraction associated with mobile phone use in general (and texting while driving in particular) compromises a driver's visual, physical, and cognitive resources, leading to slower response times, missed detection opportunities, frequent and prolonged glances away from the road, more frequent lane departures, and a higher number of crashes (Caird et al.,

2014; Rumschlag et al., 2015). Perhaps unsurprisingly, distracted driving was implicated in 33% of fatal crashes and 46% of serious injury crashes in South Australia in 2015 alone (Department of Planning, Transport, and Infrastructure, 2015), with similar figures being reported in the United States of America (National Highway Traffic Safety Administration, 2017) and worldwide (World Health Organisation, 2011). Although these figures are disturbing, crash involvement from mobile phone use may be much higher than what is currently reported due to difficulties with establishing mobile phone use as a contributing factor at crash events (Transport for New South Wales, 2017).

Current strategies aimed at reducing mobile phone use while driving include nationwide bans on hand-held mobile phone use while driving for unrestricted licence holders, and hand-held and hands-free mobile phone use for both learner and provisional drivers (including when the car is stationary, but not parked; Australian Road Rules, 2015). Advertising campaigns are also run frequently on television, radio, and social media highlighting the risks involved in calling and texting while driving (Department of Transport and Main Roads, 2017; Transport for New South Wales, 2017). Despite these efforts, research suggests they offer little deterrence for some drivers. For example,

research by Nemme and White (2010) and Rumschlag et al. (2015) found drivers in their studies admitted to texting while driving despite acknowledging it is unsafe to do so, with some drivers also choosing to conceal their mobile phone use from view to avoid being penalised (Gauld et al., 2014). This paradoxical commitment from drivers to continue using their mobile phone while driving despite acknowledging both the legal ramifications and safety risk posed, suggest alternative explanations beyond legal deterrence and risk factors need to be explored.

Our study aimed to examine the cognitive and personality factors associated with uncontrolled mobile phone use, focusing on texting while driving. Drawing on past research exploring relationships between self-regulation and habit (Tokunaga, 2013), self-regulation and mindfulness (Friese et al., 2012), and associations these variables have with the frequency of texting in general and texting while driving (Bayer et al., 2016; Panek et al., 2015), the focus of this study is on examining the nature of the relationship that trait self-regulation and habitual text messaging behaviour have with the frequency of texting while driving. We also examined whether these relationships differ according to an individual's trait mindfulness levels. In doing so, the present paper addresses three research questions. First, what is the nature of the relationship between trait self-regulation and frequency of texting while driving? Second, does habitual texting behaviour have a mediating role in the relationship between trait self-regulation and frequency of texting while driving? Third, does this relationship differ depending on levels of trait mindfulness?

1.1. Relationship between trait self-regulation and texting while driving

Trait self-regulation refers to one's innate capacity to control, modify, and adapt behaviour to make plans, meet goals, and follow personal (and societal) rules and standards (Baumeister et al., 2006). Bandura's (1991) social cognitive theory of self-regulation suggests behavioural control requires one to self-monitor behaviour and the associated outcomes, have clear personal standards or an external comparison on which to base standards, and accurately anticipate the affective consequences of actions; however, if any of these processes are inhibited one's ability to monitor and self-direct behaviour, regulate behaviour, and implement behaviour change can be impaired (Bandura, 1991). Despite humans having an impressive capacity for self-regulation, failures are common. The cognitive "strength" model (Baumeister and Heatherton, 1996) suggests self-regulation is a finite, renewable resource that is subject to depletion depending on the demands placed upon it. That is, acts of self-regulation rely on a global energy reservoir and once this is used one falls in to a state of "ego depletion" where further attempts at self-regulation are more likely to fail.

Despite individuals being susceptible to the ego-depletion effect, studies utilising delay of gratification and delay discounting tasks as a measure of self-regulatory ability (i.e., forgoing a smaller reward immediately in favour of a larger reward later; Audrain-McGovern et al., 2009; Hayashi et al., 2015; Metcalfe and Mischel, 1999) suggest self-regulation is a dispositional, trait-like construct that manifests in diverse behavioural outcomes. For example, individuals with naturally high levels of self-regulation have been shown to experience more psychological wellbeing, positive emotions, and high self-esteem, and less psychological distress than people lower in this trait (Bowlin and Baer, 2012; Tangney et al., 2004). Conversely, individuals with lower self-regulatory capacity experience problems such as obesity, addiction, and criminal behaviour more so than individuals who are dispositionally higher in this trait (Baumeister et al., 1994; Vohs and Baumeister, 2011).

Similar associations have been found between trait self-regulation and texting behaviour both in general and while driving. Bayer et al. (2016) found individuals who were lower in trait self-regulation were more likely to text automatically (or habitually) across several texting

behaviours (i.e., checking, reading, starting, sending) than individuals higher in this trait. Similarly, a study by Panek et al. (2015) measuring trait self-regulation and frequency of texting while walking and texting while driving found participants lower in trait self-regulation were more likely than those who were higher in this trait to both text while walking and text while driving. As such, the first hypothesis of the current study was that low levels of trait self-regulation would be associated with greater frequency of texting while driving.

1.2. Relationship between trait self-regulation and habit

Failure to self-regulate behaviour, by definition, suggests that one's behaviour is no longer under volitional control. When attempts to self-regulate a given behaviour fail often enough the behaviour can become habitual (Orbell and Verplanken, 2010). Habitual behaviour is defined as "a form of automaticity in responding that develops as people repeat actions in stable circumstances" (Verplanken and Wood, 2006, p. 91). That is, once a behaviour has been repeated sufficiently, behavioural responses that were once able to be controlled become automatically elicited and carried out with little attention, awareness, control, or intention (Bargh, 1996; Orbell and Verplanken, 2010). Studies analysing the effects of self-regulation and habit when interacting with information technology platforms such as the Internet and mobile phones reflect how self-regulatory failure assists in habit formation. For example, experimental research by Tokunaga (2013) found the frequency of unregulated Internet use was predictive of habitual use, whereby frequent lapses in self-regulation (i.e., high levels of concentration, reduced self-consciousness, lack of awareness of the external environment, and distortions of time) increased habitual responding to future internet use. Likewise, Soror et al. (2012) found that unregulated mobile phone use positively influenced the strength of one's mobile phone habits.

1.3. Relationship between habit and texting while driving

There is extant research on the significant relationship between habitual mobile phone use and texting while driving. Studies have shown habitual text messaging behaviour significantly predicts texting while driving above and beyond constructs such as attitude, social norms, behavioural intentions, and perceived behavioural control (Nemme and White, 2010), and age, gender, driving confidence, and past texting behaviour (Bayer and Campbell, 2012). Moreover, when habitual behaviour is strong relative to self-regulation, people are more likely to act in accordance with their habits (Aarts and Dijksterhuis, 2000). For example, Bayer et al. (2016) and Panek et al. (2015) found people with strong texting habits (in the presence of low self-regulation) were more likely to text automatically in general and text while driving more frequently. As such, a second hypothesis was proposed that habitual texting behaviour would mediate the relationship between trait self-regulation and frequency of texting while driving.

1.4. Relationship between trait self-regulation and trait mindfulness

Mindfulness refers to the non-judgemental attention and awareness of thoughts, emotions, and bodily sensations as they arise in the present moment (Bishop et al., 2003; Kabat-Zinn, 2003). Like self-regulation, mindfulness is considered to vary from low to high levels naturally throughout the population as a dispositional, trait-like characteristic (Brown and Ryan, 2003). Whilst research has shown that self-regulation and mindfulness are highly correlated (Fetterman et al., 2010), research by Bowlin and Baer (2012) and Friese et al. (2012) indicate they are, in fact, distinct constructs that influence one another.

In their research on relationships between trait self-regulation, trait mindfulness, and psychological wellbeing, Bowlin and Baer (2012) found trait mindfulness moderated the relationship between trait self-regulation and wellbeing. That is, while trait mindfulness and trait self-

regulation were both positively associated with psychological health and negatively associated with psychological distress, those high in both traits were less likely than those high in self-regulation but low in mindfulness to experience general distress.

Furthermore, training in mindfulness meditation (i.e., an activity that induces a state of mindfulness) has been shown to increase self-regulatory strength by counteracting the effects of ego depletion (Friese et al., 2012). Friese et al. (2012) conducted activities designed to deplete participants' self-regulatory resources before assigning them to either a meditation group or non-meditation group. After five minutes of either meditating or completing an alternative activity, both groups completed a task requiring further self-regulatory resources. The results indicated the meditation group performed equally as well on the subsequent self-regulation task as participants in a control group who did not exert self-regulation prior. Conversely, participants who were in the non-meditating group showed impaired performance on the subsequent self-regulation task in comparison to the meditation and control groups (Friese et al., 2012). It is thought trait mindfulness exerts this effect on self-regulation by emphasising and enhancing awareness and attention, thus counteracting the depletion of attentional resources required for behavioural control (Baumeister and Heatherton, 1996; Friese et al., 2012).

1.5. Relationship between trait mindfulness and texting while driving

The positive association between trait mindfulness and behavioural control has also been shown in studies measuring relationships between trait mindfulness and frequencies of texting in general and texting while driving (Bayer et al., 2016; Feldman et al., 2011; Panek et al., 2015). Despite research exploring these relationships being relatively novel and limited at present, the outcomes reported have shown promise regarding the use of this construct within this domain. For example, research by Bayer et al. (2016) found individuals higher in trait mindfulness are less likely to text out of habit than individuals who are lower in this trait. Similarly, research into the relationship between trait mindfulness and texting while driving by Feldman et al. (2011), and Panek et al. (2015) concluded that individuals higher in trait mindfulness were more likely to refrain from texting while driving than individuals who were lower in this trait. Therefore, our third hypothesis was that the indirect relationship between trait self-regulation and frequency of texting while driving via habit would be moderated by trait mindfulness, such that this indirect relationship would be significant at low levels of trait mindfulness but not at high levels.

1.6. The current study

Whilst habit, trait self-regulation, and trait mindfulness have been shown to uniquely predict the frequency of texting while driving (e.g., Bayer and Campbell, 2012; Panek et al., 2015), no studies to date have examined relationships among these variables, specifically related to the frequency of texting while driving. The current study aimed to add to the research on this topic by exploring how the interaction among these constructs are associated with the frequency of texting while driving.

Fig. 1 presents the conceptual model guiding this study. The model posits that trait self-regulation has both direct (see hypothesis one, Section 1.1) and indirect associations with the frequency of texting while driving. The indirect association in the model posits habitual texting behaviour as a mediator of the relationship between trait self-regulation and frequency of texting while driving (see second hypothesis, Section 1.3). Further, as per the third hypothesis (Section 1.5), trait mindfulness is positioned as a moderator such that the indirect relationship between trait self-regulation and frequency of texting while driving via habit differs according to levels of trait mindfulness.

2. Method

2.1. Participants and procedure

A total of 170 participants were recruited using convenience and snowball sampling techniques. One hundred and nine (64.1%) were undergraduate psychology students at a university in Canberra, Australia, with the remaining 61 (35.9%) from the general community Australia wide. The sample comprised 47 males (27.6%), 121 females (71.2%), and 2 other (1.2%), with an age range of 18 to 66 years ($M = 28.11$, $SD = 12.04$). The study was conducted online utilising Qualtrics (2017) online survey software. After gaining institutional ethical approval, the study was advertised to students through their online unit websites. These websites contain information and learning materials required for the unit of study being undertaken and are the primary means by which to communicate with the student population. Advertising to the public was conducted through the creation of a public Facebook page that was initially promoted to the first author's Facebook network. This network was then encouraged to share the page with their own networks. Participants were assured participation was voluntary and anonymous, and supplied with general information outlining the purpose of the study, participation requirements, and foreseeable risks and benefits associated with participation. Participants responded to two screening questions (i.e., "do you use a mobile phone?" and "do you drive a car?") to ensure respondents were within the target population of drivers who own mobile phones. Only those affirming both were able to continue with the survey. After initially providing age and gender demographics, participants responded to survey items regarding habitual text messaging behaviour, trait self-regulation, and trait mindfulness, followed by estimates of the frequency with which they read and send text messages in general, and while driving. Additional questions related specifically to driving were also gathered at the end of the survey. The survey took approximately 20 min to complete. In return for participation, students were offered 30 min of course credit or entry in a draw to win one of two $50 gift cards. All other participants had the option of entering the prize draw.

2.2. Measures

The survey consisted of 41 items in total. Seven items measured demographic information (age and gender), questions related specifically to driving (driver licence type, hours driving per week, and years of driving experience), and frequency of reading and frequency of sending text messages in general. The demographic questions and driving related questions were either multiple choice (e.g., licence type: learners, provisional, full, suspended, no licence) or open response (e.g., "how many hours per week do you spend driving a car?"). Frequency of reading and frequency of sending text messages in general was assessed on a 9-point scale (1 = *never*, 2 = *monthly*, 3 = *weekly*, 4 = *2–3 times a week*, 5 = *daily*, 6 = *2–3 times a day*, 7 = *hourly*, 8 = *2–3 times an hour*, and 9 = *about every* 10 min; Bayer and Campbell, 2012).

2.2.1. Trait self-regulation

Tangney, Baumeister, and Boone's (2004) 13-item Brief Self-Control Scale (BSCS) was utilised to measure trait levels of self-regulation. Scale items include "I am good at resisting temptation" and "I have a hard time breaking bad habits" (reverse). Participants indicated their agreement with each item on a scale from 1 (*not at all like me*) to 5 (*very much like me*). Nine negatively worded items were reverse scored prior to averaging across items to gain a composite score for further analysis, with higher scores indicating higher trait self-regulatory ability. The scale showed good internal consistency with a Cronbach alpha of 0.83.

2.2.2. Habit

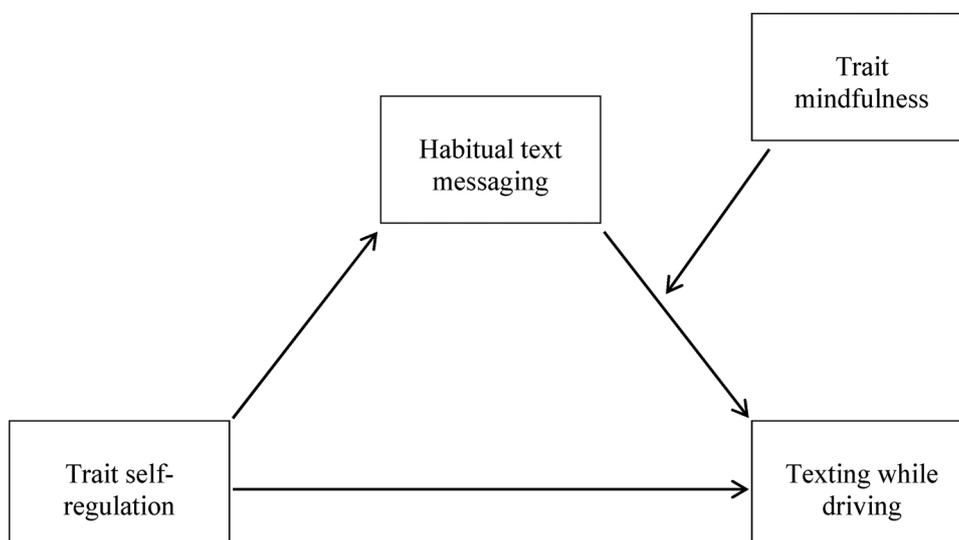Habit was measured using the Self-Report Behavioural Automaticity

Fig. 1. Conceptual moderated mediation model.

Index (SRBAI; Gardner et al., 2012). The four-item measurement began with the statement: "texting is something" (with texting defined as including checking for a new text, reading a text, replying to a text, or initiating a text) and completed with each of the following items: "I do without thinking", "I do without meaning to do it", "I begin doing before I realise I'm doing it", and "I find hard to stop myself from doing". Participants indicated their agreement with each item on a scale ranging from 1 (*not at all*) to 5 (*completely*). Scores were averaged across items to obtain an overall habit score, with higher scores indicating stronger habitual text messaging behaviour. The scale showed a high degree of internal consistency with a Cronbach alpha of 0.85.

2.2.3. Trait mindfulness

The Mindfulness Attention Awareness Scale (MAAS; Brown and Ryan, 2003) was used to measure the dispositional tendency for participants to be mindful in everyday life. The 15-item scale includes items such as "I could be experiencing some emotion and not be aware of it until sometime later" and "I find it difficult to stay focused on what's happening in the present". Participants rated their agreement with each item on a scale from 1 (*almost always*) to 6 (*almost never*). Scores were averaged across items to gain an overall mindfulness score, with higher scores indicating greater mindfulness. The scale exhibited a high degree of internal consistency with a Cronbach alpha of 0.85.

2.2.4. Texting while driving

Texting while driving was operationalised similarly to that reported in previous research (e.g., Atchley et al., 2011; Nemme and White, 2010; Walsh et al., 2008). Participants were asked to estimate, on average, how often they read text messages while driving, and how often they send text messages while driving. Texting while driving was defined as reading/sending a message while the car is both stationary but not stopped (e.g., at traffic lights) and/or while the car is in motion. This definition is in line with the Australian Road Rules (Australian Road Rules, 2015). Frequency was measured on a scale from 1 (*never*) to 5 (*almost always*). Scores were averaged across both texting behaviours to create a composite texting while driving score, with higher scores indicating more frequent texting while driving. The scale showed strong internal consistency with a Cronbach alpha of 0.87.

2.3. Analyses

To test the hypotheses, a simple mediation analysis and a moderated mediation analysis were conducted using IBM SPSS Statistics (version 24) and PROCESS (Model 14; Hayes, 2014). Trait self-regulation was

the proposed independent variable in these analyses, habit was the proposed mediator, and mindfulness was the proposed moderator, with texting while driving as the outcome variable.

3. Results

3.1. Data screening

Prior to conducting the analyses, the data was screened for any out of range or missing data, univariate outliers, and normality. There was no out of range data in the sample, missing data was found to be missing completely at random, and the assumption of normality was satisfied.

3.2. Descriptive analysis of the data

The means, standard deviations, and ranges for all continuous variables are presented in Table 1, and bivariate correlations for the predictor variables, demographic variables, and frequency of texting while driving are presented in Table 2. Fifty seven percent of the sample had a full driver's licence, 37.1% a provisional licence, 5.3% a learner's licence, and 0.6% no licence. This sample had relatively low mean levels of habitual text messaging and texting while driving, and moderate

Table 1
Means, Standard Deviations, and Ranges for Continuous Variables (Listwise N = 161).

| Variable | *M* | *SD* | Range | |
			Potential	Actual
Age	28.11	12.04	–	18–66
Years of driving experience	10.22	10.80	–	1–45
Hours driving per week	7.51	5.45	–	1–25
Frequency of texting in general	6.17	1.43	1–9	3–9
Trait self-regulation	3.05	0.62	1–5	1–5
Habit	2.09	0.97	1–5	1–5
Trait mindfulness	3.60	0.79	1–6	1–6
Frequency of texting while driving	2.28	1.12	1–5	1–5

Note. The potential scale range anchors are: Frequency of texting in general (1 = *never*, 9 = *about every* 10 min), trait self-regulation (1 = *not at all like me*, 5 = *very much like me*), habit (1 = *not at all*, 5 = *completely*), trait mindfulness (1 = *almost always*, 6 = *almost never*), and frequency of texting while driving (1 = *never*, 5 = *almost always*). For all scales higher scores indicate higher levels of the variable.

Table 2

Bivariate Correlations between Demographic Variables, Predictor Variables, and Frequency of Texting While Driving (N = 164 - 170)

	1	2	3	4	5	6	7	8	9	10
1. Age	–	0.03	0.53***	0.95***	−0.10	−0.29***	0.23***	−0.29***	0.27***	−0.09
2. Gender		–	−0.08	−0.01	−0.15**	0.01	0.05	0.12	−0.06	0.07
3. Licence type			–	0.58***	−0.10	−0.25***	0.18	−0.23***	0.16**	0.05
4. Years of driving experience				–	−0.07	−0.28***	0.25***	−0.30***	0.26***	−0.08
5. Hours driving per week					–	−0.01	−0.08	0.13	−0.08	0.25***
6. Texting in general						–	−0.29***	0.45***	−0.19**	0.24***
7. Trait self-regulation							–	−0.37***	0.47***	−0.15*
8. Habit								–	−0.44***	0.26***
9. Trait mindfulness									–	−0.01
10. Texting while driving										–

Note: Pairwise deletion was utilised for all bivariate correlations.

  * $p = .05$.

  ** $p < .05$.

  *** $p < .01$ (2-tailed).

levels of trait self-regulation and trait mindfulness when compared to the mid points of each scale. Hours driving per week, frequency of reading or sending a text message in general, and stronger text messaging habits were all significantly positively correlated with frequency of texting while driving. Lower levels of trait self-regulation were also correlated with higher frequency of texting while driving, however this relationship was relatively weak. Relationships between the predictor variables revealed text messaging habits were significantly negatively correlated with both trait self-regulation and trait mindfulness, and trait self-regulation and trait mindfulness were significantly positively correlated with each other.

3.3. Relationships between trait self-regulation, habit, and frequency of texting while driving

To test the relationships between trait self-regulation, habit, and frequency of texting while driving a simple mediation analysis was conducted utilising a 5000-sample bootstrapping procedure informed by Hayes (2014). This model simultaneously tests the direct relationship between the predictor variable and the outcome variable, and the indirect relationship between the predictor variable and the outcome variable via a third, mediating variable (see Fig. 2). Trait self-regulation was entered as the predictor variable, texting while driving as the outcome variable, and habit as the mediator. As can be seen in Fig. 2, the total effect of trait self-regulation on frequency of texting while driving reached significance c = −0.26, $t(167) = −1.93$, $p = .05$, the direct effect of trait self-regulation on texting while driving was non-significant c' = −.11, $t(166) = −0.78$, $p = .43$, and the indirect effect of trait self-regulation on frequency of texting while driving via habit

was significant, with a point estimate of −0.15 ($SE = 0.06$) and 95% bias-corrected bootstrapped confidence interval between −0.29 to −0.04. As the direct effect was non-significant, and zero is outside the range of the confidence interval for the indirect effect, it appears habit is mediating the relationship between trait self-regulation and frequency of texting while driving, where lower levels of trait self-regulation are associated with higher levels of habitual text messaging, $B = −0.55$, $t(167) = −5.02$, $p < .001$, and higher levels of habitual text messaging, in turn, are associated with more frequent texting while driving, $B = 0.27$, $t(166) = 2.95$, $p = .004$.

3.4. The association of trait mindfulness with the relationship between trait self-regulation and frequency of texting while driving via habit

To test if trait mindfulness moderated the indirect relationship between trait self-regulation and frequency of texting while driving via habit, a moderated mediation analysis was conducted. This model extends the simple mediation model by examining whether the indirect relationship between the predictor variable and outcome variable (via the mediator) changes at, or is conditional upon, different levels of a fourth, moderating variable (see Fig. 1). As such, trait mindfulness was added as the moderator in the moderated mediation analysis. As can be seen in Table 3, the interaction term between habit and trait mindfulness was non-significant $B = −0.08$, $t(163) = −0.80$, $p = .42$, and the index of moderated mediation was also non-significant, with a point estimate of 0.04 ($SE = 0.07$) and 95% confidence interval between −0.09 and 0.20.

These results indicate there is no overall moderation of the indirect effect between trait self-regulation and frequency of texting while
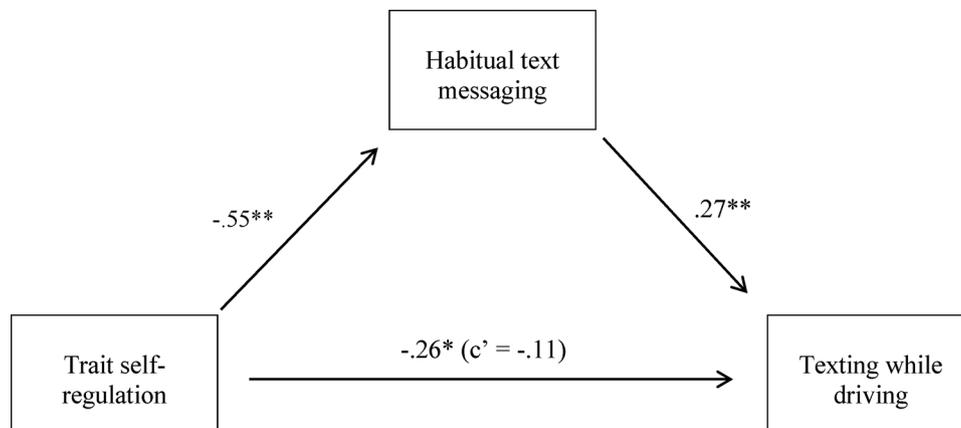

Fig. 2. The mediating effect of habit on the relationship between trait self-regulation and frequency of texting while driving. Values are unstandardised regression coefficients. For the final model $R^2 = 0.07$, $F(2, 166) = 6.30$, $p < .01$.* *$p = .05$. **$p < .05$.

Table 3

Regression Results Testing Moderated Mediation of the Relationship between Trait Self-Regulation with Frequency of Texting While Driving via Habit (N = 163).

Predictors	B	SE	Bootstrapped 95% CI	
			Lower	Upper
Trait self-regulation	− 0.24	0.15	− 0.55	0.06
Habit	0.30[*]	0.10	0.11	0.50
Trait mindfulness	0.24	0.12	− 0.00	0.49
Habit X trait mindfulness	− 0.08	0.11	− 0.31	0.13

Note. B = Unstandardised regression coefficient, SE = Standard error. Bootstrapping 95% confidence intervals are bias-corrected.

* $p < .05$.

driving via habit; that is, there is no evidence the indirect effect is contingent on levels of trait mindfulness. Trait mindfulness, however, may still be moderating the relationship between habit and frequency of texting while driving. Hayes (2014, 2015) discusses that it is not unusual for moderation of one of the indirect pathways to occur (i.e., the mediator to outcome in this study) despite non-significant omnibus tests of moderated mediation. Importantly, Hayes (2015) argues it is permissible to interpret moderation of singular pathways within the model even in the absence of evidence of moderated mediation; however, it must be noted that others disagree with this position suggesting the issue remains controversial (Hayes, 2015).

As such, Table 4 contains the results of the moderated relationship between habit and frequency of texting while driving conditioned at low, medium, and high levels of trait mindfulness. As can be seen, the 95% bootstrap confidence intervals indicate significance at low to moderate levels of trait mindfulness, but not at high levels. This suggests habitual texting behaviour is significantly associated with greater frequency of texting while driving for people low to moderate in trait mindfulness, but not those higher in this trait.

The following conclusions can be drawn from the current results. First, the non-significance of both the interaction term and index of moderated mediation indicate that no moderation of the mediation effect is present within the model. Thus, it cannot be said that the indirect relationship between trait self-regulation and frequency of texting while driving via habit is associated with trait mindfulness levels. Second, as the conditional indirect effect was significant (and interpretation of conditional indirect effects are permissible) it can be inferred that habitual texting behaviour is associated with greater frequency of texting while driving only among those who are low to moderate in dispositional mindfulness, and not among those who are higher in this trait.

4. Discussion

The aim of this study was to examine cognitive and personality factors associated with uncontrolled mobile phone use, specifically texting while driving. The focus was on examining the nature of the

Table 4

Relationship between Habit and Frequency of Texting While Driving at Values of the Moderator (N = 163).

Moderator	Level	Conditional indirect effect	SE	LLCI	ULCI
Mindfulness	Low	− 0.21[*]	0.06	− 0.36	− 0.09
	Moderate	− 0.17[*]	0.07	− 0.32	− 0.04
	High	− 0.13	0.11	− 0.36	0.07

Note. Levels for the moderator (low, moderate, high) are at the mean and plus/minus one standard deviation from the mean. LLCI and ULCI = Lower limit and upper limit of 95% bias-corrected bootstrap confidence intervals.

* $p < .05$.

relationships between trait self-regulation, habitual text messaging, and frequency of texting while driving and whether these relationships differed according to an individual's trait mindfulness levels. The first hypothesis was that low levels of trait self-regulation would be related to greater frequency of texting while driving, and the second hypothesis proposed habitual texting behaviour would mediate the relationship between trait self-regulation and frequency of texting while driving. It was further hypothesised that the indirect relationship between trait self-regulation and frequency of texting while driving via habit would be significant at low levels of trait mindfulness, but not at high levels. The results of this study indicate that most of the predicted outcomes are supported.

In support of hypothesis one, individuals lower in trait self-regulation were found to text while driving more frequently than individuals higher in this trait. Additionally, the relationship between trait self-regulation and frequency of texting while driving was mediated by habitual texting behaviour, which supports hypothesis two. Hypothesis three was not supported as there was no evidence to suggest one's dispositional mindfulness was associated with the relationship between trait self-regulation and frequency of texting while driving, via the mediator habit. Interestingly, trait mindfulness did have a significant association with the relationship between habitual texting behaviour and frequency of texting while driving when assessed individually, such that habitual texting was associated with greater frequency of texting while driving among individuals who were low to moderate in dispositional mindfulness, but not among those who were higher in this trait.

These results both reflect, and extend, findings of previous research into the relationships between these constructs. For example, the significant direct relationship in this study between low trait self-regulation and frequency of texting while driving, the significant relationship between low trait self-regulation and habitual text messaging, and the significant relationship between habitual text messaging and frequency of texting while driving are consistent with outcomes reported in previous studies (e.g., Bayer and Campbell, 2012; Panek et al., 2015; Soror et al., 2012). The significant mediation, however, extends what is known about these relationships and their influence on texting while driving. Once the effect of habit was accounted for in the model, the direct relationship between trait self-regulation and frequency of texting while driving became non-significant. While both of these constructs have been found to uniquely predict texting while driving when assessed individually, or in parallel (e.g., Bayer and Campbell, 2012; Panek et al., 2015), it appears when they are assessed sequentially (i.e., trait self-regulation to habit, then habit to texting while driving) the proportion of variance in texting while driving behaviour associated with low levels of trait self-regulation is diminished, relative to the strength of one's texting habits. Despite previous research across various domains having reached similar conclusions when assessing relationships between habit and self-regulation, that is, deficiencies in self-regulation are associated with greater habitual behaviour, and behaviour is more likely to be in line with one's habits when self-regulation is low (Aarts and Dijksterhuis, 2000; Soror et al., 2012), this is the first known study to test this relationship specifically in relation to texting while driving behaviour.

Similarly, previous studies have shown that high levels of trait mindfulness are associated with less texting while driving when assessed alone or in parallel with trait self-regulation and habit (Feldman et al., 2011; Panek et al., 2015); however, no studies to date have assessed the association between trait mindfulness and the frequency of texting while driving when assessed in relation to trait self-regulation and habit. The finding that trait mindfulness did not moderate the indirect relationship between trait self-regulation and frequency of texting while driving was inconsistent with previous research assessing relationships between trait self-regulation and trait mindfulness (e.g., Bowlin and Baer, 2012; Friese et al., 2012). However, trait mindfulness did moderate the relationship between habitual texting behaviour and

frequency of texting while driving. This unexpected result could reflect similarities between low self-regulation and habitual behaviour, alongside habit mediating the relationship between trait self-regulation and frequency of texting while driving.

For example, it has been argued by LaRose (2010) that it is difficult to distinguish whether unregulated behaviour is the result of self-regulatory failure or habit, as both present with similar behavioural characteristics. That is, even though failures in self-regulation are mostly spontaneous (Tokunaga, 2013) and habit requires behavioural repetition, they both are enacted with little attention, awareness, intention, or control (Bargh, 1996; LaRose, 2010). As high levels of trait mindfulness oppose automatic behavioural responses, it is likely that the moderating relationship seen in previous research between high levels of trait mindfulness and low levels of trait self-regulation (Bowlin and Baer, 2012) would also hold between high levels of trait mindfulness and habitual behaviour, as indicated in this study. Additionally, as habit mediated the relationship between low trait self-regulation and frequency of texting while driving, the significant moderating relationship between trait mindfulness and habit alone may be due to trait self-regulation becoming non-significant once habit entered the model.

The overall findings of this study indicate that individuals are texting while driving primarily out of habit, which is influenced by deficiencies in self-regulation. Furthermore, the relationship between habit and frequency of texting while driving is associated with levels of trait mindfulness, such that individuals with low to moderate levels of trait mindfulness are significantly more likely to habitually text while driving than individuals who are higher in this trait. Given these personality traits are considered malleable (Kiken et al., 2015; Muraven, 2010) there are practical implications arising from these results for texting while driving behaviour.

As this research found individuals high in trait mindfulness are less likely to habitually text while driving compared to individuals lower in this trait, increasing one's levels of trait mindfulness would arguably reduce the frequency of texting while driving. In contrast to personality traits such as the Big Five that are relatively stable over time (i.e., extraversion, neuroticism, openness, conscientiousness, agreeableness; Cobb-Clark and Schurer, 2012), evidence suggests trait self-regulation and trait mindfulness are modifiable with training (e.g., Friese et al., 2012; Gailliot et al., 2007). Although there are different approaches to achieving this (e.g., exerting small amounts of self-control over time to increase self-regulatory capacity; Gailliot et al., 2007), particularly relevant to this study is the finding that training in mindfulness meditational practice increases both trait self-regulation, and trait mindfulness (Friese et al., 2012).

Training in mindfulness practice to raise one's levels of trait mindfulness (and trait self-regulation) is therefore arguably worth exploring as a possible future intervention strategy aimed at reducing texting while driving behaviour. As indicated in this study, and elsewhere (e.g., Bayer et al., 2016; Panek et al., 2015), habitual texting while driving is more likely to occur when self-regulation and mindfulness are low. As the current results also suggest, personality constructs related to attention, awareness, and control of behaviour play a significant role in the association between habitual texting behaviour and the frequency of texting while driving. Therefore, increasing the strength of these traits may reduce the frequency of texting while driving by counteracting the automatic processes synonymous with habitual behaviour.

4.1. Strengths and limitations

This study is the first to our knowledge to simultaneously assess relationships between trait self-regulation, habit, and trait mindfulness with texting while driving behaviour. Despite it being well established throughout the literature that each of these factors individually predicts texting while driving (e.g., Bayer and Campbell, 2012; Feldman et al., 2011; Panek et al., 2015) our study assessed how these constructs interact in association with the frequency of texting while driving, representing a novel contribution to the existing literature. Furthermore, as these personality constructs are potentially modifiable the results of this study hold greater practical significance for changing this behavior. An additional strength is the age range and diversity of the sample. Previous research into texting while driving has mostly used samples comprising young drivers and university students (e.g., Hayashi et al., 2015; Nemme and White, 2010; Struckman-Johnson et al., 2015; Walsh et al., 2010). Although the sample in this study was not a representative random sample, the broad range of ages covered (i.e., 18–66 years old) and the recruitment of both university students and the public suggests this research has greater generalisability than that of previous research on this topic.

This study also had some limitations. As this study was asking about illegal behaviour, it is possible that the reliance on self-report measures resulted in an increase in socially desirable responding. For example, mean levels of habitual texting and texting while driving fell below the midpoints of the scales suggesting relatively low reported levels of these variables. However, as the survey was delivered anonymously online it is expected the incidence of inaccurate reporting of texting while driving behaviour would be minimised. Additionally, the operationalisation of texting while driving may limit generalisability to domains outside of Australia. Whilst the definition of texting while driving used in this study reflects current Australian laws (Australian Road Rules, 2015), it must be acknowledged that the pattern of results may vary depending on how texting while driving is defined. Future research could examine how different operationalisations of texting while driving impact these findings.

The study design was also cross-sectional and correlational meaning causality cannot be inferred. Therefore, it would be beneficial in future research to employ an experimental or longitudinal design to address this limitation. It also must be noted that although this study revealed significant findings, the overall variance in texting while driving behaviour explained by trait self-regulation, habit, and trait mindfulness was quite low ($R^2 = 0.09$). This indicates there is a significant proportion of variance in texting while driving behaviour currently unaccounted for by these constructs suggesting additional variables need to be explored.

4.2. Future directions

Future research could expand on these findings by examining relationships that trait self-regulation, habit, and trait mindfulness have with individual texting behaviours. Research has shown that texting behaviour in general ranges from more automatic (i.e., habitual) to more controlled depending on the texting task (e.g., checking/sending; Bayer et al., 2016). Additionally, trait mindfulness moderated the relationship between habit and texting while driving, but not the relationship between trait self-regulation and texting while driving via habit. Therefore, future studies may benefit from further exploring the shared and unique variance of trait self-regulation and habit with texting while driving behaviours. Furthermore, both deficiencies in self-regulation and habit have been implicated in the development of mobile phone dependence (i.e., use that is addiction-like; Khang et al., 2013; van Deursen et al., 2015; Walsh et al., 2010) with mobile phone dependence, in turn, increasing the frequency of texting while driving (Struckman-Johnson et al., 2015). As such, future studies could evaluate mobile phone dependence, trait self-regulation, habit, and trait mindfulness using a similar model to the one utilised in this study.

Also, of interest for future research may be examining mobile phone activities beyond just calling and texting behaviours. With the advent of "smartphone" technology there is an array of alternative behaviours that drivers are likely engaging in. For example, recent research by George et al. (2018) identified other activities (e.g., playing music, using GPS navigation) that a large percentage of drivers in their study were engaging in while driving in addition to calling and texting.

Therefore, understanding how these alternative mobile phone use behaviours relate to mobile phone dependence, trait self-regulation, trait mindfulness, and habit could be an avenue worth pursuing.

5. Conclusion

Texting while driving is a common behaviour not only in Australia but worldwide, with the potential deadly consequences associated with it being well documented. Reducing the number of drivers who text while driving is imperative for improving road safety. Expanding on the literature on trait self-regulation, trait mindfulness, habit, and texting while driving, the current study identified that habitual text messaging is significantly related to greater frequency of texting while driving behaviour, with this relationship being significantly associated with lower levels of trait mindfulness. As trait self-regulation and trait mindfulness are considered malleable the findings of this research may prove useful in developing new programs that specifically target drivers who are dispositionally lower in personality traits that allow habitual responding to their mobile phones, regardless of how inappropriate, illegal, or dangerous the context. Such developments may reduce the frequency with which drivers text behind the wheel and improve safety on Australian roads. As this is the first piece of research to examine relationships between trait self-regulation, habit, and trait mindfulness specifically related to texting while driving behaviours, these findings also provide an avenue for future research into alternative mobile phone use behaviours while driving (beyond calling and texting) that are yet to be explored.

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Declarations of interest

None.

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