Evidence that implementation intentions reduce drivers' use of mobile phones while driving

Mark A. Elliott[1], Abigail Paterson[1], Scott Orr[1], Colin Marshall[1], Claire Wood[2], Martin Toye[3] & Claire Wilson[4]

[1] School of Psychological Sciences and Health, University of Strathclyde

[2] The Leith Agency

[3] Moray House School of Education, University of Edinburgh

[4] School of Media, Culture and Society, University of the West of Scotland

Correspondence concerning this article should be addressed to Dr. Mark A. Elliott, School of Psychological Sciences and Health, University of Strathclyde, 40 George Street, Glasgow, G1 1QE, UK. E-mail: mark.a.elliott@strath.ac.uk Tel: +44 (0) 141 548 5829.

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Abstract

Implementation intentions are IF-THEN plans that have the potential to reduce mobile phone use while driving and thus contribute towards the prevention of road traffic crashes. We tested whether an intervention, designed to promote the formation of implementation intentions, could reduce drivers' use of mobile phones. A randomized controlled design was used. The participants (N = 136) were randomised to an implementation or a control condition. Self-report questionnaires were administered to all participants at both pre- and one-month post-intervention to measure the use of mobile phones while driving, goal intentions and the theoretically derived motivational pre-cursors of goal intentions (attitudes, subjective norm and perceived behavioural control). Immediately following the pre-intervention questionnaire, the participants in the implementation intention condition (n = 67) were given a volitional help sheet, which asked them to form implementation intentions by specifying target driving situations that tempted them the most to use a mobile phone and linking them with goal-directed responses that could be used to resist the temptation. The participants in the control condition (n = 69) were asked to specify target situations that tempted them the most to use a mobile phone while driving and to generally try to avoid using a mobile phone in those situations. One-month post-intervention, the participants in the implementation intention condition reported using a mobile phone less often while driving in their specified target driving situations than did the participants in the control condition. As expected, no differences were found between the conditions in the reported frequency of mobile phone use in unspecified driving situations, goal intentions or any motivational pre-cursor of goal intentions. The implementation intention intervention that was tested in this study is a potentially effective tool for reducing mobile phone use while driving in target driving situations where behaviour-change is most needed.

Keywords: Implementation intentions; Volitional help sheet; Mobile phone use; Driving.

1. Introduction

Operating a motor vehicle while using a hand-held mobile phone is illegal in the UK and many other countries. Research shows that it is a source of driver distraction that directs drivers' attention away from the road, reduces awareness of and slows responses to driving hazards, increases mental workload, reduces the number of checks of vehicle instruments and mirrors, makes it more difficult to maintain lane position, speed and headway, and increases crash-risk by up to a factor of four (e.g., Basacik et al., 2011; Caird et al., 2008 and 2014; McEvoy et al., 2005; Parkes et al., 2007). However, research also shows that hand-held mobile phones are used by drivers for a variety of purposes. They are used to make and receive phone calls, send and read text messages and emails, check social media updates, operate SAT NAVs and music applications, and take photographs or record videos while driving (e.g., KwikFit, 2017; Prat et al., 2017; RAC, 2016; RSA Insurance Group, 2017; Sullman et al., 2018b). These studies typically show that between 25% and 40% of UK motorists admit to using a hand-held mobile phone while driving. They also show that around 50% of drivers admit to using a mobile phone in stationary traffic, which is still illegal. Interventions to reduce the use of mobile phones while driving are therefore needed. In this study, we aimed to test whether an intervention based on Gollwitzer's (1993, 1999) concept of implementation intentions could reduce driving whilst using a mobile phone.

1.1 Implementation intentions

The theoretical framework for implementation intentions comes from the model of action phases (e.g., Gollwitzer, 1990; Heckhausen, 1991; Heckhausen & Gollwitzer, 1987). According to this model, an individual must pass through two distinct action phases in order to perform a behaviour (e.g., the avoidance of using a mobile phone while driving). First, an individual must pass through a motivational action phase, which culminates in the formation of a goal intention (e.g., "I intend to avoid using a mobile phone while driving"). Once the

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goal intention is in place, the individual must pass through a volitional action phase, which focuses on *intention realisation* (i.e., the conversion of the goal intention into action).

Implementation intentions (e.g., Gollwitzer, 1993 and 1999) are important with respect to the volitional action phase. They are IF-THEN plans that facilitate intention realisation (for reviews see Adriaanse et al., 2011; Belanger-Gravel, 2013; Gollwitzer & Sheeran, 2006; Toli et al., 2016). In the IF component of an implementation intention, individuals are required to specify a target situation[1] in which they will perform a goal-intended behaviour or a situation that would tempt them to do otherwise (e.g., a driver who intends to refrain from using a mobile telephone while driving might specify: "If I am tempted to use a mobile phone while driving because someone important is calling me…"). In the THEN component of an implementation intention, an individual is required to link the specified target situation with an appropriate goal-directed response, or a behaviour-change strategy (e.g., the aforementioned driver might specify: "Then I will remind myself that using a mobile phone while driving is dangerous as it takes my attention away from the road").

The act of specifying an implementation intention promotes intention realisation because it serves to encode a representation of the specified target situation to memory along with a link to the specified goal-directed response (e.g., Webb & Sheeran, 2004; Webb & Sheeran, 2008 [study 2]). Subsequently, the mental representation of the specified target situation (e.g., an mental image of oneself using a mobile phone while driving in order to answer a phone call from an important social referent) is 'activated' by relevant contextual cues in the environment (e.g., receiving a phone call from an important social referent while

[1] Note that the term 'critical-', rather than 'target-', situation is customarily used in the literature on implementation intentions. However, in the context of road safety, the term 'critical situation' is typically restricted to a driving situation that is risky or hazardous, in terms of contributing to road traffic crashes. We therefore use the term 'target situation' in this article to refer, more broadly, to the situations that tempt drivers to refrain from the relevant goal intended behaviour (avoidance of mobile phone use while driving), which may or may not also be 'risk-increasing'. We thank an anonymous reviewer for this suggestion.

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driving). As a result, the specified goal-directed response (e.g., reminding oneself that using a mobile phone while driving takes attention away from the road) is initiated and increases the overall likelihood of the goal-intended behaviour.

1.2 Rationale for expecting implementation intentions to reduce mobile phone use while driving

In line with social psychological models of behaviour (e.g., Ajzen, 1985; Fishbein & Ajzen, 1975; Gibbons & Gerrard, 1995) and studies of other driving behaviours (e.g., Elliott, 2012; Elliott et al., 2013 and 2017), several studies have shown that goal intentions ("I intend/do not intend to use a mobile phone while driving") are key predictors of mobile phone use while driving. These studies have focused on answering a phone call (e.g., Elliott, 2012), sending or receiving text messages (e.g., Gauld et al., 2014; Nemme & White, 2010; Prat et al., 2015) and general hand-held mobile phone use (e.g., Elliott et al., 2019). They have shown that goal intentions typically account for between 23% and 53% of the variance in the frequency of mobile phone use while driving. However, while these findings are regarded as large-sized effects in the social sciences (e.g., Cohen, 1992), they also show that there is a large proportion (i.e., 47% to 77%) of the variance in the frequency of mobile phone use while driving that is not accounted for by goal intentions. This means that while many drivers behave in line with their goal intentions, many others do not.

Previous research on other health-risk and driving behaviours has shown that the variance that is unaccounted for in behaviour by goal intentions is, for the most part, attributable to individuals who perform undesirable or risky behaviours in spite of goal intentions that are, in general, socially desirable (e.g., Elliott & Armitage, 2006; Orbell & Sheeran, 1998; Sheeran, 2002). A re-analysis of a dataset containing $N = 198$ UK driving licence holders that was collected by Elliott (2012) showed a similar trend for mobile phone use while driving. The re-analysis of this dataset showed that only 43% of the participants who reported regularly using a mobile phone while driving (defined as using a mobile phone

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while driving more often than the sample median) also reported prior goal intentions to do so. In line with the recommendations of other researchers (e.g., Gauld et al., 2014; Nemme & White, 2010; Oviedo-Trespalacious et al., 2017; Sullman et al., 2018a), interventions that aim to encourage the development of desirable goal intentions and underlying motivational cognitions (e.g., attitudes) are appropriate for this group. This is because it has undesirable goal intentions that need changing from a road safety point of view. However, the re-analysis of Elliott's (2012) dataset showed that a substantial proportion (57%) of the participants who reported regularly using a mobile phone while driving did *not* report prior goal intentions to do so. Interventions that aim to encourage the development of desirable goal intentions are unlikely to be effective at reducing mobile phone use while driving for this group. This is because it already has the required goal intentions in place, which are not in favour of mobile phone use while driving. Instead, this group needs an intervention that is designed to help it convert generally desirable goal intentions into action (i.e., an intervention that promotes intention realisation). Implementation intention are therefore ideally suited for this group.

1.3 Previous research on implementation intentions

Previous research has shown that asking individuals to specify implementation intentions is an effective behaviour-change strategy across many studies of social and health behaviours (for meta-analytic reviews see Adriaanse et al., 2013; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006; Toli et al., 2016). In the context of driving, previous research on speeding has shown that participants allocated at random to an implementation intention condition are subsequently more likely to report complying with the speed limit and less likely to report exceeding the speed limit than are participants allocated at random to a control condition (Brewster et al., 2015; Elliott & Armitage, 2006). Participants allocated at random to an implementation intention condition have also been observed to exceed the speed limit less frequently and drive at slower average (mean) speeds than participants allocated to a control condition (Brewster et al., 2016). The effect sizes in these studies have

ranged from $d = 0.39$ to $d = 0.95$. According to established criteria in the social sciences, $d = 0.20$ is a small-sized effect, $d = 0.50$ is a moderate-sized effect and $d = 0.80$ is a large-sized effect (Cohen, 1992). Previous research has therefore shown that specifying an implementation intention can generate (approaching) moderate- to large-sized changes in driver behaviour, which is consistent with the findings from studies of social and health behaviours more generally (Adriaanse et al., 2013; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006; Toli et al., 2016).

The above-cited studies have also provided evidence in support of the theoretical processes through which the specification of an implementation intention is held to generate behaviour-change. They have shown that behaviour-change tends to occur more readily in the target situations that participants specify in the IF components of their implementation intentions than in other, unspecified, situations (also see Aarts et al., 1999; Brandstatter et al., 2001; Parks-Stamm et al., 2007 [study 1]; Webb & Sheeran, 2004, 2007 and 2008). This finding is consistent with the theoretical proposition that relevant environmental cues activate the mental representations of the target situations that are encoded to memory during the specification of the IF components of implementation intentions, which in turn initiate the goal-directed responses specified in the THEN components (for a formal test of these processes see Webb & Sheeran, 2007 [study 2]). The above-cited studies have also shown that there are no effects of implementation intentions on measures of goal intentions or key theoretical pre-cursors of goal intentions (e.g., attitudes, subjective norms or perceived behavioural control), which is also consistent with the idea that the specification of an implementation intention generates behaviour-change through the process of intention realisation because changes in behaviour due to changes in goal intentions or underlying motivational cognitions can be ruled out (e.g., Webb & Sheeran, 2007 [study 1]).

Previous research therefore attests to the effectiveness of implementation intentions as a strategy for generating behaviour-change through intention realisation. However, while a

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substantial proportion of drivers would potentially benefit from an intervention to promote intention realisation in order to reduce mobile phone use while driving, no previous studies have tested whether implementation intentions can reduce this aberrant behaviour.

1.4 The present study

In this study, we aimed to test, for the first time, whether an implementation intention intervention could reduce mobile phone use while driving. In line with the literature reviewed above, we hypothesised that drivers asked to link target situations with goal directed responses (implementation intention condition) would subsequently (one month post-intervention) report using a mobile phone less often while driving in specified target situations than would drivers asked only to specify target situations (control condition). No difference between the conditions in subsequent mobile phone use while driving was expected in unspecified situations and no differences between the conditions were expected in measures of goal intentions or constructs that have previously been found to predict goal intentions, namely attitudes, subjective norms and perceived control.

2. Method

2.1 Participants

One hundred and thirty six participants took part in the study. All of the participants were at least 17 years of age, owned a full UK driving licence and drove at least once a week. The mean age of the sample was 26.35 years old (SD = 10.67; range = 17 to 60 years old) and 23% was male. The mean number of years that the participants had held a full UK driving licence was 7.18 years (SD = 10.06; range 0.25 to 43.00 years) and the mean weekly

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mileage was 93.47 miles (SD = 101.68; range 5 to 700 miles).[2] A power analyses showed that the achieved sample size provided sufficient power (power >= 0.80; Cohen, 1988) to detect an effect size of $d = 0.42$, which is towards the lower end of the effect size estimates that are typically found in studies of implementation intentions and driver behaviour (see introduction). For $N = 136$, $d = 0.42$ at $\alpha = 0.05$, power = 0.80.

2.2 Design & Procedure

A randomised-controlled design was used with the pre- and post-intervention measures separated by a month.

The participants were recruited using advertisements on social media (Facebook and Twitter) and class notices that were sent to students across a range of disciplines (Psychology, Computing Sciences and Education) at three large Universities in Scotland, two in Glasgow and one in Edinburgh. The advertisements stated that the study was a general-purpose investigation into attitudes and mobile phone use while driving and that participants needed to be at least 17 years old, hold a full UK driving licence and drive at least once a week. Volunteers who met the eligibility criteria were sent a link to an online, pre-intervention questionnaire.

[2] In the UK, statistics on driving license holding (Department for Transport, 2015) show that 2% of license holders are aged 17-19 years old, compared with 30% of this sample, 6% are aged 20-24 years old, compared with 36% of this sample, 16% are aged 25-34 years old, compared with 14% of this sample, 19% are aged 35-44 years old, compared with 11% of this sample, and 59% are aged 45 years old or above, compared with 9% of this sample. Additionally, 54% of UK driving license holders are male, compared with 23% of this sample. The sample therefore comprised an overrepresentation of younger drivers and an underrepresentation of males. This is unsurprising given the participants were recruited from social media and Universities (see section 2.2; we also discuss this issue in section 4). However, we re-ran the ANCOVAs presented in sections 3.3 and 3.4 with age and gender as additional independent variables and the same pattern of results as presented in the main text was found. The 2x2 ANCOVA still yielded a significant interaction between condition and the post-intervention measures of mobile phone use while driving in the specified versus unspecified target situations. There were no three-way or four-way interactions between behaviour in specified versus unspecified target situations, condition, age, and sex. The one-way ANCOVAs (see table 4) still yielded a significant difference between the implementation intention and control condition for the measure of behaviour in specified target situations but not for any other measure. There were no significant two-way or three-way interactions between condition, age, and sex. Therefore, the findings presented in the main text were not sensitive to age or sex differences, meaning that there was no evidence to suggest that they were unduly influenced by the overrepresentation of younger drivers and the underrepresentation of male drivers in the sample.

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At the start of the pre-intervention questionnaire, and in line with legislation in the UK and many other countries, the participants were told that 'driving while using a mobile phone' meant physically touching a mobile phone for any purpose while driving. An example item was also provided along with instructions to help the participants understand how to complete the questionnaire. Next, the participants were presented with standard items, commonly used in previous research, to measure their demography (age and sex), the number of years they had been licenced to drive, their weekly mileage, their frequency of mobile phone usage while driving over the last month (behaviour) and goal intentions to use a mobile phone while driving over the next month. Attitudes (positive or negative evaluations about the use of mobile phones while driving), subjective norms (perceived social pressure to use a mobile phone while driving) and perceived behavioural control (perceived ability to avoid using a mobile phone while driving) were also measured because previous research has shown that these theoretical constructs predict goal intentions to use a mobile phone while driving (e.g., Bazargan-Hejazi et al., 2017; Elliott et al., 2019; Nemme & White, 2010; Sullman et al., 2018a).

After the participants completed the questionnaire items, they were allocated at random by the online questionnaire to an implementation intention or a control condition. The participants who were allocated at random to the implementation intention condition (n = 67) received an intervention asking them to link situations that tempted them to use a mobile phone while driving with strategies for resisting the temptation (i.e., form implementation intentions). The participants who were allocated at random to the control condition (n = 69) received an intervention asking them to specify situations that tempted them to use a mobile phone only. These participants were asked to try to avoid using a mobile phone while driving in their specified target situations rather than link their specified target situations with specific goal directed strategies.

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One month later, all participants were sent a link to a post-intervention online questionnaire that contained the same items as the pre-intervention questionnaire to measure behaviour, goal intentions and the theoretical pre-cursors of goal intentions. After completing these items, the participants were directed to a debriefing sheet and thanked for their time.

The pre- and post-intervention data were matched using the primary email addresses that were provided by the participants in both questionnaires. Once the pre- and post-intervention data were matched, the email address information were deleted permanently, making the data anonymous. Seventy four percent (n = 100) of the participants who completed a pre-intervention questionnaire completed a post intervention questionnaire. Both questionnaires were designed and administered using Qualtrics Survey Design and Administration Software. Ethical approval for this research was awarded by the Ethics Committee in the University's School of Psychological Sciences and Health.

2.3 The Implementation Intention Intervention

The implementation intention intervention was a volitional help sheet (Armitage 2008)[3]. A volitional help sheet is a method for helping individuals link target situations with goal-directed responses and thereby form implementation intentions. It contains a list of empirically derived target situations that are known from previous research to tempt people to perform the problem behaviour (e.g., driving while using a mobile phone) and a list of theoretically derived goal directed responses (strategies) that could be used to resist the temptation. Participants are asked to form implementation intentions by selecting the target situations that are most likely to tempt them to perform the problem behaviour and linking each one with a goal directed response. Previous research has shown that volitional help sheets promote the development of implementation intentions that are effective changing a

[3] The implementation intention intervention was developed as part of a separate project that was funded by Road Safety Scotland (for the full report see Elliott et al., 2018). The authors thank Road Safety Scotland for supporting the development of the intervention.

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variety of social behaviours (e.g., Arden & Armitage, 2012; Armitage 2008; Armitage & Arden, 2010 and 2012; Armitage et al., 2016 and 2017). In the context of driving, they have been previously shown to be effective at helping drivers form implementation intentions that reduce speeding (e.g., Brewster et al., 2015 and 2016).

The volitional help sheet used in this study comprised 20 tempting situations. Following the above cited research, these situations were presented as IF statements (see table 1) and identified from the literature on road safety. They were common driving situations in which drivers are known to use mobile phones (e.g., Kwikfit, 2017; Prat et al., 2017; RAC, 2016; RSA Insurance Group, 2017).

The volitional help sheet also included 20 goal directed responses for helping drivers resist the temptation to use a mobile phone. Following the above cited research, the goal directed responses were presented as THEN statements (see table 2) and mapped onto Prochaska and DiClemente's (1983) ten processes of behaviour-change: (1) consciousness raising (acquiring information about the problem behaviour); (2) self-reevaluation (assessing how one thinks and feels about oneself with respect to the problem behaviour); (3) self-liberation (choosing and making a commitment to change the problem behaviour and believing in one's ability to do so); (4) counter-conditioning (substituting the problem behaviour with alternatives); (5) stimulus control (avoiding the stimuli that elicits the problem behaviour); (6) reinforcement management (rewarding oneself for changing the problem behaviour); (7) helping relationships (seeking social support for changing the problem behaviour); (8) dramatic relief (experiencing and expressing emotions about the consequences of the problem behaviour); (9) environmental re-evaluation (assessing how the problem behaviour affects the physical environment); and (10) social liberation (acknowledging societal support for changing the problem behaviour). There were two THEN statements for each of these ten processes of change (see table 2). The specific

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wording of these statements was informed by previously published studies (e.g., Armitage, 2008; Brewster et al., 2015) but adapted to suit the present target behaviour.

In this study, the participants randomised to the implementation intention condition, were asked to choose, from a drop-down list of the IF statements, the situation that they felt would tempt them the most to use a mobile phone while driving over the next month. Next, they were asked to choose, from a drop-down of the THEN statements, a strategy that they would try to employ should they find themselves in their specified target situation over the next month. The participants were asked to complete this task three more times for the situations that would next most tempt them to use a mobile phone while driving, thus forming a total of four implementation intentions, in line with previous research suggesting that this is the optimum number (see Brewster et al., 2015).

2.4 The Control Intervention

The participants in the control condition were presented with the same 20 empirically derived target situations as were the participants in the implementation intention condition. As with the implementation intention intervention, the control intervention asked the participants to select four target situations. However, the control participants were instructed to select the four situations that they felt would most tempt them to use a mobile phone while driving and to try to avoid using their mobile phone over the next month in each situation only. They were not asked to link their specified target situations with goal directed responses and, therefore they were not asked to form implementation intentions.

2.5 Measures

The following items were included in both the pre- and one month post-intervention questionnaires. The items were presented in a pseudo random order with the response scales reversed for approximately half the items in order to reduce consistency (e.g., Budd, 1987) and response set (e.g., Coolican, 2004) biases, respectively. All items were measured using 9-point scales following previous research on implementation intentions and driver behaviour

(Brewster et al., 2015 and 2016) in order to reduce the risk of hitting floor effects, which can often occur with smaller scales in the measurement of illegal behaviours such as mobile phone use and other driving violations (e.g., Elliott et al;., 2003).

2.5.1 Frequency of Mobile Phone Use (Behaviour) in Specified and Unspecified Situations. The frequency of mobile phone use was measured with 20 items. The participants were asked: 'How often, over the LAST month, did you find yourself using a mobile phone while driving, even for a very short amount of time, in the following situations?' The participants were then presented with the 20 target situations from the volitional help sheet (see table 1). For each situation, the participants indicated their response using a 9-point scale from *never* (scored 1) to *often* (scored 9). The arithmetic mean of the items corresponding to the target situations that the participants selected in the implementation intention or control intervention was taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of behaviour in specified target situations (α = .88 at pre-intervention and α = .85 at post-intervention). The arithmetic mean of the remaining items, corresponding to the target situations that the participants did not select in the implementation intention or control intervention, was also taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of behaviour in unspecified situations (α = 0.94 at pre-intervention and α = 0.92 at post-intervention).

2.5.2 Goal Intentions to use a mobile phone while driving. Goal intentions to use a mobile phone while driving generally were measured with five items. The participants responded to all items using 9-point scales: 'To what extent do you intend to use a mobile phone while driving, even for a short amount of time, over the NEXT month?' (*no extent at all* [scored 1] to *a great extent* [scored 9]); 'To what extent do you think you will want to use a mobile phone while driving, even for a short amount of time, over the NEXT month?' (*no extent at all* [scored 1] to *a great extent* [scored 9]); 'How likely or unlikely is it that you will

use a mobile phone while driving, even for a short amount of time, over the NEXT month?' (*extremely unlikely* [scored 1] to *extremely likely* [scored 9]); 'To what extent is it likely that you will use a mobile phone while driving, even for a short amount of time, over the NEXT month?' (*no extent at all* [scored 1] to *a great extent* [scored 9]); and 'To what extent do you plan to use a mobile phone while driving, even for a short amount of time, over the NEXT month?' (*no extent at all* [scored 1] to *a great extent* [scored 9]). The arithmetic mean of the five items was taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of goal intentions (α = .94 at pre-intervention and α = .91 at post-intervention).

2.5.3 Attitudes Towards Mobile Phone Use. Attitudes towards using a mobile phone while driving generally were measured with seven items. The participants were presented with the sentence stem: "For me, using a mobile phone while driving, even for a short amount of time, over the NEXT month would be…". They completed this sentence with six 9-point, bi-polar semantic differential scales: *extremely unsafe* (scored 1) to *extremely safe* (scored 9), *extremely foolish* (scored 1) to e*xtremely wise* (scored 9), *extremely negative* (scored 1) to *extremely positive* (scored 9), *extremely bad* (scored 1) to *extremely good* (scored 9), *extremely worthless* (scored 1) to *extremely valuable* (scored 9), and *extremely useless* (scored 1) to *extremely useful* (scored 9). The arithmetic mean of the seven items was taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of attitudes towards using a mobile phone while driving (α = .90 at pre-intervention and α = .82 at post-intervention).

2.5.4 Subjective Norms. Subjective norms were measured with three items, to which the participants responded using 9-point scales: "How often do you think other people, who you know, will use a mobile phone while driving over the NEXT month?" (*not at all* [scored 1] to *very often* [scored 9]); "Of the people you know, how many do you think will use a mobile phone while driving over the NEXT month?" (*none of them* [scored 1] to *all of them*

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[scored 9]); and "How often will the people important to you use a mobile phone while driving over the NEXT month?" (*never* [scored 1] to *very often* [scored 9]). The arithmetic mean of the three items was taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of subjective norms (α = .80 at pre-intervention and α = .83 at post-intervention).

2.5.5 Perceived Behavioural Control. Perceived behavioural control was measured with four items to which the participants responded using 9-point scales: "For me, avoiding using a mobile phone while driving, even for a short amount of time, over the NEXT month would be…" (*extremely difficult* [scored 1] to *extremely easy* [scored 9]); "How confident are you that you will be able to avoid using a mobile phone while driving over the NEXT month?" (*not confident at all* [scored 1] to *very confident* [scored 9]); "I have complete control over whether or not I will use a mobile phone while driving over the next month" (*strongly disagree* [scored 1] to *strongly agree* [scored 9]); and "I believe I have the ability to avoid using a mobile phone while driving over the NEXT month" (*strongly disagree* [scored 1] to *strongly agree* [scored 9]). The arithmetic mean of the four items was taken at both pre- and post-intervention. These composite scales were used in the subsequent data analyses as the measures of perceived behavioural control (α = .82 at pre-intervention and α = .74 at post-intervention).

3. Results

3.1 Tests of Randomisation to Conditions and Attrition

A series of two-way ANOVAs was conducted to test whether there were any detectable pre-intervention differences between the participants in the implementation intention and control conditions and the participants who completed the study (n = 100) and those who dropped out at the post-intervention stage (n = 36). The dependent variables in these ANOVAs were age (ANOVA 1), years licensed to drive (ANOVA 2), weekly mileage (ANOVA 3), and the pre-intervention measures of the frequency of mobile phone use in the

specified (ANOVA 4) and unspecified (ANOVA 5) target situations, and general goal intentions (ANOVA 6) attitudes (ANOVA 7), subjective norms (ANOVA 8) and perceived behavioural control (ANOVA 9). The independent variables in each analysis were condition (0 = control; 1 = implementation intention) and attrition (0 = study dropouts; 1 = study completers).

As table 3 shows, no significant differences were found between the implementation intention and control conditions on any of the measures. A chi-square test also showed that there was no detectable difference between the conditions in the proportions of males and females, $\chi^2(df = 1, N = 136) = 0.50$, $p = .543$, $\omega = .06$ The two conditions were therefore judged to be equivalent at the pre-intervention stage of the study, meaning that randomisation to the conditions was successful.

Table 3 also shows that there were no significant differences between the study dropouts and completers on the pre-intervention measures of age, years licensed to drive, weekly mileage, attitudes or subjective norms. A chi-square test also showed that there was no detectable difference between the dropouts and completers in the proportions of males and females, $\chi^2(df = 1, N = 136) = 2.21$, $p = .168$, $\omega = .13$ However, there were significant differences on the pre-intervention measures of the frequency of mobile phone use in both the specified and unspecified target situations, goal intention and perceived behavioural control. Inspection of the mean scores on these variables indicated that the study completers were more safety conscious than were the dropouts because they reported a lower frequency of mobile phone while driving in both the specified (study completers: $M = 3.24$, $SD = 2.25$; dropouts: $M = 4.49$, $SD = 2.63$) and unspecified (study completers: $M = 1.82$, $SD = 1.30$; dropouts: $M = 2.72$, $SD = 1.88$) target situations, they reported lower goal intentions to use a mobile phone while driving (study completers: $M = 2.59$, $SD = 1.92$; dropouts: $M = 3.36$, $SD = 2.26$) and they reported higher levels of perceived control over the avoidance of mobile phones while driving (study completers: $M = 8.70$, $SD = 1.31$; $M = 7.40$, $SD = 1.73$ dropouts).

However, there were no condition X attrition interactions for any measure (see table 3), meaning that there was no evidence that attrition had a differential effect on the conditions.

Given the differences between the study completers and the dropouts on the pre-intervention measures of mobile phone use, goal intention and perceived behavioural control, the intention to treat principle (e.g., Hollis & Campbell, 1999) was used in the subsequent data analyses. The participants who dropped out of the study at the post-intervention stage were treated as "no changers" by imputing their pre-intervention scores into the post-intervention measures. This approach is commonly used in intervention research to guard against the potential biases that can be introduced into the sample through the non-random loss of participants, such as attrition (Lachin, 2000). It provides conservative estimates of intervention effects (e.g., post-intervention differences between experimental and control conditions), which are based on the full sample rather than a potentially biased sub-sample (i.e., study completers only), who may be more susceptible to intervention.

3.2 Descriptive Statistics

Table 1 shows the proportion of both the implementation intention and control conditions that selected each target situation in their respective interventions. In both conditions, the most commonly selected situations were: "because I want to use the SAT NAV on my phone"; "because I need to let someone know I will be late picking them up"; "because I want to control the music in my car"; "because I need to let someone know I will be late for a meeting or appointment"; and "because I want to read a text message". The least commonly selected situations were: "If I am tempted to use a mobile phone while driving because I am bored"; "because I want to check my emails"; "because I want to check social media"; and "because I want to take a photograph or record a video".

Table 2 shows the proportion of the implementation intention condition that selected each goal-directed response in the THEN component of the intervention. The most commonly chosen responses were: "remind myself that it is illegal to use a hand-held device

while driving"; "remind myself that using a mobile phone while driving is dangerous as it takes my attention away from the road"; and "think about the emotional pain I would suffer if I caused death or injury to someone from being distracted by my phone". The least commonly chosen responses were: "remind myself that society is not accepting of drivers who use a mobile phone while driving"; "remember to tell myself that I am a good driver when I do not use my mobile phone while driving"; and "remember that I have made a commitment to avoid using my mobile phone while driving".

Table 4 shows the means and standard deviations for all measures at both pre- and one month post-intervention. As the table shows, the participants, on average, reported using a mobile phone reasonably infrequently while driving in both specified and unspecified target situations (i.e., the mean score on the measure of behaviour in both the specified and unspecified target situations was between the bottom [score of 1] and the mid-point [score of 5] of the response scale). The table also shows that the participants, on average, reported that they did not have strong goal intentions to use a mobile phone while driving, had negative attitudes towards using a mobile phone while driving, perceived moderate amount of social pressure (subjective norm) to use a mobile phone while driving and perceived high levels of control over their ability to avoid using a mobile phone while driving.

It is notable, however, that the mean for the pre-intervention measure of behaviour in the specified target situations was higher than was the mean for the pre-intervention measure of behaviour in the unspecified target situations. Repeated measures ANOVAs showed that these differences were statistically significant for both the implementation intention condition, $F(1, 135) = 99.94$, $MSE = 1.03$, $p < .001$, $d = 0.93$, and the control condition, $F(1,68) = 41.48$, $MSE = p < .001$, $d = 0.60$, indicating that the participants in both conditions were accurately selecting the target situations that were most likely to tempt them to use of mobile phone while driving, as instructed.

It is also worth noting, in line with the hypothesis, that the mean for the post-intervention measure of behaviour in specified target situations was lower for the implementation intention condition than it was for the control condition. This was in spite of a higher mean on the pre-intervention measure (see table 4).

3.3 Effects of Implementation Intentions on the Frequency of Mobile Phone Use in Specified and Unspecified Target Situations

A mixed 2x2 analysis of covariance (ANCOVA) and follow-up one-way ANCOVAs were conducted to test the hypothesis that the participants in the implementation intention condition would subsequently (one month post-intervention) report driving while using a mobile phone less often than would the participants in the control condition but only in the specified (not the unspecified) target situations. The within-subjects factor in the 2x2 ANCOVA was the post-intervention measure of mobile phone use while driving in the specified versus unspecified target situations. The between-subjects factor was condition (0 = control condition; 1 = implementation intention condition). The covariates were the pre-intervention measures of mobile phone use while driving in specified and unspecified target situations.

The results of the 2x2 ANCOVA showed that there was no statistically significant effect of the within-subjects factor, $F(1, 132) = 0.21$, $MSE = 0.44$, $p = .652$, $d = 0.08$. It also showed that there was no statistically significant effect of the between-subjects factor, $F(1, 132) = 3.79$, $MSE = 1.24$, $p = .054$, $d = 0.34$. However, in line with the hypothesis, there was a statistically significant interaction between the within- and between-subjects factors, $F(1,132) = 4.39$, $MSE = 0.44$, $p = .038$, $d = 0.36$.[4]

[4]We also analysed the data using a mixed 2 (pre-to post intervention behaviour in specified situations) x2 (pre-to post intervention behaviour in unspecified situations) x2 (condition: 0 = control condition; 1 = implementation intention condition) ANOVA. Consistent with the significant 2x2 interaction from the mixed ANCOVA, reported in the main text, a significant three-way interaction was found, $F(1,134) = 7.20$, $p = .008$, $d = 0.46$.

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The statistically significant interaction was decomposed using two separate one-way ANCOVAs. The dependent variable in the first one-way ANCOVA was the post-intervention measure of mobile use in the specified target situations. The covariate was the pre-intervention measure of mobile use in the specified target situations. The dependent variable in the second one-way ANCOVA was the post-intervention measure of mobile use in the unspecified target situations. The covariate was the pre-intervention measure of mobile use in the unspecified target situations. The independent variable in both of the one-way ANCOVAs was condition (0 = control condition; 1 = implementation intention condition).[5]

In support of the hypothesis, table 4 shows that there was a statistically significant difference between the conditions in the first one-way ANCOVA with the participants in the implementation intention condition reporting at post-intervention that they had used a mobile phone while driving less frequently in their specified target situations (adjusted $M = 2.96$, $SE = 0.13$) than did the participants in the control condition (adjusted $M = 3.35$, $SE = 0.13$).

3.4 Effects of Implementation Intentions on Goal Intentions and the Pre-Cursors of Goal Intentions

To help ensure the difference between the implementation intention and control conditions on the post-intervention measure of mobile phone use in the specified target situations was not attributable to any post-intervention differences between the conditions on

[5] We also ran these analyses with the measures of goal intentions, attitudes, subjective norms and perceived control as additional covariates. The findings were the same as reported in the main text. There was still a statistically significant difference between the conditions in the first ANCOVA, $F(10, 125) = 4.63$, $p = .033$, $d = -0.37$, and no difference in the second, $F(10, 125) = 0.87$, $p = .353$, $d = -0.15$.

The findings reported in the main text were also not found to be sensitive to the target situations or goal directed responses that were selected by the participants. ANCOVAs were conducted with the dependent variable being the post-intervention measure of mobile phone use in specified target situations, the covariate being the pre-intervention measure of mobile phone use in specified target situations and the independent variables being the each of the 20 specified target situations and 20 goal directed responses (0 = not selected; 1 = selected). There were no differences for any of the target situations or goal directed responses, Fs(2, 64) = 0.00 to 3.42, ps = .069 to .947. The same analyses using the measures of mobile phone use in unspecified target situations yielded the same results, Fs(2, 64) = 0.00 to 3.42, ps = .069 to .947.

the measures of goal intentions or the pre-cursors of goal intentions, another series of one-way ANCOVAs was conducted. The dependent variables in these analyses were the post-intervention measures of goal intentions (ANCOVA 1), attitudes (ANCOVA 2), subjective norms (ANCOVA 3) and perceived behavioural control (ANCOVA 4). The independent variable in each analysis was condition (0 = control condition; 1 = implementation intention condition). The covariates were the pre-intervention measures of goal intentions (ANCOVA 1), attitudes (ANCOVA 2), subjective norms (ANCOVA 3) and perceived behavioural control (ANCOVA 4). As shown in table 4, these analyses did not reveal any statistically significant differences between the implementation intention and the control conditions, in line with expectations.

4. Discussion

This study was conducted to test, for the first time, whether implementation intentions could reduce the use of mobile phones while driving. The participants were allocated at random to an implementation intention or a control condition. In the implementation intention condition, the participants were presented with an intervention that contained a comprehensive list of 20 target situations in which drivers are known to use mobile phones while driving and 20 goal-directed responses that could be used to resist the temptation to use a mobile phone when those target situations are encountered. They were asked to specify the four target situations that tempted them the most to use a mobile phone while driving and form implementation intentions by linking each of their chosen target situations with a goal-directed response. In the control condition, the participants were presented with an intervention that contained the list of 20 target situations only. They were asked to specify the four target situations that tempted them the most to use a mobile phone while driving and to try to avoid using a mobile phone when in those situations over the next month. They were not asked to link their specified target situations with goal directed responses. It was hypothesised that the participants in the implementation intention condition would

subsequently (one month post-intervention) report that they had used a mobile phone less frequently while driving in their specified target situations than would the participants in the control condition. No difference between the implementation intention and control conditions in subsequent mobile phone use while driving was expected in the unspecified target situations. No post-intervention differences were expected in general goal intentions to use a mobile phone while driving or any of the measured theoretical pre-cursor of goal intentions (attitudes, subjective norms or perceived behavioural control).

4.1. Support for the hypothesis and contextualisation of the findings in the literature on implementation intentions

The results supported the hypothesis. One-month post-intervention, it was found that the participants in the implementation intention condition reported that they had used a mobile phone less frequently while driving in their specified target situations than did the participants in the control condition. According to conventional criteria for interpreting effect sizes in the social sciences (Cohen, 1992), this reduction in the use of mobile phones while driving (d = 0.42) was approaching a moderate magnitude (d = .50). This finding is particularly encouraging given that the participants reported low levels of mobile phone use in their specified target situations prior to receiving the interventions (the mean scores for both the implementation intention and control conditions were between 3 and 4 on a scale ranging from 1 to 9). While it is not uncommon for samples of drivers to report, on average, low levels of risky driving behaviours (e.g., Brewster et al., 2015; Elliott & Armitage, 2006 and 2009; Nemme & White, 2010; Prat et al., 2015; Sullman & Baas, 2004), this means that there was somewhat limited scope to detect reductions in the reported use of mobile phones while driving in the present research. The finding that the implementation intention intervention still generated a reduction is therefore a testament to its efficacy. The findings of this study are therefore in line with the broader literature on other driving (e.g., Elliott & Armitage, 2006; Brewster et al., 2015 and 2016) and social behaviours (e.g., Adriaanse et al.,

2013; Belanger-Gravel et al., 2013; Gollwitzer & Sheeran, 2006; Toli et al., 2016), which have also shown that asking people to specify implementation intentions is an effective strategy for changing behaviour.

In line with expectations, it was found that the post-intervention difference between the conditions in the reported frequency of mobile phone use while driving in specified target situations was not accompanied by a difference between the conditions in the reported frequency of mobile phone use while driving in unspecified target situations. This finding is also consistent with previous research on other behaviours (e.g., Brewster et al., 2015; Webb & Sheeran, 2007) and is consistent with the theoretical process through which implementations are held to change behaviour. More specifically, the finding is consistent with the theoretical proposition that asking people to form implementation intentions generates mental representations of specified target situations along with links to specified goal-directed responses. As a result, relevant environmental cues that are contained within specified, but not unspecified, target situations activate the mental representations of the specified target situations, which in turn initiate the specified goal-directed responses and increase the overall likelihood of goal-intended behaviour (Gollwitzer, 1993; Gollwitzer & Sheeran, 2006).

The finding that the implementation intention condition reported a lower frequency of mobile phone use than did the control condition in specified but not unspecified target situations may imply that implementation intention interventions have limited capacity to generate behaviour-change generally (i.e., across all situations). However, at the pre-intervention stage of this study, the participants in both conditions reported a significantly higher frequency of mobile phone use while driving in their specified target situations than they did in their unspecified target situations, implying that the implementation intention intervention reduced mobile phone use in the target situations where behaviour-change was most needed. Additionally, the reported levels of mobile phone use in unspecified target

situations were very low (the mean scores for both the implementation intention and control conditions were around 2), implying that there was not much need for drivers to change their behaviour in those situations in the first place. More generally, the finding that the implementation intention intervention reduced mobile phone use in specified driving situations only means that there is no evidence for any unintended detrimental effects of the current intervention on behaviour. Specifically, if the implementation intention intervention caused drivers to transfer their mobile phone use from one situation to another (Huth et al., 2015; Oviedo-Trespalacios, 2018 and 2019; Young et al., 2019), then an increase in mobile phone use in the unspecified situations would have been expected. However, that was not the case.

It should also be noted that some previous studies have shown that asking people to specify implementation intentions can change behaviour in both specified and unspecified target situations so long as the specified and unspecified target situations are contextually similar (Bieleke et al., 2018; Brewster et al., 2016). The rationale is that a target situation that is contextually similar the one specified in an implementation intention will contain enough salient features (environmental cues) to activate the mental representation of the specified target situation, similar to a classic stimulus generalisation effect (e.g., Skinner, 1938). Consequently, this will initiate the specified goal-directed response with which the specified target situation has been linked and increase the overall likelihood of the goal-intended behaviour (Brewster et al., 2016). In the present study, it was not possible to provide a controlled test of this generalisation effect from specified to contextually similar, unspecified target situations. This was because the participants were given free choice over which target situations to specify in their implementation intentions. Further research is required in which participants are asked to specify implementation intentions to avoid using a mobile phone while driving in a pre-specified selection of target situations (e.g., 'IF I am stuck in a traffic jam'), contextually similar target situations (e.g., 'IF I am stuck at traffic lights') or

contextually different target situations (e.g., 'IF I am driving in free flowing traffic). This would permit a controlled test of whether reductions in mobile phone use while driving can generalise to target situations that are contextually similar to those specified in drivers' implementation intentions (e.g., Brewster, 2016).

Finally, in line with expectations and previous research on other behaviours (e.g., Elliott & Armitage, 2006; Brewster et al., 2015 and 2016; Webb & Sheeran, 2007 [study 1]), the results of this study showed that the post-intervention difference between the implementation intention and control conditions in the reported frequency of mobile phone use while driving in specified target situations was not accompanied by a difference between the conditions on the post-intervention measures of general goal intentions or any of the measured pre-cursors (general attitudes, subjective norms and perceived control). Although these results do not provide an empirical test of idea that implementation intentions change behaviour by helping people convert existing goal intentions into behaviour (Gollwitzer, 1993; Gollwitzer & Sheeran, 2006), they are in line with this principle because behaviour-change through changes in general goal intentions, and the other underlying motivational constructs, can be ruled out. This conclusion is also in line with previous studies in which a formal test of the interplay between implementation intentions and goal intentions has been a key research aim (e.g., Elliott & Armitage, 2006; Gollwitzer et al., 2005; Sheeran et al., 2005). These studies have shown that the association between implementation intentions and behaviour-change increases with goal intentions, consistent with the idea that the required goal intention (e.g., to not use a mobile phone while driving) needs to be in place before implementation intentions generate behaviour-change. Further research of focusing on the interplay between implementation intentions and goal intentions is warranted in the specific context of mobile phone use while driving given the encouraging findings from this study. That research might also usefully focus on a comprehensive range of motivational constructs that underpin goal intentions as put forward by the reasoned action approach (Fishbein &

Ajzen, 2010) and other extended models of motivation (see Elliott & Thomson, 2010 for an example in the context of driving). It might also usefully employ situation specific measures of goal intentions and the underlying motivational constructs rather than the more general measures employed in this research (we return to this issue in the proceeding 'methodological considerations' subsection).

Given the encouraging findings of this study, future research might also usefully be carried out to investigate the interplay between implementation intentions and habit. Habits are learned associations between situational cues behaviour. Those associations subsequently serve to initiate the behaviours automatically (rapidly, with little conscious awareness) when the associated situational cues are subsequently encountered (e.g., Orbell & Verplanken, 2010). Habits therefore influence behaviour in a similar way to implementation intentions. Within the literature on implementation intentions, researchers have previously shown that habit attenuates the effects of implementation intentions (e.g., Webb et al., 2009) and implementation intentions and break or replace unwanted habits (e.g., Adriaanse et al., 2011; Brewster et al., 2015; Holland et al., 2006; Verplanken & Faes, 1999). Given the importance of habit in the prediction of mobile phone use while driving (e.g., Bayer & Campbell, 2012) and driver behaviour more generally (e.g., Elliott et al., 2003; Elliott & Thomson, 2010), these issues represent theoretical importance for future work in this area, as does the interaction between habit and implementation intentions with goal intentions in the process of changing behaviour (e.g., Adriaanse et al., 2011).

4.2. Practical implications

As discussed in section 1.2, road safety interventions that aim to achieve behaviour-change by encouraging drivers to alter their goal intentions and underlying motivational cognitions (e.g., attitudes) are commonplace. These interventions are appropriate for drivers who currently intend to use a mobile phone while driving because they possess goal intentions that need to be changed from a road safety point of view. However, they are not

appropriate for the substantial proportion of drivers who currently do not intend to use a mobile phone while driving and, instead, need help converting their generally desirable goal intentions into action. On the other hand, the implementation intention intervention tested in this study was designed to promote intention realisation and was found to generate reductions in mobile phone use in the target driving situations where behaviour-change was most needed. It is therefore likely to be appropriate for reducing mobile phone use in drivers who need help converting their goal intentions into action. An advantage of this intervention, and others like it (e.g., Armitage, 2008; Brewster et al., 2015), is that it can be self-completed. It is therefore inexpensive to administer (e.g., no need for a trained road safety professional to deliver it). In particular, the intervention that was tested in this study was administered within an online questionnaire, meaning that it is readily amendable to web-based delivery. It could therefore be administered through road safety or vehicle insurance websites or smartphone applications, which have the potential for reaching substantial numbers of drivers and therefore generating large-scale improvements in road safety.

The present intervention might also be usefully incorporated into existing driver educational interventions, which are designed to encourage changes in goal intentions and underlying motivational cognitions (e.g., RoSPA, 2018). Such interventions do not often generate changes in behaviour and when they do the changes are typically small (e.g. d = 0.20) at best (e.g., Elliott & Armitage, 2009). One reason is that changes in goal intentions do not guarantee changes in behaviour because drivers can revert to their habitual driving patterns (e.g., Elliott et al., 2003; Brewster et al., 2015). However, asking drivers to specify implementation intentions can break unwanted habits (e.g., Brewster et al., 2015). The efficacy of driver educational interventions, which focus on the use of mobile phones while driving, might therefore be usefully enhanced by incorporating the implementation intention intervention that was tested in this research.

4.3 Methodological considerations

Although this study supports the efficacy of implementation intentions for reducing drivers' use of mobile phones while driving in specified target situations, several methodological considerations need to be taken into account when interpreting the findings. First, the effects of the present implementation intention intervention were tested over a month. Although further research testing the longer-term effects of the intervention would be valuable, previous research has shown that changes in behaviour that have been observed after one month do tend to persist (e.g., Armitage, 2005) and that the effects of implementation intentions on behaviour tend to increase, rather than decrease, over time (e.g., Sheeran & Orbell, 1999) and can last years (e.g., Conner & Higgins, 2010).

A second methodological feature of this study that needs considering is that the sample comprised an overrepresentation of younger drivers and an underrepresentation of males in comparison with the UK general population of driving license holders (see footnote 1 in section 2). This is unsurprising given the sample was recruited from social media and University student populations. Future research in which samples are recruited from the general population or in which quota sampling is employed to ensure greater representation of older and male drivers would be worthwhile. However, it should be noted that when the analyses that were conducted in this study were re-run to include age and sex as additional independent variables, it did not alter the findings. The implementation intention condition was still found to report using a mobile phone less frequently in specified target situations than the control condition and the two conditions did not differ on any other measure. There was also no evidence that the effects of the implementation intention intervention on the measures of behaviour, general goal intentions and the pre-cursors of goal intentions were sensitive to age or sex differences within the sample (see footnote 1).

On a related point, the present sample might raise concerns because of potentially different frequencies and patterns of mobile phone usage between student and non-student populations. This is because daily mobile phone use is known to be associated with mobile

phone use while driving (e.g., Phillips et al., 2008). However, while there may be specific parts of the non-student population whose lifestyle has a bearing on mobile phone use while driving (e.g., employment that requires an individual to drive and be available on the phone), it is also known that university students are, in general, heavier users of mobile phones than are non-students (e.g., DeBaillon & Rockwell, 2005). Given the aforementioned association between general mobile phone use and mobile phone use while driving, it is important to focus interventions on the sections of the population with the greatest usage. Similarly, young drivers, such as those readily found in university student populations, have a greater propensity to commit driving violations (e.g., de Winter & Dodou, 2010; Reason et al., 1990) and be crash involved (e.g., Department for Transport, 2018) than do older drivers. It is therefore important to test interventions to reduce driving violations (e.g., the use of mobile phones while driving) using samples such as the one recruited in this study. More generally, it is worth noting that previous research in the context of driving (speeding) has shown that asking participants to specify implementation intentions generates changes in behaviour for non-student samples (e.g., Elliott & Armitage, 2006) in addition to samples comprising mainly university students (e.g., Brewster et al. 2015 and 2016). This is consistent with meta-analytic reviews of previous studies of general social behaviour, (e.g., Gollwitzer & Sheeran, 2006).

A third methodological consideration that needs to be borne in mind is that there were observable differences between the study completers and the dropouts on some of the pre-intervention measures, with the results showing that the study completers were more safety conscious, on average, than the drop-outs (e.g., reporting a lower usage of mobile phones while driving). A potential criticism is that greater safety consciousness can potentially make people motivated to change their behaviour when they are given a safety intervention such as the one tested in this study, meaning that the present results may not generalise beyond the sample. However, it is also possible that greater safety consciousness of participants can

make it can make it more difficult to observe a detectable effect of a safety intervention because their baseline provides less scope for desirable change. In the present context, the study completers mean score on the pre-intervention measures of mobile phone use were lower than they were for the dropouts, meaning there was less scope to reduce the scores further in the study completers. Regardless, as noted in the method section, the intention to treat principle (e.g., Hollis & Campbell, 1999) was used in the present data analyses. This technique protected against any potential biases that might have been introduced from the observed attrition because study dropouts were included in the data analyses. Furthermore, in line with this gold standard practice, they were included by imputing their pre-intervention scores into the post-intervention measures, meaning that it was assumed the intervention would not have resulted in any reduction in their behaviour, even though it might have done so. In spite of this conservative approach, the present intervention was still found to reduce mobile phone use while driving, potentially making the conclusions even more robust.

A fourth methodological feature of this study that needs to be considered is that it focused on hand-held mobile phone use. The participants were told that mobile phone use meant physically touching a mobile phone for any purpose while driving. Although this definition was in line with legislative practices in the UK and many other countries, we acknowledge that hands-free operation of mobile phones while driving also represents a safety concern because the act of looking at a phone or holding a telephone conversation without touching the device can take drivers' visual or attentional resources away from the driving task (e.g., Department of Transportation, 2016; Oviedo-Trespalacios et al., 2016; Simmons et al., 2016). Further research testing whether implementation intentions can reduce this aspect of mobile phone used is warranted. Legislative support and driver education, making the risks of hand-free mobile phone use clear to drivers would also be desirable as part of a multi-pronged approach to tackling this issue.

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A fifth methodological feature that warrants consideration is that the participants in the implementation intention condition were asked to select four target situations in which they felt they would be tempted to use a mobile phone while driving over the next month and to link these with goal directed responses to help them avoid the temptation whereas the control participants were asked to select four target situations only. Although the control participants were also asked to try to avoid using a mobile phone in their specified driving situations (thus inducing a demand to change their behaviour), the small additional task of linking the situations to goal directed responses potentially might have induced additional commitment to change behaviour and thus increase the likelihood of behaviour-change (e.g., Burger, 1999; Lokhorst et al., 2011). While future research might usefully utilise a control intervention that includes a manipulation of goal directed responses (e.g., asking participants to select goal directed responses without linking them to specified target driving situations), it should be noted that significant effects of implementation intentions have still been found in previous research when this procedure has been used (e.g., Armitage, 2008; Armitage & Arden, 2010; Armitage et al., 2017). The effect size estimates for the resulting changes in behaviour have been similar to the one observed in the present study.

Similarly, the goal directed responses that were included in the implementation intention intervention consisted of various theoretically derived behaviour-change strategies, some of which required reflection on attitudinal, or consequential, factors (e.g., “remind myself that using a mobile phone while driving is dangerous as it takes my attention away from the road”), normative factors (e.g., “remember that there are people in my life who think that it is important to avoid using a mobile phone while driving”) and control factors (e.g., “remind myself that I have good self-control when I do not use my mobile phone while driving”). For the participants who selected those strategies, it is possible that this will have generated changes in attitudes, subjective norms and perceptions of control with respect to the specific target driving situations in this study. Those potential changes might have been

responsible, in part, for the observed changes in behaviour. Further research employing situation specific measures of both behaviour and underlying cognitions would be necessary to help address this issue.

That said, as noted already, the effects of implementation intentions on the measure of behaviour in specified situations in this study (situation specific) was not accompanied by any observed effects on the general (non-situation specific) measures of goal intentions and underlying attitudes, subjective norms and perceived control. These findings were consistent with previous research in the context of driving (e.g., Elliott & Armitage, 2006) and other domains (e.g., Webb & Sheenan, 2007 [study 1]) in which general (non-situation specific) measures of both behaviour and underlying cognitions have been employed. Consistent with the principle of correspondence (Fishbein & Ajzen, 1975), the expectation would be that same pattern of results would persist for situation specific measures. The situation specific measures of behaviour used in this study were also not found to vary by the goal-directed responses that were selected by the participants in the implementation intention intervention (see footnote 5). This helps rule out the possibility that any changes in attitudes, subjective norms and perceptions of control might have generated the observed change in the situation-specific behaviour measure (i.e., if the observed changes in behaviour in specific driving situations had been attributable to changes in attitudes, subjective norms or perceptions of control in those specific situations, then differences between the participants who selected the goal directed responses mapping onto the aforementioned attitudinal, normative and control factors and other participants would be expected).

A final methodological feature of this study that needs considering is that self-reported measures of behaviour were used. Although recognised as a valuable methodology in the social sciences, self-reported behaviour measures are susceptible to cognitive (e.g., Luchins, 1957), affective (e.g., Bower, 1992) and self-presentational biases (e.g.,Paulhus, 2002), which can lead to either under- or over-reporting, particularly in relation to deviant or

criminal behaviours such as mobile phone use while driving (e.g., Corbett, 2001). Furthermore, self-reported behaviour measures can be particularly vulnerable to demand effects, meaning that participants can report changing their behaviour relatively easily just because they know they have received an intervention. Research testing the effects of implementation intention interventions using objective measures of mobile phone use while driving is therefore warranted. Driving simulation studies would enable the collection of observed behaviour data under experimentally controlled conditions in both specified and unspecified target situations (e.g., Brewster et al., 2016).

It should be noted, however, that findings of this study are held with confidence for several reasons. First, objective behaviour measures are less vulnerable to the above-cited biases than are self-reported behaviour measures and self-reported and objective measures of driving behaviour have been found to correspond well in previous studies (e.g., De Waard & Rooijers, 1994; Rolls et al., 1991; West et al., 1993). Second, on a related point, previous studies of driver behaviour (speeding) have shown that implementation intentions tend to generate equivalent sized changes in self-reported behaviour measures (Brewster et al., 2015) as they do objective behaviour measures (Brewster et al, 2016), which is consistent with meta-analytic findings from the broader literature on implementation intentions (e.g., Gollwitzer & Sheeran, 2006). Third, this study was a randomised controlled experiment in which both conditions received an intervention, meaning that a demand was placed on all of the participants to change their behaviour and any potential effects of self-reporting biases would have been equalised across the conditions (note that the randomised controlled design also meant that other unmeasured factors, which can influence mobile phone use while driving, such as enforcement or new technologies designed to prevent drivers from using their phone during the driving task, was controlled and rules out these factors as a potential explanation for the findings). Fourth, in line with the theoretically-derived hypothesis that was tested in this study, the observed difference between the implementation intention and

control conditions in reported mobile phone use while driving in specified target situations was not accompanied by a difference in any other self-reported measure (i.e., the frequency of mobile phone use in unspecified target situations, goal intentions, attitudes, subjective norms or perceived behavioural control) and a difference between the conditions on all measures would have been expected if the findings were attributable to a general demand effect.

4.5 Conclusions

This research provides evidence, for the first time, that an intervention to encourage drivers to form implementation intentions reduces their use of mobile phones while driving. In line with theory, the reductions in mobile phone use were specific to the target driving situations that were specified in the participants' implementation intentions. These were target driving situations where mobile phones were used most frequently, prior to intervention, and therefore situations where behaviour-change was most needed. In line with theoretical expectations, reductions in mobile phone use were not found in the target situations that the participants did not specify in their implementation intentions but there was little need for drivers to change their behaviour in those situations in the first place. The implementation intention intervention did not changes general goal intentions or any of the measured pre-cursors of general goal intentions (attitudes, subjective norms or perceived behavioural control). The findings suggest that future interventions would benefit from encouraging drivers to specify implementation intentions. The intervention developed in this study could be usefully administered through web-based platforms to obtain wide 'reach' or incorporated into existing driver education programmes.

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Table 1. Percent of participants selecting each tempting situation in the implementation intention and control conditions

If I am tempted to use a mobile phone while driving…	%	
	IMP	CONT
… because I want to use the SAT NAV on my phone	65	76
… because I need to let someone know I will be late picking them up	58	42
… because I want to control the music in my car with my phone (e.g. through Spotify or another music app)	52	39
… because I need to let someone know I will be late for a meeting or appointment	44	49
… because I want to read a text message	42	43
… because I need to speak with my partner about something	28	29
… because I am in a traffic jam	22	24
… because I am waiting at traffic lights	19	18
… because someone important (e.g. my boss or doctor) is calling to speak with me	13	35
… because I have a work related call to make	7	14
… because I want to send a text message	7	6
… because I am on a quiet or empty road	4	1
… because I think there is little chance of being caught by the Police	4	0
… when driving on a very familiar road	4	0
… because I am driving in slow moving traffic	3	3
… because I want to show a passenger something	3	3
… because I want to take a photograph or record a video	2	1
… because I want to check social media (e.g. Facebook or Twitter)	0	0
… because I want to check my emails	0	4
… because I am bored	0	1

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Table 2. Percent of participants selecting each goal directed response/strategy in the implementation intention condition

Then I will…	%
… remind myself that it is illegal to use a handheld device when driving (CR)	73
… remind myself that using a mobile phone while driving is dangerous as it takes my attention away from the road (CR)	65
… think about the emotional pain I would suffer if I caused death or injury to someone from being distracted by my phone (DR)	61
… remind myself to set up my phone before starting my next journey so I do not need to touch it while driving (SC)	35
… remember how upsetting it is to see/hear about road traffic crashes caused by drivers on their mobile phones, and the distress suffered by the victims and their families (DR)	26
… tell myself that I will be less likely to cause a traffic crash if I avoided using my mobile phone (ER)	20
… make a concerted effort to ignore the urge/pressure to use my mobile phone (CC)	19
… remember that drivers caught by the Police for using a mobile phone face sanctions (e.g. fines/penalty points) (SocLib)	17
… tell myself that I can avoid using my mobile phone whilst driving if I really want to (SelfLib)	13
… remind myself to turn my mobile phone off before entering the car (SC)	12
… remember that using a mobile phone while driving contradicts the view I have of myself as a considerate and responsible person (SR)	10
… remember that there are people in my life who think that it is important to avoid using a mobile phone while driving (HR)	9

… concentrate on keeping my hands "on the wheel" rather than on my mobile phone (CC) 9

1

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1 Table 2 (continued). Percent of participants selecting each goal directed response/strategy in
2 the implementation intention condition

Then I will…	%
… remind myself that I have good self-control when I do not use my mobile phone while driving (RM)	9
… tell myself that I would be making the roads safer by not using my mobile phone (ER)	7
… remember that there are people in my life who would approve of me not using my mobile phone while driving (HR)	6
… think about how disappointed I would be in myself for using my phone (SR)	6
… remember that I have made a commitment to avoid using my mobile phone while driving (SelfLib)	3
… remember to tell myself that I am a good driver when I do not use my mobile phone while driving (RM)	2
… remind myself that society is not accepting of drivers who use a mobile phone while driving (SocLib)	0

Note: Acronyms in parentheses indicate the processes of change (Prochaska and DiClemente, 1983) that the goal-directed responses were designed to tap: CR = consciousness raising; SR = self-reevaluation; SelfLib = self liberation; CC = counter conditioning; SC = stimulus control; RM = reinforcement management; HR = helping relationships; DR = dramatic relief; ER = environmental re-evaluation; SocLib = social liberation.

3

4

1 Table 3. ANOVAs testing the effects of condition and attrition on the pre-intervention

2 measures

Dependent Variable	*F (df* = 3, 132*)*	*MSE*	*P*	*d*
Condition (0 = Control; 1 = Experimental)				
Age	0.43	114.35	.431	-0.10
Years licensed to drive	0.51	87.16	.939	-0.15
Weekly mileage	0.01	10272.73	.920	-0.09
Behaviour in specified situations	3.07	5.42	.082	+0.30
Behaviour in unspecified situations	0.06	2.16	.811	-0.04
Goal Intentions	0.10	4.09	.752	+0.06
Attitudes	0.39	2.26	.534	+0.11
Subjective Norms	0.01	3.74	.941	-0.02
Perceived behavioural control	0.00	2.06	.995	<+0.01
Attrition (0 = Study Dropout; 1 = Study Completer)				
Age	1.85	114.35	.176	-0.11
Years licensed to drive	3.83	87.16	.052	-0.30
Weekly mileage	0.76	10272.73	.385	-0.06
Behaviour in specified situations	10.52	5.42	.001	-0.56
Behaviour in unspecified situations	11.99	2.16	.001	-0.60
Goal Intentions	4.93	4.09	.028	-0.38
Attitudes	2.20	2.26	.141	-0.26
Subjective Norms	0.15	3.74	.696	-0.17
Perceived behavioural control	6.71	2.06	.011	+0.45

3

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Table 3 (continued…). ANOVAs testing the effects of condition and attrition on the pre-intervention measures

Dependent Variable	*F (df* = 3, 132*)*	*MSE*	*p*	*d*
Condition X Attrition Interactions				
Age	0.26	114.35	.611	+0.07
Years licensed to drive	1.06	87.16	.305	+0.11
Weekly mileage	0.40	10272.73	.529	-0.12
Behaviour in specified situations	2.09	5.42	.151	-0.25
Behaviour in unspecified situations	0.61	2.16	.438	-0.14
Goal Intentions	0.03	4.09	.855	-0.03
Attitudes	0.00	2.26	.951	-0.01
Subjective Norms	0.41	3.74	.523	-0.11
Perceived behavioural control	0.04	2.06	.845	+0.04

Table 4. Sample means (standard deviations) at both pre- and post-intervention and one-way analyses of covariance (ANCOVAs) testing post-intervention differences between the conditions while controlling for pre-intervention

	M (*SD*)				ANCOVA			
	Pre-Intervention		Post-Intervention		*F*	*MSE*	*p*	*d*
	CONT	IMP	CONT	IMP	(*df* = 2, 133)			
Behaviour in specified situations	3.39 (2.52)	3.75 (2.29)	3.24 (2.34)	3.07 (2.18)	5.59	1.29	.019	-0.42
Behaviour in unspecified situations	2.12 (1.68)	2.00 (1.35)	2.04 (1.55)	1.85 (1.31)	0.65	0.38	.423	-0.14
Goal Intentions	2.79 (2.21)	2.80 (1.85)	2.77 (2.11)	2.64 (1.71)	0.59	1.02	.443	-0.13
Attitude	2.31 (1.47)	2.45 (1.54)	2.32 (1.42)	2.40 (1.35)	0.01	0.84	.932	-0.02
Subjective Norm	4.93 (2.02)	4.83 (1.82)	4.88 (1.98)	4.72 (1.76)	0.22	1.07	.637	-0.08
Perceived behavioural control	7.84 (1.55)	7.94 (1.38)	7.81 (1.48)	7.88 (1.46)	0.02	0.72	.885	0.02

Note: CONT = Control Condition. IMP = Implementation intention condition