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Mobile phone use while driving: Predicting drivers' answering intentions and compensatory decisions

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ABSTRACT

The current study considered, for the first time, compensatory decisions within the theory of planned behaviour (TPB) to explain why people use mobile phones while driving. The effects of age, gender, and mobile phone mode on respondents' answering intentions and compensatory decisions were mainly examined. A series of questions were administered to 333 drivers (ages 25–59), which included (1) demographic measures, (2) scales that measured prior mobile use activities in both driving and ordinary contexts, (3) a question to measure drivers' perceptions of the safety of hands-free phones, and (4) TPB measures, which measured answer intention and two compensatory behavioural decisions (i.e., reminding the caller that he/she is driving, limiting the length of a conversations (including perceived its limits)), along with predictive variables. Drivers reported a moderate likelihood of answering intention and a strong tendency to engage in the two compensatory behaviours. Answering intention and compensatory decisions, perceived behavioural control, perceived risk, and usage frequency were more dependent on mobile phone mode and age group than gender. The regression models explained 64% and 67% of the variance in answering intention in the handheld and hands-free scenario separately. Attitudes, subjective norms, perceived behavioural risk and control (PBRC), and prior answering behaviour emerged as common predictors. The predictive models explained 31% and 37% of the variance for perceived limits of a conversation length in handheld and hands-free scenarios, respectively. Answering intention and PBRC consistently predicted most of the variance (handheld: 28%; hands-free: 32%) for this compensatory perception limits. The theoretical and practical implications of these results are discussed.

1. Introduction

Mobile phone use while driving is an important contributor to driver distraction, and a significant body of recent research has revealed that this behaviour can cause impairments in driving performance (e.g., Strayer and Johnston, 2001; Strayer et al., 2003; Gugerty et al., 2004; Rakauskas et al., 2004; Svenson and Patten, 2005; Horrey et al., 2008; Nasar et al., 2008; Backer-Grøndahl and Sagberg, 2011). Epidemiological and correlational studies suggest that this behaviour also increases the likelihood of serious driving accidents (e.g., Violanti and Marshall, 1996; Violanti, 1999; Lamble et al., 2002; Laberge-Nadeau et al., 2003; McEvoy et al., 2006). However, mobile phone use while driving represents a pervasive world-wide phenomenon, and a great number of drivers use their phones while driving. Given the safety implications of mobile phone use while driving and the scarcity of studies focusing on drivers' intentions (especially with regard to the engagement in compensatory actions) (e.g., Walsh et al., 2008; Zhou et al., 2009b; White et al., 2010), this study aimed to consider drivers' compensatory behavioural decisions within a modified structure of the theory of planned behaviour (TPB) to explore why people use mobile phones while driving.

1.1. Mobile phone use and driving

Driver distraction can be defined as a diversion of attention away from activities critical for safe driving and towards a competing activity (Lee et al., 2008). Mobile phone use is considered to be a distracting activity; therefore, many countries (e.g., Australia, China, and Norway) have created legislation to restrict the use of handheld mobile phones while driving. A considerable number of studies have focused on the safety of mobile phone use while driving. Using methods such as simulation or field testing, a significant body of research confirms that both the handheld and hands-free modes of mobile phone use impair driving performance, even though the physical demands may be less for the hands-free mode

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than for the handheld mode (e.g., Haigney et al., 2000; Strayer and Johnston, 2001; Strayer et al., 2003; Gugerty et al., 2004; Rakauskas et al., 2004; Treffner and Barrett, 2004; Tornros and Bolling, 2005; Horrey and Wickens, 2006; Caird et al., 2008; Nasar et al., 2008). These studies suggest that regardless of the mode of mobile phone use, driving should always be the primary task, and the act of phoning while driving should always be specified as a secondary task. In this dual-task scenario, drivers may not have enough cognitive capacity to allocate to both talking and driving simultaneously, and driving performance suffers when mental resources are diverted in favour of the secondary task (e.g., Dressel and Atchley, 2008; Nelson et al., 2009). The cumulative results of these studies suggest that mobile phone use while driving has a significant negative effect on drivers' cognitive distraction or performance for both the hands-free and handheld modes.

However, evidence from other studies addressing driver's risk perception indicated that people perceived the behaviour of mobile phone use when driving to be safer and reported stronger intentions to use mobile phone in hands-free mode than in handheld mode (e.g., White et al., 2004; Zhou et al., 2009b; Backer-Grøndahl and Sagberg, 2011). Public opinion surveys reflect these results. For example, in China, 65.3% of internet respondents perceived a higher risk for the handheld mode than for the hands-free mode, and only 25% of them thought that the use of hands-free kits had the same risk level as handheld sets when driving (CCTV and Sina, 2006). In the UK, two public surveys found that 88% of people are in favour of regulating the use of handheld sets, whereas public opinion seems far more ambivalent about the use of hands-free kits, with only 45% calling for similar regulation (see White et al., 2004). In Finland, over 75% of survey respondents believed that the government should ban the use of handheld mobile phones while driving, but only 27% believed that hands-free mobile phone use should be banned while driving (Lamble et al., 2002). However, the majority of people still tend to use handheld sets. For example, a survey conducted in a sample group of Spanish university workers indicated that only 14.3% of respondents who use a mobile phone while driving use a hands-free device (Gras et al., 2007), and a survey of Austrian citizens suggested that 63.9% of drivers did not own hands-free kits and that, of the drivers who did own hands-free kits, 32% did not use those kits most or all of the time (White et al., 2010). Therefore, when examining drivers' attitudes and motivations to use mobile phones while driving, the type of mobile phone (handheld or hands-free) should be considered an important variable. Drivers' differing responses based on cell phone mode should be stressed in tandem with their risk perception of this behaviour.

Some studies, using either self-report or observational methods, have focused on drivers' perceived risk of mobile phone use while driving. Generally, people ranked mobile phone use as riskier in a driving context than in other ordinary situations (Zhou et al., 2009b). A recent study conducted by Backer-Grøndahl and Sagberg (2011) asked drivers to rate the perceived degree of risk for 23 distracting activities and other risky behaviours. Sending text messages, reading, and writing were perceived to be the most dangerous of the distracting activities. An earlier study (Smith, 1978) also found that reading a map and writing something down were perceived to be the riskiest activities for drivers. The results of these perceived risk studies were consistent with those of some current studies asking drivers' about their engagement in distracting activities. These current studies suggest that the order of frequency for intended mobile phone activities when driving is (1) answering calls, (2) making calls, (3) reading text messages, and (4) sending text messages (Walsh et al., 2008; Zhou et al., 2009b; White et al., 2010).

Driver demographic characteristics are also considered to be important factors moderating drivers' engagement in mobile phone use while driving. Some studies have examined the impact of age and gender on drivers' mobile phone use and on the perceived risk of this behaviour. Evidence indicates that younger drivers tend to use mobile phones while driving more often than older drivers. For example, a survey by Backer-Grøndahl and Sagberg (2011) found that only 27.8% of older drivers (55+ years) reported using a mobile phone while driving, compared to 69.8% of middle-aged drivers (aged 26–54 years) and 69.6% of young drivers (aged 18–25 years). Other studies (Lamble et al., 2002; Brusque and Alauzet, 2008) also found that young drivers reported a much higher level of mobile phone use while driving than did older drivers. When examined in combination with gender, research shows that the youngest drivers and males use their phones while driving more often than older drivers and females (Brusque and Alauzet, 2008) and that females are almost twice as likely to restrict mobile phone use than males (Lamble et al., 2002). Zhou et al.'s study (2009b) indicated that males learning to drive reported relatively stronger perceived behavioural control for using a mobile phone when driving than females. Moreover, these two individual factors also influenced the drivers' perceived risk of mobile phone use while driving. Two surveys conducted in Australia indicated that young drivers rated most items on a list of distracting and risky activities (e.g., dialling, answering and talking on a mobile phone while driving) as less dangerous than the older drivers rated them (i.e., McEvoy et al., 2006; Backer-Grøndahl and Sagberg, 2011). Male drivers rated some activities, such as answering a mobile phone while driving, as less dangerous than the females rated them (Backer-Grøndahl and Sagberg, 2011).

Overall, the collective results of these studies suggest that the use of mobile phones is pervasive around the world, and people's risk perception of this behaviour varies on different situations or variables. It is therefore important to focus on explaining drivers' motivations and decision-making processes in addition to factors such as perceived risk, gender, age, and modes of mobile phone use.

1.2. Theory of planed behaviour and mobile phone use while driving

As a complete model for explaining social behaviour, the theory of planned behaviour (TPB; Ajzen, 1991) can be applied to address the issue of people's decisions to use mobile phones while driving. According to the TPB, behavioural intentions are immediate predictors of behaviour and are influenced by attitudes towards the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991). Behavioural intention reflects the motivation to perform the behaviour and the likelihood with which respondents will perform it in the future. Attitudes are personal beliefs about the potential outcomes of the behaviour, including either positive or negative evaluations of these outcomes. Subjective norms reflect personal beliefs about the normative expectations of others and the motivation to comply with these expectations. Perceived behavioural control (PBC) refers to beliefs about one's ability to perform (or not to perform) the behaviour, which has direct effects on behaviour.

In a wide variety of behavioural domains, including road safety, a number of studies have used the TPB to account for drivers' intentions to obey the speed limit (e.g., Elliott et al., 2003, 2005, 2007; Newnam et al., 2004; Paris and Broucke, 2008; Forward, 2009; Cestac et al., 2011) and commit driving violations (e.g., Parker et al., 1992; Díaz, 2002; Poulter et al., 2008; Forward, 2009), passengers' seat belt use intentions (Şimşekoğlu and Lajunen, 2008), and pedestrians' road crossing intentions (e.g., Evans and Norman, 1998, 2003; Holland and Hill, 2007; Zhou et al., 2009a; Zhou and Horrey, 2010). The TPB has also been successfully employed to address drivers' mobile phone use intentions while driving (Walsh et al., 2008; Zhou et al., 2009b). Zhou et al. (2009b) investigated young student drivers' (aged from 17 to 34 years) intentions to use a mobile phone when driving. The results of the study indicated that the TPB variables (attitude, subjective norm, and perceived behavioural control) were able to explain the relatively large (43% and 48%) variance for hands-free and handheld mobile phone use intentions, respectively, with perceived behavioural control emerging as the strongest predictor. Walsh et al. (2008) used the TPB framework to examine predictors (i.e., attitudes, norms, control factors, and risk perceptions) of drivers' (aged from 17 to 76 years) intentions to use a mobile phone while driving in general, as well as for calling (defined as making or answering a call) and text messaging (defined as sending or reading a text message), in four scenarios differing in descriptions of vehicle speed and time pressure (i.e., 100 km/h, running late; 100 km/h, not in a hurry; waiting at traffic lights, running late; and waiting at traffic lights, not in a hurry). The results indicated that attitude, subjective norms, and PBC accounted for 32–39% of the variance for general and calling intentions, with attitude identified as the strongest predictor. Less support was found for the predictive ability of subjective norms and PBC on text messaging intention, although the models in the four situations accounted for 11–14% of the variance in these scenarios. Overall, the results from these two studies (Walsh et al., 2008; Zhou et al., 2009b) support the validity of the TPB and indicate that in addition to the standard TPB components of attitude, subjective norm, and PBC, extended variables such as individual factors (e.g., gender and age), driving purpose, crash risk, and risk apprehension are also possible predictors of intentions to use a mobile phone when driving.

1.3. The need to extend the TPB to include compensatory decisions

The previous literature suggests that many drivers continue to use handheld devices and that they believe the use of hands-free mobile phones is safer while driving (e.g., Zhou et al., 2009b). Mobile phone use in conjunction with more physical demands, such as using a handheld set, making a call, and sending a short message, tends to be perceived as riskier. Drivers tend to give low ratings when asked of their intentions to use a phone while driving. However, there is increasing evidence of widespread actual mobile use while driving. This leads to a question: When a driver knows that using a mobile phone while driving is risky, but he/she needs to use a mobile phone while driving, how does he/she modulate his/her behaviour accordingly?

To answer this question, it may be important to know whether and how drivers self-regulate their driving to compensate for the impairment caused by phone use. With more research now documenting the effect of mobile phone use on driving safety, some recent attention has been given to the possible compensatory behaviours involved in mobile use while driving, including stopping the vehicle (e.g., Gras et al., 2007), reducing the speed (e.g., Haigney et al., 2000; Rakauskas et al., 2004), and increasing the following distance (e.g., Alm and Nilsson, 1995; Strayer et al., 2003, 2006; Strayer and Drews, 2004). However, evidence from studies exploring whether drivers adopt these behaviours to compensate for driving performance decrements during cell phone is complicated, and the major of the research does not show compensation or its opposite (Haigney et al., 2000; Caird et al., 2008; Rosenblatt and Li, 2010). Some findings indicate that drivers may engage in such compensatory action to offset perceived risk when using a cell phone. For example, drivers may reduce their speed and increase their following distance in response to changing or competing task demands to maintain an adequate level of safe driving (Haigney et al., 2000; Rakauskas et al., 2004; Strayer and Drews, 2004). The driver's a priori confidence in his/her ability to deal with distracters (i.e., cell-phone use) may impact decisions to engage in compensatory behaviours (Lesch and Hancock, 2004). Drivers may compensate for the deleterious effects of cell phone use by decreasing their speed when using a handheld phone but neglect to do so when using a hands-free phone (e.g., Ishigami and Klein, 2009). However, some researchers have not found evidence of driver compensation. For example, drivers did not compensate for impairment during cell phone conversations by increasing headway or decreasing their speed during the phone task (Alm and Nilsson, 1995; Rosenbloom, 2006). And drivers using either phone type (i.e., handheld or hands-free mobile phone) do not appreciably compensate by increasing following distance or reducing speed (e.g., Caird et al., 2008).

Most commonly, pulling over to the side of the road, increasing following distance, and stopping the vehicle were reported as compensatory actions by the major of drivers when they engaged in distracting activities such as mobile phone use Young and Lenné (2010). However, other compensatory behaviours that are more directly related to mobile phone use (such as shortening the conversation time while on a mobile phone and reminding the caller that he/she is currently driving) were not considered in previous studies. Therefore, to understand the relationship between drivers' confidence in driving ability, risk perception, mobile phone activities and compensatory behaviours, it is important to find a suitable way to predict drivers' decisions regarding compensatory behaviours.

In psychology, human behaviour is often used to illustrate an individual's observable responses in a given situation with respect to a given target. Usually, human actions are related. Compensatory behaviour is created because of a primary behaviour; it occurs in response to the primary action. Correspondingly, an individual's intention to perform a compensatory behaviour can be called compensatory behavioural intention or decision. How does one predict compensatory behavioural intention? We can use the TPB and design specific scenarios to investigate these decisions. Using this method, however, makes it difficult to find the relationship between mobile phone use intention and a driver's compensatory decisions. According to the TPB (Ajzen, 1991), a behaviour is a function of behavioural intentions and perceived behavioural control. Additionally, according to a previous study (e.g., Lesch and Hancock, 2004), drivers' decisions to engage in compensatory behaviours are impacted by their confidence in the ability or perceived behavioural control toward mobile phone use while driving. Considering this finding, we present a modified TPB model (see Fig. 1), which assumes that behavioural intentions are an indication of an individual's potential compensatory behavioural decisions and that perceived behavioural control will moderate the effect of behavioural intentions on compensatory decisions. For example, in the context of driving, driving safely is a primary action, mobile phone use is a secondary task, and behaviour such as reducing mobile phone use is a compensatory action. Therefore, from the perspective of the driver, compensatory behaviour is enacted to maintain a balance between driving safely and using a mobile phone. According to the TPB, behavioural intention is assumed to be an immediate antecedent of behaviour (Ajzen, 1991). The intentions to remind a caller of one's driving status and to limit mobile conversation time (including perceived limits of a conversation length) were selected as compensatory decisions in the study.

To date, few studies have focused on predicting compensatory decisions in the context of driving. The current study seeks for the first time to consider compensatory decisions within a modified TPB framework to explain why people use mobile phones while driving. In this study, we extend the findings from Zhou et al.'s study (2009b) to another driver population. Whereas Zhou and colleagues focused on students in driving schools, the current study uses a sample of licensed drivers with at least 1 year of driving experience to increase external validity and practical significance. Another change that we made was to use indirect belief-based scales to measure respondents' attitudes and subjective

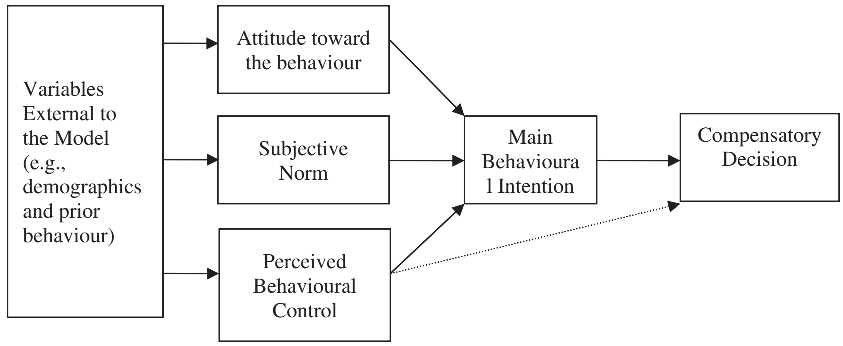

Fig. 1. The structure model of compensatory intentions (modified from the theory of planned behaviour; Ajzen, 1991).

norms. Specifically, we tried to use the modified TPB model as presented in Fig. 1 to examine how different demographic characteristics influence (1) a driver's decision to answer a call and (2) a driver's compensatory intentions to deal with the call, in both handheld and hands-free scenarios. In this study, we define answering a call as the main behavioural intention, and we define reminding the caller that one is driving and limiting the length of the conversation (including perceived limits of a conversation length) as compensatory behavioural decisions or intentions. We expect that these decisions will have a direct relationship with the control of mobile phone use while driving.

Thus, the main goals of this study were to:

1. Examine the effects of age and gender on behavioural intentions (including answering intention and compensatory intentions) in scenarios that include either handheld sets or hands-free kits.
2. Investigate whether age, gender or situation (handheld vs. hands-free scenario; driving vs. ordinary life context) affects drivers' perceived behavioural control, perceived risk, or mobile phone use activities.
3. Address the extent to which the answering intentions of drivers can be predicted by the TPB variables (i.e., attitude, subjective norm, perceived behavioural control, and prior answering behaviour), gender, age, and prior use behaviour.
4. For the first time, address whether compensatory decisions to use mobile phone while driving can be predicted by a modified TPB model with predictors of the answering intention and other elements of the TPB, in particular PBC.

2. Method

2.1. Participants

A total of 333 drivers, aged 25–59, participated in the study. In 2006, more than 93% of traffic accidents in China were caused by people aged 21–60, and nearly 70% were caused by people aged 26–45 (CRTASR, 2007). Drivers aged older than 59 must pass additional tests and meet additional requirements to obtain a driver's license. Therefore, as in our previous study (Zhou et al., 2009b), we divided participants into the following age groups: 25–34, 35–44, and 45+ years. The respondents were recruited from eight major city zones in Beijing. Only those with at least 1 year of driving experience and a self-reported driving frequency of at least 4 days per week were invited to complete the study. In this way, novice drivers were excluded. The demographic profile of the respondents and their driving experience are presented in Table 1. As shown in the table, respondents were approximately balanced between gender and age group. With respect to educational level, 31.8% of the participants had bachelor's degrees, and 45.6% had less education (i.e., middle school, high school, or secondary technical school). The mean past driving mileage was 81656.4 km, and the mode was 10,000 km.

Respondents were approached by trained interviewers in public places, such as office buildings or supermarket gates. They were asked to read an informed consent form and written instructions for completing the questionnaires. Respondents were ensured that their participation was voluntary and that they would be remunerated for their anonymous responses. It took respondents approximately 15 min to complete the survey.

2.2. Survey materials

2.2.1. Mobile phone mode scenarios

Respondents were asked to fill out a questionnaire that included two scenarios. One scenario depicted a situation in which the driver uses a handheld mobile phone (handheld scenario). The second scenario depicted a situation in which the driver uses a hands-free mobile phone (hands-free scenario). The two scenarios were based on Zhou et al.'s study (2009b):

- <u>Handheld scenario</u>
  You use a mobile phone with handheld mode. And now are driving at 60 km/h. At this moment, you receive an important incoming call, so you answer the call while driving.
- <u>Hands-free scenario</u>
  You use a mobile phone with hands-free mode. And now are driving at 60 km/h. At this moment, you receive an important incoming call, so you answer the call while driving.

2.2.2. Questionnaire measures

The survey contained four sections. The first two sections were the primary sections of the survey, and they contained the same questions about TPB variables and compensatory decisions for the handheld scenario and the hands-free scenario. The next section assessed the respondents' prior mobile phone usage behaviours. The final section was developed to establish the demographic profile and drivers' perceptions of the safety of hands-free mobile phone kits. The details of the questionnaires are presented below.

2.2.2.1. TPB questions. The TPB items were based on previous studies on road safety (see for example, Zhou et al., 2009a) and previous studies of the TPB applied to mobile phone use intentions (Walsh et al., 2008; Zhou et al., 2009b). Additionally, as recommended by Ajzen (1991), seven-point unipolar scales were used to measure the standard components of the TPB (behavioural intention, attitude, subjective norm, and perceived belief control) and additional components included for the purposes of this study (perceived risk and prior behaviours). These questions were asked for each mobile phone mode scenario. The order of scenarios was

Table 1
Survey respondents' demographic profile and driving experience.

	25–34 years	35–44 years	45+ years	Total
Total				
N[a]	98 (29.5)	121 (36.3)	114 (34.2)	333 (100)
Mean age[b]	30.6 (3.1)	39.1 (3.0)	49.7 (3.7)	40.2 (8.3)
Male				
N[a]	50 (15.0)	62 (18.6)	56 (16.8)	168 (50.4)
Mean age[b]	31.3 (2.8)	39.0 (3.0)	49.8 (3.8)	40.3 (8.1)
Female				
N[a]	48 (14.4)	59 (17.7)	58 (17.4)	165 (49.6)
Mean age[b]	29.9 (3.3)	39.1 (3.1)	49.6 (3.6)	40.1 (8.6)
Educational level				
Lower school education[a]	32 (9.6)	48 (14.4)	72 (21.6)	152 (45.6)
Junior college education[a]	24 (7.2)	33 (9.9)	18 (5.4)	75 (22.5)
Graduate education or above[a]	42 (12.6)	40 (12.0)	24 (7.2)	106 (32.8)
Driving experience				
Mean driving age (years)[b]	5.6 (3.4)	10.0 (5.7)	13.9 (8.1)	10.1 (7.0)
Mean driving frequency per week (days)[b]	5.3 (1.0)	5.5 (1.0)	5.3 (1.0)	5.3 (1.0)
Mean number of miles driven (10,000 km)[b]	6.2 (5.7)	7.7 (6.2)	10.3 (9.9)	8.2 (7.7)

[a] Percentages in parentheses.
[b] Standard deviations in parentheses.

counterbalanced across individuals, and the associated questions were listed in random order.

Table 2 includes a summary of the TPB questionnaire variables and items used. In contrast with previous studies (e.g., Zhou et al., 2009b), attitude was categorised as either a positive or negative belief attitude (e.g., Zhou and Horrey, 2010) and was measured indirectly using belief-based measures (Ajzen, 1991). The subjective norm was also measured using belief-based measures. Following previous studies (e.g., Zhou et al., 2009a,b; Zhou and Horrey, 2010), the data of five subscales (i.e., behavioural intention, positive belief attitude, negative belief attitude, subjective norm, and perceived behavioural control) were submitted separately to a principal component factor analysis (PCA). For each analyse, the responses for responding items in handheld and hands-free scenarios were used together. For example, the PCA procedure for the scale of answering intention was conducted based on total responses of 333 (participants) $\times$ 4 (items) $\times$ 2 (mobile scenarios). At the beginning of the study, we tried to identify perceived risk as one of extended variables, but one common single factor for the three PBC items and one perceived risk item were found in an initial test (*note*: considering only one item was designed for measuring perceived risk, and this variable also was related to PBC, then we did the initial test). For this reason, we named the common factor the perceived behavioural risk and control (PBRC). Except where noted, using an eigenvalue greater than 1 as a criterion (i.e., indentifying a clear elbow point with an eigenvalue greater than 1.0 in a scree test), the PCA analysis yielded a single-factor solution for each subscale (see Table 2). As shown in the table, each subscale accounted for at least 55% for the variance and the factor loading for responding items were greater than 0.6. To check the reliability of the each subscale, internal consistency analysis (Cronbach's α) were conducted. In Table 2, the Cronbach's α statistic for each subscale was high (0.61 or higher) and indicated reasonable inner reliability for each TPB component measured. These psychometric analyses showed that the self-report measures designed for this study were valid and reliable.

2.2.2.2. Compensatory intentions. Following each scenario, one question was used to measure time limiting intention for conversations on mobile phones (scored 1 (strongly disagree) to 7 (strongly agree)): "In this scenario, I would consciously control the length of time spent answering a call." This was followed by an open-ended question, "If you agree that it is necessary to control conversation time, how long do you think you should take for the conversation on the mobile phone (in minutes or seconds)?" If respondents disagreed to control conversation time, he/she could choose the answer of "I think it is no need to control conversation time in this condition", and then leaf the open-ended question blank. Finally, to measure 'reminding intention', we used the question "I generally like to mention to the caller that I am driving" (scored 1 (strongly disagree) to 7 (strongly agree)).

2.2.2.3. Perceived hands-free mobile phone safety. Risk perception of hands-free mobile phones was measured with one item: "While driving, using a hands-free mobile phone is safer than using a handheld mobile phone." The statement was rated by respondents on a seven-point scale from 1 (strongly disagree) to 7 (strongly agree).

2.2.2.4. Prior mobile phone usage activities. The respondents were asked how frequently they made calls, answered calls, refused calls, read short messages, and sent short messages while driving (prior mobile use behaviour when driving) and how frequently they made calls, answered calls, read short messages, and sent short messages in ordinary, non-driving contexts (prior mobile use behaviour in ordinary context). These questions were presented following the questions on the two scenarios. Each item was rated on a seven-point scale ranging from 1 (*very infrequently*) to 7 (*very frequently*).

2.2.2.5. Demographic measures. Demographic information including age, gender, education, driving age, number of miles driven, driving frequency per week, and occupation was gathered.

3. Results

The data were analysed using SPSS version 16.0. For behavioural intentions or decisions, measures of perceived behavioural control and perceived risks, and activities of mobile phone use, we first calculated descriptive statistics in percentages (e.g., how many drivers tended to agree that '*It is likely that I will answer the call in such a way in the future*') and average response scores. Table 3 presents these results by mobile phone scenarios (handheld, hands-free) or use contexts (driving context, ordinary context). Then we used analysis of variance (ANOVA) to test for differences on average response scores between scenarios or contexts, gender, and age groups. Beside provided the difference on measures' response scores in Table 3, we also used Fig. 2 to mainly illustrate the significant effect of age group on answer intention, perceived behavioural control, and mobile phone use activities (i.e., refuse, answer, and make calls) in driving context. Finally, linear regression was used to analyse the relationship between intentions and corresponding prefigured predictors. The results of zero-order correlations and a series of hierarchical multiple regression analyses are contained in Table 4–6.

Table 2
Summary of questionnaire variables and items, including results from the principle components analysis and Cronbach's α.

Variables and items	Measure	Factor loading	Cumulative percent of variance	Cronbach's α
Behavioural intention (BI)				
BI1	How likely is it that you would answer the call as described in the scenario (scored 1 *very unlikely* to 7 *very likely*)?	0.95	89	0.96
BI2	I would expect to answer the call in such a scenario (scored 1 *strongly disagree* to 7 *strongly agree*)	0.96		
BI3	How likely is it that a situation will arise in the future when you would answer in this manner (scored 1 *very unlikely* to 7 *very likely*)?	0.94		
BI4	It is likely that I will answer the call in such a way in the future (scored 1 *strongly disagree* to 7 *strongly agree*)	0.93		
Attitude (AT)[a]				
	My answering the call in such a scenario would [one behavioural belief] (scored 1 *very unlikely* to 7 *very likely*) × [responding belief] would be ...(scored −3 *very bad* to +3 *very good*)			
Positive_AT1	Get me dealing with issues as soon as possible	0.85	72	0.61
Positive_AT2	Relax me and kill time	0.85		
Negative_AT1	Influence regular driving	0.91	82	0.78
Negative_AT2	Get me punished with a two-point deduction	0.91		
Subjective norm (SN)[b]				
	[One related referent] would think I could answer the call as depicted in the situation (scored −3 *very unlikely* to +3 *very likely*) × I generally like to answer the call in a way that [responding referent] think I should (scored 1 *strongly disagree* to 7 *strongly agree*)			
SN1	My friends	0.61	55	0.72
SN2	My families	0.86		
SN3	Other drivers	0.81		
SN4	Police	0.66		
Perceived behavioural risk and control (PBRC)				
PBC1	For me, answering the call in this way would be (scored 1 *very difficult* to 7 *very easy*)	0.85	72	0.87
PBC2	I believe that I have the ability to answer the call as described in this situation (scored 1 *strongly disagree* to 7 *strongly agree*)	0.90		
PBC3	For me, answering the call in this situation would not affect my regular driving (scored 1 *strongly disagree* to 7 *strongly agree*)	0.82		
Perceived risk	Answering the call as described in this situation would be (scored 1 *very unsafe* to 7 *very safe*)	0.82		

[a] Beliefs about the likely outcomes of the behaviour and the evaluations of these outcomes. The average value of each product (belief × outcome evaluation) was calculated to produce a belief-based measure for each item pair.
[b] Beliefs about the normative expectations of others and motivation to comply with these expectations. The average value of each product (belief × motivation to comply) was calculated to produce a belief-based measure for each item pair.

Table 3
Respondents' response in measures of behavioural intentions, perceived risks, and perceived behavioural control, and mobile phone use activities (standard deviation in parentheses).

Measures		1	2	3	4	5	6	7	Head 3	Back 3	Mean score
Behavioural intentions											
Answering intention	HH	13.4	26.1	29.4	3.2	15.8	7.5	4.7	68.9	28.0	3.23 (1.58)
	HF	4.9	14.3	23.9	2.6	28.0	18.1	8.3	43.1	54.4	4.22 (1.60)
Reminding decision	HH	1.5	0.6	2.7	2.7	44.4	23.1	24.9	4.8	92.4	6.06 (1.02)
	HF	0.6	0.6	3.6	3.0	50.8	26.7	14.7	4.8	92.2	5.95 (1.06)
Limiting decision	HH	0.6	0.0	0.9	3.0	26.1	25.5	43.8	1.5	95.4	5.57 (1.56)
	HF	0.3	0.9	1.5	2.1	30.0	26.7	38.4	2.7	95.1	5.42 (1.00)
Perceived behavioural risk and control											
PBC	HH	7.2	22.9	39.9	3.8	19.2	5.4	1.5	70.0	26.1	3.27 (1.20)
	HF	3.0	15.2	28.5	5.6	27.4	15.4	4.8	46.7	47.6	4.11 (1.35)
Perceived risk	HH	21.0	33.6	33.6	2.7	6.3	2.7	0.0	88.2	9.0	2.48 (1.20)
	HF	11.7	23.7	32.7	2.7	18.6	9.3	1.2	68.1	29.1	3.26 (1.57)
Perceived HF safety		1.5	0.3	3.3	9.3	12.3	21.0	52.3	5.1	85.6	6.03 (1.32)
Mobile phone use activities											
Making a call	D	40.5	34.5	8.1	7.8	2.1	4.2	2.7	83.1	9.0	2.20 (1.52)
	O	2.1	4.8	7.8	12.0	18.0	33.3	21.9	14.7	73.2	5.27 (1.53)
Answering a call	D	32.1	26.4	16.2	9.9	3.6	4.8	6.9	74.7	15.3	2.68 (1.80)
	O	2.4	3.6	5.4	8.7	18.6	26.1	35.1	11.4	79.8	5.56 (1.54)
Refusing a call	D	13.2	6.9	6.0	11.4	18.6	25.2	18.6	26.1	62.4	4.65 (1.99)
Sending a text message	D	66.7	24.6	4.8	2.1	0.9	0.3	0.6	96.1	1.8	1.49 (0.91)
	O	9.9	11.7	10.2	12.9	22.8	17.4	15.0	31.8	55.2	4.39 (1.90)
Reading a text message	D	47.1	30.3	10.5	4.8	2.7	3.0	1.5	87.9	7.2	2.01 (1.37)
	O	5.7	11.7	11.4	12.6	16.5	18.0	24.0	28.8	58.5	4.73 (1.90)

Note: HH = handheld; HF = hands-free; D = driving; O = ordinary; Head 3 means the sum percentage of respondents who scaled the head three points (e.g., 1, 2, and 3); Back 3 means the sum percentage of respondents who scaled the back three points (e.g., 5, 6, and 7).

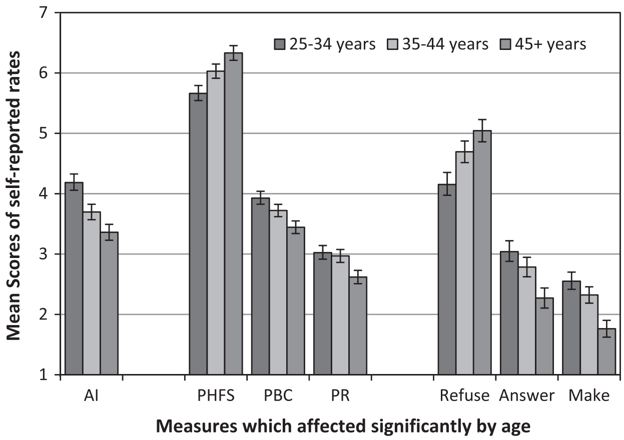

Fig. 2. Illustrating the effect of age on answering intention, perceived behavioural control, and activities of mobile phone use in driving context (mean ratings (raw) with standard error bars are shown). *Note*: AI = answering intention; PHFS = perceived hands-free safety; PBC = perceived behavioural control; PR = perceived risk; Refuse = refuse calls; Answer = answer calls; Make = make calls. The measures of AI, PHFS, and PBC were scored 1 *strongly disagree* to 7 *strongly agree*; the measure of PR was scored 1 *very unsafe* to 7 *very safe*; and the prior activities of refuse, answer, and make calls were scored 1 *very infrequently* to 7 *very frequently*.

3.1. Answering intentions and compensatory decisions

Drivers' intentions to (1) answer (i.e., answer a call when driving), (2) remind (i.e., remind a caller that he/she is driving, and (3) limit the conversation (i.e., intentionally control the amount of time spent answering a call) were measured with the rating scales. 68.9% and 43.1% of the respondents did not tend to answer calls in the handheld and hands-free scenario respectively, and the majority of respondents (more than 92%) tended to say they are likely to engage in compensatory actions by reminding the caller that he/she is driving and limiting the conversation in both scenarios ($M_{\text{reminding}} = 6.00$, $M_{\text{limiting}} = 5.50$) (see Table 3). In order to address aim 1, the conclusion and the significance of differences on average responses scores between age groups and gender were tested by ANOVA. Mean scores for answering, reminding, and limiting were separately subjected to a repeated measures ANOVA: scenario (within-subjects variable, handheld vs. hands-free) × age groups (between-subjects variable, 25–34, 35–44, 45+) × gender (between-subjects variable, male vs. female). The main effect of the mobile phone mode was significant. Respondents were more likely to say they would answer a call in the hands-free scenario ($M = 4.22$) than in the handheld scenario ($M = 3.23$), $F(1, 327) = 176.64$, $p < 0.001$, partial $\eta^2 = 0.35$. They were less likely to remind the caller that they were driving or to limit the length of the conversation in the hands-free scenario than in the handheld scenario, $F(1, 327) \geqq 4.32$, $p < 0.05$, partial η^2 varied from 0.01 to 0.02. The main effect of age was only significant for answering intention, $F(1, 327) = 9.10$, $p < 0.001$, partial $\eta^2 = 0.05$. Post hoc tests (LSD) showed that the youngest drivers reported stronger intentions to answer a call ($M = 4.18$) than did members of the other two age groups ($M_{35\text{–}44\text{years}} = 3.69$, $M_{45+\text{years}} = 3.36$). The impacts of age group on answer intention are illustrated in Fig. 2. There were no main effects of age on intention to remind or intention to limit, no main effect of gender on any of the three measures, and no significant interactions.

How long do drivers think they should be talking on the mobile phone while driving? To better understand the compensatory decision of limiting a conversation, we asked respondents to estimate their perceived conversation time length limits. The majority of respondents (91.3%, $n = 304$) thought that it was necessary to control cell phone conversation length when driving in both the handheld and the hands-free scenario. An ANOVA indicated that respondents reported that conversations should be shorter in the handheld scenario ($M = 0.81$ min) than in the hands-free scenario ($M = 1.38$ min), $F(1, 298) = 87.61$, $p < 0.001$, partial $\eta^2 = 0.23$. There were no significant main effects for age or gender, and there was no significant interaction between them.

3.2. Perceived risk and perceived behavioural control

Aim 2 focused on examining whether perceived risk-related variables (i.e., perceived the safety of hands-free phones and perceived risk) and perceived behavioural control differed between demographic groups (gender, age) and between mobile mode scenarios (handheld, hands-free). As seen in Table 3, (1) nearly half of the respondents (47.6%) tended to have confidence in their ability to use a phone while driving in the hands-free scenario, whereas only 26.1% reported this tendency in the handheld scenario; and (2) more than 85% of the survey respondents agreed that "While driving, using a hands-free mobile phone is safer than using a hand-set mobile phone." More drivers tended to think it was safe to use a mobile phone in the hands-free scenario (29.1%) than in the handheld scenario (9.0%), although most of the respondents considered mobile phone use while driving to be a risky behaviour. The mean scores for these items (see Table 3) also indicate that drivers perceived having greater control over mobile phone use while driving in the hands-free scenario ($M = 4.11$) than in the handheld scenario ($M = 3.27$), and they perceived this activity to be safer in the hands-free scenario ($M = 3.26$) than in the handheld

Table 4
Zero-order correlations between intentions and corresponding predictor variables.

Variable	Handheld scenario				Hands-free scenario			
	Answer[a]	Remind[b]	Limit[c]	Length[d]	Answer	Remind	Limit	Length
1. Answering intention		−.08	.10	.49***		−.12*	.22***	.52***
2. PBRC	.69***	−.17**	.05	.46***	.78***	−.15**	.16**	.52***
3. Positive belief attitude	.49***	−.02	.15*	.27***	.34***	−.10	.09	.30***
4. Negative belief attitude	.22***	−.07	.05	.05	.18**	−.08	−.03	.10
5. Subjective norm	.50***	−.21***	−.03	.27***	.57***	−.24***	.02	.43***
6. Prior answer behaviour	.63***	−.08	.05	.45***	.51***	−.17**	.02	.40***
7. Age	−.19***	.08	.01	−.12*	−.20***	.02	.01	−.08
8. Gender	−.10	.06	.01	0	−.08	.12*	.06	.03

Note: PBRC = perceived behavioural risk and control; prior answer behaviour meant prior behaviour of answering calls when driving.
[a] Intention to answer when driving.
[b] Intention to remind he/she is driving.
[c] Intention to limit conversation length.
[d] Perceived limits for a conversation.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

Table 5
Hierarchical regression analysis: predicting answering intentions when driving.

Step and predictor	Handheld scenario			Hands-free scenario		
	Step 1 β	Step 2 β	Step 3 β	Step 1 β	Step 2 β	Step 3 β
1						
Gender	−.10	−.04	−.01	−.08	.03	.04
Age	$-.19^{***}$	−.07	−.05	$-.20^{***}$	$-.08^{*}$	$-.07^{*}$
2						
Positive belief attitude	$.28^{***}$	$.19^{***}$		$.16^{***}$	$.12^{**}$	
Negative belief attitude	$-.17^{***}$	$-.12^{**}$		$-.21^{***}$	$-.18^{***}$	
Subjective norm		$.19^{***}$	$.17^{***}$		$.13^{**}$	$.11^{**}$
PBRC		$.55^{***}$	$.43^{***}$		$.71^{***}$	$.66^{***}$
3						
Prior answer behaviour			$.28^{***}$			$.13^{**}$
R^2	.05	.59	.64	.05	.66	.67
ΔR^2	.05	.54	.05	.05	.61	.01
F_{change}	8.24^{***}	106.72^{***}	46.00^{***}	8.08^{***}	145.38^{***}	11.13^{**}
df	(2,330)	(4,326)	(1,325)	(2,330)	(4,326)	(1,325)

Note: PBRC = perceived behavioural risk and control; Prior answer behaviour meant prior behaviour of answering calls when Driving.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

scenario ($M = 2.48$) ($M = 6.03$ for perceived hands-free safety). The above findings were supported by further ANOVA tests on response score. ANOVA studies indicated that the differences between scenarios were significant for PBC (F (2, 327) = 170.54, $p < 0.001$, $\eta^2 = 0.34$) and perceived risk (F (2, 327) = 94.06, $p < 0.001$, $\eta^2 = 0.22$). The main effects of age were significant for PBC (F (2, 327) = 5.00, $p < 0.01$, $\eta^2 = 0.03$) and perceived risk (F (2, 327) = 3.82, $p < 0.05$, $\eta^2 = 0.02$). Post hoc tests suggested that young ($M_{PBC} = 3.93$, $M_{perceivedrisk} = 3.02$) and middle-aged ($M_{PBC} = 3.72$, $M_{perceivedrisk} = 2.97$) drivers experienced more PBC and feelings of safety of mobile phone use while driving than older drivers ($M_{PBC} = 3.44$, $M_{perceivedrisk} = 2.62$). The age difference was also significant for the perceived safety of hands-free phones, F (2, 327) = 7.03, $p = 0.001$, $\eta^2 = 0.04$. Post hoc tests indicated that the perceived safety of hands-free phones decreased as age increased (mean scores were 5.66, 6.03, and 6.33 for young, middle-aged, and older drivers, respectively). The impacts of age group on risk perception and PBC are illustrated in Fig. 2. Male and female drivers did not differ significantly in PBC, perceived risk, or perceived safety of hands-free phones. There were no significant interactions between age and gender for these measures.

3.3. Prior mobile phone use activities

As shown in Table 3, drivers were less likely to send text messages (1.8%), read text messages (7.2%), make calls (9.0%), or answer calls (15.3%) when driving than in other contexts. This pattern was consistent with drivers' response scores, which indicated that respondents reported that they more frequently engaged in all mobile phone use activities in the ordinary context than in the driving context. Drivers reported a tendency to refuse a call when driving ($M = 4.65$). The order of reported frequency of mobile phone activities from lowest to highest was (1) sending a text message

Table 6
Hierarchical regression analysis: predicting perceived conversation time length limits.

Step and predictor	Handheld scenario				Hands-free scenario			
	Step 1 β	Step 2 β	Step 3 β	Step 4 β	Step 1 β	Step 2 β	Step 3 β	Step 4 β
1								
Gender	.001	.05	.05	.07	.03	.09	$.11^{*}$	$.12^{*}$
Age	$-.12^{*}$	−.03	−.03	−.03	−.08	.01	−.003	$-.07^{*}$
2								
Answering intention	$.33^{***}$	$.27^{***}$	$.18^{*}$		$.30^{***}$	$.18^{*}$	$.15^{*}$	
PBRC		$.23^{***}$	$.27^{***}$	$.24^{*}$		$.31^{***}$	$.32^{***}$	$.30^{***}$
3								
Positive belief attitude		.12	.08			$.17^{**}$	$.13^{*}$	
Negative belief attitude		$-.15^{*}$	$-.12^{*}$			$-.18^{**}$	$-.16^{**}$	
Subjective norm			.01	.02			$.16^{*}$	$.15^{*}$
4								
Prior answer behaviour				$.20^{**}$				$.13^{**}$
R^2	.02	.28	.29	.31	.01	.32	.36	.37
ΔR^2	.02	.26	.01	.02	.01	.31	.04	.01
F_{change}	2.23	55.87^{***}	2.23	10.81^{**}	1.09	69.47^{***}	6.84^{***}	5.28^{**}
df	(2,312)	(2,310)	(3,307)	(1,306)	(2,306)	(2,304)	(3,301)	(1,300)

Note: PBRC = perceived behavioural risk and control; prior answer behaviour meant prior behaviour of answering when driving.
* $p < 0.05$.
** $p < 0.01$.
*** $p < 0.001$.

(M = 1.49), (2) reading a text message (M = 2.01), (3) making a call (M = 2.20), and (4) and answering a call (M = 2.68). The same order was found for ordinary context: (1) sending (M = 4.39), (2) reading (M = 4.72), (3) making (M = 5.27), and (4) answering (M = 5.56). Statistical tests of significance support these findings. First, the differences between the driving context and the ordinary context were significant in all mobile phone use activities, as indicated by a one-factor repeated ANOVA, $F(1, 332) \geqq 476.07$, $p < 0.001$, with partial η^2 varied from 0.59 to 0.71. With respect to the differences among these prior usage behaviours, t-tests showed the order of frequency to be refusing > answering > making = reading > sending for the driving context (t (332) $\geqq$ 5.96, $p < 0.001$) and answering > making > reading > sending for the ordinary context (t (332) $\geqq$ 4.86, p < 0.001). Following this test, the differences between gender and age groups in the five self-reported usage variables were subjected to a multivariate ANOVA. Significant effects of age were found for making, answering, and refusing calls in the driving context, $F(1, 327) \geqq 5.34$, p < 0.01, with partial η^2 varied from 0.03 to 0.04. Post hoc tests (LSD) showed that the young (M_{making} = 2.78, and $M_{\text{answering}}$ = 3.04) and middle-aged respondents (M_{making} = 2.32, and $M_{\text{answering}}$ = 2.55) reported more frequently engaging in making and answering calls than older respondents (M_{making} = 1.76, and $M_{\text{answering}}$ = 2.28), and young drivers were least likely to report that they refused calls (mean scores were 4.16, 4.70, and 5.04 for young, middle-aged, and older respondents, respectively) (see Fig. 2). There were few differences between male and female drivers regarding these five measures. Males rated answering calls significantly more frequently than females, F (1, 327) = 5.34, $p < 0.05$, partial η^2 = 0.02. No other main effects or interaction effects were significant. The patterns of mobile phone use activities in ordinary life were quite different from those seen while driving. ANOVAs indicated that the main effects of age group and gender were significant for reading and sending text messages in ordinary context, respectively, $F(1, 327) \geqq 4.82$, $p < 0.01$, partial η^2 varied from 0.03 to 0.05. Post hoc tests (LSD) showed that the young (M = 4.94) and middle-age respondents (M = 4.42) engaged more frequently in sending text messages than respondents aged 45+ (M = 3.91) and that young respondents (M = 5.18) reported more frequently reading text messages than the oldest respondents (M = 4.39). Females (M_{sending} = 4.73, M_{reading} = 5.02) reported more frequent sending and reading of text messages than males (M_{sending} = 4.11, M_{reading} = 4.47). No other significant main effects or interaction effects were found.

3.4. Predictors of behavioural intentions and compensatory intentions

Consistent with the TPB, zero-order correlations and a series of hierarchical multiple regression analyses were used to analyse the relationships between intentions and corresponding predictive variables. As displayed in Table 4, the TPB components of positive belief attitude, negative belief attitude, subjective norm, and perceived behavioural risk and control (PBRC) were all positively correlated with main behavioural intention (i.e., answering a call). To test predictive effects, a three-step hierarchical regression analysis was performed using demographic measures, tenets of the TPB, and prior behaviours as predictors of behavioural intention. We used past mobile phone conversation behaviours while driving as prior behaviour predictors, which can be considered as one component of TPB (Ajzen, 1991; Forward, 2009). For each of the two scenarios, gender and age were entered in Step 1, the basic TPB variables (positive belief attitude, negative belief attitude, subjective norm, and PBRC) were added in Step 2, and prior answering behaviours while driving were added in Step 3. By controlling for the influence of other variables, this approach allowed us to assess the predictive utility of each predictor. The results are summarised in Table 5. As shown in the table, the addition of standard TPB variables resulted in substantial and statistically significant increases to 59% and 66% of the variance accounted for in the handheld scenario and the hands-free scenario, respectively. For both scenarios, as presented in Step 3, drivers' PBRC for answering a call, positive belief attitude, negative belief attitude, subjective norm, and prior answering behaviours when driving were all significant predictors of answering intention. Age emerged as a weak significant predictor for the hands-free scenario only.

Following previous studies (e.g., Holland and Hill, 2007; Zhou et al., 2009a), a t-test method was used to compare the difference between unstandardised beta weights for variables in the handheld and hands-free scenarios (Edwards, 1984). With this approach, we can compare the predictive validity of significant predictor variables across the two full regression models in Step 3. PBRC was a significantly stronger predictor in the hands-free scenario than in the handheld scenario, t (648) = 5.46, $p < 0.001$, and the contribution of prior answering when driving was greater in the handheld scenario than in the hands-free scenario, t (648) = 6.54, $p < 0.001$. No significant differences were found across the model for positive belief attitude, negative belief attitude, or subjective norm, t (648) $\leqq$ 0.95, $p > 0.05$.

Aim 4 was to address the relationship between compensatory decisions or intentions (i.e., reminding the caller that he/she is driving, and limiting the conversation length and perceived its limits) and answering intention, PBRC, and other TPB components. As shown in Table 4, the perceived conversation length limit was very strongly correlated with answering intention, PBRC, positive belief attitude, subjective norm, and prior behaviour when driving both in the handheld and hands-free scenarios. Reminding and limiting intentions were moderately or weakly correlated with answering intention, PBRC, and some other TPB variables. A four-step hierarchical regression analysis was conducted to investigate the utility of predictors, especially answering intention and PBRC (see Fig. 1), for reminding intention, limiting intention, and compensatory perception of conversation length limits. For each mobile scenario, the predictors of drivers' compensatory decisions were identified by regressing each of the three compensatory decisions on the demographic measures (gender and age, Step 1), answering intention and PBRC measure (Step 2), other TPB variables (positive and negative belief attitude, and subjective norm, Step 3), and prior answering behaviour when driving (Step 4). The results showed that all variables, including answering intention and PBRC, accounted for less than 1% of the variance in the compensatory decisions of limiting and reminding in both the handheld and hands-free scenarios. On the other hand, all measures explained a statistically significant portion of the variance in perceived conversation length limits (see Table 6). In support of the modified TPB model for this compensatory decision, answering intention and PBRC, when added to the regression equations, resulted in substantial and statistically significant increases in R^2, and they collectively explained 28% and 32% of the variances in the handheld and hands-free scenarios, respectively. The standardised regression coefficients (see beta weights in Table 6) also indicated that these two measures were statistically significant predictors of perceived conversation length limits. As presented in the table, other variables were also tested as predictors of this compensatory decision in some regression models, but the contributions of demographic measures, other TPB variables, and prior answering behaviour when driving accounted for very little of the variance.

4. Discussion

In the current study, the main aim was to use TPB models to address self-reported handheld and hands-free mobile phone use while driving in a sample of Chinese drivers. We identified a primary behavioural intention and its compensatory behavioural intentions. The results supported the efficacy of TPB in predicting the primary behavioural intention (i.e., answering intention). However, the efficacy of modified TPB was supported partially in explaining the compensatory decisions (i.e., perception of conversation length limits). Before illustrating these, we first discussed the effects of mobile phone modes and demographics on drivers' answering intention and compensatory decisions (i.e., reminding, limiting, and perception of talk length limits), PBC and perceived risk, as well as drivers' prior use activities (making a call, answering a call, refusing a call, reading a text message, and sending a text message in both driving and ordinary contexts).

Overall, although respondents had moderate intentions to answer a call while driving, they reported very strong intentions to mention to the caller that they were driving and to control the time spent in conversation. Across all groups, the findings were in line with those found by Young and Lenné (2010), who discovered that the duration of phone calls while driving is typically short, with respondents reporting that their average phone call lasted for about one minute. The majority of drivers reported a strong intention to change regular mobile phone use behaviours when driving. The findings confirmed previous indications (e.g., Young and Lenné, 2010) that drivers reported compensatory actions for mobile phone use while driving. The current study is the first to examine a driver's willingness to engage in compensatory actions that involve changing mobile phone use (e.g., reminding a caller that he/she is driving and limiting the conversation time), as opposed to those that involve modifying driving behaviours (e.g., reducing speed, increasing the following distance, and stopping the vehicle). The two compensatory behaviours studied here may be used as different strategies to compensate for mobile phone use activities. With respect to the differences between handheld and hands-free device use and compensatory intentions, the results found here were consistent with those of a previous study (e.g., Zhou et al., 2009b) in that drivers were more like to answer a call while driving in the hands-free scenario than in the handheld scenario. Furthermore, there were strong significant differences between the different mobile phone modes in the compensatory decisions of reminding the caller that he/she is driving, limiting the conversation time, and perceived limits of the conversation length. In the hands-free mobile phone scenario, participants perceived phone use to be somewhat easier to control, and they ranked it as a safer behaviour than in the handheld scenario. In this study, respondents perceived the safety of hands-free devices to be high. These results are consistent with those of previous studies (e.g., White et al., 2004; Zhou et al., 2009b), which indicated that drivers tend to perceive hands-free devices as safer while driving. However, in practice, a small portion of drivers held a hands-free device and used it for making calls while driving (e.g., Gras et al., 2007). How can we explain the gulf between drivers' subjective perceptions or intentions and actual risk-taking behaviour? Risk perception and risk taking may be important considerations.

Generally, risk perception (that could be defined as the subjective experience of risk in potential traffic hazards in driving context) is considered a precursor of risk taking (that could be defined as performing actual risk driving behaviour) (e.g., Rosenbloom et al., 2008; Machin and Sankey, 2008; Young and Lenné, 2010). That means that a higher level of perceived risk for a particular mobile use activity is associated with a lower chance that an individual will perform the activity (Machin and Sankey, 2008). For example, the results of some previous studies (e.g., Smith, 1978; White et al., 2004; Young and Lenné, 2010), which aimed to understand drivers' subjective perceived risk for secondary activities while driving, suggested that the activities that cause greater levels of distraction scored higher risk ratings. Consistent with this, when we asked drivers to report mobile phone usage frequency for different mobile use activities in prior driving and other ordinary scenarios, we found that mobile use activities that caused more distraction were rated to be less frequent activities, and drivers report less frequent mobile usage while driving than in other ordinary contexts. In this case, risk perception is negatively related to risk-taking behaviours. On the other hand, there is some controversy about the direction of the relationship between risk perception and risk taking, in that sense, high risk perception may not decrease risky behaviours (e.g., Ulleberg and Rundmo, 2003; Machin and Sankey, 2008). Consistent with this, more respondents of the current survey tended to agree that answer calls in driving context was an unsafe behaviour (handheld: 88.2%; hands-free: 68.1%), while less people reported that they were unlikely to answer call in handheld and hands-free scenario respectively (handheld: 68.9%; hands-free: 43.1%). The findings regarding compensatory intentions in the current study may be used to explain the discrepancy between drivers' high risk perception and actual risk-taking behaviour. As for mobile phone use while driving, compensatory decisions may influence the primary answering intention for actual risky behaviour since compensatory decisions (such as reminding and time limits) may partially balance the risk in drivers' eyes.

With regard to demographic groups, the results of the present study align with those of previous studies (e.g., Pöysti et al., 2005; Brusque and Alauzet, 2008; Walsh et al., 2008; Nelson et al., 2009) in which young drivers were found to report stronger answering intentions, than older drivers. We believe this conclusion does not conflict with findings in Zhou et al.'s study (2009b), which indicated that there was no age effect for answering intention since all drivers in this previous study were young (17–34 years old). The same effect of age was found in this study for PBC, perceived risk and perceived hands-free safety, and phone call-related activities (i.e., refusing, answering, and making a call) in a driving context. In contrast with one of our previous studies based on young participants (e.g., Zhou et al., 2009b), the effect of gender was not significant for the main behavioural intention of answering a call.

Like those of previous studies (Walsh et al., 2008; Zhou et al., 2009b), the findings of the current study provide strong support for the ability of the TPB to predict mobile phone answering intentions while driving. Initial consistency and principal-components analysis provided evidence for the difference between positive and negative attitude; therefore, we considered them to be two separate predictors of mobile use intention. Previous studies (Walsh et al., 2008; Zhou et al., 2009b) suggested that perceived risk should be an extended predictor. However, we found that the perceived risk item shared a common factor with PBC items, and we termed the common factor "perceived behavioural risk and control" (PBRC). This finding might suggest that it would be better to combine PBC with perceived risk in risky behaviours research and specifically in research on mobile phone use while driving since drivers' confidence in their ability to drive may influence their risk perceptions in each scenario and may also influence their compensatory behaviours (Lesch and Hancock, 2004). Moreover, the TPB allows for the possibility of modifying the model to change or incorporate additional factors that may impact decision making (Ajzen, 1991), and it was therefore suitable to use positive attitude, negative attitude, subjective norm, and PBRC as core predictors of mobile phone use intention while driving. Taken as a set, the three key TPB variables accounted for a high portion of the variance in answering intention, even after controlling for demographic and prior behaviour variables. Compared to those used in previous studies (Walsh et al., 2008; Zhou et al., 2009b), the four core predictors in this study can better explain variance in answering intention. This difference may be due to how the predictors were measured. Unlike direct measures of attitude and subjective norm used in the two similar studies (Walsh et al., 2008; Zhou et al., 2009b), attitudes and subjective norm in the present study were measured using belief-based measures. Among the core variables, PBRC was the most important predictor of intentions in both the handheld and hands-free regression models, which was consistent with findings in a student driver sample group (Zhou et al., 2009b). Moreover, we compared with predicting power of PBRC between the two different models in the current study, and results showed that PBRC was a significantly stronger predictor in the hands-free scenario than in handheld scenario. Similar findings of PBC having higher predictive power in Conformity scenario than in the Non-conformity scenario were found in pedestrians' road-crossing studies (Zhou et al., 2009a; Zhou and Horrey, 2010). These two road-crossing studies and the current study share one common point that PBC related measures has more powerful predictive ability in scenario causing low behavioural intention than in scenario causing high behavioural intentions. However, this result was not reported by one of previous study sampled with students in driving schools (Zhou et al., 2009a). Therefore, the conclusion may be used cautiously. As for other variables, past answering behaviour while driving was the only extended variable to show significant beta weights for both mobile phone modes. The finding was also found that past answering behaviour was a stronger predictor in the handheld scenario than in the hands-free one. Overall, the results indicated the effectiveness of these measures as significant predictors of behavioural intention in relation to answering a call with either a handheld or hands-free mobile phone. However, some findings need further more explain in future research. For example, the predictive utility of some variables like PBRC and past answering behaviours differed in different scenarios.

One aim of the present study was to predict compensatory behavioural intentions. Findings of the study partially supported this attempt. As for the compensatory intentions to remind or limit, the answering intention and PBRC did not account for a significant portion of the variance in responses. Respondents reported very high intentions to remind and limit, with average scores of 6.01 or 5.50, respectively. This finding also reflected that drivers perceived answering a call while driving to be a dangerous behaviour and this may explain why they reported only a moderate answering intention. It is possible that this is the reason that reminding and controlling intentions cannot be predicted by answering intention and PBRC. However, with respect to the perception of conversation length limits, the results supported partially the assumption that primary intention and PBRC are predictive of the compensatory decision, with both emerging as significant predictors in both the handheld and hands-free scenarios. Overall, these findings may indicate that the efficacy of the modified TPB presented in this study for compensatory decisions may be dependent of compensatory behaviour types. This research illustrates the utility of the concepts of compensatory behaviour and compensatory behavioural intention within a TPB framework in explaining why people use mobile phones while driving. We believe that a focus on compensatory behaviours that are used by drivers may enrich driving safety research. Nevertheless, the modified model TPB used in this study needs to be verified in future research.

Similar to many previous TPB-related studies (e.g., Evans and Norman, 1998, 2003; Elliott et al., 2005; Holland and Hill, 2007; Zhou et al., 2009a,b), there is an important limitation of the present work: the reliance on behavioural intentions rather than actual behaviour. That being said, the TPB has been demonstrated as an effective tool to explore the underlying factors related to, though in the absence of, behaviour (Ajzen, 1991). Consequently, many previous studies on traffic safety (e.g., Evans and Norman, 1998, 2003; Elliott et al., 2005; Holland and Hill, 2007; Zhou et al., 2009a,b) often address the potential to develop interventions based on TPB outcomes. Accordingly, the findings of the current work may be used in transportation safety education for drivers, at least in China. Currently, safety education for drivers in China focuses on the traffic rules (e.g., ''Do not use a mobile phone while driving''). However, this work suggests that it might be important to understand and focus on some of the important factors that cause violations of traffic rules. For example, drivers generally perceive mobile phone use while driving to be a risky behaviour, but mobile phone use while driving is a universal, world-wide phenomenon. For this reason, compensatory behaviours should receive extra attention in safety education programs, as they may help drivers to avoid hazards due to mobile phone use when driving. Moreover, the results of this study might influence the design of new technologies that provide alerts and long-term feedback to help drivers pay attention to the road (Lee, 2009).

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