USING AN EXTENDED THEORY OF PLANNED BEHAVIOUR TO INVESTIGATE SLEEP IMPAIRED DRIVING

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Background: A significant proportion of vehicle accidents in the UK are caused by drivers falling asleep at the wheel and these accidents often occur at high speeds and result in fatalities (Horne & Reyner, 1995b). Research has shown that driving after 15 or more hours of wakefulness increases the risk of being involved in a sleep-related vehicle accident (Stutts *et al.*, 2003). Further, young and elderly adults have been found to have more sleep-related accidents between midnight and 6am and between 3pm and 6pm, respectively (Summala & Mikkola, 1994). An extended theory of planned behaviour (TPB; Ajzen, 1988, 1991) was used to understand the reasons why young, middle-aged and elderly adults drive while sleep impaired with a view to reducing the incidence of this behaviour. Specifically, the determinants of driving after 15 or more hours of wakefulness, between midnight and 6am and between 3pm and 6pm were explored.

Methods: A preliminary study in which sleep duration and quality were measured in young, middle-aged and elderly adults established the validity of actigraphy to reliably differentiate periods of sleep and wake. After identifying the accessible beliefs underlying each specific behaviour and constructing questionnaires tailored to each age group and behaviour, the main study was conducted. Two hundred and ten young, middle-aged and elderly adults completed TPB questionnaires in relation to driving after being awake for 15 or more hours in the following week. Measures of behaviour (using both subjective and objective methods, i..e., actigraphy) were obtained eight days later from the young adults. Additionally, the young and elderly adults completed TPB measures regarding driving between midnight and 6am and between 3pm and 6pm, respectively. The young adults provided behavioural data prospectively. The ability of anticipated regret, impulsive sensation seeking, past behaviour and gender to account for additional proportions of variance over and above the TPB was also explored.

Results: The TPB explained significant proportions of variance in intention to drive after 15 or more hours of wakefulness in all three age groups. Injunctive norm was a consistent predictor in all groups. The model predicted a subjective measure of driving after 15 or more hours of wakefulness but failed to predict a more objective measure, obtained from the young adults. Both the young adults' intentions to drive between midnight and 6am and their self-reported behaviour were successfully predicted by the TPB, as were the intentions of elderly adults to drive between 3pm and 6pm. Several beliefs which discriminated those who did and who did not perform (or intend to perform) the behaviours were identified. Anticipated regret independently predicted the intentions of young adults to drive after 15 or more hours of wakefulness and between midnight and 6am, as well as the intentions of elderly adults to drive between 3pm and 6pm. The TPB failed to mediate the effect of gender on driving between midnight and 6am in the young adults.

Conclusions: The TPB provided useful, but not sufficient, accounts of the determinants of intentions to drive while sleep impaired. The model was able to predict subjective measures of sleep impaired driving but failed to predict a measure based on more objective methods. This research can be used to inform interventions attempting to reduce sleep impaired driving. A number of possible behavioural change strategies are proposed based on the empirical, theory-based results obtained here.

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LIST OF TABLES

LIST OF FIGURES

SUMMARY

This thesis investigates sleep impaired driving using the framework of the theory of planned behaviour (TPB; Ajzen, 1988, 1991). Specifically, the determinants of refraining from driving after 15 or more hours of wakefulness were explored in young, middle-aged and elderly adults. In addition, antecedents of refraining from driving between midnight and 6am and between 3pm and 6pm were examined in young and elderly adults, respectively.

Chapter 1 includes a review of the existing literature on sleep impaired driving, along with a description of the TPB and issues surrounding the model. General methodological considerations are discussed and the chapter concludes with the main aims and hypotheses of the research.

In Chapter 2, the sleep duration and quality of young, middle-aged and elderly adults were measured over one week using subjective and objective methods. This established the validity of actigraphy prior to the main study.

Chapter 3 describes the elicitation study which was performed to identify the accessible beliefs of each age group regarding each specific behaviour. It also provides details of questionnaire construction, which included conducting a pilot study.

In Chapter 4, the TPB was applied to refraining from driving after 15 or more hours of wakefulness in young, middle-aged and elderly adults, as well as to refraining from driving between midnight and 6am and between 3pm and 6pm in young and elderly adults, respectively. Measures of prospective behaviour were obtained from the young adults based on subjective and partly objective (actigraphic) methods.

Chapter 5 provides a general discussion of the research. Key findings and conclusions, general methodological issues and directions for future research are considered. In addition, a number of strategies for reducing the incidence of sleep impaired driving in the general population are suggested, based on the present results.

1.0 LITERATURE REVIEW

This review begins by exploring the existing research on sleep impaired driving, before going on to describe the theory of planned behaviour (TPB; Ajzen, 1988, 1991) and issues relating to the model. The final section describes the present research in terms of general methodological considerations and concludes with the main aims and hypotheses.

1.1 DRIVING WHILE SLEEP IMPAIRED

Evidence from single vehicle accidents in which cars drifted off the road leaving no signs of braking has led to the widely accepted view that a large proportion of road accidents are caused by drivers falling asleep at the wheel (Empson, 2002). Horne and Reyner (1995b) presented compelling evidence to show that 16% and 20% of all vehicle accidents on major roads and motorways respectively, in England, were the result of sleep impaired driving. Vehicle accidents caused by sleepiness are more likely to occur on motorways and other monotonous roads (Horne & Reyner, 1995b), involve high speeds and result in fatalities (Garbarino *et al.*, 2001; Horne & Reyner, 1995b, 1999, 2001; Johns, 2000; Pack *et al.*, 1995).

It is well-established that driver sleepiness, like cognitive functioning, is largely dependent on two factors: duration of prior wakefulness and natural variations in wakefulness depending on time of day (Dement, 1997; Horne & Reyner, 1995b, 1999; Johns, 2000). The former is due to a progressive increase in the need for sleep during wakefulness and the latter to circadian rhythm (Johns, 2000). This section reviews the literature relating to these two factors.

1.1.1 Driving after prolonged wakefulness

Alcohol has long been recognised as the primary cause of driving-related impairments. Sleepiness, however, has received less attention, despite it being the cause of a high proportion of vehicle accidents (Arnedt *et al.*, 2000; Horne & Reyner, 1995b; Martin, 2002; Yegneswaran & Shapiro, 2007). In the UK and many other countries, there is an established legal limit for alcohol consumption in relation to driving a vehicle and yet there remain no guidelines for drivers as to how sleepiness may affect driving skills. Further, and in contrast to drink driving, measuring sleep impaired driving is neither quick nor easy and in practice is simply not done (Dement, 1997; Martin, 2002).

In an attempt to 'provide policy-makers and the community with an easily grasped index of the relative impairment associated with fatigue' (Dawson & Reid, 1997, p. 235), research has compared the decrements caused by differing amounts of prior wakefulness with those caused by alcohol. Performance on neurobehavioural and cognitive tasks, including reaction time, attention, vigilance and co-ordination have been found to be equally impaired by blood alcohol concentrations (BACs) of 0.05% and 0.10% and following 17-19 and 18-25 hours of wakefulness, respectively (Dawson & Reid, 1997; Lamond & Dawson, 1999; Williamson & Feyer, 2000).

These findings have been extended using driving simulators, which have the advantage of replicating aspects of real driving and are sensitive to the impairments caused by both sleepiness and alcohol (Arnedt *et al.*, 2001, 2005). Arnedt *et al.* (2000, 2001) reported equivalent deteriorations in simulated driving after 18.5 and 20-21 hours of wakefulness and at BACs of 0.05% and 0.08%, respectively, in their samples of young males. In both experimental conditions, participants drifted across their lane and their lane position and speed became more variable. In other words, continuous wakefulness of 20-21 hours reduced driving skills to those of a drunk driver, as 0.08% is the current UK legal BAC limit. Moreover, Alford and Meyer (2002) found that 18 hours of extended wakefulness and 0.10% BAC produced similar performance impairments, and 20 hours of prolonged wakefulness exacerbated performance further. Although these results are important, it is difficult to generalise simulated driving tasks to real driving (Fairclough & Graham, 1999), particularly when these tasks do not include the presence of other traffic on the road (Arnedt *et al.*, 2001). A review of data from studies using driving simulators, however, concluded that there was a consistent effect of sleepiness on real and simulated driving performance (George, 2003).

Levels of fatigue in all of these studies were caused by a combination of hours of wakefulness and circadian factors, making it possible that the same amount of prior wakefulness at a different time of day would produce a different BAC equivalent (Arnedt *et al.*, 2000; Lamond & Dawson, 1999). Nevertheless, fatigue caused by prolonged wakefulness is likely to be combined with circadian factors in real life, as many individuals wake in the morning. Most of the studies also used a sample of young adults (below 40 years old; except for the study by Williamson & Feyer, 2000), making it difficult to generalise the results to older adults. There is some evidence that young and middle-aged adults respond similarly in terms of subjective alertness to increasing time awake (Drapeau & Carrier, 2004). However, to the extent that elderly adults suffer from increased daytime sleepiness (Ancoli-Israel, 1997), it is reasonable to predict more severe alertness and performance deteriorations in this group. Despite these limitations, the implications of these findings are important. Yegneswaran and Shapiro (2007) argued that the number of hours of wakefulness producing equivalent impairments to BACs of 0.05% (i.e., 17-19 hours) should be considered the upper limit for which an individual can perform tasks involving high psychomotor function.

In the early literature, Kleitman (1963) argued that 15 to 17 hours was the 'natural' maximum for an adult to remain awake in a sleep-wakefulness rhythm of 24 hours. Dijk *et al.* (1992) reported that alertness and performance deteriorate with increasing time awake, but in a typical waking day circadian influences may counteract these effects up until 16 hours of wakefulness. Campbell and Murphy (2007) used a disentrainment protocol in which adults aged from 19 to 81 years were permitted to sleep whenever they wished over 72 hours and found that less than 10% of waking episodes continued for as long as 12 hours. Other studies have revealed that cognitive and neurobehavioural impairments begin to significantly increase after 10 (Dawson & Reid, 1997) to 16 (Graw *et al.*, 2004; Maruff *et al.*, 2005) hours of wakefulness and subjective sleepiness starts to increase after 14 hours of wakefulness (Maruff *et al.*, 2005). A recent experiment by Van Dongen *et al.* (2003) involving various levels of chronic and total sleep deprivation identified the 'critical wake period' to be 15.84 hours of wakefulness. After this period, lapses in behavioural alertness, as assessed via a psychomotor vigilance task, increased in a near-linear fashion with more time awake.

Prolonged wakefulness has also been identified as a risk factor for being involved in a sleep-related motor vehicle accident. Stutts *et al.* (2003) found that almost one in five drivers who were involved in a sleep-related crash reported being awake for 20 or more hours prior to crashing, compared to less than 1% of control crash (not sleep-related) drivers. Further, they reported that drivers who had been awake for between 10 and

14.9 hours before the accident were 1.53 more times more likely to be involved in a sleep-related accident than a control crash, and after 15 to 19.9 hours of wakefulness the odds of being involved in a sleep-related compared to control crash increased ten-fold. Stutts *et al.* (2003) concluded that driving after being awake for more than 15 hours increased the risk of being involved in a sleep-related vehicle accident.

1.1.2 Time of day and sleep-related vehicle accidents

Drivers also become increasingly vulnerable to having a sleep-related vehicle accident during the night and in the mid to late afternoon (e.g., Horne & Reyner, 1995b; Johns, 2000; Laube *et al.*, 1998; Mitler *et al.*, 1988; Pack *et al.*, 1995; Stutts *et al.*, 2003). As Mitler *et al.* (1988) stated, 'given the similarity of the temporal pattern of vehicular accidents to the temporal pattern underlying sleep processes, the inattentiveness and carelessness that contributes significantly to the former has its basis in the latter' (p. 105). That is, the occurrence of these peaks in the incidence of sleep-related vehicle accidents reflect the natural reductions in alertness governed by the circadian rhythm present in all humans (Garbarino *et al.*, 2001; Horne & Reyner, 1995b; Johns, 2000). Moreover, research has shown that these peaks are dependent on the age of the adult.

It is well-established that young males are the most likely group to have an accident caused by sleepiness (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003). A study of fatal vehicle accidents by Summala and Mikkola (1994) revealed that the peak time for sleep-related accidents involving young drivers aged 18-20 years was between midnight and 6am. Similarly, Horne and Reyner (1995b) analysed data from sleep-related vehicle accidents and reported that almost 75% of drivers under the age of 30 years had crashed between midnight and 7am. These drivers were the most common group of road users at this time of day. Finally, Akerstedt and Kecklund (2001) found that young adults, aged 18-24 years, were five and ten times more likely to crash late at night than middle-aged and elderly adults respectively, and the peak time for young adults to have a vehicle accident on a motorway was 5am.

Horne and Reyner (1995b) reported that since normative data regarding road use are not available, this higher prevalence of sleep-related vehicle accidents among young male adults may be a mixture of higher risk and more exposure. However, Laapotti *et al.*

(2006) found that night-time driving was over-represented in young drivers' self-reported and fatal accidents compared to their share of driving at night. Further, the elevated vulnerability of young adults to having a vehicle accident at night may be due to an increased sleepiness during the night amongst this age group (Akerstedt & Kecklund, 2001). Lowden *et al.* (2009) demonstrated that young drivers were sleepier than older drivers when taking part in a driving simulator task at night. Sleep deprivation has also been found to increase the reaction time of young adults, whereas the reaction time of older adults remained unaffected (Philip *et al.*, 2004). These results suggest that young adults have a heightened sensitivity to sleep loss (Philip *et al.*, 2004).

Young adults are also over-represented in vehicle accidents in general (Briem *et al.*, 2000; Leigh, 1999). Massie *et al.* (1995) proposed that night driving may create a level of difficulty that cannot be compensated for. They suggested that young males, in particular, may be used to relying on their quick reaction times to avoid accidents, but the additional demands of diminished visibility may reduce their success in avoiding a crash. Other possible reasons for the increased risk in this age group include relative lack of experience, a greater tendency to avoid or delay taking a break from driving despite fatigue, and an increased likelihood of driving aggressively and showing off in an attempt to assert themselves socially (Briem *et al.*, 2000; Gregersen & Bjurulf, 1996; Summala & Mikkola,1994). Indeed, young adults are more likely to take risks while driving (Leigh, 1999; Reimer *et al.*, 2007; Summala & Mikkola, 1994), such as not using seatbelts and exceeding the speed limit (Zhang *et al.*, 1998). Young drivers, and in particular, young males, underestimate the risks of driving and overestimate their driving skills (Gregersen & Bjurulf, 1996; Jones *et al.*, 2006; Leigh, 1999). Gregersen and Bjurulf (1996) argued that existing research about the factors that influence young drivers and their driving behaviour is 'very limited and highly focused on the problem of alcohol' (p. 237). This suggests a need for research into an alternative area to alcohol-induced driving accidents.

With increasing age, adults have been found to be less likely to be involved in a sleep-related vehicle accident at night but more likely to have an accident in the mid to late afternoon (Akerstedt & Kecklund, 2001; Summala & Mikkola, 1994). There may be less vehicle accidents involving older adults at night because, with increasing age, only those adults who feel capable may expose themselves to the difficulties of night driving

(Akerstedt & Kecklund, 2001). Increased risk awareness and compensation may protect older adults from the dangers of driving at night (Massie *et al.*, 1995; Summala & Mikkola, 1994). Horne and Reyner (1995b) reported that the peak time for sleep-related accidents in drivers aged 50-69 years was between 2pm and 5pm, which was also one of the least likely times of day for young adults to crash. Summala and Mikkola (1994) found that drivers aged 56 years and older were more likely to have a sleep-related vehicle accident between 3pm and 6pm.

Massie *et al.* (1995) reported that adults over the age of 75 years had the highest risk of having a fatal (not necessarily sleep-related) vehicle accident during the day than any other age group. It is possible that the greater risk in the afternoon for older adults may be due to them being the most prevalent group on the road at that time (Horne & Reyner, 1995a). However, as noted earlier, elderly adults sleep the most during the day and are more likely to experience circadian peaks of sleepiness in the afternoon than younger age groups (Dement & Vaughan, 1999; Horne & Reyner, 1995a; Summala & Mikkola, 1994), making it likely that sleepiness plays a prominent role.

Therefore, two distinct peaks for the occurrence of a sleep-related vehicle accident have been identified; young adults were more likely to crash during the night and older adults in the mid to late afternoon. A specific time of day when middle-aged adults tend to have sleep-related vehicle accidents has not been identified in the literature (Akerstedt & Kecklund, 2001; Summala & Mikkola, 1994). In terms of general driving behaviour (i.e., not just sleep-related), middle-aged adults have frequently been identified as the safest age group (Massie *et al.*, 1995; Reimer *et al.*, 2007; Zhang *et al.*, 1998), however, this age group do drive while sleep impaired (Summala & Mikkola, 1994).

In the study conducted by Simmala and Mikkola (1994), the young adults who had crashed between midnight and 6am had typically been awake for between 16 and 21 hours and in a quarter of cases, the time awake exceeded 21 hours. Also, all of the older adults who had crashed during the mid to late afternoon had been awake for between eight and 16 hours prior to the crash. This emphasises the combined influence of extended wakefulness and circadian factors on the likelihood of having a sleep-related vehicle accident.

1.1.3 Summary

The studies reviewed clearly showed that relatively short periods of sustained wakefulness produced performance deficits similar to or greater than those observed at levels of alcohol intoxication deemed unacceptable for driving (Alford & Meyer, 2002; Arnedt *et al.*, 2000, 2001; Dawson & Reid, 1997; Lamond & Dawson, 1999). In particular, driving after being awake for 15 or more hours appeared to increase an individual's risk of being involved in a vehicle accident (Stutts *et al.*, 2003). Additionally, taking all of the evidence into account, young adults appeared more vulnerable to being involved in a sleep-related vehicle accident between midnight and 6am and elderly adults were most at risk between 3pm and 6pm (Summala & Mikkola, 1994). A particular peak time for the occurrence of a sleep-related vehicle accident amongst middle-aged adults did not appear to exist (Akerstedt & Kecklund, 2001; Summala & Mikkola, 1994).

Numerous studies have reviewed motor vehicle accident data in an attempt to pinpoint risk factors for being involved in a sleep-related accident. No research could be identified, however, that explored the reasons *why* people drove after prolonged wakefulness or at particularly vulnerable times of the day. It is crucial to identify the social cognitive determinants of a behaviour in order to produce behavioural change (Armitage *et al.*, 2002).

Motivational social cognition models have been designed to identify the motivational factors that underlie behavioural decisions and to assess their ability to predict behaviour (Armitage & Conner, 2000). Although there were several models that could have been used to explore the determinants of sleep impaired driving in the present research, the TPB was chosen for a number of reasons. First, the health belief model (HBM; Janz & Becker, 1984), protection motivation theory (PMT; Rogers, 1975) and social cognitive theory (SCT; e.g., Bandura, 1998) were specifically developed to explain health-protective behaviours, whereas the TPB was not (Ajzen, 1991; Bish *et al.*, 2000; Weinstein, 1993). Sleep impaired driving can be classed as a safety risk behaviour and so a general model was deemed more appropriate. Second, the three predictors of intention in the TPB represent important social psychological concepts, i.e., attitude has long been recognised as a predictor of behaviour (e.g., Fishbein &

Ajzen, 1974, 1975; Weigel & Newman, 1976), norms have a central role in the determinants of intention and behaviour (Terry *et al.*, 2000; White *et al.*, 2009) and PBC is similar to self-efficacy (Ajzen, 1991) which is consistently predictive and forms a 'major basis of action' (Bandura, 1998, p. 624). The alternative models do not effectively represent all of these constructs, in particular, social influence is not explicitly specified, and/or models focus on one of these constructs at the expense of others, for example, self-efficacy has become more important than SCT *per se* (Armitage & Conner, 2000).

Third, both conceptual issues underlying the models and operational matters have been better described for the TPB, relative to the HBM and PMT (Bish *et al.*, 2000; Norman & Conner, 2005; Quine *et al.*, 1998), and finally, the TPB has greater predictive utility than the HBM, PMT or SCT (Armitage & Conner, 2000; Bish *et al.*, 2000; Norman & Conner, 2005; Quine *et al.*, 1998). The better defined relationships between constructs and the superior predictive validity of the TPB makes it a good framework for the development of behavioural change interventions (Norman & Conner, 2005). Indeed, research has shown that TPB-based interventions significantly impact upon behaviour (Elliott & Armitage, 2009; Hardeman *et al.*, 2002; Quine *et al.*, 2002; see section 5.3). Therefore, in the present research, the determinants of sleep impaired driving were explored using the framework of the TPB with the ultimate view to reducing the incidence of this behaviour in the general population. The following section describes this model and reviews the literature relating to the prominent issues regarding its operationalisation.

1.2 THE THEORY OF PLANNED BEHAVIOUR

1.2.1 The model

The TPB (Ajzen, 1988, 1991) comprises a set of variables proposed to determine an individual's decision whether or not to perform a given behaviour. The model was an extension of the theory of reasoned action (TRA; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975) in that it addressed the latter model's limitation of predicting only behaviours that were completely under an individual's control (Ajzen, 1988). The TPB was therefore based on the TRA but included the additional variable, perceived behavioural control (PBC; Ajzen, 1988, 1991). The TRA and TPB are the most influential and widely applied models of the attitude-behaviour relationship (Armitage & Conner, 2001a; Manstead & Parker, 1995), however, the TPB's predictive superiority over the TRA has been clearly demonstrated (e.g., Ajzen, 1991; Madden *et al.*, 1992).

The TPB proposes that the intention to enact a particular behaviour is determined by the combined influence of three factors. These are the individual's attitude towards the behaviour, which is the degree to which the behaviour is positively or negatively evaluated, their subjective norm, defined as the perceived general social pressure to engage or not engage in the behaviour and their PBC, which is the individual's perception of the ease or difficulty of performing the behaviour, reflecting opportunities to partake in the behaviour, past experience and anticipated impediments and obstacles. Behavioural intention, together with PBC (which is also proposed to directly influence behaviour, partly to the extent that it accurately reflects *actual* control) determine whether or not the individual actually performs the behaviour.

The original TRA constructs (attitude and subjective norm) represent personal and social influences on intention, respectively, and provide a bridge between two basic social psychological concepts that have traditionally been treated independently (Fishbein & Ajzen, 1975; Terry *et al.*, 1993). The empirical weights of attitude, subjective norm and PBC on intention vary depending on the type of behaviour, the conditions under which the behaviour is to be performed, and the particular individual (Ajzen, 1991; Finlay *et al.*, 1997; Fishbein & Ajzen, 1975). As a general rule, the more favourable an individual's attitude and subjective norm and the greater the PBC, the stronger the individual's intention to perform the behaviour (Ajzen, 1991, 2002c, 2005). The influence of PBC on behaviour is proposed to be in direct proportion to the extent that the behaviour of interest is under the individual's (perceived) volitional control; the less control the individual believes they have over the behaviour, the stronger should be the predictive effect of PBC (Ajzen, 1991; Madden *et al.*, 1992). PBC is also treated as a proxy for actual control, which is the causal determinant of behaviour (Sheeran *et al.*, 2003). In general, the stronger the intention and the greater the PBC (partly to the extent that it is an accurate perception), the more likely the individual is to perform the behaviour (Ajzen, 1991).

The TPB also specifies the antecedents of attitude, subjective norm and PBC, each of which are based on an expectancy-value model of the attitude-behaviour relationship (Fishbein & Ajzen, 1975). Attitude is determined by a set of accessible behavioural beliefs, defined as the likelihood of perceived positive and negative consequences of performing the behaviour (expectancy), weighted by an evaluation of each of these outcomes (value). For example, 'Not driving when I have been awake for 15 or more hours would mean I would be unable to drive for work purposes...unlikely-likely' (behavioural belief strength); 'Being unable to drive for work purposes is...bad-good' (outcome evaluation). Individuals develop a favourable attitude towards behaviours which they believe will lead to positively-valued consequences and an unfavourable attitude towards behaviours that produce negative consequences (Ajzen, 1988).

Accessible normative beliefs provide the informational foundation of subjective norm in the form of expectations of specific important others (expectancy), weighted by the motivation to comply with these referents (value). For example, 'My partner thinks that I should not drive when I have been awake for 15 or more hours...unlikely-likely' (normative belief strength); 'Generally speaking, how much do you want to do what your partner thinks you should do?...not at all-very much' (motivation to comply). Individuals possess a favourable subjective norm if specific important referents with whom they are motivated to comply approve of them performing the behaviour.

PBC is determined by a set of accessible control beliefs which reflect factors that may facilitate or impede performance of the behaviour (expectancy), weighted by the power of each of these factors (value). For example, 'How often do you give someone a lift or pick them up?...never-frequently' (control belief strength); 'Giving someone a lift or picking them up would make it...more difficult-easier...for me to refrain from driving when I have been awake for 15 or more hours' (power of control factor). Greater PBC is evident to the extent that the individual anticipates no/few barriers to them carrying out the behaviour and/or several factors which would facilitate their performance of the behaviour (Ajzen, 1988).

In accordance with an expectancy-value model, the value component of each TPB variable contributes to the overall variable in direct proportion to the expectancy component (Ajzen, 1991). That is, to obtain a measure of the overall construct, the two underlying components are multiplied together for each belief and the resulting products averaged (or summed) over all of the accessible beliefs. Therefore, attitude can be predicted from the mean of the multiplicative composites of each accessible behavioural belief and its corresponding outcome evaluation, subjective norm from the average of each accessible normative belief multiplied by its motivation to comply, and PBC from the averaged products of the strength of each control belief by its power. It is important to note that this mathematical model is intended only as a computational representation rather than a description of the process by which individuals make behavioural decisions (Ajzen & Fishbein, 2000; Fishbein, 1993).

The practice of multiplicatively combining the belief components has received criticism due to the high dependency of the resulting product on the scale values applied to each component, which influences the product's relationships with other variables (Evans, 1991; van den Putte & Hoogstraten, 1997). However, the alternative additive model is theoretically meaningless (Ajzen & Fishbein, 2008; Eagly & Chaiken, 1993), and support for a multiplicative underpinning for each of the constructs has been demonstrated (Ajzen & Driver, 1991; Ajzen & Fishbein, 2008; Armitage *et al.*, 1999; Elliott *et al.*, 2005). Therefore, in the absence of a more satisfactory alternative (Conner & Sparks, 1996), the multiplication rule, 'which is at the core of the EV [expectancy-value] model, is a reasonable and well supported assumption' (Ajzen & Fishbein, 2008, p. 2243).

When empirically applying the model, the beliefs underlying a particular behaviour are typically identified via a preliminary elicitation study involving semi-structured interviews with members of the target population (Ajzen & Fishbein, 1980). The resultant belief-based measures, as well as direct measures of overall attitude, subjective norm, PBC and intention are obtained via a questionnaire at Time 1, followed by an assessment of behaviour at Time 2.

1.2.2 Empirical support for the TPB

The TPB has been shown to be useful in predicting and explaining intention and behaviour across a range of health-related behaviours including exercising (Payne *et al.*, 2004), healthy eating (Payne *et al.*, 2004; Povey *et al.*, 2000), taking dietary supplements (Conner *et al.*, 2001), drug use (Armitage *et al.*, 1999) and complying with speed limits (Elliott *et al.*., 2003, 2007). Armitage and Conner (2001a) conducted a meta-analysis involving 185 independent studies and found that the TPB accounted for 39% and 27% of the variance in intention and behaviour, respectively. According to Cohen (1992), both of these values represent large effect sizes.

1.2.3 The sufficiency of the TPB

The TPB provides a highly parsimonious account of the determinants of intention and behaviour (Conner & Armitage, 1998; Sheeran & Orbell, 1999). Sutton (1998) noted that a model which accounts for 50% of the variance in intention using only two or three predictors is more impressive than a model explaining the same amount of variance but requiring a large number of predictors to do so. Similarly, Fishbein (1993) argued that, 'stringing together a long list of variables in a regression equation does not make a theory' (p. xxi).

Ajzen and Fishbein (1980) proposed that the TRA provided a complete, i.e., sufficient, description of the proximal causes of volitional behaviour and that any other influences on intention and/or behaviour should have an effect only via the TRA variables. Indeed, large effect sizes have been reported for the prediction of intention and behaviour using the TRA and TPB (Armitage & Conner, 2001; Sheppard *et al.*, 1988), but there remains a considerable proportion of variance yet to be accounted for. Methodological factors may be partly responsible for some of the unexplained variance (Sutton, 1998), however, conceptual factors should also be considered (Rivis & Sheeran, 2003). Fishbein (1993) pointed out that one of the most frequently voiced criticisms of the TRA was that additional variables should be included. As the TPB was, itself, an extension of the TRA with the addition of PBC, Ajzen (1991) remained flexible on the issue and stated that 'the TPB is, in principle, open to the inclusion of additional predictors if it can be shown that they capture a significant proportion of the variance in intention or behaviour after the theory's current variables have been taken into account' (p. 199).

1.2.3.1 External variables

Conner and Armitage (1998) argued that for an external variable to be considered as a valuable extension to the model, as well as empirical evidence for its usefulness, a theoretical description of its role must be demonstrated. They specified that this description should include the process by which the additional variable influences intention and behaviour, its relationship with the original TPB variables, and the conditions in which the new variable should make an impact. Therefore, there should be a strong theoretical justification and a body of empirical evidence for an external variable to be added to the model (Ajzen & Fishbein, 2005; Conner & Sparks, 2005).

An external variable may be included in a TPB study if it has the potential to offer explanatory power over and above the TPB variables when the model is applied to a particular behaviour. In other words, the specific external variable(s) examined depend(s) on the nature of the behaviour being investigated (Conner & Armitage, 1998; Payne *et al.*, 2004). As Fishbein (1993; Ajzen & Fishbein, 1980) admitted, additional variables may enhance our understanding and be important in a given content domain. Research has shown that several external variables have accounted for additional variance in intention and/or behaviour over and above the TPB variables and there is some understanding of how these variables may be related to the existing model (Conner & Armitage, 1998).

1.2.3.1.1 Past behaviour and habit

Past behaviour is the most consistent independent predictor of intention and behaviour (Conner *et al.*, 2002). The influence of an individual's past behaviour should be mediated particularly by PBC as past experience informs individuals of their degree of behavioural control (Ajzen, 1991). Instead, this construct has frequently been reported to exert an independent influence on intention (e.g., Bagozzi & Kimmel, 1995; Beck & Ajzen, 1991; Conner & Armitage, 1998; Elliott *et al.*, 2003; Forward, 2009; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998). The relationship between intention and past behaviour has also been found to be so strong as to indicate a lack of discriminant validity between the constructs (e.g., Conner & McMillan, 1999), perhaps due to intention being a likelihood judgement based on past experience with the behaviour (Ouellette & Wood, 1998). Past behaviour has also commonly been found to be the strongest predictor of future behaviour (Bagozzi & Kimmel, 1995; Conner & Armitage, 1998; Cooke *et al.*, 2007; Elliott *et al.*, 2003; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998), over and above the TPB variables. There has been some debate as to the implications of the latter finding.

Ouellette and Wood (1998) argued that the residual effect of past behaviour on future behaviour was due to habituation of the behaviour caused by repeated performance in a consistent context. When a behaviour is habituated, Ouellette and Wood (1998) proposed that it is no longer controlled by deliberative reasoning (such as the TPB variables), but is repeated automatically in the presence of environmental cues and without conscious intention. Using meta-analyses, they found that past behaviour was a significantly stronger predictor of behaviours that were performed frequently and under stable conditions than intention, whereas intention more strongly predicted behaviours that were performed only a few times a year in less stable contexts than past behaviour.

Ajzen (2002c) dismissed Ouellette and Wood's (1998) habituation perspective on the grounds that repeated performance of a behaviour does not prove it has become habituated, nor does it explain the residual effect of past behaviour found in the prediction of less frequent behaviours performed in unstable contexts. He stated that frequent behaviours are not guided by stimulus cues but by automatically activated TPB concepts. In addition, Sheeran (2002) pointed out that Ouellette and Wood's (1998) meta-analysis included only 14 studies and that studies have found that past behaviour does not affect the intention-behaviour relationship when intentions are stable, regardless of the frequency or context of performance of the behaviour (e.g., Conner *et al.*, 2000, 2002; Sheeran *et al.*, 1999).

Ajzen (1991, 2002c; Beck & Ajzen, 1991) argued that from a theoretical perspective, past behaviour fails to add to our understanding of the determinants of behaviour and the correlation between past and future behaviour merely represents the behaviour's temporal stability. A significant residual effect of past behaviour beyond the TPB variables may also be explained by another unmeasured variable present at both time points and therefore it can be used to test the sufficiency of the TPB (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). Alternatively, it may be due to shared method variance between the two behaviour measures (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). Ajzen (2002c) reviewed a number of studies and made the case that past behaviour is more likely to predict behaviour when intentions are weak and unstable, when underlying beliefs and expectations are inaccurate and when people have not formulated a clear plan of action. He argued that these represent the limitations of the reasoned action approach, not habituation.

However, research that has attempted to assess habit *per se*, rather than inferring the extent to which a behaviour is under habitual control from the frequency of past behaviour, has provided support for the habituation approach (Aarts *et al.*, 1997; Verplanken *et al.*, 1998). The measure employed in these studies assessed the habit of choosing a particular mode of travel by presenting respondents with several hypothetical trips (e.g., going to the supermarket, visiting friends) and asking them to indicate as quickly as possible which travel mode they would choose in that situation. The imposed time pressure was intended to induce automatic responses (Aarts *et al.*, 1997) and distinguished the measure from simply being a generalised assessment of intention or past behaviour (Ajzen, 2002c). The measure was found to be highly reliable and valid (Aarts *et al.*, 1997). Using this measure of habit, Verplanken *et al.* (1998) reported that when habit was weak, intention significantly predicted future behaviour, but as habit strength increased, its influence decreased and became non-significant at moderate and strong levels of habit strength. They also found that although attitude significantly predicted intention at all levels of habit strength, its impact diminished as habit became stronger.

Similarly, Trafimow (2000) reported that attitude and subjective norm predicted intention to use condoms only for those who were not in the habit of doing so. Therefore, it does appear that the presence of a habit may weaken the elaborateness of information use in decision making which, in contrast to Ajzen's (2002c) claims, may set a boundary for the applicability of the TPB (Aarts *et al.*, 1997, 1998; Trafimow, 2000; Verplanken *et al.*, 1998).

1.2.3.1.2 Anticipated regret

Regret is a pervasive and powerful emotion (Sheeran & Orbell, 1999). Anticipated regret refers to an individual's 'beliefs about the extent of regret, tension, or upset they would feel if they did not perform a particular behaviour' (Sheeran, 2002, p. 22). The concept was introduced through regret theory in which the basic underlying assumption was that individuals are motivated to avoid feeling post-behavioural regret (Manstead & Parker, 1995; van der Pligt & de Vries, 1998b). It has frequently been argued that anticipated regret should be included as a predictor of intention within the TPB (e.g., Abraham & Sheeran, 2004).

Anticipated regret could initially be viewed as an aspect of attitude towards the behaviour. However, van der Pligt and de Vries (1998b) argued that there are two fundamental conceptual differences between attitude and anticipated affective reactions; firstly, the former deals with mainly utilitarian, non-affective consequences and the latter with affective consequences of behaviour and secondly, there are differences in time perspective with the former assessing evaluative beliefs about the act itself as well as longer term consequences, and the latter addressing immediate, post-behavioural affective outcomes. Richard *et al.* (1996) pointed out that the difference in time perspective may make different aspects of a behaviour accessible, which can result in contradictory affective responses that can independently influence behaviour. Consistent with this, research in a variety of behavioural domains has consistently revealed that attitude and anticipated regret are separate constructs (Abraham & Sheeran, 2003, 2004; Rapaport & Orbell, 2000; Richard *et al.*, 1995, 1998; Sandberg & Conner, 2008; Sheeran & Orbell, 1999).

Studies have shown that anticipated regret significantly predicts intention over and above the TPB variables (e.g., Conner *et al.*, 2006; Rapaport & Orbell 2000; Richard *et al.*, 1995, 1998). Sheeran and Orbell (1999) found that anticipated regret was a stronger predictor of intention to play the lottery than the TPB variables and descriptive norm, in three separate studies. In the domain of driving, Parker *et al.* (1995) reported that personal norm, which incorporated a measure of anticipated regret, significantly predicted intention to commit three driving violations over and above TPB constructs.

Abraham and Sheeran (2004) extended these findings by controlling for past behaviour. They argued that this constituted a more robust test since it eliminated the possibility that anticipated regret is a proxy measure of past behaviour. Anticipated regret explained additional variance in intention to exercise over and above the TPB variables and past behaviour. Since then, more studies have shown that anticipated regret independently predicts intention even after controlling for past behaviour (Conner *et al.*, 2007; Cooke *et al.*, 2007). Further, a meta-analysis demonstrated that anticipated regret explained an additional 7% of the variance in intention over and above the TPB constructs, that it was a stronger predictor than the TPB variables, and that its influence remained significant after past behaviour was included in the analysis (Sandberg & Conner, 2008).

1.2.3.1.3 Impulsive sensation seeking

The TPB proposes that external variables, such as personality traits, should influence intention and behaviour only via the model's existing constructs (Ajzen, 1991). Armitage *et al.* (2002), however, found that the TPB failed to fully mediate the effects of personality on intention and behaviour and concluded that 'the assessment of individual differences may prove fruitful in enhancing the predictive power of social cognition models' (p. 314). In particular, they suggested that personality variables such as sensation seeking (SS; Zuckerman, 1994) may be useful predictors of behaviours that involve a degree of risk-taking (Armitage *et al.*, 2002).

SS is a personality trait defined by the seeking of varied, novel and intense sensations and experiences and the willingness to take all kinds of risks to achieve them (Zuckerman, 1994). Although risk-taking is related to SS in that high sensation seekers are often high risk takers, they are not viewed as synonymous; sensation seekers do not attempt to maximise risks but instead accept and try to reduce them (Zuckerman, 1994; Zuckerman & Kuhlman, 2000).

A type of impulsivity, namely a lack of planning and a tendency to act impulsively without thinking, is closely related to SS (Zuckerman, 1994; Zuckerman *et al.*, 1993). Both have important psychobiological bases and items assessing each trait have been found to load onto the same major personality dimension in the optimal five-factor structure (Zuckerman, 2002; Zuckerman *et al.*, 1993). Consequently, items assessing SS and impulsivity have been combined into a single scale which was included in the Zuckerman-Kuhlman Personality Questionnaire (ZKPQ), along with scales which assessed four other personality traits (Zuckerman *et al.*, 1993). All items of the ZKPQ were of a true-false forced-choice format and were found to be reliable and valid (Zuckerman, 2002; Zuckerman *et al.*, 1993). The impulsive SS (ISS) scale was not found to be related to social desirability or social acquiescence but was negatively and weakly correlated with a lie scale (Zuckerman *et al.*, 1993). The scale, which essentially taps SS and the non-planning type of impulsivity, measures the general SS tendency and is the most useful assessment of the trait (Zuckerman, 1994).

SS and ISS are consistently higher among males than females (Aluja *et al.*, 2006; Zuckerman, 1994; Zuckerman & Kuhlman, 2000; Zuckerman *et al.*, 1993) and peak in adolescence or early adulthood before steadily declining with age (Zuckerman, 1994). ISS has been found to fully mediate the effect of gender on risk taking (Zuckerman & Kuhlman, 2000). Demographic data suggesting that young males are most likely to be sensation seekers are consistent with the elevated risk for this group in terms of having a vehicle accident (Zuckerman, 1994). Zuckerman (1994) reviewed a large body of literature and consistently found that individuals scoring high on SS were more likely to speed, drive under the influence of alcohol and have more driving accidents and convictions. These findings are due to a general difference in risk appraisal of high and low sensation-seekers, whereby the former tend to estimate the level of risk as lower (Zuckerman, 1994, 2007).

Little attention has been paid to individual differences in personality within the framework of the TPB (Churchill *et al.*, 2008). Three studies have explicitly examined whether SS and/or impulsivity predicted intention and/or behaviour over and above TPB variables. Beadnell *et al.* (2007) found that the effects of SS on the intentions of adolescents to have sex were mediated by attitude. In a study of adolescents' intention to use marijuana, Fishbein *et al.* (2002) found that while SS was significantly related to intention, it did not predict intention over and above the TPB variables. Finally, Churchill *et al.* (2008) administered TPB measures in relation to avoiding high-calorie snacks, as well as an impulsivity scale, which consisted of four subscales, one of which assessed SS. None of the components of impulsivity were related to intention so no further analyses involving intention were conducted. One of the subscales, urgency, which referred to the tendency to give in to strong impulses when distressed, did predict self-reported prospective behaviour over and above the TPB. Higher impulsivity was associated with more frequent snacking. Churchill *et al.* (2008) argued that more impulsive behaviours or individuals override the rational decision-making processes proposed by the TPB. Indeed, researchers have contemplated that the impulsiveness of the behaviour may account for differences in the ability of the TPB to predict various behaviours (e.g., Beck & Ajzen, 1991). Churchill *et al.* (2008) concluded that including measures of impulsivity alongside TPB constructs may enhance the capacity of the model to predict behaviours not characterised by careful decision-making.

1.2.3.2 Subcomponents of the TPB constructs

Although attitude, subjective norm and PBC are described in the TPB as single variables, Ajzen (2002b) went on to suggest that each of these constructs consists of subcomponents. The presence of these subcomponents within the concepts of attitude (cognitive and affective), subjective norm (injunctive and descriptive) and PBC (self-efficacy, controllability and perceived difficulty) has been widely supported (Hagger & Chatzisarantis, 2005; Rhodes & Courneya, 2003). In addition, research has been conducted on the different conceptualisations of intention (e.g., Fishbein & Stasson, 1990; Warshaw & Davis, 1985).

1.2.3.2.1 Attitude

Attitude is proposed to have a cognitive (i.e., perceived costs and benefits) and an affective (i.e., positive and negative feelings) component. Adjectives assessed via the semantic differential such as 'foolish-wise' and 'harmful-beneficial' capture cognitive responses, whereas affective considerations are reflected in adjective pairs such as 'pleasant-unpleasant' and 'enjoyable-unenjoyable' (Ajzen, 2002b). These two types of scales are often highly correlated, suggesting that they tap the same underlying factor, however, they have also been reported to represent two distinct components (Ajzen, 1988, 2002b).

In an influential review of the TPB, Manstead and Parker (1995) argued that the model largely neglects the role of affective processes. In particular, the procedure for eliciting behavioural beliefs, i.e., asking for the advantages and disadvantages of performing the behaviour, may lead to the production of only cognitive outcomes, at the expense of more emotional reactions. As affectively-orientated adjective pairs are used in the direct measure of attitude, this may explain why some studies have obtained only moderate correlations between belief-based and direct measures of attitude (van der Pligt *et al.*, 1998). Sutton *et al.* (2003) conducted an elicitation study whereby they asked participants, on the one hand, about the advantages and disadvantages of being more physically active (cognition), and on the other hand, about what they liked or enjoyed and disliked or hated about being more physically active (affect). As hypothesised, they found that the two types of questions elicited systematically different beliefs. Moreover, research using a similar methodology not only supported the cognitive-affective distinction (Manstead & Parker, 1995), but also showed that the resulting cognitive and affective beliefs were more strongly associated with a corresponding direct measure of cognitive and affective attitude, respectively (French *et al.*, 2005), and that the two types of beliefs differentially predicted self-reported behaviour one year later (Ajzen & Driver, 1991).

When attitude has been assessed directly, its cognitive and affective components have been found to display discriminant validity (Ajzen & Driver, 1992; Bagozzi *et al.*, 2001; French *et al.*, 2005; Hagger & Chatzisarantis, 2005; Lemmens *et al.*, 2009; Payne *et al.*, 2004; Rhodes & Courneya, 2003; Rhodes *et al.*, 2006; Rise *et al.*, 2008). Affective attitude has generally been found to be a stronger predictor of intention than cognitive attitude, regardless of behaviour (e.g., Ajzen & Driver, 1992; French *et al.*, 2005; Lemmens *et al.*, 2009; Payne *et al.*, 2004; Rhodes *et al.*, 2006; Rise *et al.*, 2008; Trafimow *et al.*, 2004), although there are exceptions, for example, Paisley and Sparks (1998) found that cognitive and affective attitude predicted expectation to reduce fat intake to the same extent.

Outside of the attitude-behaviour realm, Eagly *et al.* (1994) used open-ended measures of attitudes, which they argued have greater validity to assess the cognitive and affective components of attitude than rating scales. They also provided evidence for the distinction between the two components of attitude, however, they reported that cognition consistently played a more important role, shown by its greater ability to predict attitude towards a variety of policies. It seems that the relative importance of the affective and cognitive components largely depends on the attitude being investigated, as well as on individual differences and situational circumstances (Eagly *et al.*, 1994). Therefore, at least in some instances, it may prove beneficial to include measures that assess both types of consequences (Eagly & Chaiken, 1993; Esses & Maio, 2002).

Fishbein (1993) questioned the usefulness of obtaining multiple measures of attitude and argued that it may be preferable to view the components as indicators of a single attitudinal construct. Indeed, Ajzen and Driver (1992) found that although the affective and cognitive components of attitude displayed discriminant validity, a total attitude measure based on all of the semantic differential scales predicted intention to engage in leisure activities to the same extent as did the separate affective and cognitive measures. They concluded that affect and cognition combine in a compensatory manner which can be reflected in an overall attitude measure. A general factor comprising cognitive and affective attitude has also been found to more strongly predict intention to exercise than two separate subcomponents in a sample of young adults, but not in cancer survivors (Rhodes & Courneya, 2003). Finally, structural equation modelling has shown that the effects of cognitive and affective attitude on intention can be effectively summarised by a higher-order attitudinal factor (Bagozzi *et al.*, 2001; Hagger & Chatzisarantis, 2005).

1.2.3.2.2 Subjective norm

Despite the central and important role for norms as determinants of intention and behaviour (Terry *et al.*, 2000; White *et al.*, 2009), subjective norm is commonly found to be the weakest predictor of intention in TPB studies (Ajzen, 1991; Armitage & Conner, 2001a; Godin & Kok, 1996). This pattern of results may be due to the way in which subjective norm is operationalised and conceptualised in the TPB. A major problem with the measurement of subjective norm is that it is frequently assessed using a single item (e.g., Bagozzi & Kimmel, 1995; Paisley & Sparks, 1998), of which problems with reliability and validity are abundant (Ajzen, 1988). Armitage and Conner (2001a) reported that 62% of the 84 studies included in their meta-analysis that assessed subjective norm directly employed single-item measures. Further, their analyses showed that the poor ability of subjective norm to predict intention was principally a function of its measurement. Other critics have argued that the TRA provides neither an operational nor a conceptual basis for the cognitive independence of attitudinal and normative influences (Miniard & Cohen, 1981). Trafimow and Fishbein (1995), however, showed that attitude and subjective norm are distinct constructs by demonstrating that individuals cognitively distinguish between attitudinal and normative belief types during intention formation. There is also evidence to suggest that individuals have particular problems with accurately answering TPB-style items assessing subjective norm, rendering their responses potentially invalid (French *et al.*, 2007).

It has been claimed that the conceptualisation of norms in the TPB is too narrow to capture all of the important aspects of social influence (Donald & Cooper, 2001; Terry *et al.*, 2000). Ajzen (2002b) viewed the concept of subjective norm as consisting of two aspects, injunctive norm, which is the individual's belief that their important others would approve or disapprove of them performing the behaviour, and descriptive norm, the individual's perception of the extent to which their important others perform the behaviour themselves. Traditionally, studies administered items assessing injunctive norm only (e.g., Armitage & Conner, 1999a, 1999b). In an attempt to incorporate broader social influences which may be more powerful than those addressed by injunctive norms (Donald & Cooper, 2001), research has specifically examined the role of descriptive norm.

Cialdini *et al.* (1990) argued that injunctive and descriptive norm are conceptually and motivationally distinct and for a proper understanding of the role of normative influence, they should be measured separately. Their natural field studies, which were designed to reduce littering, demonstrated the considerable impact that norms can have on behaviour. Moreover, manipulation of one of the two types of norm caused participants' decisions to change only in accordance with the affected norm.

In two studies in which the TRA was applied to smoking, Grube *et al.* (1986) reported that injunctive and descriptive norm were conceptually distinct and that descriptive norm was generally the stronger predictor of intention and behaviour. While this early study showed promise for the predictive validity of descriptive norm, PBC was not measured and this construct may tap an individual's ability to resist conforming to other people's behaviour (Sheeran & Orbell, 1999). Therefore, it remained unclear whether descriptive norm would have a significant effect on intention after all of the TPB variables had been controlled. Sheeran and Orbell (1999) subsequently conducted a series of TPB studies, with the inclusion of a descriptive norm measure, designed to predict intention to play the lottery. They consistently found satisfactory discriminant validity for injunctive and descriptive norm, and that descriptive norm predicted intention better than any of the TPB variables. Other research has also found that descriptive norm is distinct from injunctive norm (Hagger & Chatzisarantis, 2005; Lemmens *et al.*, 2009; Rhodes & Courneya, 2003; Rhodes *et al.*, 2006; Rise *et al.*, 2008) and that it independently predicts intention within the framework of the TPB (Conner & McMillan, 1999; Conner *et al.*, 1996; Forward, 2009; Lemmens *et al.*, 2009; Rise *et al.*, 2008; White *et al.*, 2009).

Rivis and Sheeran (2003) conducted a meta-analysis involving 21 hypotheses, 8097 participants and a wide range of behaviours, to assess the role of descriptive norm in the domain of the TPB. Injunctive and descriptive norm were found to be only moderately correlated (r = .38), further supporting their discriminant validity. Regression analysis showed that after attitude, injunctive norm and PBC had been taken into account, descriptive norm significantly increased the variance in intention by 5%. Further, descriptive norm was the second strongest predictor of intention, after attitude, demonstrating its superior predictive validity relative to injunctive norm. In addition, the meta-analysis found that the relationship between descriptive norm and intention was stronger for younger samples and for health-risk, as opposed to health-promoting, behaviours. One explanation as to why descriptive norm has a strong influence upon intention is because it represents what is typical or normal and indicates that the given behaviour is effective or appropriate (White *et al.*, 2009).

Fishbein (1993) argued that injunctive and descriptive norm should not be treated as separate variables, but should be viewed as components of a single normative construct that taps perceived social pressure to perform or not perform the behaviour. In support of this position, structural equation modelling has demonstrated that the effects of injunctive and descriptive norm can be adequately captured by a higher-order social norm factor (Hagger & Chatzisarantis, 2005; Rhodes & Courneya, 2003).

1.2.3.2.3 PBC

Ajzen (1991) proposed that PBC refers to an individual's perception of the ease or difficulty of performing a behaviour, but went on to state that it is compatible with the concept of self-efficacy, which has been defined as 'confidence in one's own ability to carry out a behaviour' (Armitage & Conner, 1999a, p. 75). Further, Ajzen (1988, 2002a) argued that control beliefs can be either internal to the individual, for example, possessing the appropriate skills or knowledge, or external, for example, situational and environmental factors. Therefore, PBC was conceptualised as a combination of perceived difficulty, self-efficacy and controllability. These subcomponents are far from synonymous, however. For example, it is possible for an individual to perceive a behaviour to be under their control yet at the same time believe they would have considerable difficulty in performing it (Conner & Sparks, 1996) or lack the self-confidence to carry it out (Terry & O'Leary, 1995). In the case of refraining from driving while sleep impaired, for instance, an adult may feel that there is nothing stopping them from refraining from driving after 15 or more hours of wakefulness (it is under their control), but that the prospect of going out socialising may make it difficult.

Indeed, the direct measurement of PBC has proved problematic and there have been many reports of low internal consistency among the items used to assess it (e.g., Ajzen & Driver, 1992; Paisley & Sparks, 1998; Parker *et al.*, 1995). Further, a large body of research has demonstrated that the subcomponents of self-efficacy and/or perceived difficulty on the one hand and controllability on the other are empirically distinct (Armitage & Conner, 1999a, 1999c, 2001b, Armitage *et al.*, 1999; Hagger & Chatzisarantis, 2005; Jackson *et al.*, 2003; Povey *et al.*, 2000; Rhodes & Courneya, 2003; Terry & O'Leary, 1995; Trafimow *et al.*, 2002). These results were achieved using a variety of methods including principal components analyses, confirmatory factor analyses, structural equation modelling, analyses of underlying control beliefs and different predictive utility in terms of intention and behaviour. Also, the fact that these studies applied the TPB to a variety of different behaviours (such as food choice, drug use, blood donation and exercising) suggests that this finding is robust (Conner &

Armitage, 1998) and that PBC is multidimensional (Armitage *et al.*, 1999; Trafimow *et al.*, 2002). On the other hand, a minority of studies have found that PBC is unidimensional (e.g., Rise *et al.*, 2008).

Regarding the comparative predictive validity of the subcomponents of PBC, research has consistently found that a measure containing self-efficacy and/or perceived difficulty items predicts intention better than a measure comprising controllability items (Armitage & Conner, 1999a, 1999c, 2001a, 2001b, Armitage *et al.*, 1999; Hagger & Chatzisarantis, 2005; Jackson *et al.*, 2003; Povey *et al.*, 2000; Rhodes & Courneya, 2003; Terry & O'Leary, 1995). Less reliable findings have been reported for the prediction of behaviour; most studies found a measure tapping self-efficacy and/or perceived difficulty to be the superior predictor (e.g., Armitage & Conner, 1999c, 2001a; Norman & Conner, 2006; Povey *et al.*, 2000), however, Terry and O'Leary (1995) found that only controllability predicted a self-report prospective measure of exercise. These inconsistencies may be due to the target behaviours in these studies differing in volitional control (Conner & Armitage, 1998).

Trafimow *et al.* (2002) extended these findings by not only showing that people distinguish and cluster the beliefs which are presumed to underlie controllability and perceived difficulty, but also by providing the first experimental evidence for the distinction between the subcomponents. Experimental manipulations were successful in producing differential effects on the two components. Moreover, Trafimow *et al.* (2002) used meta-analyses to demonstrate that the relationship between a combined self-efficacy/perceived difficulty construct and controllability was only moderate (r = .38) and that the self-efficacy/difficulty construct was the superior predictor of both intention (r = .53 versus r = .27) and behaviour (r = .48 versus r = .27). They suggested that controllability may play a less important role because people may perceive it as dichotomous, i.e., a behaviour may be seen as either controllable or uncontrollable, whereas self-efficacy and perceived difficulty may be more continuous and therefore more capable of accounting for variance in other variables. An alternative explanation for the greater predictive validity of self-efficacy and perceived difficulty relative to controllability may be that these components share a greater conceptual redundancy with intention, rather than a stronger causal relationship (Rhodes & Courneya, 2003).

Although Ajzen (2002a) recognised that there was a clear distinction between the subcomponents of PBC, he argued that this did not invalidate the unitary nature of the variable. He proposed that the subcomponents were not independent constructs but that PBC was best conceptualised as a two-level hierarchical model in which PBC is the superordinate construct and the subcomponents are subordinate variables. Findings using structural equation modelling have been mixed; Hagger and Chatzisarantis (2005) directly supported Ajzen's (2002a) suggestion, however, Rhodes and Courneya (2003) found that a specific self-efficacy component was the optimal predictor of intention.

1.2.3.2.4 Intention

Warshaw and Davis (1985) proposed that an individual's intention to perform a given behaviour is separate to their behavioural expectation, which is a self-prediction of their future behaviour. The latter is assumed to capture anticipated problems with resources, opportunities and skills, as well as other nonvolitional and foreseeable factors (Eagly & Chaiken, 1993). For this reason, Warshaw and Davis (1985) claimed that expectation is the more accurate overall predictor of behaviour and their findings supported this position.

Fishbein and Stasson (1990), however, pointed out that the distinction between intention and expectation is only valid when the behaviour under investigation is nonvolitional. They stated that for behaviours under volitional control, measures of what one intends, will try, or will do are all assessments of the same underlying variable, i.e., intention. Only when nonvolitional behaviours, goals or outcomes are investigated does the intention term become ambiguous, and in these cases, expectation may play a role. Fishbein and Stasson (1990) applied the TRA to employee attendance at a training session and, rather than using a traditional measure of intention (i.e., 'I intend to...'), they administered single items of desire ('I want to...'), which they reasoned came close to the meaning of intention by tapping motivational aspects, and expectation ('I will...'). They found, in contrast to Warshaw and Davis (1985), that desire not only captured the cognitions underlying the behaviour better than expectation (i.e., attitudes and subjective norms were significantly better predictors of desire than expectation), desire was also a significantly better predictor of training session attendance than expectation. The majority (55%) of participants believed that attending the training session was under their control, providing partial support for Fishbein and Stasson's (1990) argument.

Conversely, Bagozzi (1992) argued that intention and desire are distinct constructs because intention, but not desire, takes self-efficacy into account. He also proposed that desire may mediate the influence of attitude on intention. Bagozzi and Kimmel (1995) found that intention and desire displayed discriminant validity for exercising but not dieting and suggested that this discrepancy may be due to the different time interval between forming an intention and acting for these two behaviours. They also provided some evidence for the mediating role of desire on intention, a finding replicated by Perugini and Bagozzi (2001). Armitage and Conner's (2001a) meta-analysis treated desire and intention as separate components. They showed that attitude, subjective norm and PBC were better predictors of desire than of intention, expectation or a measure based on a mixture of these components. They also reported that intention and expectation were better predictors of behaviour than desire. These findings support Bagozzi's (1992) position and Armitage and Conner (2001a) similarly attributed these findings to the greater ability of intention and expectation to capture difficulties with control, relative to desire. In addition, Armitage and Conner (2001a) found no reliable difference in the ability of intention versus expectation to predict future behaviour, which supports a past meta-analysis on the prediction of condom use (Sheeran & Orbell, 1998).

1.3 THE PRESENT RESEARCH

The final part of this chapter reviews the literature concerning general methodological considerations which were apparent in the present research and offers justifications for the design in ensuring it allowed for a complete and accurate account of the determinants of sleep impaired driving. As this section includes a review of past research, it is presented here rather than in subsequent method sections. It concludes with the main aims and hypotheses of the research.

1.3.1 The specific behaviours under investigation

Three behaviours were identified from the literature as being risk factors for being involved in a sleep-related vehicle accident (Stutts *et al.*, 2003; Summala & Mikkola, 1994; see section 1.1). In the current research, the determinants of these behaviours were investigated using the framework of the TPB. Specifically, refraining from driving after being awake for 15 or more hours in the next week was investigated in young, middle-aged and elderly adults. In addition, refraining from driving between midnight and 6am and between 3pm and 6pm, in the next week, were also examined in young and elderly adults, respectively.

1.3.2 Methodological issues

1.3.2.1 The principles of aggregation and compatibility

Wicker's (1969) early review on the attitude-behaviour relationship suggested that attitudes were generally unrelated to behaviour. Weigel and Newman (1976) suggested that this finding was partly the result of serious methodological problems with the research reviewed and partly due to problems with the specificity/generality of the measure of behaviour. The latter issue was also identified by Fishbein and Ajzen (1974, 1975), who argued that previous studies had found a poor relationship between attitudes and behaviour because, in the majority of cases, the researchers had attempted to predict a single-act behaviour from a general attitude. They suggested that general attitudes should be strongly related to multiple behaviours, but correlations between general attitudes and individual behavioural measures should be weak, i.e., attitude and behaviour must be measured at the same level of specificity/generality. Thus, in order to predict a behavioural tendency, observations of the behaviour on different or repeated occasions must be aggregated to cancel out influences which vary from one occasion to the next (Ajzen, 1988). Fishbein and Ajzen (1974, 1975) named this proposition the principle of aggregation and subsequent research provided strong support for it (e.g., Weigel & Newman, 1976).

Ajzen and Fishbein (1977) went on to suggest that attitudinal and behavioural entities can be defined in terms of four elements. These are the action, the target at which the action is directed, the context in which it occurs and the time at which it takes place. They concluded from their own review that strong attitude-behaviour relationships were found only when there was high correspondence between at least the action and target elements of the attitudinal and behavioural entities (Ajzen & Fishbein, 1977). This was later named the principle of compatibility (Ajzen, 1988) and proposed that the greater the compatibility between constructs, the higher the correlation between attitude and behaviour. This contention also received extensive empirical support, for example, Kraus (1995) concluded from his meta-analysis of 88 attitude-behaviour studies that the principle of compatibility was a 'sound and useful measurement principle' (p. 70). It is clear that the principle, at least partly, explains the low relationships between attitude and behaviour found in earlier studies. Therefore, for optimal prediction of intention and behaviour, all of the variables in the TPB (attitude, subjective norm, PBC, intention and behaviour) should be defined using exactly the same elements.

In the present research, for each behaviour, the vast majority of items assessing the TPB and additional variables (except for ISS which is a personality trait) were defined in terms of identical elements that corresponded to the behavioural criterion (Ajzen, 1988). It was also ensured that at least the action and target elements were specified (Ajzen & Fishbein, 1977). That is, refraining from driving (the action) after being awake for 15 or more hours/between midnight and 6am/between 3pm and 6pm (the target) in the next week (time). This promoted optimal prediction of intention and behaviour, as proposed by the principle of compatibility (Ajzen, 1988). The action and target elements were relatively specific, however, the time frame of one week was more general. Thus, as specified in the principle of aggregation, daily-reported and partly objective measures of behaviour, where obtained, were estimated by taking into account several observations of behaviour over the week, in order to provide accurate and reliable measures (Ajzen, 2002b).

1.3.2.2 Time interval between Time 1 and Time 2

Another condition for accurate behavioural prediction is that the time interval between the assessment of intention and PBC at Time 1 and the observation of behaviour at Time 2 should remain stable (Ajzen, 1991; Ajzen & Fishbein, 1980). Intervening events may change an individual's intention or PBC, resulting in an inaccurate prediction of behaviour. Therefore, for maximum prediction, intention and PBC should be measured as close in time as possible to the behaviour (Ajzen, 1991; Ajzen & Fishbein, 1980). An additional advantage of this is that intentions are less likely to be provisional or hypothetical, and are more likely to reflect real decision making (Sutton, 1998). Terry *et al.* (1993) further stated that the use of a short time frame reduces problems of recall and distortion, which are abundant in studies carried out over long time periods that use self-reported behaviour. The moderating role of time interval on the intention-behaviour relationship has been empirically demonstrated. In their meta-analysis, Sheeran and Orbell (1998) found a significantly stronger correlation between intention and behaviour (condom use) when the time interval was shorter, supporting Ajzen's (1991; Ajzen & Fishbein, 1980) claims.

Ouellette and Wood (1998) reported that future behaviour is typically measured for either one or two weeks. These time frames may be commonly utilised as it may be easier for participants to consider the next one or two weeks when completing a TPB questionnaire, rather than, for example, an arbitrary number of days, such as nine. Whilst maintaining that shorter time intervals produce better prediction of behaviour (and increase the accuracy of self-reports, Terry *et al.*, 1993), it is also useful to study behaviour over a longer time period (Sheeran & Orbell, 1999). In the present research, however, the use of actiwatches (recording at 30-second epochs) restricted the recording period to one week, rather than two, which was held consistent for each behaviour.

Therefore, where behaviour was assessed, the subjective measure of behaviour was obtained a week after the participants completed the TPB questionnaire. This ensured that the time interval between the assessment of intention and PBC and the measurement of subjective behaviour was relatively short, promoting optimal prediction of behaviour by reducing the incidence of intervening events (Ajzen, 1991), hypothetical intentions (Sutton, 1998) and/or distorted memory (Terry *et al.*, 1993). The use of daily-reported and partly objective measures further diminished, if not completely eliminated, these problems.

1.3.2.3 The direct measurement of attitude

Research using the TPB typically employs Osgood *et al.*'s (1957) semantic differential scales to assess attitude directly (Ajzen, 2002b; Eagly & Chaiken, 1993). Osgood *et al.* (1957) argued that an individual's attitude towards a behaviour is equivalent to their evaluative meaning of that behaviour. Hence, it is possible to measure attitude towards any behaviour using a set of scales that load highly on the evaluative factor.

In order to use the semantic differential to measure attitude towards a behaviour, a participant would be asked to indicate how they would rate performing that behaviour on a set of opposing adjective-pairs (for example, 'For me to refrain from driving after I have been awake for 15 or more hours is... bad-good') using a seven-point scale with points representing 'very', 'quite' and 'slightly' at each side of the scale, with the centre signifying that 'neither' option was appropriate (Osgood *et al.*, 1957). This captured both the direction and intensity of the judgement (Osgood *et al.*, 1957). This operationalisation of attitude supports the view shared by Osgood *et al.* (1957) and Fishbein and Ajzen (1975) that the construct can best be defined in terms of a bipolar evaluative dimension (Fishbein & Ajzen, 1975). Four or five bipolar adjective scales are sufficient to measure attitude in most cases (Eagly & Chaiken, 1993), and this was adhered to in the present research by ensuring that the direct measure of attitude comprised at least five items.

In most cases, seven-point scales were used in the items assessing the remaining TPB variables measured at Time 1, the additional variables and subjective behaviour. This was for consistency and again, to allow participants to indicate both the direction and strength of their response.

1.3.2.4 Direct versus belief-based measures of TPB constructs

Although beliefs are assumed to determine the corresponding overall construct, Ajzen (1991, 2002b) proposed that attitude, subjective norm and PBC can be assessed directly and/or via their expectancy-value underpinnings, i.e., using behavioural, normative and control beliefs, respectively. Consequently, direct and belief-based measures of attitude, subjective norm and PBC are alternative ways of assessing the same underlying constructs. Correlations between the two types of measure for each construct have been found to be medium to large (Ajzen, 1991; Armitage & Conner, 2001a).

While direct measures allow the prediction of behaviour at a general level (Ajzen & Fishbein, 1980), belief-based measures provide information about the cognitive foundations of the constructs and allow a deeper understanding of the factors influencing behaviour (Ajzen, 1988, 2002b, 2005; Ajzen & Fishbein, 1980). Therefore, either type of measure may be used to *predict* intention and behaviour, and in practice, as intention and typically behaviour are measured directly, for the sake of consistency, the direct measures are usually utilised (Ajzen, 2002b). Although prediction is useful, the ultimate goal is explanation (Armitage & Reidy, 2008). As argued by Sutton (1998), an explanatory model has wider implications and greater strategic value than a purely predictive model. In order to *explain* intention and behaviour, it is necessary to identify the beliefs that determine performance of the behaviour (Ajzen, 1991, 2005; Ajzen & Fishbein, 1980; Symons Downs & Hausenblas, 2005; Terry *et al.*, 1993).

Thus, by measuring beliefs, insight can be gained into why people hold certain attitudes, subjective norms and PBC (Ajzen, 2002b) and they also capture important situational factors (Sutton, 1998). Moreover, utilising belief-based measures in TPB research allows the most important beliefs which ultimately determine whether or not an individual performs a behaviour to be identified. This has clear implications for the development of behavioural change interventions (Terry *et al.*, 1993). It is these underlying beliefs that should be targeted and changed in order to produce a change in the corresponding construct, which may lead to a change in intention and ultimately behaviour (Ajzen, 2002b, 2005; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; Fishbein *et al.*, 1980). The key beliefs are the ones that discriminate between individuals who perform the behaviour from those who do not, as they provide insight into the considerations that guide people's actions (Ajzen & Fishbein, 1980; Ajzen & Gilbert Cote, 2008; Armitage & Conner, 2001b; Fishbein & Yzer, 2003; Sutton, 2002). For example, if attitude was found to be the strongest predictor of intention and intention significantly predicted behaviour, then the discriminating behavioural beliefs should be identified. Moreover, it is possible to pinpoint the specific component, e.g., behavioural belief(s), outcome evaluation(s) or both, of the construct which the intervention should primarily concentrate on changing (Eagly & Chaiken, 1993; van der Pligt & de Vries, 1998b).

Obtaining belief-based measures of the TPB constructs allows comparisons among different groups of participants to be made, for example, different groups may hold contrasting behavioural, normative and/or control beliefs (Terry *et al.*, 1993). This complements the closed-ended approach of the direct measures which permits comparisons between groups of participants on the *same* content (Esses & Maio, 2002). Exploring the differences in behavioural, normative and control beliefs, attitudes, subjective norms and PBC underlying sleep impaired driving between three age groups of adults was a key objective of the current research.

There may also be particular problems with assessing the TPB variables directly. Some reviews have highlighted problems associated with measuring attitude using the semantic differential. Respondents may not freely associate the behaviour with the particular adjective pairs presented in semantic differential scales (Eagly *et al.*, 1994; Haddock & Zanna, 1998), leading to responses which are consistent with overall attitude, irrespective of whether the participant believes that the adjectives adequately describe the behaviour (Eagly *et al.*, 1994). Ajzen (1991) suggested that direct measures may evoke a relatively automated response from participants, whereas belief-based measures require more careful deliberation. Moreover, forcing participants to evaluate their attitude on a predetermined set of scales may fail to capture the idiosyncratic responses crucial to fully understand an individual's attitude (Haddock & Zanna, 1998). Belief-based measures attempt to more fully represent the participants' unique perceptions of the behaviour by including only modal accessible beliefs, as identified in the elicitation study. It has also been argued that the direct measure of subjective norm underestimates the influence of social norm on intention and thus the more specific belief-based measure is preferable (Donald & Cooper, 2001), however, Armitage and Conner (2001a) reported that the two types of measure predicted intention equally well. On a final and practical note, French *et al.* (2007) recently found that individuals have more difficulty in understanding the items used to assess the TPB constructs directly, as opposed to the belief-based measures.

Armitage and Conner's (2001a) meta-analysis revealed that most TPB studies do not employ belief-based measures of attitude, subjective norm and PBC, but rely only on direct measures. Therefore, these studies are limited in that they only provide tests of the prediction of intention and behaviour, rather than identifying important underlying beliefs which are crucial to understanding why an individual may or may not perform a behaviour. In the present research, both direct and belief-based measures of attitude, subjective norm and PBC were administered; the former to allow for a fair test of the influence of additional variables (see section 1.3.2.6) by removing method effects and the latter because of all of the issues discussed in this section.

1.3.2.5 Measures of behaviour

Armitage and Conner's (2001a) meta-analysis showed that numerous studies focused on predicting intention and did not measure behaviour at all. Although interesting inferences can be obtained from such studies on the underlying determinants of intention, the usefulness of the findings is restricted as the extent to which intention is related to behaviour remains unknown. Further, prospective studies involving measures of behaviour are crucial from an applied perspective, as it these studies on which recommendations for interventions should be based (Elliott *et al.*, 2003).

Armitage and Conner (2001a) found that the majority of studies in which behaviour was assessed either employed a cross-sectional design, which makes the measure actually one of *past* behaviour, or it was assessed subjectively. Ajzen and Fishbein (1977) argued that self-reports of behaviour are vulnerable to several biases and should only be treated as acceptable behavioural criteria when it would have been difficult or impossible to obtain an actual observation of behaviour. Assessing behaviour using subjective methods artificially inflates its relationships with other variables due to the similar manner in which they are obtained (which is accentuated further following the principle of compatibility), compared to the measurement of objective or observed behaviour. Specifically, it introduces problems of shared method variance, i.e., individuals answering questions in the same way because they have the same wording (Sutton, 1998) and/or self-presentational biases, such as consistency bias, whereby participants strive to give consistent views (Budd, 1987; Sherman, 1980). Augmented predictions of subjective behaviour may alternatively be due to individuals inferring their actions from their attitude due to problems with memory (Kraus, 1995). Finally, subjective behaviour may actually represent notions such as an individual's attempt to perform the behaviour or unrealistic optimism over achieving one's intentions (Armitage & Conner, 1999a).

Indeed, Armitage and Conner (2001a) found (including only those studies which obtained prospective measures of behaviour) that intention and PBC were superior predictors of subjective behaviour (they accounted for 31% of the variance) than objective or observed behaviour (20% of the variance was explained). The arguments discussed render subjective measures less reliable than objective measures (Armitage & Conner, 2001a), suggesting a need for more studies to objectively measure behaviour. More recent research conducted by these investigators has used objective indices of behaviour and has generally provided support for the TPB (e.g., Armitage, 2008; Christian *et al.*, 2007; Conner *et al.*, 2006, 2007; Elliott *et al.*, 2007). In most cases, intention emerged as the sole or dominant predictor of objective behaviour (Armitage, 2008; Christian *et al.*, 2007; Conner *et al.*, 2007; Elliott *et al.*, 2007). However, in Conner *et al.*'s (2006) investigation into adolescents' smoking, both intention and PBC significantly predicted smoking (as assessed by carbon monoxide breath monitoring) but PBC was the strongest predictor. In contrast to these studies, Sandberg and Conner (2009) reported that neither intention nor PBC were able to predict an objective measure of cervical screening attendance.

Nonverbal measures supplement and cross-validate self-reports (Ajzen & Driver, 1991; Conner *et al.*, 2006) and using multiple measures of behaviour represents good research practice (Armitage & Conner, 1999a) and allow method effects to be investigated (Sutton, 1998). Furthermore, comparisons between subjective and objective measures enhance understanding of the cognitions underlying behaviour (Armitage & Conner, 1999a). The current research incorporated prospective designs and where possible, multiple measures of future behaviour. These included subjective retrospective accounts, subjective daily-reported records and a partly objective measure of behaviour, based on diaries and actigraphy.

1.3.2.6 Measurement of additional variables

1.3.2.6.1 Subcomponents of the TPB constructs

Although the TPB proposes that a common factor structure for attitude, subjective norm and PBC is optimal, research has supported the presence of subcomponents within these variables (Hagger & Chatzisarantis, 2005; Rhodes & Courneya, 2003; see section 1.2.3.2). In the present research, it was ensured that the direct measure of attitude included adjective pairs of both a cognitive and an affective nature to allow for the effects of both components, as instructed by Ajzen (2002b; Ajzen & Fishbein, 2005). In addition, problems inherent with the measurement and conceptualisation of subjective norm were tackled by ensuring that multi-item measures were employed and by including a direct assessment of descriptive norm to tap broader social influences, respectively. Adequately measuring injunctive norm allowed for a complete test of the comparative utility of descriptive norm (Armitage & Conner, 2001a) and the inclusion of both types of items obtains a complete measure of social norm (Ajzen, 2002b; Ajzen & Fishbein, 2005). Similarly, items assessing all three subcomponents, self-efficacy, perceived difficulty and controllability were included in the direct measure of PBC (Ajzen, 2002b; Ajzen & Fishbein, 2005).

Although they labelled the construct, intention, Ajzen and Fishbein (1980) originally contended that in some circumstances, it is preferable to employ a 'more precise measure of the likelihood that the person will engage in the behaviour' (p. 42). A pure expectation measure was not utilised in the present research due its limitations in explaining behaviour (Sheeran, 2002). That is, although expectation may be useful for predicting behaviour (Armitage and Conner, 2001a), it is debatable whether it qualifies in causal models of behaviour (Sheeran, 2002). Specifically, Fishbein and Stasson (1990) recommended that in the investigation of nonvolitional behaviours, both motivational and expectation measures should be administered. Driving while sleep impaired may be perceived as socially unacceptable and thus the inclusion of items assessing expectation, rather than exclusively employing direct intention items, may reduce the potential for socially desirable responses (Eiser *et al.*, 1989; Parker *et al.*, 1995). Therefore, both traditional intention and expectation items were employed in the present research, the former as instructed by Ajzen (2002b), and the latter to account for possible volitional and social desirability problems. In support of this, Conner and Sparks (1996) reported that intention and expectation items are typically highly intercorrelated.

In the present research, it was ensured that the investigation of the possible components of each TPB construct began with principal components analysis to empirically determine whether the components were distinguishable. This was important because if the subcomponents were independent, combining them into one construct would obscure their individual effects on intention and/or behaviour (Trafimow *et al.*, 2002), thereby reducing the sensitivity of the TPB (Armitage & Conner, 1999c).

1.3.2.6.2 External variables

It is entirely possible that the behaviours investigated in the present research could be a function of habit for some individuals. Driving in general is usually routinely performed in everyday life and the context in which it is carried out is normally stable, for example, people drive the same car for regular journeys. These factors make the generalised behaviours conducive to habit formation (Aarts *et al.*, 1997, 1998; Ouellette & Wood, 1998), although the specific elements of the behaviours under investigation may reduce habituation. There are empirical and theoretical grounds for examining the role of habit in the prediction of frequently performed behaviours, alongside TPB variables (Conner & Armitage, 1998).

Past behaviour and habit are conceptually distinguishable constructs (Ajzen, 1991, 2002c, Conner & Armitage, 1998) and in the present research, an attempt was made to assess both. Although past behaviour does not offer any explanatory power, its role was investigated to examine the possible effects of other unmeasured factors on the prediction of intention and future behaviour (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). Only when habit is defined independently of behaviour can it be added to the TPB as an explanatory variable (Ajzen, 1999, 2002c). The measure of habit strength developed by Aarts, Verplanken and colleagues (Aarts *et al.*, 1997; Verplanken *et al.*, 1998) represents an important methodological advance in this area (Conner & McMillan, 1999; Sheeran, 2002) and was adapted to the behaviours under investigation in the current research.

Anticipated regret has been found to be a reliable predictor of intention and is particularly important in the formation of intention to perform antisocial or socially controversial behaviours (Parker *et al.*, 1995, 1996). Because driving while sleep impaired is potentially dangerous and could be perceived as socially undesirable, it is likely that drivers anticipate an element of regret during their decision-making process. Therefore, the role of anticipated regret in intention to drive while sleep impaired was explored in the present research. Its disciminant validity with attitude was also established.

Driving while sleep impaired involves several types of risk, including physical, legal, financial, and social (Zuckerman, 1994). Individuals who drive while sleep impaired may not consider these risks due to ISS (e.g., a lack of planning), rather than the cognitive decision-making processes reflected in the TPB. Eagly and Chaiken (1993) argued that individuals sometimes act on their attitudes in an impulsive manner, without forming an explicit intention to act. Therefore, the ability of ISS to predict driving while sleep impaired, over and above the TPB variables, was examined in the present research. Owing to the limited body of literature investigating the role of ISS in the context of the TPB, its independent predictive effect on intention to drive while sleep impaired after controlling for the TPB variables was also explored. Because SS decreases with age (Zuckerman, 1994), its role in driving between 3pm and 6pm was not investigated due to the sample consisting entirely of elderly adults (but was included in the analyses predicting intention to drive after prolonged wakefulness in all three age groups for comparative purposes)[1].

From an empirical perspective, if found to be independent constructs, the extent to which the TPB subcomponents and/or external variables predict intention or behaviour, over and above the original conceptualisations of the TPB variables, indicated their usefulness as potential additions to the model (Conner *et al.*, 2001).

1.3.2.7 Summary of methodological issues

Ajzen and Fishbein (1980) argued that in order to provide a complete account of the relationships between the antecedents of behaviour, studies should obtain both belief-

[1] The findings of the present study supported this decision as the ISS scores of the elderly adults were significantly lower than those of the young adults (see section 4.3.2.1).

based and direct measures of TPB variables, as well as a measure of intention and crucially, behaviour itself. Further, they stated that for a behaviour to be fully explained, its determinants should be traced back to its underlying beliefs. The results can then be used to inform behavioural change interventions. The methodologies used in the present research therefore allowed for a complete and accurate investigation into the antecedents of sleep impaired driving.

1.3.3 The TPB and sleep impaired driving

Although the TPB has successfully been applied to a number of driving behaviours, for example, compliance with speed limits (Conner *et al.*, 2007; Elliott *et al.*, 2003, 2007) and intentions to commit three violations involving poor lane discipline (cutting across traffic, weaving in and out of lanes and overtaking on the inside, Parker *et al.*, 1995), it has never before been used to predict sleep impaired driving. For completeness, it is noted that Finlay *et al.* (1997) applied the TRA to intentions to perform 32 behaviours, including 'being an alert driver'. They found that the TRA successfully predicted intention and that this behaviour was under attitudinal, as opposed to normative, control. The present research represented the first time that sleep impaired driving had been explored using the TPB. Therefore, it provided a unique and original perspective on the factors that underlie this behaviour.

1.3.4 Main aims and hypotheses

The primary aim of the present research was to identify the social cognitive determinants of sleep impaired driving using the framework of a well-established model which has consistently proved to be successful when employed in alternative behavioural domains (Armitage & Conner, 2001a). The novel application of the TPB to this behaviour represents the first step in developing theory-based interventions designed to reduce the incidence of sleep impaired driving.

The determinants of refraining from driving after 15 or more hours of wakefulness were explored in young, middle-aged and elderly adults. Questionnaires were administered at Time 1 to assess the TPB and additional variables. Behaviour was then measured and triangulated over one week using subjective and partly objective methods in the young adults only as they are the most vulnerable age group for being involved in a sleep-related vehicle accident (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003) and thus the findings have more important implications for road safety intervention attempts. It was beyond the scope of the research due to limited time and resources to assess behaviour in all three age groups. The young and elderly adults also provided additional data. The antecedents of refraining from driving between midnight and 6am and between 3pm and 6pm were investigated in the young and elderly adults, respectively. Subjective measures of behaviour were obtained from the young adults over a week.

Based on the TPB and past research, the following hypotheses were devised:

H_1 Intention and, to the extent that the behaviour is perceived to be volitionally uncontrollable, PBC, would account for a significant proportion of variance in driving after 15 or more hours of wakefulness and driving between midnight and 6am.

H_2 Attitude towards the behaviour, subjective norm and PBC (or their subcomponents) would account for a significant amount of variance in intention to drive after 15 or more hours of wakefulness, intention to drive between midnight and 6am and intention to drive between 3pm and 6pm.

H_3 If intention significantly predicts behaviour (where it was measured) and at least one of the TPB variables predicts intention, there would be differences in the underlying beliefs of those who performed/intended to perform the behaviour compared to those who did not.

H_4 Anticipated regret would independently predict intention to perform all three behaviours, over and above the TPB constructs, and after controlling for past behaviour (as this constitutes a more robust test of the effects of additional variables, Abraham & Sheeran, 2004). Specifically, the more an individual anticipated that they would feel regret after driving under the particular circumstance, the weaker would be their intention to do so.

H5 ISS would significantly predict the extent to which the young adults actually drove after being awake for 15 or more hours and between midnight and 6am, over and above the TPB constructs and past behaviour. High impulsive sensation seekers would be more likely to drive after 15 or more hours and between midnight and 6am.

The predictive effects of past behaviour were also explored to test the sufficiency of the models (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). For exploratory purposes, the ability of ISS to independently predict intention to drive after 15 or more hours of wakefulness in all three age groups and intention to drive between midnight and 6am in the young adults was also investigated.

<u>Gender</u>

As young males are the most likely group to have a sleep-related vehicle accident (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003), the additional role of gender was examined in the investigation of driving between midnight and 6am (as the sample consisted of young adults only). The TPB proposes that its constructs should mediate the effects of gender upon intention and behaviour (Ajzen, 1991), however, this has generally not been supported. Even after the TPB constructs had been controlled, gender significantly predicted intention to comply with speed limits (Elliott *et al.*, 2003), to speed (Conner *et al.*, 2007), to commit three driving violations (Parker *et al.*, 1995) and to drink-drive (Armitage *et al.*, 2002), as well as predicting the actual behaviour of attending a health screening appointment (Armitage *et al.*, 2002). On the other hand, the TPB was shown to mediate the effect of gender upon intention to binge drink (Norman & Conner, 2006) and self-reported compliance with speed limits (Elliott *et al.*, 2003).

H6 It was expected that gender would independently predict intention to drive between midnight and 6am, over and above the TPB variables and past behaviour.

The extent to which the TPB was able to mediate the effect of gender on whether or not the young adults actually drove between midnight and 6am was also explored.

The main aims and hypotheses were explored and tested in Chapter 4. The following two chapters describe preliminary work conducted prior to the main study. In Chapter 2, the sleep duration and quality of young, middle-aged and elderly adults were measured over one week using subjective and objective methods. The results of actigraphy were compared with those of subjective measures and the extent to which actigraphy differentiated the sleep duration and quality of the three age groups, which were the target populations in the main study, was determined. These issues were important because actigraphy was used in the main study to provide a partly objective measure of driving after 15 or more hours of wakefulness. As this preliminary study allowed an investigation into the sleep duration and quality of these groups of adults, relevant literature was reviewed and additional hypotheses formulated and tested. These hypotheses are presented in Chapter 2 only as they diverge from the main focus of the research.

As it was desirable to administer belief-based measures of the TPB constructs in the main study, it was necessary to conduct an elicitation study to identify the accessible beliefs of young, middle-aged and elderly adults regarding sleep impaired driving. This study, together with details of questionnaire construction, which included a pilot study to establish the reliability and validity of the measures, is described in Chapter 3.

2.0 USING ACTIGRAPHY TO MEASURE SLEEP DURATION

2.1 INTRODUCTION

Actigraphy was used to identify periods of sleep and wake in the main study and this preliminary study examined its correspondence with subjective measures. In addition, the extent to which actigraphy was able to differentiate the sleep duration and quality of the three age groups of adults that were the target populations in the main study, i.e., young, middle-aged and elderly, was determined. As this allowed an investigation into the sleep duration and quality of these three age groups, the relevant literature is reviewed below and specific hypotheses formulated and tested.

2.1.1 The importance of adequate sleep duration

Chronic sleep loss results from the accumulation of a sleep debt within an individual who regularly does not get enough sleep and is extremely prevalent in today's 24-hour society (Balkin *et al.*, 2008; Bonnet, 1994; Bonnet & Arand, 1995; Coren, 1996; Klerman & Dijk, 2008; Knutson & van Cauter, 2008; Meerlo *et al.*, 2008; Webb & Agnew, 1975). The effects of insufficient sleep are wide-ranging and include cognitive, affective, social and motor impairment (Durmer & Dinges, 2005). Poor self-rated health (Steptoe *et al.*, 2006), energy, satisfaction and success (Groeger *et al.*, 2004) have also been found to be associated with self-reported insufficient sleep. In addition, chronic sleep loss has been related to loss of optimism, poor social skills and amplification of bodily pain (Haack & Mullington, 2005).

There has been increasing concern over the effects of habitually short sleep on physiological processes (Balkin *et al.*, 2008), including evidence to suggest its association with obesity (Cappuccio *et al.*, 2008; Knutson & van Cauter, 2008), diabetes (Knutson & van Cauter, 2008; Krueger & Friedman, 2009), high blood pressure and increased incident hypertension (Knutson *et al.*, 2009), metabolic syndrome (Hall *et al.*, 2008), coronary artery calcification (King *et al.*, 2009) and cardiovascular disease (Krueger & Friedman, 2009). Meerlo *et al.* (2008) argued that chronic sleep loss affects the major neuroendocrine stress systems which leads to increased sensitivity to stress-related disorders including cardiovascular and affective conditions. Sleep deprivation also has detrimental effects on the immune system (Bryant *et al.*, 2004) and sleeping for less than eight hours a night has been found to be associated with an increased risk of developing the common cold (Cohen *et al.*, 2009). In the long term, short sleep durations have been associated with a significantly increased mortality risk (Hublin *et al.*, 2007).

Sleep duration is directly related to the degree of daytime sleepiness (Bonnet, 1994; Rosenthal *et al.*, 1993; Roth *et al.*, 1994) and even moderate levels of sleepiness can have substantial detrimental effects on general health and quality of life (Briones *et al.*, 1996). Modest sleep restriction in which young adults curtailed their sleep duration from eight to six hours per night for one week was found to be associated with increased sleepiness and impaired psychomotor performance (Vgontzas *et al.*, 2004). Furthermore, it is well-established that inadequate sleep is a major cause of human error, and sleepiness-related accidents represent the most crucial health risk of habitually short sleep (Dement & Mitler, 1993; Horne, 2008).

Research has indicated that eight or more hours of sleep each night is associated with optimal physiological and psychological function in healthy adults (e.g., Ancoli-Israel, 1996; Coren, 1996; Dement & Vaughan, 1999; Lilley *et al.*, 2002; Martin, 2002; Van Dongen *et al.*, 2003). An experimental study conducted by Van Dongen *et al.* (2003) revealed that healthy adults have an average sleep need of 8.16 hours per 24 hours. Regularly sleeping for this amount of time should prevent neurobehavioural deficits (Van Dongen *et al.*, 2003). Studies have also extended the usual sleep durations of healthy adults in the laboratory and have generally found that extended sleep leads to improved alertness, reaction time, divided attention, mood and well-being (e.g., Carskadon *et al.*, 1986; Kamdar *et al.*, 2004; Klerman & Dijk, 2008; Roehrs, Timms *et al.*, 1989, Roehrs, Zwyghuizen-Doorenbos *et al.*, 1989), though there are exceptions (Harrison & Horne, 1996). This suggests that the more sleep an individual can achieve, the better. In fact, Coren (1996) argued that 'it is probably the case that we may need 9½ to 10 hours of sleep a day for optimal performance' (p. 286), reasoning that normal efficiency, alertness and creativity are better after 10 hours of sleep than they are after eight hours. Coren (1996) also noted that this sleep duration does not have to be taken in one nightly period, but can be spread over 24 hours.

This body of research is not without opposition, although this standpoint forms a minority view. Harrison and Horne (1995) argued that most people are not chronically sleep-deprived and that evidence documenting improvements to subjective well-being and performance capabilities with extended sleep are inconsistent. A number of population-based surveys have also reported that an average sleep duration of over eight hours can be detrimental to health (e.g., Ayas, White, Al-Delaimy *et al.*, 2003; Ayas, White, Manson *et al.*, 2003; Qureshi *et al.*, 1997) and can increase the risk of mortality (Youngstedt & Kripke, 2004). The vast majority of these studies, however, were epidemiological in which there were methodological flaws, including the use of self-reports, rendering measures of usual sleep duration potentially unreliable, and incomplete health and behavioural information, which may have obscured undiagnosed conditions which led to the long sleep duration (Buysse & Ganguli, 2002; Foley, 2004).

Although there are individual differences in sleep need (Ancoli-Israel, 1996; Carskadon, 1993), the consensus is that on average, healthy adults require at least eight hours of sleep per 24 hours. Most research has suggested that people sleep substantially less than this, with average sleep durations being closer to six-seven hours (Bonnet & Arand, 1995; Hicks *et al.*, 2001b; Jean-Louis *et al.*, 2000; Martin, 2002). A recent nationally representative survey of 1997 British adults found that the average sleep duration was seven hours (Groeger *et al.*, 2004). Bonnet and Arand (1995) warned that a mean sleep duration of below 7.5 hours is deficient and regularly sleeping for less than 6.5 hours can be disastrous in terms of the risks to safety.

The increasing pressures in today's 24-hour society place demands on individuals to go to bed later and reduce the time they spend asleep (Dinges, 1995; Martin, 2002). People are expected to work longer hours, there are more opportunities for entertainment and leisure and sleep is generally regarded as a poor relation to other activities (Coren, 1996; Martin, 2002). Although a considerable proportion of the population is chronically sleep-deprived, there has been a tendency for the scientific community to gather descriptive statistics about patterns of actual sleep behaviours rather than tackling the underlying beliefs and attitudes about sleep which ultimately determine when and for how long people sleep.

In the following sections, the existing literature is reviewed to identify the average sleep duration obtained by young, middle-aged and elderly adults, as well as age-specific information about their sleep, including possible causes of inadequate sleep duration. While sleep is important for health and quality of life at all ages (Asplund, 1999), the comparison between these groups is important because they are under different pressures to reduce their amount of sleep and experience various levels of success in sleeping when attempted (Dement & Vaughan, 1999; Martin, 2002). Attitudes about sleep and sleep habits change substantially with increasing age (Dement & Vaughan, 1999), yet sleep deprivation is a severe health and safety issue common to adults of all ages (Bonnet & Arand, 1995).

2.1.2 The sleep of young adults

The consensus that sleep becomes increasingly disturbed with age (Carrier *et al.*, 1997) suggests that young adults have the least problems with sleep *per se*. Smith *et al.* (2005) found that the average nocturnal sleep duration of 47 young adults recruited from the general population as estimated from sleep diaries was 8.1 hours. Conversely, Lehnkering and Siegmund (2007) used actiwatches and reported that 34 young adults slept for an average of 6.4 hours per night. A questionnaire-based study of 1610 UK university students revealed that 24% slept for only 5-6 hours a night and 69% complained of sleep problems, including difficulty initiating and maintaining sleep and difficulty waking up properly in the morning (Webb *et al.*, 1996). Similarly, Hicks *et al.* (2001a) found that 71% of American university students reported dissatisfaction with their sleep. Research by Horne and colleagues revealed that young adults move around more than other age groups during the night, suggesting increased restlessness amongst this group (Horne *et al.*, 1994; Reyner & Horne, 1995). Steptoe *et al.* (2006) took daytime sleep into account in their large-scale cross-cultural study. It involved 17,465 university students from 24 countries and found that the average self-reported sleep duration per 24 hours was 7.5 hours.

Young adults gain increased freedom and control over their sleep-wake cycles, relative to their childhood and adolescence, which is likely to lead to a reduction in nocturnal sleep duration (Dinges, 1993). Also, the demands of university, extracurricular, social and work activity contribute to insufficient sleep (Dinges, 1993). Broman *et al.* (1996)

found that the most frequent self-reported causes of insufficient sleep amongst young adults were social factors, namely leisure activities, having too little time and watching television. Young adults attempt to make up for the chronic sleep debt they have accumulated during the week by extending their sleep duration at the weekend (Dement & Vaughan, 1999; Hawkins & Shaw, 1992).

Coren (1996) argued that the introduction of novel technology has drastically changed our environmental conditions and is a fundamental cause of the current societal problem of chronic sleep deprivation. Young adults may be the age group more prone to engaging in this new media, such as using computers, the Internet and watching DVDs, as they have grown up with this technology and have learnt how to use it during their educational years. Indeed, Ban and Lee (2001) reported that one third of their sample of 1414 Korean university students who reported insufficient sleep pointed to visual media as the primary cause. Further, 60% of this media-generated insufficient sleep was attributed to computers.

After young adults leave education, the pressure to sacrifice sleep increases further as they assume the responsibilities of full-time jobs and families (Bonnet & Arand, 1995). The switch from a typical night-owl student schedule to one more suited to the working world is a difficult process of adaptation, particularly as the old schedule is usually maintained on the weekends (Dement & Vaughan, 1999). In addition, the unconventional sleep-wake schedule resulting from shift work can contribute to bouts of insomnia (Dement & Vaughan, 1999). Sleep can also be severely disturbed during pregnancy and one of the greatest disruptions to the sleep of adults is the sleep problems and patterns of their infants and children (Dement & Vaughan, 1999).

2.1.3 The sleep of middle-aged adults

Studies employing objective measures of sleep have found that middle-aged adults sleep for less at night (Campbell & Murphy, 2007; Carrier *et al.*, 1997; Landolt *et al.* 1996) and have a lower sleep efficiency score, i.e., the percentage of time spent asleep in the nocturnal sleep period (Carrier *et al.*, 1997; Landolt *et al.* 1996), relative to young adults. Large-scale questionnaire-based studies and surveys have also found that middle-aged adults had a shorter nocturnal sleep duration (Anderson & Horne, 2008;

Groeger *et al.*, 2004) and higher levels of daytime sleepiness (Anderson & Horne, 2008) than young adults. A population-based study that assessed sleep duration via actigraphy found that a sample of 669 middle-aged adults slept for an average of 6.1 hours per night (Lauderdale *et al.*, 2008). Jean-Louis *et al.* (2000) used actiwatches to measure the usual sleep and wake patterns of a representative sample of 273 adults aged from 40 to 64 years over a 24-hour period in order to take account of daytime naps as well as nocturnal sleep. They reported that the average daily sleep duration was just 6.2 hours. Hublin *et al.* (2001) showed that 20% of middle-aged adults reported insufficient sleep. Middle-aged adults also commonly report problems with their nocturnal sleep quality. For example, Owens and Matthews (1998) found that 42% of middle-aged women experienced some type of sleep disturbance.

Reasons for short sleep duration in middle-aged adults include a reliance on children's sleeping patterns (Broman *et al.*, 1996), an increased prevalence of sleep disorders relative to young adults (Bonnet & Arand, 1995; Dement & Vaughan, 1999), the menopause (Ancoli-Israel, 1996; Dement & Vaughan, 1999; Owens & Matthews, 1998) and shift work (Bonnet & Arand, 1995).

Recent narrative reviews and meta-analyses have identified a significant gap in the literature regarding the sleep of middle-aged adults, one that is crucial to fill as recognising the effects of aging on sleep is the initial step in overcoming its problems (Campbell & Murphy, 2007; Dement and Vaughan, 1999; Ohayon *et al.*, 2004).

2.1.4 The sleep of elderly adults

Hume *et al.* (1998) found that nocturnal sleep duration, assessed objectively, was longest amongst young adults, followed by middle-aged adults, and shortest amongst elderly adults. Indeed, the majority of past research shows that both nocturnal sleep duration (Brower & Hall, 2001; Campbell & Murphy, 2007; Ferrara & De Gennaro, 2001; Floyd *et al.*, 2000; Ohayon *et al.*, 2004; Phillips & Ancoli-Israel, 2001; Reyner & Horne, 1995; Walsleben *et al.*, 2004; Yoon *et al.*, 2003) and efficiency (Buysse *et al.*, 1991; Dement & Vaughan, 1999; Haimov & Lavie, 1997; Ohayon *et al.*, 2004; Phillips & Ancoli-Israel, 2001; Walsleben *et al.*, 2004; Yoon *et al.*, 2003) are lowest amongst elderly adults.

Elderly adults sleep the least primarily because the ability to sleep at night decreases with age (Ancoli-Israel, 1996, 1997). With advancing years, sleep becomes increasingly disrupted by circadian rhythm changes, medication, health problems and bad sleep habits (Ancoli-Israel, 1997). Older adults are also more likely to report symptoms of insomnia (Ohayon & Lemoine, 2004). Between 23% and 34% of over 9000 American adults over the age of 65 years complained of insomnia, for example, having trouble falling asleep and waking too early (Foley *et al.*, 1995). Moreover, this age group are more vulnerable to suffering from sleep disorders such as sleep apnoea and periodic limb movements (Ancoli-Israel, 1989; Carskadon & Dement, 1981; Daly, 1989; Phillips & Ancoli-Israel, 2001) which lead to sleep fragmentation and ultimately excessive daytime sleepiness (Bonnet & Arand, 1995; Carskadon *et al.*, 1982; Roth *et al.*, 1994). Poor health has also been cited as a cause of the age-related deteriorations in sleep quantity and quality (Bliwise *et al.*, 1992; Foley *et al.*, 1995, 1999; Mallon & Hetta, 1997).

The reduced sleep duration and quality should result in a higher level of daytime sleepiness amongst this age group and some reviews state that this is the case (e.g., Ancoli-Israel, 1997). However, two recent laboratory-based studies found that when given the opportunity to sleep during the day, the propensity to sleep was actually lower among elderly adults, relative to younger groups (Campbell & Murphy, 2007; Klerman & Dijk, 2008). Older adults have also been found to report less sleepiness during the night than young individuals (Lowden *et al.*, 2009). These findings may be due to an age-related reduction in sleep need (Klerman & Dijk, 2008). This issue has received attention in the literature, however, results have been mixed. On the one hand, Dement and Vaughan (1999) argued that the need for sleep decreases through adulthood by approximately 30 to 60 minutes from young to old age, an argument qualified by Klerman and Dijk's (2008) recent laboratory-based finding that the asymptotic sleep needs of young (mean age = 22 years) and elderly (mean age = 68 years) adults were 8.9 and 7.4 hours respectively, as well as from findings that self-reported sleep need decreases with age (Anderson & Horne, 2008; Broman *et al.*, 1996; Lowden *et al.*, 2009). Conversely, Phillips and Ancoli-Israel (2001) made the case that, providing the individual remains healthy in old age, sleep need should remain stable with increasing age, and research by Drapeau and Carrier (2004) suggested the presence of a similar sleep need amongst young and middle-aged adults. Despite the proposed age-related decline in sleep need, Dement and Vaughan (1999) maintained that elderly adults are the most sleep deprived age group.

It has generally been found that elderly adults sleep the most during the day relative to younger adults (e.g., Dement & Vaughan, 1999; Dinges, 1993; Groeger *et al.*, 2004). This may reflect excess leisure time due to retirement, rather than a biological necessity (Bliwise, 1993; Haimov & Lavie, 1997). Goldman *et al.* (2008) monitored the sleep of 235 healthy elderly adults using actiwatches and sleep diaries over a typical one week period. Over 75% of participants reported napping during the daytime, although nap duration was not linked to the duration or continuity of sleep the previous night. This suggests that the role of the daytime nap in the elderly is not simply to remedy deficiencies of nocturnal sleep. Goldman *et al.* (2008) also found that nocturnal sleep duration and quality were equivalent for those who did and those who did not nap. This latter finding was corroborated by Picarsic *et al.* (2008) in their study of 414 elderly adults, of which 54% reported daytime napping. Further, an experimental study found that daytime naps did not interfere with subsequent nocturnal sleep duration or quality (Campbell *et al.*, 2005), although there may be cognitive, psychomotor and affective benefits to be gained from extra daytime sleep among the elderly (Campbell *et al.*, 2005; Milner & Cote, 2009).

In those who nap, the average duration of daytime sleep taken by elderly adults has often been found to be approximately one hour (Evans & Rogers, 1994; Goldman *et al.*, 2008; Picarsic *et al.*, 2008). Evans and Rogers (1994) reported that all of their 14 healthy elderly participants napped and actigraphy estimated that their average sleep duration per 24 hours was 7.3 hours, of which 86% was taken at night. Similarly, Picarsic *et al.* (2008) found that their sample of 414 elderly adults self-reported sleeping an average of 7.4 hours per 24 hours. The redistribution of sleep over the 24-hour day allows elderly adults to supplement their reduced nocturnal sleep (Campbell & Murphy, 2007) and suggests that the average daily sleep duration of healthy elderly adults may equal that of younger adults (Bliwise, 1993; Haimov & Lavie, 1997).

Martin (2002) pointed out the many similarities between the characteristics of old age and sleep deprivation, such as slow reactions, impaired memory and depressed mood. These states are often interpreted as unavoidable consequences of old age, however, it is possible that they are caused by chronic sleep deprivation and are therefore relatively preventable (Martin, 2002).

2.1.5 Measures of sleep duration

The accuracy of self-reports of nocturnal sleep duration is disputed in the literature and this may be due to the different methods employed in various studies. In many reviews, subjective estimates of sleep duration are considered to be inherently inaccurate relative to objective measures (e.g., Hublin *et al.*, 2001; Marshall *et al.*, 2004). Individuals both with and without sleep disorders have been found to underestimate their sleep duration when asked the morning after a night of polysomnograph-recorded sleep (Carskadon *et al.*, 1976; Coren, 1996; McCall *et al.*, 1995). The poor perceived accuracy of self-reported measures of nocturnal sleep duration may have stemmed from the use of single administration questionnaires asking about *usual* sleep patterns, which have several drawbacks. Subjective responses to questions regarding bedtimes and waking up times (which are essential for estimating sleep duration) can be vague and inaccurate, with participants often reporting to the nearest hour (Monk *et al.*, 2003). Also, asking individuals to provide an average of their usual sleeping patterns may be difficult for them to estimate due to the dependence of their sleep on various social and occupational constraints (Monk *et al.*, 2003).

A more reliable subjective measure than a single administration question is to ask individuals to complete a sleep diary, in which they answer the same question every day regarding their sleep the previous night (Buysse & Ganguli, 2002; Horne *et al.*, 1994). The quality and richness of data acquired from a sleep diary surpasses that attained from a single measure (Monk *et al.*, 2003). In support of sleep diaries, Mullington *et al.* (1987) reported a stronger correlation between averages of nocturnal sleep duration taken over one week and over six weeks, both obtained via sleep diaries ($r = .85$, $p < .001$) compared to the relationship between the average duration over six weeks and sleep duration as estimated by participants on a single occasion at the beginning of the study ($r = .59$, $p < .01$). This weaker correlation was attributed to participants underestimating their average sleep duration in the single administration measure. Studies have also found moderate to strong correlations between nocturnal sleep duration when assessed subjectively via sleep diaries and objectively via actigraphy (e.g., Lauderdale *et al.*, 2008; Lockley *et al.*, 1999; Matsumoto *et al.*, 2003).

On the other hand, although sleep diaries collect prospective data, they still rely on retrospective reports, albeit with a short recall period (Buysse, 2004). Also, individuals sometimes forget to make notations, particularly in the daytime (Dement & Vaughan, 1999). Carney *et al.* (2004) reported that the validity of sleep diaries is questionable among young adults, as they found that college students reported their bedtimes inaccurately. Also, individuals have been found to both overestimate (Lauderdale *et al.*, 2007, 2008; Matsumoto *et al.*, 2003; van den Berg *et al.*, 2008) and underestimate (Lockley *et al.*, 1999) their nocturnal sleep duration and to considerably underreport their daytime napping behaviour (Evans & Rogers, 1994; Lockley *et al.*, 1999; Lotjonen *et al.*, 2003; Matsumoto *et al.*, 2003; Yoon *et al.*, 2003) in their sleep diaries compared to objective estimates. Regarding the latter finding, Evans and Rogers (1994) reasoned that participants may not have realised or may have forgotten that they had actually fallen asleep whilst relaxing, for example, while watching television, listening to music or reading, and argued that 'if more accurate information is needed regarding daytime napping, objective rather than subjective measures must be used' (p. 82). Alternatively, the comparative objective methods may have been unable to reliably differentiate sleep from quiet wakefulness (Yoon *et al.*, 2003; see below and section 2.4.3).

Objective measures of behaviour are more accurate, valid and reliable than subjective reports (Armitage & Conner, 2001a). Actigraphy has become a widespread method for studying sleep patterns (Jean-Louis *et al.*, 1997b, 2001). Actigraph data are usually obtained via a wrist-worn monitor- an actiwatch. The actiwatch records and stores the movement and activity pattern of the individual, along with the times of the measurements, allowing the data to be downloaded to a computer for subsequent analysis. A scoring algorithm, which has been validated against polysomnographic data, is then applied to the nocturnal data to identify periods of sleep and wake, based on the premise that the wrist is moved more during periods of wake (Lotjonen *et al.*, 2003).

This objective method of assessing sleep has numerous advantages over the traditional approach of assessing sleep in a laboratory using polysomnography (PSG). It is a relatively simple, inexpensive and unobtrusive method (Ancoli-Isael *et al.*, 2003), which facilitates compliance, permits representative recruitment of participants (Jean-Louis *et al.*, 2000) and allows a greater number of participants to be monitored at once. Actigraphy eliminates the need for participants to be assessed in the laboratory, allowing sleep-wake schedules to be measured in the individual's habitual sleeping environment (Jean-Louis *et al.*, 1997a), and it can record for a much longer period of time compared to the usual one to three nights of PSG (Cole *et al.*, 1992). The 'first night effect', in which the individual's adaptation to the unfamiliar surroundings and to wearing recording electrodes has a significant effect on sleep, that is usually reported in laboratory-based studies is eliminated with actigraphy (Evans & Rogers, 1994; Hume *et al.*, 1998; Jean-Louis *et al.*, 1997b; van Hilten *et al.*, 1993). Additionally, the actiwatch records continuously over the study period, i.e., every day and night, with little impedance to the participant's lifestyle (Reid & Dawson, 1999). In summary, the data recorded by actiwatches are more likely to reflect an individual's real, usual sleep-wake schedule, as measured in their own home, during their normal daily routine and over a longer period of time.

A slight decrease in the accuracy and validity of actigraphic sleep scoring, compared to PSG, with increasing age, has been observed (Jean-Louis *et al.*, 2001; Lotjonen *et al.*, 2003; Reid & Dawson, 1999). Actigraphy has been found to be systematically biased in the estimation of sleep duration in individuals who have poor sleep quality, such as those with sleep disorders and the elderly (Ancoli-Israel *et al.*, 2003; Buysse, 2004; Sadeh & Acebo, 2002). It tends to overestimate sleep duration in these populations by misclassifying quiet wakefulness as sleep, both during the night when individuals lie awake for long periods (Blackwell *et al.*, 2008; Klosch *et al.*, 2001; Lotjonen *et al.*, 2003; Paquet *et al.*, 2007; Pollak *et al.*, 2001; Reid & Dawson, 1999; Reyner & Horne, 1995) and during periods of low activity in the daytime (Ancoli-Israel *et al.*, 2003; Buysse, 2004). Based on the same principle, actigraphy also tends to overestimate sleep efficiency in these populations (Buysse, 2004; Paquet *et al.*, 2007; Pollak *et al.*, 2001). On the other hand, actigraphy may also underestimate sleep duration by misclassifying activity during sleep as wake (Ferrara & de Gennaro, 2001; Klosch *et al.*, 2001). Despite these limitations, a recent review comparing actigraphy to the 'gold standard' of

PSG found it to be a valid and reliable method of assessing sleep duration in healthy adult populations with over 90% agreement between the two methods (Ancoli-Israel *et al.*, 2003).

Summary of measures of sleep duration

When single administrative measures of sleep duration have been used, individuals have been found to underestimate their nocturnal sleep duration. Sleep diaries appear to provide more reliable and valid data, however, studies have found that individuals both overestimate and underestimate their nocturnal sleep duration and underreport their daytime sleep, compared to objective estimates. Actigraphy provides an objective measure of sleep duration and its ability to continually record periods of sleep and wakefulness while participants continue with their usual daily activities over a substantial number of days (e.g., a week) makes it a more valid option than traditional PSG.

2.1.6 The present study

Despite their questionable accuracy, there remains a rationale for obtaining subjective estimates of sleep duration. They provide useful information regarding an individual's perception of their sleep (Baker *et al.*, 1999), which has been found to be related to daytime functioning and psychological distress, regardless of the objective results (Lauderdale *et al.*, 2008; Regestein *et al.*, 2004; Semler & Harvey, 2005; Shaver *et al.*, 1991; Tworoger *et al.*, 2005). Regarding subjective methods, employing both single administrative and sleep diary measures of sleep duration is the ideal (Kelly, 2002) and was adhered to in the present study.

The use of only self-report measures of sleep duration may introduce bias and where possible, multiple measures should be obtained (van den Berg *et al.*, 2008). Actiwatches, as well as providing the advantages over PSG outlined above, may also increase the accuracy and reliability of the corresponding sleep diaries compared to when sleep diaries are used alone with no objective check on the data (Sadeh *et al.*, 1995). In a review of the literature, Sadeh *et al.* (1995) reported that actigraphy and sleep diaries are complementary and should always be used together. The former provides objective data which the participant may be unaware of and the latter supplies essential information for editing the objective data, e.g., actiwatch removal, bedtimes and get up times, as well as subjective sleep-related information, e.g., sleep quality. This permits cross-validation of both methods (Klosch *et al.*, 2001; Sadeh *et al.*, 1995). Therefore, actigraphy was used to obtain an objective measure of sleep duration. The relationship between subjective and actigraphic measures of sleep duration has not been extensively studied over multiple days in a healthy adult population (Lauderdale *et al.*, 2008; van den Berg *et al.*, 2008).

It was important that the time frame was sufficient to establish *usual* sleeping patterns. The period of a week allows sleep and wake to be assessed on both weekdays and at the weekend, which is important as sleep patterns vary depending on the night of the week (Dement & Vaughan, 1999; Hawkins & Shaw, 1992; Tworoger *et al.*, 2005; Yoon *et al.*, 2003). A week of continuous monitoring is usually considered appropriate to verify the usual sleep duration of adults in studies utilising both sleep diaries (Dement & Vaughan, 1999) and actiwatches (e.g., Colecchia *et al.*, 2000). A measure of nocturnal sleep duration obtained via sleep diaries and averaged over one week was found to be strongly related to a measure averaged over six weeks (Mullington *et al.*, 1987). Moreover, five to six nights of data has been reported to result in reliable actigraphic estimates of sleep duration (Knutson *et al.*, 2007; Tworoger *et al.*, 2005).

The vast majority of studies examining sleep duration have concentrated on nocturnal sleep at the expense of daytime napping (Ferrara & De Gennaro, 2001). However, people sleep less now than they ever have (Ferrara & De Gennaro, 2001; Hicks *et al.*, 2001b; Martin, 2002) and compensatory napping is the most common reason for healthy adults to sleep during the day (Dinges, 1993). This suggests that daytime sleep should be taken into account to reach an overall daily sleep duration, particularly in research involving middle-aged and elderly adults (Bliwise, 1993; Ferrara & De Gennaro, 2001; Picarsic *et al.*, 2008). Idzikowski (2003) reported that 'it is the amount of sleep over a 24-hour period that is important, rather than the amount of sleep that takes place during the night' (p. 18). A further practical advantage of recording sleep and wake for the entire 24 hours is that sleep at home does not always occur in a single nocturnal period as individuals often take evening or morning naps that are not easily differentiated from the main sleep period (Jean-Louis *et al.*, 2000). For these reasons, sleep was assessed continuously over the week under investigation, allowing seven 24-

hour blocks of data to be obtained from the sleep diaries and actiwatches. This also addressed a clear gap in the literature: 'There have been few studies which have recorded 24-h sleep-wake pattern for as much as a week by any means' (Yoon *et al.*, 2003, p. 91).

Measures of sleep duration used in the present research

Three measures of sleep duration during the week under investigation were obtained.

1. A **subjective** (single administration) measure of average sleep duration was obtained at the end of the week.

2. A **diary-based** measure of sleep duration was the average of seven daily accounts of sleep duration provided by participants via a sleep diary.

3. An **objective** measure of sleep duration was acquired by averaging sleep duration per 24 hours as estimated by the actiwatch over the seven days.

2.1.7 Objective sleep hypotheses

The hypotheses detailed below diverged from the main focus of the research and so are referred to as the objective sleep hypotheses (OSH).

2.1.7.1 Effects of age group on objective sleep duration

Three hypotheses were devised based on the literature reviewed above regarding age-related differences in sleep duration. Only the objective measure of sleep duration, i.e., actigraphy, was employed in testing these hypotheses due to its higher accuracy, validity and reliability compared to more subjective measures (Armitage & Conner, 2001a).

1) All three age groups would sleep less than eight hours per 24 hours (OSH_1).

2) Young adults would have the longest nocturnal sleep duration and elderly adults the shortest (OSH_2).

3) Elderly adults would have significantly more daytime sleep, relative to young and middle-aged adults (OSH_3).

2.1.7.2 Effects of age group on objective sleep quality

Past research also led to a hypothesis regarding sleep quality which has been found to be associated with health and well-being (Barton *et al.*, 1995; Briones *et al.*, 1996; Gray & Watson, 2002; Moore *et al.*, 2002; Pilcher *et al.*, 1997; Shaver & Paulsen, 1993). Although the objective data demonstrate that sleep quality (i.e., sleep efficiency) is highest amongst young adults and lowest amongst elderly adults (e.g., Carrier *et al.*, 1997; Yoon *et al.*, 2003), studies involving subjective ratings of sleep quality do not show such consistent results. Landolt *et al.* (1996) found no differences in the self-reported sleep quality of young and middle-aged men, despite a reduced objective sleep efficiency score in the middle-aged group. Also, a large epidemiological study found equivalent proportions of respondents who were dissatisfied with their sleep across the ages of 15 and 96 years, even though the prevalence of insomnia increased with age (Ohayon & Lemoine, 2004). These findings suggest that people may not be consciously aware of the extent of their sleep problems.

Further, this misconception may be more apparent in elderly adults. Seppala *et al.* (1997) reported that interrupted sleep was commonly reported by their sample of 600 elderly adults, however, 88% of respondents described their sleep as at least satisfactory. Studies have also shown that despite objective data indicating that the nocturnal sleep of elderly participants was of poor quality, these individuals reported their sleep as good (Evans & Rogers, 1994; O'Donnell *et al.*, 2009). Psychologically and physiologically healthy elderly adults may adapt their subjective perception of sleep quality to the age-related increase in sleep disturbance, resulting in a preservation of sleep satisfaction (Buysse *et al.*, 1991; Zilli *et al.*, 2009). Therefore, the following hypothesis was devised for the objective measure of sleep quality only.

4) Young adults would have the best sleep quality and elderly adults the worst (OSH_4).

2.1.7.3 Comparisons between measures of sleep duration

No previous studies have explicitly investigated differences between overall sleep duration per 24 hours as estimated by various subjective and objective methods, and so two hypotheses were made based on the previous literature on nocturnal sleep duration reviewed above.

5) Out of the two self-reported measures of overall sleep duration, the diary-based measure would be more closely related to the objective measure, than the subjective measure (OSH_5).

6) Participants would underestimate their overall sleep duration when reporting it retrospectively on a single occasion (subjective measure), compared to the diary-based and objective measures (OSH_6).

2.2 METHOD

2.2.1 Design

Participants wore an actiwatch (Actiwatch®, Cambridge Neurotechnology, Cambridge, UK) and completed a sleep diary for one week, after which they returned to complete a short questionnaire regarding their sleep duration over the previous seven days.

2.2.2 Participants

To ensure that only healthy adults who had fairly normal and natural sleep patterns (not induced by work or unusual circumstances) were recruited and that the data obtained from the actiwatches were accurate, the screening process excluded people who worked night-shifts, people with a diagnosed sleep disorder, people taking sleeping pills, people who were chronically or acutely ill or who had a psychiatric illness, pregnant women and people with a new born baby in the house. The recruitment campaign included the placement of posters in public places, emails sent to the students and staff of a north-west university, attendance at a number of clubs arranged for older adults and word of mouth. Potential participants were told they would receive a £10 gift-card for a local supermarket at the end of their role in the study and that they would be informed of their average nightly sleep duration and sleep efficiency score if they requested. This was to encourage participation and compliance with the study requirements, and to cover any expenses incurred.

A total of 218 healthy volunteers were recruited via quota sampling. Six participants (two from each age group) began the study but did not complete it, giving a total completion rate of 97.2%. Their data could therefore not be used. The final sample comprised 71 young (36 female; mean age = 22.6 years, SD = 3.3), 71 middle-aged (36 female; mean age = 49.7 years, SD = 4.39) and 70 elderly (35 female; mean age = 73.4 years, SD = 5.7) adults (overall mean age = 48.4 years, SD = 21.3).

2.2.3 Measures

2.2.3.1 Actiwatches and scoring software

The actiwatches (Actiwatch®, Cambridge Neurotechnology, Cambridge, UK) consisted of a piezoelectric accelerometer with a sensitivity of 0.05g and a sampling frequency of 32Hz. Data were automatically saved in the actiwatch and then downloaded onto a computer. It is crucial that the validity of the scoring algorithm employed to identify sleep and wake in the actiwatch data has been previously established (Sadeh & Acebo, 2002). The Actiwatch®, along with the scoring algorithm used in the accompanying software, The Actiwatch Activity & Sleep Analysis 5 software (Version 5.36, Cambridge Neurotechnology Ltd), was validated against PSG by Kushida *et al.* (2001).

Objective sleep duration: The Actiwatch Activity & Sleep Analysis 5 software scored each 30-second epoch of the 24-hour actigraphic data as sleep or wake using a previously-validated scoring algorithm (Kushida *et al.*, 2001). Nocturnal sleep periods were defined by the bedtimes and wake times recorded in the sleep diary (Lowden *et al.*, 2004; Monk *et al.*, 1999) and the actual nocturnal sleep durations were calculated by the sleep program using a medium level of sensitivity, as recommended by Cambridge Neurotechnology (The Actiwatch User Manual, Version 7.2, 2008). The week under investigation began at 8pm on Day 1 and ended at 8pm on Day 8. Therefore, there were seven 24-hour blocks assessed from 8pm to 8pm for each participant.

In some cases, it was clear from the very long periods of continuous inactivity (which were or were not recorded in the sleep diary) that the actiwatch had been removed from the wrist. It was important to identify and remove these periods of noncompliance; otherwise they would be scored as sleep, resulting in an overestimation of sleep duration (Pollak & Stokes, 1997; Pollak *et al.*, 2001). Where this period of inactivity exceeded 10% of the 24-hour day, i.e., when it was equal to or over two hours and 24 minutes, the 24-hour block was considered invalid due to the threat to the objectivity of the data[2]. Thirty-three blocks were omitted based on this criterion (2% of the total number of blocks).

After omitting these periods of inactivity caused by noncompliance, the periods of time between each participant (objectively) waking up until the time they (objectively) went to sleep were analysed to establish any daytime naps (Yoon *et al.*, 2003)[3]. The highest sensitivity level (0) was selected so that only periods of absolutely no movement were identified as actigraphy has been found to overestimate daytime sleep (Ancoli-Israel *et al.*, 2003; Buysse, 2004). Despite this, a very high frequency of periods of no movement lasting over five minutes was found both between and within participants (only one participant out of the whole sample did not have any of these instances) and the vast majority of these were not recorded in the sleep diaries. It was therefore decided that periods of no movement lasting between five and 9.5 minutes duration constituted quiet resting, whereas periods equal to or over 10 minutes were defined as a daytime nap. This is consistent with the method used by Lotjonen *et al.* (2003).

Although Lotjonen *et al.* (2003) set the maximum duration for a daytime nap at two hours, the maximum daytime nap duration in the present study was set at two hours and 24 minutes (i.e., corresponding to the cut-off point for defining noncompliance). One participant had one nap lasting over two hours and another had two naps over this duration and in all three cases, these naps took place just before or after the nocturnal

[2] Previous studies using different actiwatches have defined shorter periods of continuous inactivity as representing noncompliance, based on the maximum duration of zero activity of physiological origin identified by the actiwatches, ranging from 25 (Pollak & Stokes, 1997) to 90 (Pollak *et al.*, 2001) minutes. However, these durations are largely dependent on the particular actiwatch used and should therefore not automatically be applied to data obtained from different actiwatches (Pollak & Stokes, 1997; Pollak *et al.*, 1998). The cut-off period defined in the present study was driven by the data obtained from the actiwatches and was supported by the existence of relatively long periods of inactivity which were likely to be actual naps.

[3] Thus, although there was an element of subjectivity in distinguishing daytime sleep from nocturnal sleep (due to reliance on subjective bedtimes and wake times), the measure of overall sleep duration per 24 hours was estimated using purely objective methods.

sleep period. Additionally, the participant with two naps of over two hours recorded them in her sleep diary and the remainder of her naps were relatively long, i.e., she had eight naps of over one hour duration. Therefore, the evidence suggested that these relatively long periods of inactivity were actual naps, as opposed to periods of watch removal, providing support for the cut-off period employed.

The objective measures of nocturnal and daytime sleep duration were produced by taking the mean for the seven days (overall: $\alpha = .74$; young: $\alpha = .30$; middle-aged: $\alpha = .67$; elderly: $\alpha = .91$ and overall: $\alpha = .79$; young: $\alpha = .69$; middle-aged: $\alpha = .71$; elderly: $\alpha = .85$, respectively). Nocturnal sleep durations and daytime naps for each day were summed, resulting in seven 24-hour blocks for each participant (assuming no missing data). The mean of these blocks represented the objective measure of overall sleep duration, i.e., per 24 hours (overall: $\alpha = .75$; young: $\alpha = .34$; middle-aged: $\alpha = .71$; elderly: $\alpha = .91$).

For a participant's average sleep duration to be valid, they must have had data for at least six of the seven 24-hour blocks. This was judged to be an acceptable representation of an average week as it ensured that at least one weekend block was taken into account (Yoon *et al.*, 2003). Furthermore, due to the nature of the participants' role in the study, i.e., the inconvenience of wearing the actiwatch continuously for a week, it was deemed important to utilise the data to its full extent and prevent unnecessary cases of missing data. (The same criterion was applied to the daytime and nocturnal sleep duration measures.)

Objective sleep quality: The Actiwatch Activity & Sleep Analysis 5 software calculated a sleep efficiency score for each of the seven nocturnal sleep periods for each participant. This value denoted the percentage of time that the participant was actually asleep out of their whole nocturnal sleep period (from sleep onset until their final wake time) and can be used to indicate the quality of their sleep (Akerstedt *et al.*, 1994; Reid & Dawson, 1999). The mean of the seven values was taken as the objective measure of sleep quality (overall: $\alpha = .90$; young: $\alpha = .84$; middle-aged: $\alpha = .89$; elderly: $\alpha = .94$).

2.2.3.2 Sleep diary

The sleep diary included instructions on how to complete the items accurately, as well as a reminder of the importance of recording any times of watch removal (e.g., for showering) in the sleep diary and of making these periods as brief as possible. Open-ended questions to be completed each morning were, 'Time you went to bed last night with the intention to go to sleep', 'Time you fell asleep', 'Final time you woke up this morning', 'Number of times awakened during night' and 'Total amount of time awake during night' (modified from Dement & Vaughan, 1999). Responses to these items were required for the calculation of the diary-based and objective behaviour measures. In addition, two items employing seven-point rating scales (scored -3 to 3), to be answered each morning assessed sleep quality, 'How would you assess the quality of your sleep?' (*extremely bad-extremely good*) and 'How did you feel when you woke up this morning?' (*extremely tired-extremely refreshed*; Akerstedt *et al.*, 1994; Pankhurst & Horne, 1994). The positive and negative endpoints were counterbalanced. A further three open-ended questions were to be answered throughout or at the end of each day, 'Number of naps taken during day', 'Times of naps (fell asleep and woke up)' and 'Time(s) you took the actiwatch off, for how long and the reason for removing it'. The first four pages of the sleep diary which include the instructions and questions to be answered on the first two days, are presented in Appendix 2.1 (the remaining pages contained the same questions to be answered each day).

Diary-based sleep duration: As for the objective measure, seven 24-hour blocks were assessed from 8pm to 8pm for each participant. Nocturnal and daytime sleep durations (the latter was the total duration of any daytime naps lasting over 10 minutes to concur with the calculation of the objective measure) were calculated for each day using the data from the sleep diary. The diary-based measures of nocturnal and daytime sleep duration were formed by averaging the data over the seven days (overall: $\alpha = .76$; young: $\alpha = .43$; middle-aged: $\alpha = .71$; elderly: $\alpha = .89$ and overall: $\alpha = .67$; young: $\alpha = .40$; middle-aged: $\alpha = .70$; elderly: $\alpha = .79$, respectively). Overall sleep duration was calculated by summing the nocturnal and daytime sleep durations for each day and taking the mean of the resulting values (overall: $\alpha = .72$; young: $\alpha = .44$; middle-aged: $\alpha = .63$; elderly: $\alpha = .85$). Participants must have had at least six blocks of data for their sleep duration measure to be valid.

Diary-based sleep quality: Both of the items assessing sleep quality displayed high internal consistency across the seven days (overall: $\alpha = .73$ and $\alpha = .78$). The mean of these two items over the week were averaged together to create the diary-based measure of sleep quality (overall $\alpha = .78$; young: $\alpha = .75$; middle-aged: $\alpha = .81$; elderly: $\alpha = .77$).

2.2.3.3 Short questionnaire

To obtain a single administrative subjective account of sleep duration over the previous seven days, participants were asked 'On average, how many hours of sleep did you get per 24 hours in the last week?'. To assess the extent to which the week under investigation was a typical week for participants in terms of sleeping patterns, they were asked, 'Did anything out of the ordinary happen in the last week which significantly affected your sleeping patterns and if so, what happened?'. Participants were also asked a number of demographic questions including age, gender, occupation, usual hours of work, marital status and whether they lived with any children. Finally, participants were asked whether or not they normally slept alone as research has suggested that sleeping with a partner can affect sleep (Pankhurst & Horne, 1994). The short questionnaire can be found in Appendix 2.2.

2.2.4 Procedure

Prior to arranging a start date for each participant, it was ensured that they chose a week that they anticipated would be fairly normal in terms of sleeping patterns. For example, it was checked that they were not going on holiday or had booked several days off work during the week in which they were required to wear the actiwatch.

Each actiwatch was set up to collect data in 30-second epochs and was labelled with a unique participant number.

Prior to 8pm on Day 1 of the study, participants reported to the laboratory and were fully informed of the purpose of the study and their role (see Appendix 2.3). After being made aware that all of the data they supplied would remain confidential and anonymous and that they had the right to withdraw from the study at any time, the participants signed a consent form. They were then asked to wear an actiwatch around their nondominant wrist and to complete a sleep diary every day for the next seven days.

Participants were made aware of what the actiwatch measured and were told that it was crucial that they wore the monitor continuously for the full week until they met with the investigator again. The only exception to this rule was when participants were taking a shower or bath or if they were to go swimming, etc, as the actiwatches were not fully waterproof. The importance of recording any incidences of actiwatch removal in the sleep diary was stressed to participants, as well as the need to remember to put the actiwatch back on as soon as possible, and always to put it on the nondominant wrist. The date on which the participant began the study was written on Day 1 of the sleep diary, followed by the consecutive dates to aid their understanding. Finally, participants were reminded to maintain their usual activities over the week under investigation.

Participants returned at the end of the week to complete the short questionnaire. It was ensured that participants did not look at their sleep diary when estimating their sleep duration so that the measures were independent. Finally, participants were thanked, debriefed and given a supermarket gift-card for their participation. If requested, they were contacted and told their average nightly sleep duration and sleep efficiency score after the data had been analysed. When their role in the study was complete, the data from each participant were matched and stored together under their unique participant number.

Although actigraphy has been found to be valid and reliable for detecting sleep in healthy adults (Ancoli-Israel *et al.*, 2003), a simple accuracy check was conducted whereby the data from the actiwatches from the first three participants were matched with the corresponding sleep diaries. This revealed no problems.

Responses to the item in the short questionnaire enquiring about the occurrence of any unusual events were dichotomously coded to indicate whether or not the week under investigation was typical for participants in terms of sleeping patterns. Responses indicating the occurrence of no unusual events or those detailing only very minor (perhaps non-existent) deviations to normality (e.g., participants stated that they went out at the weekend) signified a normal week. Answers which described more unusual events, ranging from minor but ongoing (e.g., having a minor illness) to more serious departures from normality which were clearly not anticipated (e.g., death of a friend) represented an atypical week.

2.3 RESULTS

Two actiwatches malfunctioned resulting in the loss of two sets of objective data (for one young and one middle-aged adult). It was found that 68% of young, 69% of middle-aged and 80% of elderly adults experienced a normal week while they were taking part in the study.

2.3.1 Effects of demographics on overall objective sleep duration and sleep quality

Females slept for longer ($M = 7.55$ hours, SD = 0.75) than males ($M = 7.16$ hours, SD = 0.92) per 24 hours ($t\ (195.92) = -3.32, p < .01$). Marital status ($F\ (4, 197) = 1.42, p > .05, \eta^2 = .03$), whether or not the participant lived with any children ($t\ (203) = 1.02, p > .05$), slept alone ($t\ (147.57) = -1.18, p > .05$) and the extent of week typicality ($t\ (203) = -0.39, p > .05$) all did not influence overall objective sleep duration. Gender ($U = 5245$, $p > .05$), whether the participant lived with any children ($U = 2316, p > .05$) and week typicality ($U = 4061, p > .05$) did not significantly affect objective nocturnal sleep quality. Adults who slept alone had poorer sleep (*Mdn* = 87%, range = 32) than those who slept with a partner (*Mdn* = 88%, range = 27; $U = 3591, p < .05$). Also, marital status (single, co-habiting, married, divorced/separated, widowed) significantly influenced sleep quality ($H\ (4) = 15.36, p < .01$). Post hoc tests based on average rankings with Siegel and Castellan (1988) corrections for multiple comparisons revealed that married individuals (*Mdn* = 89%, range = 44) had better sleep than single individuals (*Mdn* = 87%, range = 33; $p < .05$). All remaining comparisons were not significant ($ps > .05$).

2.3.2 Effects of age group on objective sleep duration

Table 2.1 shows the descriptive statistics for overall, nocturnal and daytime sleep durations, and the proportion of sleep that was taken during the day, as estimated by actigraphy, for the whole sample and the separate age groups.

Table 2.1: Mean (SD) objective sleep durations and proportion of sleep taken during the day, overall and by age group

	Overall objective sleep duration (in hours)	Objective nocturnal sleep duration (in hours)	Objective daytime sleep duration (in minutes)	Proportion of overall sleep taken during the day (%)
Overall	7.35 (0.86)	6.87 (0.84)	28.31 (29.10)	6.42
Young	7.42 (0.71)	7.09 (0.66)	18.28 (24.10)	4.11
Middle-aged	7.02 (0.72)	6.53 (0.65)	29.91 (31.32)	8.00
Elderly	7.61 (1.02)	6.99 (1.04)	36.98 (28.72)	8.09

Overall, participants slept for an average of 7 hours and 21 minutes over a 24-hour period. This comprised 6 hours and 52 minutes during the night and 28 minutes during the day. The finding that all of the overall sleep durations were less than eight hours supports the first hypothesis (OSH_1).

Figure 2.1: Objective sleep durations of young, middle-aged and elderly adults (in minutes)

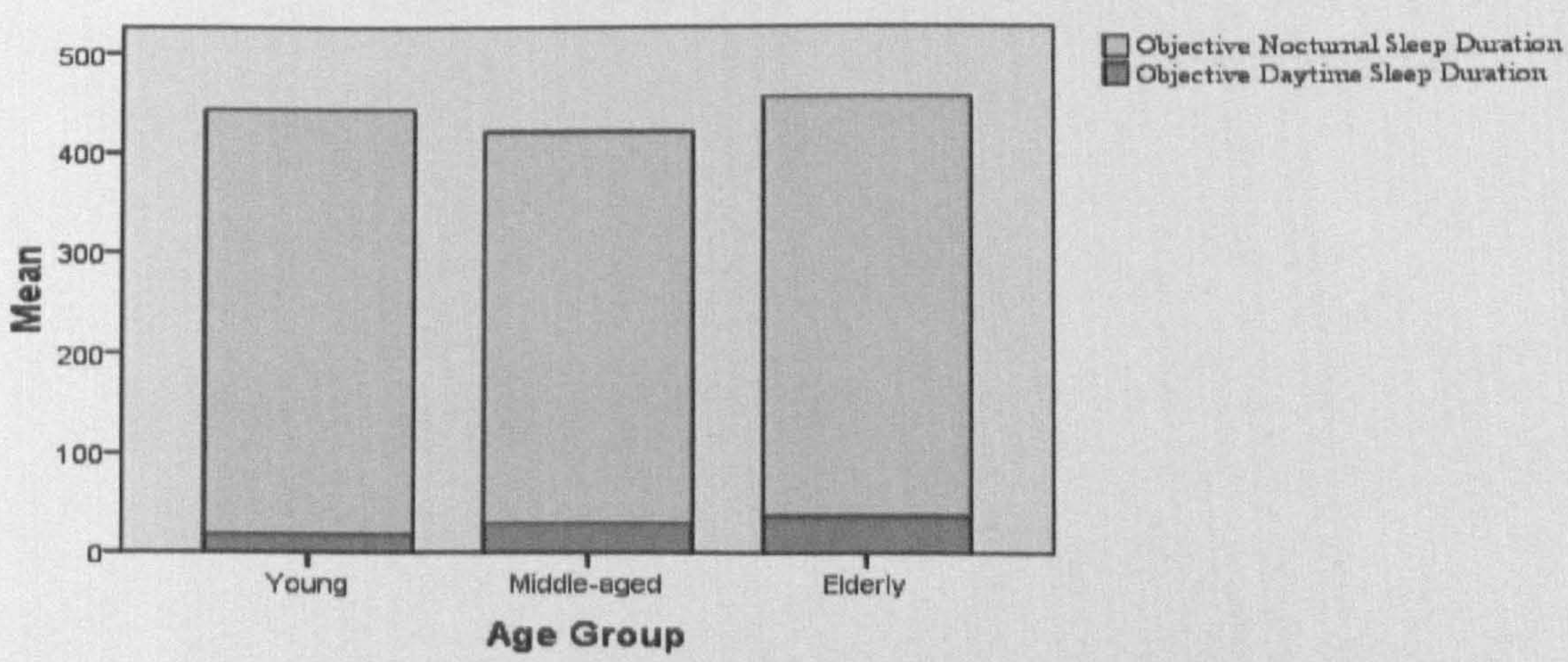

Table 2.1 and Figure 2.1 show that elderly adults slept for the longest time per 24 hours and during the day. Conversely, middle-aged adults slept for the least time over a 24-hour period and this appears to be due to their noticeably short nocturnal sleep duration. Young adults slept less during the day but more at night compared to the other groups.

Figure 2.2: Error bar chart to show 95% confidence intervals of overall objective sleep duration (in minutes) for young, middle-aged and elderly adults

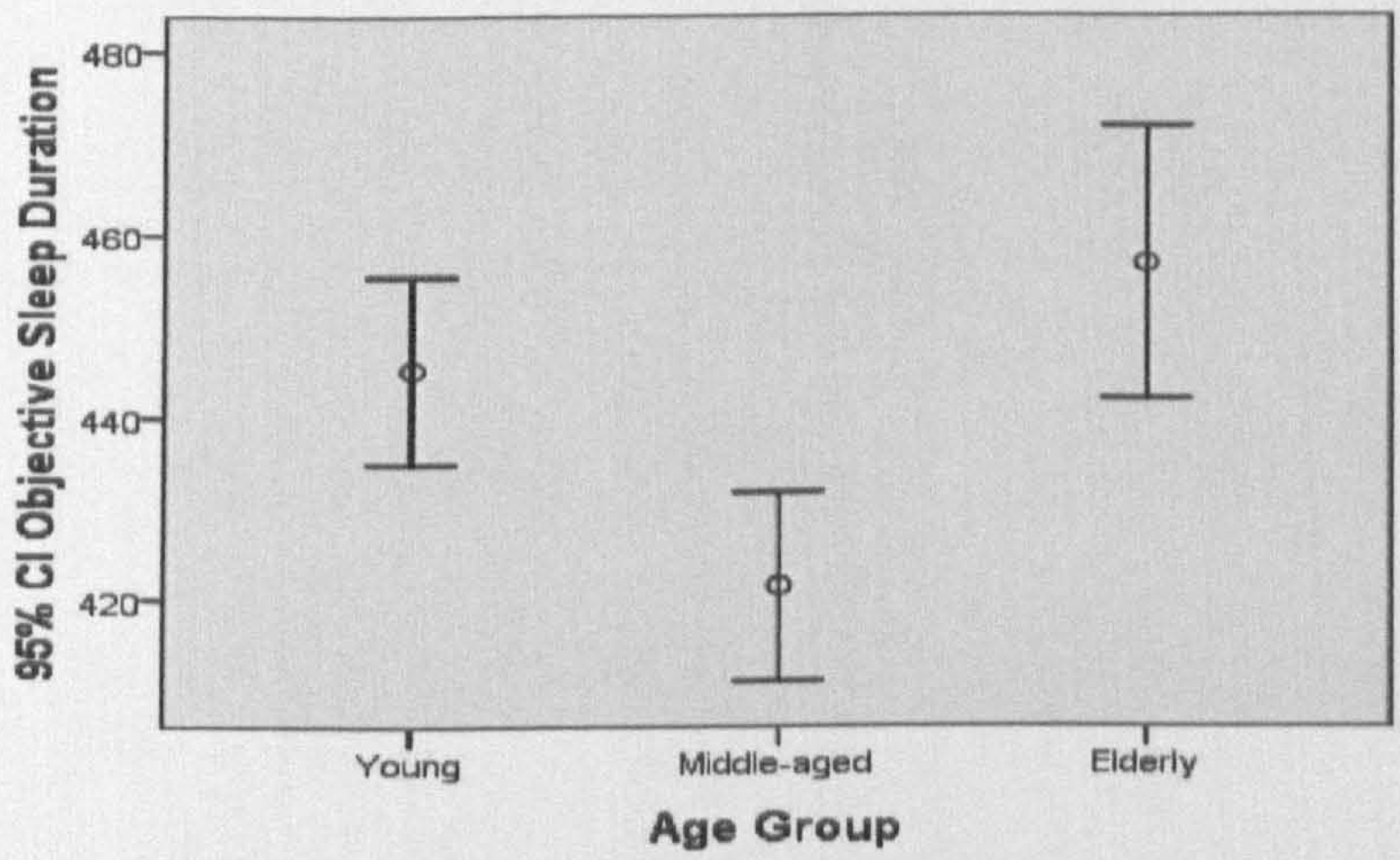

Figure 2.2 indicates that there is a 95% chance that the population mean for the overall sleep duration of middle-aged adults is lower than those of the young and elderly adults. There appears to be no difference in the overall sleep duration of the latter groups.

Overall objective sleep duration: To examine age differences in objective sleep duration per 24 hours, the data were first screened to test if it met the assumptions for parametric analyses. Objective sleep duration was normally distributed for young (D (69) = 0.08, p > .05), middle-aged (D (69) = 0.07, p > .05) and elderly (D (67) = 0.09, p > .05) adults. Although Levene's test revealed that the variances were heterogeneous (F (2, 202) = 4.30, p < .05), the sample sizes of the three groups were approximately equal and therefore ANOVA is fairly robust to this minor violation (Field, 2005). A one-way independent ANOVA indicated that age significantly affected overall sleep duration (F (2, 202) = 8.99, p < .001, η^2 = .08). Post hoc Tukey tests revealed that middle-aged adults slept significantly less than young (p < .05) and elderly (p < .001) adults. There was no difference between the sleep duration of young and elderly adults (p > .05).

Objective nocturnal sleep duration: The data deviated from normality in two out of the three groups (ps < .05) and the variances were unequal (F (2, 207) = 6.29, p < .05), so a Kruskal-Wallis test was performed. Age significantly influenced nocturnal sleep duration (H (2) = 26.30, p < .001). Post hoc tests with Siegel and Castellan (1988) corrections for multiple comparisons revealed that, as with overall sleep duration, middle-aged adults slept significantly less than young ($p < .05$) and elderly adults ($p < .05$), whereas there was no difference in the nocturnal sleep of young and elderly adults ($p > .05$). This finding does not support the hypothesis (OSH_2) that young adults would have the longest nocturnal sleep duration and elderly adults the shortest.

Objective daytime sleep duration: Levene's test showed that the variances of the groups were homogeneous (F (2, 202) = 1.04, $p > .05$). However, daytime sleep duration was not normally distributed for any of the three age groups (ps < .05), so a Kruskal-Wallis test was performed. Age significantly affected objective daytime sleep duration (H (2) = 28.96, $p < .001$). Post hoc tests indicated that the elderly adults slept more than the young ($p < .05$) and the middle-aged ($p < .05$) adults, and the middle-aged adults had more daytime sleep than the young adults (p (one-tailed) < .05).

Proportion of overall sleep taken during the day: The variances of the groups were equal (F (2, 202) = 1.29, $p > .05$), but due to the non-normal distribution of the data (ps < .05) a Kruskal-Wallis test was performed. Age significantly influenced the proportion of sleep that was taken in the daytime (H (2) = 28.57, $p < .001$). Post hoc tests showed that young adults took the least amount of their sleep during the day than both middle-aged ($p < .05$) and elderly adults ($p < .05$). There was no significant difference between the proportion of daytime sleep taken by the middle-aged and elderly adults ($p > .05$).

The hypothesis (OSH_3) that elderly adults would sleep the most during the day was partially supported.

2.3.3 Effects of age group on nocturnal sleep quality

Table 2.2 shows the descriptive statistics and the relationship between the diary-based and objective measures of sleep quality, for the whole sample and the separate age groups.

Table 2.2: Mean (SD) and correlations between measures of sleep quality

	Diary-based sleep quality (-3 to 3)	Objective sleep quality (%)	Pearson's correlation
Overall	0.51 (0.87)	86.19% (6.20)	.09
Young	0.38 (0.68)	84.91% (5.55)	-.02
Middle-aged	0.40 (0.99)	87.34% (5.47)	-.06
Elderly	0.76 (0.89)	86.34% (7.26)	.30**

$^{**}p < .01$

Overall, participants spent 86% of the time in which they were in bed asleep. Elderly adults perceived their sleep quality was good in comparison to the other groups, yet the objective data indicated that the middle-aged adults had the best quality of sleep. The young adults had the lowest sleep quality as estimated by both methods. The two measures of sleep quality were not significantly related in the overall sample or amongst the separate groups of young and middle-aged adults. Elderly adults seemed more able to accurately estimate the quality of their nocturnal sleep as the two measures were significantly and moderately related.

Diary-based sleep quality: Despite Levene's test showing that the variances were heterogeneous (F (2, 205) = 3.36, p < .05), the sample sizes of the three groups were approximately equal and the data were normally distributed in two out of the three groups (D (71) = 0.08, p > .05 and D (71) = 0.10, p > .05 for the young and middle-aged adults respectively; D (66) = 0.13, p < .05 for the elderly adults). Thus, the evidence supported the use of a parametric test. A one-way independent ANOVA revealed that age significantly affected the diary-based measure of sleep quality (F (2, 205) = 4.13, p < .05, η^2 = .04). Elderly adults perceived their sleep quality was significantly better than young (p < .05) and middle-aged adults (p < .05). The average sleep quality reported by young and middle-aged adults did not differ (p > .05).

Objective sleep quality: The variances were homogeneous (F (2, 207) = 1.53, p > .05), but the distribution of the data failed to meet the assumptions for a parametric test (p < .05 for all three groups). A Kruskal-Wallis test showed a significant effect of age on objective sleep quality (H (2) = 9.45, p < .01). Young adults had a significantly lower sleep quality percentage than middle-aged (p < .05) and elderly (p < .05) adults.

Objective sleep quality did not differ between the remaining two groups ($p > .05$). This finding did not support the hypothesis (OSH4) that young adults would have the best objective sleep quality and elderly adults the worst.

2.3.4 Comparisons between measures of sleep duration

Overall sleep duration per 24 hours: To test the effect of type of measure on average sleep duration per 24 hours, data from all three age groups were analysed together. A total of three measures of overall sleep duration were obtained; subjective (the open-ended measure in the Time 2 questionnaire), diary-based and objective[4]. The two self-reported measures of overall sleep duration correlated strongly with each other ($r = .72$, $p < .001$), however, their correlations with the objective measure were substantially weaker. As predicted by the hypothesis (OSH5), objective sleep duration had a slightly stronger relationship with the diary-based measure than with the subjective, retrospective measure ($r = .43, p < .001$ versus $r = .33, p < .001$).

Table 2.3 shows the descriptive statistics for the three measures of sleep duration for the overall sample of adults.

Table 2.3: Average sleep duration (SD) by type of measure

Type of measure	Mean sleep duration (SD) in hours
Subjective	6.98 (1.12)
Diary-based	7.38 (1.03)
Objective	7.38 (0.86)

The average sleep duration calculated by the diary-based and objective measures of sleep duration were identical, whereas the subjective measure averaged a duration of 24 minutes shorter.

[4] The subjective measure did not correspond fully to the other two measures. Participants were asked to estimate their sleep duration over the seven days on which they wore the actiwatch but the diary-based and objective measures were considered valid measures of average sleep duration even if based on only six out of the seven nights (see section 2.2.3). The diary-based and objective measures were based on six nights for 25 and 17 participants, respectively.

As the sample size was large, the distribution of the data and the size of skewness and kurtosis statistics were visually inspected to assess whether or not the data were normally distributed (Field, 2005; Tabachnik & Fidell, 2007). Histograms, boxplots and normal Q-Q plots revealed no substantial variations from normality. Furthermore, four out of the six *z*-scores for skewness and kurtosis were below 3.29 (Field, 2005) and the remaining two values both indicated positive kurtosis (4.28 and 6.43) which is not problematic for samples of over 100 (Tabachnik & Fidell, 2007).

A one-way repeated measures ANOVA revealed that average sleep duration was significantly different according to the type of measure (F (1.69, 323.44) = 19.98, $p <$ .001, partial $\eta^2 = .10$). Pairwise comparisons with Bonferroni adjustments indicated that participants significantly underestimated their sleep duration when they reported it retrospectively (subjective measure), compared to when they reported it daily ($p < .001$) and when it was measured objectively ($p < .001$). There were no differences in the diary-based and objective measures of sleep duration ($p > .05$). These findings fully support the hypothesis (OSH6) that participants would underestimate their overall sleep duration when reporting it retrospectively on a single occasion.

Nocturnal sleep duration: The diary-based and objective measures of nocturnal sleep duration were strongly correlated (r_s = .69, $p < .001$). Participants significantly overestimated their nocturnal sleep in their sleep diary by an average of 16 minutes (*Mdn* = 435.86 minutes, range = 399.43), compared with the objective data (*Mdn* = 419.50 minutes, range = 360; $Z = -6.23$, $p < .001$).

Daytime sleep duration: The diary-based and objective measures of daytime sleep duration were also strongly related ($r_s = .56$, $p < .001$). In contrast to the findings for nocturnal sleep duration, however, participants significantly underestimated their daytime nap duration by 16 minutes (*Mdn* = 2.86 minutes, range = 86.43), compared with the objective results (*Mdn* = 19.14 minutes, range = 198; $Z = -10.16$, $p < .001$).

2.4 DISCUSSION

This study provided descriptive information about sleep duration and quality as assessed by the objective measure, actigraphy. In addition, comparisons were made between subjective and objective sleep duration.

2.4.1 Effects of age group on objective sleep duration

Sleep duration per 24 hours was less than the recommended quota of eight hours in all age groups which supports the first hypothesis (OSH_1) and the argument that the general population suffers from chronic sleep loss (e.g., Bonnet & Arand, 1995). This suggests that all three age groups are vulnerable to the wide range of negative effects identified in the literature (see section 2.1.1). The second hypothesis (OSH_2) that young and elderly adults would have the longest and shortest nocturnal sleep duration, respectively, was not supported. Although the middle-aged adults slept less during the night than the young adults, supporting past research (Anderson & Horne, 2008; Campbell & Murphy, 2007; Carrier *et al.*, 1997; Groeger *et al.*, 2004; Landolt *et al.* 1996), they also slept for less time than the elderly adults. This latter finding contradicts a large body of research that has found a reduction of nocturnal sleep duration associated with age (Brower & Hall, 2001; Campbell & Murphy, 2007; Ferrara & De Gennaro, 2001; Floyd *et al.*, 2000; Ohayon *et al.*, 2004; Phillips & Ancoli-Israel, 2001; Reyner & Horne, 1995; Walsleben *et al.*, 2004; Yoon *et al.*, 2003). Daytime sleep duration was highest amongst the elderly adults and lowest amongst the young adults, however the proportion of sleep taken during the day was equivalent in the middle-aged and elderly adults (8%). Therefore, the third hypothesis (OSH_3) and past research (e.g., Dement & Vaughan, 1999; Dinges, 1993; Groeger *et al.*, 2004) were only partially supported. Middle-aged adults may attempt to compensate for their short nocturnal sleep duration by napping during the day (e.g., Dinges, 1993).

The young adults slept for approximately 7.5 hours per 24 hours as estimated by actigraphy. This directly supports and extends, with the use of objective methods, the findings of Steptoe *et al.* (2006) who also found that the self-reported average sleep duration per 24 hours of young adults was 7.5 hours. Compared to the other groups, the young adults slept the most during the night (although not significantly more than the elderly adults) and the least in the daytime, in which 4% of their total sleep was taken. They also had the poorest quality of nocturnal sleep, as identified by themselves (although not significantly lower than the middle-aged adults' estimations) and actigraphy. The middle-aged adults objectively slept for seven hours per 24 hours, which is considerably more than the 6.2 hours found by Jean-Louis *et al.* (2000). As the latter study was conducted over a single 24-hour period, it can be argued that the present findings are more valid. In comparison to the other age groups, the middle-aged group slept for the least time at night and slept for significantly longer than the young adults, but shorter than the elderly adults, during the day. The middle-aged adults had the best sleep quality as determined by actigraphy, however, not significantly better than that of the elderly adults. This, coupled with their short nocturnal sleep duration, suggests that they spend less time in bed than the other age groups (as objective sleep quality was the percentage of time spent asleep out of the nocturnal sleep period).

The average sleep duration per 24 hours of the elderly adults as estimated by actigraphy was slightly above 7.5 hours, which is similar to that found by Evans and Rogers (1994; 7.3 hours) and Picarsic *et al.* (2008; 7.4 hours). This duration was very slightly (and not significantly) longer than that found for the young adults, supporting suggestions that the redistribution of sleep over the 24-hour day found in elderly adults results in their overall daily sleep duration being equivalent to that of young adults (Bliwise, 1993; Haimov & Lavie, 1997). The middle-aged adults slept for a significantly shorter duration per 24 hours than both groups.

Indices of internal reliability indicated that the inter-night variability of sleep duration decreased with age. Young adults had the most inconsistent duration of nocturnal sleep during the week under investigation, possibly due to a different pattern on weekdays versus weekends (Dement & Vaughan, 1999; Hawkins & Shaw, 1992).

2.4.2 Effects of age group on nocturnal sleep quality

Young adults had the poorest objective sleep quality directly in contrast to the fourth hypothesis (OSH_4) which predicted that they would have the best sleep quality and elderly adults the worst. Elderly adults did have poorer sleep quality than the middle-aged group, however, this difference was not significant. The finding that young adults had the worst sleep quality contradicts past studies which have found that older groups display poorer sleep quality (e.g., Dement & Vaughan, 1999; Haimov & Lavie, 1997; Ohayon *et al.*, 2004; Phillips & Ancoli-Israel, 2001; Walsleben *et al.*, 2004; Yoon *et al.*, 2003). However, the present research supports Horne *et al.* (1994) and Reyner and Horne (1995), who found that young adults move around more during the night. This issue requires consideration; actigraphy defines periods of sleep and wake according to the activity of the individual, however, movement *per se* may not accurately constitute poor sleep quality. Hume *et al.* (1998) demonstrated that 'young adult sleep is associated with more movement but less wake within the sleep period and they are therefore able to maintain their sleep better, while older subjects have less movement and more wake' (p. 92). In addition, when awake, young adults are generally more active than their older counterparts and it is reasonable to propose that this would continue into their sleep. Finally, Pollak and Stokes (1997) argued that periods of physical immobility are limited in duration, indicating that movement is a natural occurrence. This issue represents a limitation of actigraphy to validly determine sleep quality and may explain the non-significant correlations found between the subjective and objective measures of sleep quality in the present study.

Research has suggested that self-report measures of sleep quality are inaccurate (Landolt *et al.*, 1996; Ohayon & Lemoine, 2004) and that this phenomenon may be particularly apparent in elderly adults (Evans & Rogers, 1994; O'Donnell *et al.*, 2009; Seppala *et al.*, 1997; see section 2.1.7.2). The present study supports the first part of this contention as sleep quality as estimated by the objective and diary-based methods were unrelated in the young and middle-aged adults, but it could initially be seen to contradict the latter part, as the two measures were moderately correlated in the elderly adults. However, studies using objective methods have found that elderly adults perceived their sleep quality to be better than it actually was (Evans & Rogers, 1994; O'Donnell *et al.*, 2009) and the present results corroborated this as the elderly adults believed their sleep to be of significantly better quality than did the other two groups, despite there being no difference in the objective sleep quality of the middle-aged and elderly adults. This supports the argument that healthy elderly adults may adapt their subjective perception of sleep quality to the age-related increase in sleep disturbance, therefore preserving their sleep satisfaction (Buysse *et al.*, 1991; Zilli *et al.*, 2009).

The fact that elderly adults were screened to exclude those with physical or psychological illnesses, albeit using self-reported methods, may have accounted for their relatively good and adequate sleep. Health problems have been found to be associated with insufficient sleep in this age group (Bliwise *et al.*, 1992; Foley *et al.*, 1995, 1999; Mallon & Hetta, 1997), suggesting that the present findings generalise to the healthy elderly only.

2.4.3 Comparisons between measures of sleep duration

The analyses comparing the different measures of sleep duration were conducted on all of the age groups together and contributed to the relatively limited existing literature on this issue involving healthy adults (Lauderdale *et al.*, 2008; van den Berg *et al.*, 2008). All of the measures of sleep duration were significantly correlated. The strong relationships found between the diary-based and objective measures of nocturnal and daytime sleep duration establishes their convergent validity.

The two self-reported measures (subjective and diary-based) of sleep duration per 24 hours were the most strongly related and the diary-based measure had a slightly stronger correlation with the objective measure than did the subjective retrospective account. This latter result supports the fifth hypothesis (OSH_5) and prior research which argued that measures derived from sleep diaries are more reliable than single administrative questions (Buysse & Ganguli, 2002; Horne *et al.*, 1994; Monk *et al.*, 2003; Mullington *et al.*, 1987). The final hypothesis for this part of the study (OSH_6) was also fully supported, as the adults significantly underestimated their sleep duration per 24 hours when reported retrospectively in comparison to the diary-based and objective measures. The estimation of sleep duration based on the subjective measure was 24 minutes shorter than that of the other two measures, which were equivalent. This supports and extends past studies that found this effect for nocturnal sleep duration (Carskadon *et al.*, 1976; Coren, 1996; McCall *et al.*, 1995) and also again demonstrates that estimates derived from sleep diaries are more reliable and valid than single administrative measures.

On the other hand, the diary-based measure of sleep duration had problems of its own; participants significantly overestimated their nocturnal sleep duration in their sleep diaries but significantly underestimated their daytime sleep, compared to the objective measures. The former finding supports the majority of past research (Lauderdale *et al.*, 2007, 2008; Matsumoto *et al.*, 2003; van den Berg *et al.*, 2008) but contradicts the study by Lockley *et al.* (1999) who found an underestimation of nocturnal sleep duration in the sleep diaries compared to actigraphy, although it is noted that the participants in this study were blind and so it is not directly comparable. The latter finding that the adults underreported their daytime sleep also corroborates previous research (Evans & Rogers, 1994; Lockley *et al.*, 1999; Lotjonen *et al.*, 2003; Matsumoto *et al.*, 2003; Yoon *et al.*, 2003). As suggested by Evans and Rogers (1994), participants may had forgotten they had fallen asleep whilst watching television or quietly reading.

An alternative explanation for the discrepancies between the diary-based and objective measures of sleep duration lies in the possible limitations of actigraphy, although this is less likely due to its objectivity. A common drawback to this method is mainly documented in those with poor sleep quality, such as those with sleep disorders and the elderly (Ancoli-Israel *et al.*, 2003; Buysse, 2004; Sadeh & Acebo, 2002) and involves its difficulty in distinguishing sleep from quiet wakefulness (Lockley *et al.*, 1999), resulting in an overestimation of nocturnal sleep duration (Blackwell *et al.*, 2008; Klosch *et al.*, 2001; Lotjonen *et al.*, 2003; Paquet *et al.*, 2007; Pollak *et al.*, 2001; Reid & Dawson, 1999; Reyner & Horne, 1995). However, the fact that nocturnal sleep duration estimated by actigraphy was systematically shorter than that estimated by the diary-based measure renders this explanation unlikely. Another argument, as discussed above, states that actigraphy has difficulty differentiating restlessness during nocturnal sleep from awakenings (Lockley *et al.*, 1999), which leads to an underestimation of sleep duration by misclassifying activity during sleep as wake (Ferrara & de Gennaro, 2001; Klosch *et al.*, 2001). If the differences in nocturnal sleep duration as estimated by the diary-based and objective measures were due to a limitation with actigraphy, it was more plausibly due to this latter contention. This may have also led to an underestimation of objective sleep quality.

The possibility that actigraphy overestimates daytime sleep duration has been previously recognised (Ancoli-Israel *et al.*, 2003), particularly in the elderly (Buysse, 2004). In this case, the actiwatch would mis-score periods of quiet sitting when the individual was awake, as sleep (Ancoli-Israel *et al.*, 2003). Indeed, Yoon *et al.* (2003)

found that only 22.6% of older adults reported evening naps that were identified by actiwatches in their sleep diaries, and Evans and Rogers (1994) found that few of their elderly participants recorded their naps identified by actigraphy, instead indicating that they had been watching television or reading. In the present study, actigraphy identified at least one nap during the week under investigation in 98.5% of elderly adults, yet only 66.2% of these individuals recorded a nap in their sleep diaries (resulting in a difference of 32%). This problem was not limited to this age group; there was a discrepancy of 40% between the proportion of young and middle-aged adults who reported versus actually had at least one daytime nap. However, it is important to note that many episodes of sleep that were classed by actigraphy as daytime naps took place just before or after the nocturnal sleep period. Thus, it is likely that participants took this sleep into account when estimating their bed- or wake time in their sleep diary, rather than recording it as a daytime nap (see footnote 3). It is argued that this was a major factor in explaining the discrepancy between the occurrence of a daytime nap as recorded in the sleep diary and as estimated by actigraphy, rather than it (wholly) being due to a systematic limitation of any of these measures.

In addition, comparing the present findings with those of previous research suggests that actigraphy did not overestimate the total duration of daytime naps for the elderly adults, which is in contrast to Buysse's (2004) contentions. Actigraphy indicated that the elderly adults slept for an average of 37 minutes during the day, which is substantially less than the one hour documented in past studies (Evans & Rogers, 1994; Goldman *et al.*, 2008; Picarsic *et al.*, 2008). The elderly adults also took a smaller proportion of their total sleep during the day (8%) than the healthy elderly who participated in the study by Evans and Rogers (1994; 14%).

2.4.4 Methodological issues and directions for future research

As well as the limitations of actigraphy previously discussed, in any study utilising actiwatches, there is always the possibility of unrecorded watch removal (Ancoli-Israel *et al.*, 2003; Pollak & Stokes, 1997; Pollak *et al.*, 1998, 2001; Sadeh *et al.*, 1994, 1995). For example, people sometimes forget to record this information in the corresponding sleep diary, particularly during the day (Dement & Vaughan, 1997), resulting in an overestimation of sleep duration. In the present study, attention was given to identifying an appropriate cut-off period (10% of the 24-hour day) to reduce the effects of instances of non-compliance, however, the extent to which they were eliminated remains unknown. Future research may benefit from using actiwatches that continuously assess skin surface temperature to objectively detect periods of watch removal (Klosch *et al.*, 2001; Lotjonen *et al.*, 2003).

Objective nocturnal sleep durations were calculated by the sleep program using a medium level of sensitivity, as recommended by Cambridge Neurotechnology (The Actiwatch User Manual, Version 7.2, 2008). Tonetti *et al.* (2008) recently compared nocturnal sleep duration as estimated by the same actiwatch and software as used in the present study (Cambridge Neurotechnology Ltd) with PSG in 12 healthy young adults. They found that data analysis using a medium level of sensitivity resulted in a 15-minute and 4% underestimation of nocturnal sleep duration and sleep efficiency score respectively, in comparison to those estimated by PSG. Therefore, the objective measures of sleep duration and sleep efficiency calculated in the present study may also have been slightly underestimated by actigraphy. More studies comparing the levels of sensitivity used to score sleep are required. A consensus regarding the optimal level would allow more confidence to be placed in subsequent results obtained via actigraphy.

Lehnkering and Siegmund (2007) recently reported that young adults slept for significantly longer in autumn than in spring. The present study was conducted over the months of November through to June. Young adults were found to be the easiest to recruit and therefore participated earlier on in the study than the other groups, i.e., during the autumn and winter months. Therefore, it may be erroneous to fully generalise the sleep durations of young adults reported here to the spring and summer months as they may sleep for less time then. Further research attempting to identify typical sleep durations should take the seasons into account to ensure an accurate overall estimate.

As the nocturnal sleep duration of young adults was found to vary from night to night and past research has reported differences due to the day of the week (Hawkins & Shaw, 1992), a potential avenue for future research would be to compare sleep duration at weekends and on weekdays. Further, a comparison between students and other young members of the general population may be fruitful, as these groups may differ in their pressures to sacrifice sleep.

A longitudinal study investigating whether sleep duration and quality actually increase or decrease with age would be fruitful. This would not only provide a stronger within participants test of the age effects, but if adults were followed up every ten years, for example, the points at which they began to reduce their nocturnal sleep duration (i.e., as shown here in middle-age) and increase their daytime sleep duration (i.e., in middle-age to elderly adulthood) could be identified.

2.4.5 Conclusion

This study showed that objective sleep duration per 24 hours as determined via actigraphy significantly correlated with two subjective measures of sleep duration, namely a single retrospective measure and a sleep diary measure. As predicted, it was more closely related to the sleep diary measure. Further, actigraphic measures of nocturnal and daytime sleep duration were strongly related to measures based on sleep diaries. Actigraphy was also able to discriminate between the sleep duration and quality of young, middle-aged and elderly adults, i.e., the target populations in the main study. These findings corroborate past research which has established the validity of actigraphy to assess sleep duration in healthy adult populations (Ancoli-Israel *et al.*, 2003) and support the use of actigraphy to produce a partly objective measure of driving after prolonged wakefulness in the main study.

3.0 IDENTIFICATION OF ACCESSIBLE BELIEFS AND QUESTIONNAIRE CONSTRUCTION

3.1 ELICITATION STUDY

The first part of this chapter describes the elicitation study which was performed to identify the accessible beliefs regarding refraining from driving after 15 or more hours of wakefulness, between midnight and 6am and between 3pm and 6pm. A recent review emphasised the importance of elicitation studies for understanding the mechanisms underlying behavioural decisions and urged researchers to adequately report their methods (Symons Downs & Hausenblas, 2005).

3.1.1 Introduction

Over fifty years ago, Miller's (1956) now well-established (e.g., Baddeley, 1994; Shiffrin & Nosofsky, 1994) research suggested that people can usually attend to between five and nine pieces of information at any one time. This led Fishbein and Ajzen (1975) to argue that although an individual may hold a number of beliefs about a behaviour, only a small number of beliefs, i.e., five to nine, can be attended to at any given moment. The TPB proposed that it is these *accessible* beliefs that are the immediate determinants of attitude, subjective norm and PBC (Ajzen, 1991; Ajzen & Fishbein, 1980). Research has supported the importance of belief accessibility (Ajzen & Fishbein, 2000; Ajzen & Sexton, 1999) and sets of highly accessible beliefs have been found to correlate more strongly with an overall measure of attitude than non-accessible beliefs (van der Pligt & Eiser, 1984). Although non-accessible beliefs may be able to *predict* the determinants of intention, only beliefs which are accessible in memory can *explain* them (Ajzen *et al.*, 1995).

It is therefore necessary to elicit the accessible beliefs from individuals in order to gain information about the underlying foundations of a behaviour. Although the TPB attempts to explain behaviour at the level of the individual, rather than extracting accessible beliefs from each and every participant, the model typically relies upon the operational use of modal beliefs, elicited from a subsection of the target population prior to the main study (Agnew, 1998). Ajzen and Fishbein (1980) recommended the use of modal accessible beliefs on the basis that obtaining beliefs from each participant in the main study (i.e., personally accessible beliefs) produces beliefs that differ between respondents, making comparisons difficult. In addition, Agnew (1998) noted that using personally accessible beliefs requires extensive questionnaire preparation, administration and analysis.

On the other hand, potential drawbacks of the modal approach include the possibility that some of the beliefs may not be personally accessible to all of the participants in the main study or that accessible beliefs may be missed off the list (Agnew, 1998; Dickson & Miniard, 1978; East, 1997; Manstead & Parker, 1995; Sutton *et al.*, 2003). The modal set would then not represent the most relevant and important bases of participants' decisions and this may result in spontaneous responses based on whether the beliefs made sense to them (Esses & Maio, 2002). It is noteworthy that when the modal beliefs are incorporated into the main questionnaire, respondents are given the opportunity to deny that the beliefs are associated with the behaviour, for example, 'Not driving when I have been awake for 15 or more hours would mean I would be unable to go out socialising...very unlikely-very likely', 'My family think that I should refrain from driving when I have been awake for 15 or more hours...very unlikely-very likely' and 'Driving for work purposes would make it...much more difficult-much easier...for me to refrain from driving after being awake for 15 or more hours' (Ajzen & Fishbein, 1980; Eagly & Chaiken, 1993). However, this does not address the issue of whether or not the beliefs are relevant.

Agnew (1998) assessed the utility of modal versus personally accessible beliefs using the framework of the TRA and found that personally accessible beliefs were only marginally stronger predictors of the corresponding overall construct and intention. Further, the set of modal beliefs derived from the elicitation study adequately captured the kinds of beliefs that the main participants listed (personally accessible beliefs), with at least an 80% overlap between the two methods of obtaining accessible behavioural and normative beliefs. Agnew (1998) concluded that practical considerations outweighed the modest increases in predictive accuracy gained by using personally accessible beliefs, and that the use of a modal set of accessible beliefs was a valid and practical alternative. Sutton *et al.* (2003), however, reported that the extent of overlap between modal and personally accessible beliefs largely depends on the particular decision rule employed to decipher which beliefs to include in the modal set. Nevertheless, in a review, Conner and Armitage (1998) reported that the use of modal beliefs resulted in high levels of predictive validity.

Thus, in order to extract the modal accessible beliefs underlying a behaviour from the target population, an elicitation study must be conducted which involves asking a representative sample of the population a series of open-ended questions (Ajzen & Fishbein, 1980). It was recommended that participants are asked about their beliefs regarding the advantages and disadvantages of performing the behaviour (behavioural beliefs), about any specific important referents who they believe would approve or disapprove of them performing the behaviour (normative beliefs) and about factors that they perceived may facilitate or impede their performance of the behaviour (control beliefs; Ajzen, 2002b). Based on Miller's (1956) research, Fishbein and Ajzen (1975) argued that any beliefs elicited beyond the first nine are not accessible. Ajzen and Fishbein (1980) instructed that content analyses follow the interviews in order to group together beliefs reflecting the same underlying themes. The occurrence of these themes should then be counted and the behavioural, normative (and control) beliefs most frequently mentioned by the elicitation sample should constitute the modal accessible beliefs for the target population (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Beliefs having a high frequency of occurrence were found by Ajzen *et al.* (1995) to be more accessible in memory, as measured by response latencies. In addition, the frequency of elicitation method for deciphering which beliefs to include in the modal set enhances content validity (Young *et al.*, 1991) and beliefs elicited in this manner have been found to be predictive of attitude, subjective norm and PBC (Parker *et al.*, 1995).

The modal accessible beliefs, along with their corresponding evaluation items, should comprise the belief-based questionnaire items which are then administered to participants in the main study (Ajzen, 2002b; Ajzen & Fishbein, 1980). This instrument development procedure must be repeated for different target populations and behaviours, enhancing the validity and power of the measures, as well as complying with the notion of the uniqueness of humans in specific contexts (Young *et al.*, 1991). It is clear that a major strength of the measurement procedure recommended by Ajzen (2002b; Ajzen & Fishbein, 1980) is the grounding of instrument development in the qualitative findings derived from a subsection of the target population (Young *et al.*, 1991). Qualitative interviewing allows respondents to express their understandings in their own terms, thereby expressing their personal perspectives (Patton, 2002).

In spite of the important role accredited to accessible beliefs in the TPB, the elicitation stage has received relatively little attention in the literature (Sutton *et al.*, 2003). This section describes the elicitation study that was conducted in the present research. The aim was to extract modal accessible behavioural, normative and control beliefs underlying the behaviours under investigation from young, middle-aged and elderly adults.

3.1.2 Method

3.1.2.1 Design

The study employed semi-structured interviews to elicit qualitative data regarding the beliefs underlying sleep impaired driving. The interviews were transcribed and content analysed to identify modal accessible behavioural, normative and control beliefs for each age group and each specific behaviour.

3.1.2.2 Participants

Sixty healthy adults who held a current UK driving licence and had access to a car were recruited using quota and snowball sampling. They consisted of 30 males and 30 females; 10 males and 10 females took part from each of the three age groups (target populations), i.e., young (mean age = 23.6 years, SD = 2.1), middle-aged (mean age = 49.6 years, SD = 5.0) and elderly (mean age = 74.5, SD = 7.5). A sample size of 20 participants for the elicitation study is consistent with the literature (e.g., Armitage & Conner, 2002; Armitage *et al.*, 1999; van den Putte & Hoogstraten, 1997). All participants resided in the area of St Helens, Merseyside, UK and the interviews took place in the participants' homes.

3.1.2.3 Materials

Questions from a standard TPB elicitation study interview script (Ajzen, 2002b; Ajzen & Fishbein, 1980) were adapted to the behaviours under investigation (see Appendix 3.1). To elicit behavioural beliefs, participants were asked to list the advantages and disadvantages of each behaviour and to discuss any other issues which they associated with the behaviour. To elicit normative beliefs, they were asked if there were any individuals or groups who they felt would approve or disapprove of them performing the behaviour or who may have any other influence on their performance of the behaviour. To elicit control beliefs, participants were asked whether there were any factors or circumstances that would facilitate or inhibit their performance of the behaviour and to discuss any other issues that they associate with the ease or difficulty of performing the behaviour.

To reduce interviewer effects, the open-ended questions were worded in exactly the same way for each participant (Patton, 2002). Participants were allowed as long as they required to answer the questions. Each behaviour was addressed separately in the same order. Young, middle-aged and elderly adults answered questions regarding refraining from driving after 15 or more hours. In addition, the young and elderly adults responded to questions about refraining from driving between midnight and 6am and refraining from driving between 3pm and 6pm, respectively.

3.1.2.4 Procedure

<u>*Interview process and transcription*</u>

Firstly, participants were informed of the purpose of the study, that their answers would remain confidential and anonymous, and that they could withdraw from the interview at any time. Each participant then signed a consent form and supplied their demographic information. The semi-structured interview was then conducted. Each interview lasted approximately 15 minutes. All interviews were recorded by a standard tape recorder to increase the accuracy of data collection and to allow the interviewer to be more attentive to participants (Patton, 2002). The interviews were then fully transcribed (see Appendix 3.2 for an example of a transcript, i.e., regarding one of the behaviours).

Content analysis

Lists of behavioural, normative and control beliefs mentioned by the participants regarding each behaviour were formed for each age group. In the rare case that a participant listed more than nine beliefs (i.e., for one type of belief), only the first nine beliefs were recorded to ensure that all beliefs were accessible to the participant who mentioned them (Fishbein & Ajzen, 1975). Using content analysis, the beliefs were categorised into recurrent underlying themes (Ajzen *et al.*, 1995). Individual responses that were semantically similar and which reflected the same underlying theme were merged together to form one belief (Ajzen & Fishbein, 1980). In addition, inhibitors and facilitators were combined where appropriate (Sutton *et al.*, 2003), and worded as the most commonly elicited belief.

The number of participants who responded for each theme was tallied (Sutton *et al.*, 2003). Initially, beliefs that were mentioned by at least 10% of the sample were considered to be accessible to the target population. In many cases, however, the number of accessible behavioural and control beliefs exceeded the cut-off point of nine (Ajzen & Fishbein, 1980). A number of more stringent strategies were employed to reduce the number of beliefs systematically across all age groups and behaviours, e.g., using beliefs mentioned by 20% of the sample. The application of stringent criteria, however, proved not to be a universal solution, reflecting Ajzen *et al.*'s (1995) observation that the cut-off point for accessible beliefs is to some extent based on an arbitrary decision by the investigator. As a result, although it was ensured that all accessible beliefs were mentioned by at least 10% of the sample, several beliefs were excluded based on individual reasons, most commonly, for having limited explanatory power, e.g., 'Having to go somewhere would make it difficult for me to refrain from driving after being awake for 15 or more hours'. In total, across all age groups and behaviours, eight beliefs were removed. These, together with idiosyncratic beliefs mentioned by only one participant, were defined as non-accessible beliefs. Thus, the most frequently mentioned beliefs constituted the modal accessible beliefs (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975). Some modal belief sets still comprised over nine beliefs due to difficulty in reaching a decision regarding which ones to omit. This issue was dealt with in the pilot study described in section 3.2.

3.1.3 Results

Many of the accessible beliefs regarding refraining from driving after 15 or more hours of wakefulness were common to all three groups. The order of accessibility differed however, and age-specific beliefs were identified in most sets. Three tables are presented below, each containing the modal accessible behavioural, normative and control beliefs for a given age group and behaviour, and each followed by a summary of the findings. The modal accessible beliefs of the young and elderly adults regarding refraining from driving after being awake for 15 or more hours are presented in Appendix 3.3.

Table 3.1: Accessible beliefs of middle-aged adults regarding refraining from driving after 15 or more hours of wakefulness (number of participants who mentioned belief)

Behavioural beliefs	*Normative referents*	*Control beliefs*
Reduces risk of having vehicle accident (13)	Police (7)	An emergency (10)
Prevents me from driving when tired (12)	Family (6)	Socialising (6)
Inconvenient (8)	People who want a lift (5)	Driving for work purposes (6)
Prevents me from driving when unable to concentrate (6)	Other road-users (3)	Feeling too tired to drive (4)
Prevents me from driving when reactions slow (6)	Pedestrians (2)	Giving someone a lift (3)
Unable to go out socialising (3)	Boss (2)	Someone else being able to give me a lift or drive instead of me (3)
Prevents me from driving when not aware (2)	Road safety groups (2)	Drinking alcohol (2)
Prevents me from driving when unable to function properly (2)		Getting a taxi or bus (2)
Unable to give lifts to people who are relying on me (2)		
Unable to drive for work purposes (2)		
Prevents me from driving when it is dark (2)		

Summary: The key advantages cited by the middle-aged adults were largely associated with safety, and prevention from driving when in various states of difficulty caused by prolonged wakefulness, e.g., tiredness, lack of concentration. The disadvantages were mainly inconvenience and being unable to drive to get home after socialising, to give people lifts and for work purposes. The main accessible group perceived by participants as disapproving of them refraining from driving after being awake for 15 or more hours was people who wanted them to give them a lift. The number of referents who approved outweighed the disapproving referents, which indicates that perceived social pressure encouraged performance of the behaviour, rather than discouraged it. Factors that inhibited performance of the behaviour included the occurrence of an emergency, driving for work and social purposes and giving someone a lift. Internal factors, such as feeling too tired and being under the influence of alcohol, as well as the availability of alternative modes of transport, were perceived to facilitate performance. Difficulty factors were cited more frequently than facilitating factors, suggesting that the behaviour was perceived as somewhat difficult to enact.

Table 3.2: Accessible beliefs of young adults regarding refraining from driving between midnight and 6am (number of participants who mentioned belief)

Behavioural beliefs	*Normative referents*	*Control beliefs*
Reduces risk of having vehicle accident (15)	Police (8)	Driving for work purposes (10)
Prevents me from driving when tired (8)	People who want a lift (6)	Getting home after socialising (8)
Unable to drive for work purposes (6)	People at work (6)	An emergency (6)
Unable to drive home after been out socialising (5)	Parents (6)	Giving someone a lift (6)
Unable to give people lifts (4)	Other family members (6)	Someone else being able to give me a lift or drive instead of me (5)
Inconvenient and would limit what I can do (4)	Friends (5)	Getting a taxi or another form of transport (5)
Prevents me from driving when not as focused/ concentrating (3)	Partner (2)	Driving for holiday purposes (3)
Prevents me from driving when it is dark (3)	Road safety groups (2)	Drinking alcohol (2)
Less likely to be asleep between those times (3)		Getting home safely (2)
Unable to drive when there is less traffic on roads (3)		Not realising that may be tired (2)

Summary: The most frequently mentioned belief was that refraining from driving between midnight and 6am would reduce the risk of having a vehicle accident. The young adults also believed that performing the behaviour would prevent them from driving whilst tired, when they were not focused and when it was dark. The disadvantages of being unable to drive for work and social reasons were also prominent. People who wanted a lift, which included partners, parents and/or friends, were the group most perceived to disapprove of the individual performing the behaviour. Colleagues were also cited as a disapproving group due to the perception that carrying out the behaviour would lead to the individual not being present at work. Many participants mentioned referents, however, who they perceived would approve of the behaviour, including the police, parents and friends. Factors perceived to facilitate performance of the behaviour comprised having alternative transport and drinking alcohol. The key circumstances that were perceived to make refraining difficult were driving for work, social and holiday purposes, as well as the occurrence of an emergency. Two of the young adults (both females) believed that driving was the safest way of getting home between midnight and 6am and therefore, the motivation to return home safely would make it difficult for them to refrain. Relatively more difficulty factors were elicited from the sample, indicating that there were several barriers to refraining from driving between midnight and 6am.

Table 3.3: Accessible beliefs of elderly adults regarding refraining from driving between 3pm and 6pm (number of participants who mentioned belief)

Behavioural beliefs	*Normative referents*	*Control beliefs*
Pointless because do not feel tired then and feel capable of driving then (11)	Family (6)	Giving someone a lift (7)
Inconvenient and unable to do usual things (10)	Friends (3)	Feeling ill (7)
Prevents me from driving when traffic is busy (6)		An emergency (6)
Unable to socialise or visit family and friends (4)		Feeling tired (6)
Unable to give people lifts (2)		Socialising or visiting family or friends (5)
Prevents me from worrying about volume of traffic (2)		Going shopping (4)
		Taking part in recreational activities (4)
		Being busy (4)
		Drinking alcohol (3)
		Not feeling like driving (3)
		Having to go somewhere or an appointment to keep (3)
		Having jobs or activities to do which do not involve driving (2)

Summary: Only two advantages were given by the elderly adults regarding refraining from driving between 3pm and 6pm and both were associated with missing the busy traffic period during those hours, rather than being related to sleep impaired driving. Together with the fact that twice as many disadvantages were cited, this implies that the attitude of the elderly adults towards the behaviour is negative, at least when the reason for conducting it is to reduce the risks of sleep impaired driving. These results suggest that elderly adults do not perceive the risks of driving between those hours as serious. The disadvantages generally concerned the behaviour being pointless due to the individual not feeling tired during those hours and the inconvenience and disruption it would cause to their lifestyle. Two referents were accessible, and in the majority of cases, they were perceived by the elderly adults to disapprove of the behaviour. This indicates that normative influences do not support performance of the behaviour. Although some participants mentioned that the reason for the referents' disapproval was due to them being unable to get a lift, 'people who want a lift' was not introduced as its own group because in each case, the participant specified who these people were, and all were either family members or friends. Factors that promoted enactment of the behaviour were mainly the individual's internal feelings, e.g., illness, feelings of tiredness and simply not feeling like driving. Inhibiting factors centred around the individuals' usual activities of socialising, shopping, recreational activities and appointments. The fact that several of the difficulty factors were of a regular and important nature, e.g., shopping, appointments, suggests that refraining from driving between 3pm and 6pm may be quite difficult for the elderly.

3.1.4 Discussion

The elicitation study revealed the most accessible beliefs regarding the behaviours under investigation for the young, middle-aged and elderly adults. Although interesting inferences can be drawn from the qualitative data, the main study (see Chapter 4) revealed the relative importance of attitude, subjective norm and PBC in determining the behavioural decisions for each age group.

On some occasions, similar topics were mentioned in two or in all three of the modal sets of behavioural, normative and control beliefs. For example, the accessible beliefs of the young adults regarding refraining from driving between midnight and 6am included the beliefs of being 'unable to give people lifts', 'people who want a lift' and 'giving someone a lift' in the behavioural, normative and control belief sets, respectively. This issue, particularly in regards to behavioural and normative beliefs, has received attention in the literature. Miniard and Cohen (1981) expressed concerns relating to the proposed conceptual distinction between behavioural and normative beliefs on the basis that the same belief, presented in different syntactical forms, could be classified as both behavioural and normative. Fishbein and Ajzen (1975, 1981) maintained that a given belief about a referent's reactions can have different effects on the attitudinal and normative components of the model. They recognised that the distinction may appear arbitrary, but reasoned that there are many instances in which an individual may hold one type of belief but not the other (Ajzen & Fishbein, 1980). The construct validity of the TRA constructs has received considerable empirical support from both laboratory and field investigations (Fishbein & Ajzen, 1975), and by maintaining the distinction between the two variables, it is possible to gain a better understanding of the relative importance of attitudinal and normative influences on behaviour (Eagly & Chaiken, 1993; Fishbein & Ajzen, 1975). Further, research from Trafimow (Trafimow & Duran, 1998; Trafimow & Fishbein, 1995; Trafimow *et al.*, 2002) strongly supported a distinction between behavioural, normative and control beliefs. When asked to list their beliefs about a given behaviour, participants independently clustered their beliefs according to belief type, showing more associations within, rather than between, belief types.

Regarding possible limitations of the procedure, first, the elicitation task may have caused participants to construct new beliefs if they lacked prior beliefs or experience with the behaviour under investigation (Eagly *et al.*, 1994). The type of behaviour being explored here, however, was of a frequent and regular nature, i.e., driving. Even if participants had no prior experience with actually undertaking the specific behaviour, for example, driving after they had been awake for 15 or more hours, it is probable that they had driven when they were tired and thus could relate to the behaviour in some way. When confronted with familiar behaviours, respondents are likely to have engendered at least some beliefs and thus it is reasonable to assume that that they would adopt the straightforward approach of reporting these existing beliefs rather than inventing new ones (Eagly *et al.*, 1994).

Second, the current study followed the recommendations of Ajzen and Fishbein (1980) whereby the cut-off point for when individuals began to list non-accessible beliefs was between five and nine. Van der Pligt and Eiser (1984), however, argued that the proposed expectancy-value underpinnings of the TRA place high cognitive demands on individuals which impose severe limitations on the number of beliefs they can process. Van der Pligt and de Vries (1998b) reported that three to five accessible beliefs were equally predictive of attitude as a more extensive set of modal accessible beliefs. This would suggest that several non-accessible beliefs may be included in the modal sets produced here. This is potentially problematic as their appearance in the main questionnaire may make them accessible which may produce a change in the corresponding overall construct (i.e., as proposed by the TPB; Sutton *et al.*, 2003). Indeed, the elicitation phase has been criticised for prompting participants to list several referents whose views are actually irrelevant to the individual's decision whether or not to perform the behaviour under investigation (Donald & Cooper, 2001).

In contrast to these criticisms, however, the TPB does not propose that individuals review all of their beliefs about a behaviour every time they are faced with a behavioural decision, nor does it claim that people perform multiplicative calculations and sum the resulting product terms in order to reach a decision (Ajzen & Fishbein, 2000). Instead, as a behaviour is performed more frequently, accessible beliefs become stored in memory and are automatically activated and retrieved when faced with the decision whether or not to act (Ajzen & Fishbein, 2000). Additionally, as well as experience with the behaviour, Eagly and Chaiken (1993) suggested that functional considerations, for example, the importance that individuals assign to the behavioural decision, affect the depth of processing that people are willing to exert. Therefore, it is argued that modal sets comprising up to nine beliefs do not reflect unrealistic expectations regarding information processing capacity, but rather, they are valid representations of the underlying determinants of attitude, subjective norm and PBC.

Finally, the set of questions designed to identify behavioural beliefs (i.e., asking for advantages and disadvantages) has been criticised for eliciting only instrumental beliefs about the behaviour at the expense of affective responses (Manstead & Parker, 1995; van der Pligt & de Vries, 1998b; van der Pligt *et al.*, 1998; see section 1.2.3.2.1). Affective influences have been found to play an important role in the formation of intention (e.g., Payne *et al.*, 2004) and are not accounted for elsewhere in the TPB. Alternative sets of questions have been found to elicit more affective beliefs about a behaviour (e.g., Ajzen & Driver, 1991; French *et al.*, 2005; Manstead & Parker, 1995; Sutton *et al.*, 2003) and the inclusion of procedures to identify both types of outcomes may provide more information about the structure of attitudes (van der Pligt *et al.*, 1998) and significantly improve the ability of the TPB to predict intention (Manstead & Parker, 1995). It is noted that the role of affect is addressed elsewhere in the current research.

Although justifications for including measures of past behaviour and habit in the present research have previously been discussed (see section 1.3.2.6.2), another important reason became apparent from the data obtained from the elicitation study. Several participants verbally referred to their past behaviour/habitual tendencies when responding to the interview questions. For example, participants made statements such as, 'I don't drive after being awake for that long anyway' and 'I'm usually asleep at that time of night'. It was clear that participants reviewed their past behaviour and habits when considering the behaviours currently under investigation, providing additional support for measuring these variables and for examining whether the TPB variables mediate their effect on behaviour, as proposed by the model (Ajzen, 1991).

The next step was to construct the questionnaire items, whereby the belief-based items were based on the modal sets of accessible beliefs for each behaviour and age group identified here. A pilot study was necessary to, amongst other purposes, reduce the number of belief-based items in each modal set to nine or less (Ajzen & Fishbein, 1980).

3.2 QUESTIONNAIRE CONSTRUCTION

The final section of this chapter describes the development of the questionnaires which were to be used in the main study. In response to criticisms that TPB questionnaires are not subjected to the same rigorous tests of reliability and validity that are required for other psychometric tools (e.g., French *et al.*, 2007), a pilot study was conducted, the main focus of which was to strengthen the reliability and validity of the measures and to reduce the number of belief-based items. Some details and justifications are also presented here, rather than in the method section of the main study (section 4.2).

3.2.1 Key issues relevant to TPB questionnaires

3.2.1.1 Potential biases in questionnaire-based research

Questionnaires are the most commonly used method of collecting data in health and social psychology (Sheeran & Orbell, 1996). As the TPB variables are latent constructs, there are few, if any, practical alternatives for their assessment except self-reports (Beck & Ajzen, 1991). However, questionnaires are particularly vulnerable to various types of response distortions, which can produce systematic errors in the measurement of cognitions (Eagly & Chaiken, 1993).

Budd (1987) distributed two TRA questionnaires to different groups of students, each containing the same items, but presented in different formats. In the first format, items assessing the same TRA variable appeared together, whilst in the other format, all of the questionnaire items were ordered randomly, regardless of which construct they measured. Budd (1987) found that the TRA variables were more reliable and that their inter-relationships were stronger when the items assessing the same construct were presented together. He argued that this was due to the model's components becoming clear to the participants and attributed his finding to their self-presentational concerns about ensuring that their views were consistent, i.e., consistency bias. These findings suggest that the strong inter-correlations between TRA constructs found by past research may also have been affected by self-consistency biases (Kraus, 1995).

In response to these findings, Sheeran and Orbell (1996) conducted a similar study using an alternative social cognitive model (the protection motivation theory) and reported that the 'extent of response bias arising from questionnaire format observed here was considerably less than that obtained by Budd (1987)' (p. 286). Specifically, they found that the various questionnaire formats did not affect the reliabilities of the cognition measures. Further, Armitage and Conner (1999b) provided a stronger test of the influence of questionnaire format as they utilised regression coefficients corrected for unreliability, as opposed to correlation coefficients as reported in the other two studies. Moreover, they administered different formats of TPB questionnaires to their general population sample and measured subjective behaviour one month later. Although they did find differences in the patterns of the prediction of intention, they found no moderating effect of questionnaire format on the relationships between TPB variables. In contrast to Budd (1987), they found that the reliabilities of the constructs were greater in the random format condition, than in the condition where items assessing the same variable were presented together. This suggests that respondents are required to deliberate more when the items are presented separately. Armitage and Conner (1999b) concluded that the impact of questionnaire format on the TPB was minimal.

Therefore, recent studies using appropriate methods and analytical techniques have found that TPB studies are not seriously affected by consistency biases, when assessed by observing differences in responses to various questionnaire formats. These, and other investigations have also tested the effects of alternative forms of social desirability, for example, failing to admit to socially undesirable attitudes. Driving while sleep impaired can be considered a socially undesirable behaviour and hence consideration of these effects is particularly important for the current research. Beck and Ajzen (1991) found no such effects of social desirability in their application of the TPB to three dishonest behaviours, namely, cheating on a test, shoplifting and lying to get out of completing an assignment on time. This was reflected in the high percentages of their student participants who admitted to conducting these socially undesirable behaviours (70% admitted to cheating, 36% admitted to shoplifting and 60% admitted to lying to get out of an assignment). Further, hierarchical regressions indicated that responses to the Marlowe-Crowne Social Desirability Scale (SDS; Crowne & Marlowe, 1964) only explained small (but significant) amounts of the variance in intentions and the overall results and patterns in the prediction of intentions remained the same after controlling for social desirability.

Sheeran and Orbell (1996) similarly found few differences in groups who scored high and low on the SDS when they applied protection motivation theory to intention to use a condom and intention to dental floss. In support of these findings, Armitage and Conner (1999b) found that participants scoring highly on the SDS did not display patterns of responses consistent with presenting themselves in a positive light, for example, they did not exaggerate the extent to which they intended to eat a low-fat diet. There were no differences between the low and high social desirability groups in terms of the ability of the TPB to predict intention to eat a low-fat diet and subjective behaviour, measured prospectively. It was concluded that social desirability had no impact, however, caution was advised when interpreting studies utilising the SDS since this scale is, itself, a self-report measure (Armitage & Conner, 1999b).

Past studies have indicated that systematic influences due to questionnaire format and social desirability are not serious concerns for TPB research. Conversely, more subtle biases may be present in research utilising questionnaire designs such as response sets, the term given to participants' tendencies to respond in a particular way, including the propensity to agree with all of the items (acquiescence), avoid extreme responses and to always choose the neutral category (Eagly & Chaiken, 1993; Fishbein & Ajzen, 1975). As Ajzen (1988) stated, there is usually little incentive for strong biases and social desirability, and response sets can be diminished with the careful application of appropriate measurement techniques. Strategies for reducing both systematic and more subtle biases were adopted in the current research, as well as taking other precautions described throughout, to ensure accurate and valid results.

3.2.1.2 Scoring applied to belief-based measures

The particular scoring technique applied to the components of the belief-based measures has received substantial attention in the literature since multiplication of these components means it can have a dramatic impact on correlations between the resulting belief-based measure and other variables (Evans, 1991; van den Putte & Hoogstraten, 1997). The components of each belief-based measure can either be scored in a unipolar, i.e., from 1 to 7, or bipolar, i.e., from -3 to 3, fashion.

Ajzen and Fishbein (1980) originally recommended particular scoring procedures for the belief-based measures of attitude and subjective norm. They provided rationales for scoring both behavioural beliefs and outcome evaluations in a bipolar fashion (for example, it allows both likely positive consequences of the behaviour and unlikely negative consequences to contribute positively to attitude) and for using bipolar scoring for normative beliefs, but unipolar scoring for (general) motivation to comply (for example, people are considered unlikely to want to do the opposite to what they perceive their important others want them to do). Ajzen (1991) suggested that both control belief strength and power be scored using bipolar scales, but his data offered mixed support for this. Conner and Sparks (1996) reported that scoring the components of belief-based PBC is particularly problematic, and that unipolar scoring appears more appropriate for certain response formats of control belief strength (e.g., 1 'never' to 7 'frequently').

Ajzen (2002b) stated that there is no clear theory-based method for determining the appropriate scoring and so the decision must be determined empirically. Evans (1991) highlighted, however, that the scoring should reflect the actual stimuli presented to respondents, i.e., it should be based on conceptual reasoning, as well as (or rather than) methodological issues. Therefore, a combination of theoretical considerations, i.e., identifying which scoring system made the most theoretical sense, as well as empirical findings were taken into account to determine the optimal scoring procedures for each of the belief-based components in the present research.

3.2.1.3 The measurement of motivation to comply

Motivation to comply is a component of subjective norm (see section 1.2.1). Fishbein and Ajzen (1975) originally argued that both theoretically and empirically, motivation to comply is best defined as a person's general tendency to comply with each of their accessible referents, for example, 'Generally speaking, how much do you want to do what your partner thinks you should do?'. They rejected the alternative of assessing motivation to comply at the level of the behaviour, for example, 'When it comes to refraining from driving after you have been awake for 15 or more hours in the next week, how much do you want to do what your partner thinks you should do?', due to it becoming a direct correlate of intention and thus contributing little to our understanding of the determinants of intention (Fishbein & Ajzen, 1981). They did, however, recognise the potential for measuring the construct at an intermediate level, i.e., within the behavioural domain, for example, 'When it comes to driving, how much do you want to do what your partner thinks you should do?' (Ajzen & Fishbein, 1980).

Miniard and Cohen (1981) reasoned that a general measure of motivation to comply may be less conceptually sound and may be difficult for respondents to answer without any information about the behaviour and why the referent may take their viewpoint. The results of their study confirmed that motivation to comply, when assessed both at the level of the behaviour and of the behavioural domain, predicted intention significantly better than when measured at a general level. Fishbein and Ajzen (1981) criticised their findings on the grounds that they scored all three levels of their motivation to comply constructs in a bipolar fashion, when the general measure should have been scored in a unipolar fashion because people are unlikely to want to do the opposite to what they perceive their important others want them to do. Fishbein and Ajzen (1981) went on to state that due to the limited explanatory power of a behaviour-specific measure, either a general measure, scored in a unipolar fashion, or a measure at the level of the behavioural domain, scored in a bipolar fashion, should prove useful. In a reanalysis of Miniard and Cohen's (1981) data, Fishbein and Ajzen (1981) showed that when scored in these ways, taking motivation to comply into account improved the prediction of both subjective norm and intention over and above normative beliefs. These findings provided empirical support for a true bipolar measure of motivation to comply. Fishbein and Ajzen (1981) concluded that attention should move from a general to an intermediate level of specificity of the motivation to comply construct.

Despite this, the majority of TRA/TPB studies continued to utilise general measures of motivation to comply (albeit scored in a unipolar fashion), to the extent that they even appeared in Ajzen's (2002b) guidelines (it is noted that some researchers have followed the practice of assessing the construct at the level of the behavioural domain but unipolar scoring has been applied, for example, Conner and colleagues; Conner & McMillan, 1999; Conner & Sparks, 1996; Conner *et al.*, 2001). Owing to Fishbein and Ajzen's (1981) contentions, the motivation to comply measures employed in the current research were specified at the level of the behavioural domain (intermediate level of specificity) and analyses were conducted for each behaviour to identify the optimal scoring procedures (Ajzen, 2002b).

Van den Putte and Hoogstraten (1997) argued that, theoretically, the motivation to comply component should be removed from the model. They stated that it is unclear why motivation to comply should influence an individual's perception of normative pressure to perform a given behaviour and due to the referents being important others, individuals will always be motivated to comply with them which results in the measure having low variance and therefore being redundant. In addition, van den Putte and Hoogstraten (1997) reasoned that removing motivation to comply would eliminate the problems associated with multiplicative composites, i.e., their high dependency on the scales used to assess them, at least for the subjective norm construct. The results of their study demonstrated that the model fitted the data better when motivation to comply was omitted. Other studies have found that the inclusion of motivation to comply in the belief-based measure of subjective norm attenuates correlations with the direct measure (Budd, 1987) and with intention and behaviour (Grube *et al.*, 1986).

3.2.1.4 Overview of the pilot study

Due to the nature of the elicitation phase, tailored TPB questionnaire items needed to be constructed for each population and each behaviour. Hence, in the current research, a total of five sets of questionnaire items were required. These included three concerning refraining from driving after being awake for 15 or more hours, i.e., for the young, middle-aged and elderly adults, one regarding refraining from driving between midnight and 6am (young adults only) and one about refraining from driving between 3pm and 6pm (elderly adults only).

Ajzen (2002b; Ajzen & Fishbein, 1980) provided detailed instructions on how to construct a TPB questionnaire. The use of this standardised procedure facilitates comparisons between TPB studies and between different groups regarding the same behaviour. In the current research, Ajzen's (2002b) recommendations were followed unless stated and justified. Although the items intended to assess the variables directly were based on past research, they were subjected to rigorous pilot testing to ensure that they were reliable and valid when applied to sleep impaired driving. Variables external to the TPB are more likely to capture a significant proportion of the variance in intention and/or behaviour when the existing model's constructs have been inappropriately measured (Fishbein, 1993). As the present research examined the predictive effects of external variables, ensuring that the measures were reliable, valid, and that they were assessed using identical levels of specificity was therefore crucial.

The pilot study was conducted to assess the reliability and concurrent validity of the variables, as well as the face validity of the items. This stage was also essential for reducing the length of the instruments, in particular, to omit beliefs from the accessible modal sets which contained over nine beliefs. This was necessary to increase the likelihood that all beliefs were accessible to the target population (Ajzen & Fishbein, 1980) and was accomplished using item analysis procedures. Following these analyses, the necessary alterations were made and the final questionnaires were constructed for use in the main study. The rationale and justifications for the various procedures employed in the present research are presented in the following method section only, to prevent repetition.

3.2.2 Method

3.2.2.1 Design

This was a pilot study in which participants were asked to complete a questionnaire regarding sleep impaired driving and provide comments regarding the content and wording of the items, in order to supply data required to assess the reliability and validity of the measures and to reduce the number of items.

3.2.2.2 Participants

Eighteen healthy adults, consisting of six young (mean age = 24.5 years, range = 21-27), six middle-aged (mean age = 51.3 years, range = 45-54) and six elderly (mean age = 74.2 years, range = 65-79) adults (overall: 50% female, mean age = 50.0 years, SD = 21.28) were recruited via quota and opportunity sampling. All participants held a current UK driving licence and had access to a car. All adults who were asked to participate agreed (100% response rate).

3.2.2.3 Questionnaires

A separate questionnaire was produced for each age group. As the young and elderly adults were required to complete questionnaire items regarding two driving behaviours (refraining from driving after being awake for 15 or more hours and at a particular time of day), this questionnaire was divided into two parts, with the order of behaviours counterbalanced (although it is noted that Beck and Ajzen, 1991, found no effects of the order in which three behaviours were presented in a TPB questionnaire). Appendix 3.4 contains an example of a pilot questionnaire (designed for the elderly adults).

The front page of each questionnaire booklet prompted participants to answer all questions as accurately and honestly as possible and reminded them that their responses would remain confidential and anonymous, a strategy to minimise social desirability effects (Young *et al.*, 1991) and an ethical requirement. Participants were provided with a description of the (first) behaviour under investigation, along with instructions on how to complete the questionnaire. Full details of the front pages of the questionnaires are described in section 4.2.3.1.

Direct measures of the TPB and additional variables were presented before the belief-based TPB measures. This was contrary to the practice of providing participants firstly with evaluation and belief statements, followed by a direct measure of attitude, and lastly, a measure of intention (Dickson & Miniard, 1978). There was an important reason as to why the current layout was chosen. It was possible that some of the modal accessible beliefs, i.e., the belief-based items in the questionnaire, were not personally accessible to each and every participant. As Sutton *et al.* (2003) argued, when an individual is presented with a belief statement that is not personally accessible, the belief may become accessible, producing a change in the corresponding global construct, i.e., attitude, subjective norm or PBC. Therefore, providing participants with the direct measures first prevented any non-accessible beliefs from having reactive effects. Eagly and Chaiken (1993) also made the case that earlier questionnaire items can bias responses to later items as they may activate memories and/or make participants more aware of the specific properties of the attitude object that are then translated into generalised conclusions. All of the questionnaire items, except for one open-ended measure of past behaviour (presented at the end of the questionnaires), employed seven-point rating scales with the ends representing opposing viewpoints.

3.2.2.3.1 Direct measures

The items assessing the variables directly were presented under the heading of 'Section A'. Each measure was composed of multiple items because single-item measures are unreliable, invalid and unrepresentative, as they are likely to be the result of incidental factors (Ajzen, 1988). The items measuring intention, subjective norm, PBC and past behaviour were separated and ordered randomly, interspersed with items measuring other constructs (Ajzen, 2002b). Owing to the use of an item stem for ease of completion, the items designed to tap attitude, habit and anticipated regret were each presented together. The positive and negative endpoints of the scales that directly assessed the variables were counterbalanced to prevent possible response sets (Ajzen, 2002b). All of the items that used seven-point scales were scored from -3 to 3.

Some of the adjective pairs used to assess attitude directly were derived from Ajzen (2002b) and Osgood *et al.* (1957), however, others were based on the nature of the behaviour and the empirical results of the elicitation study. The adjective pairs, 'inconvenient-convenient' and 'unsafe-safe' were included in the direct assessment of attitude for all three behaviours. Concerns about convenience and safety were the bases of many accessible behavioural beliefs identified in the elicitation study for all three age groups and behaviours. In addition, the adjective pair, 'unnecessary-necessary' was included in the items designed to measure attitude towards refraining from driving between 3pm and 6pm among the elderly adults. This was considered a valid item for this behaviour as 55% of the sample involved in the elicitation study stated that the behaviour was 'pointless', indicating a strong consensus that refraining from driving between those hours was unnecessary.

Ajzen (2002b) provided standard direct items for each of the TPB components (e.g., injunctive norm, descriptive norm) that can be applied to any behaviour. The wording of the items administered in the current research followed these recommendations, as well as previous TPB studies (e.g., Parker *et al.*, 1995). Items designed to assess past behaviour were based on previous research (e.g., Bagozzi & Kimmel, 1995; Ouellette & Wood, 1998).

The measure of habit used was based on that developed by Aarts *et al.* (1997) and Verplanken *et al.* (1998) and was independent of past behaviour (Ajzen, 1991, 2002c; see section 1.2.3.1.1). For the refraining from driving behaviours, accessible control beliefs that made refraining difficult for the particular age group, for example, 'when you go out socialising' and 'for work purposes', were used as the habit scenarios, as it was possible that adults habitually drove under those circumstances. Measuring the salient goals that motivated past behaviour (i.e., using the accessible control beliefs) increased precision in the assessment of habit (Ouellette & Wood, 1998). Following the item stem, for example, 'Do you drive when you have been awake for 15 or more hours....', 'if you need to' was always presented first as this was a more general situation and could refer to an emergency of any type, which was an accessible control factor for all three behaviours and age groups. A further three scenarios, based on the accessible control factors, followed. As only two accessible control factors were identified as making refraining from driving after being awake for 15 or more hours difficult for the elderly adults, the final two items were taken from the same age group regarding refraining from driving between 3pm and 6pm, but which could be applied to the former behaviour, i.e., 'to give someone a lift' and 'to take part in recreational activities'. The specific items assessing each variable directly are described fully in section 4.2.3.1.1.

The format of the items designed to capture anticipated regret was based on Richard *et al.*'s (1998) study. The measure was presented after the other direct measures to prevent participants from being induced to anticipate regret prior to responding to the remaining measures, which has previously been found to significantly affect intention (Abraham & Sheeran, 2004; Sheeran & Orbell, 1999) and behaviour (Abraham & Sheeran, 2003).

3.2.2.3.2 Belief-based measures

Patton (2002) reported that when summarising qualitative data, it is important to use the interviewees' terminology to capture the complexities of their individual perceptions. It was ensured therefore, that for each age group, the wording of the items reflected the most frequent wording used by participants (Ajzen & Fishbein, 1980). This sometimes resulted in essentially the same underlying theme being worded differently for the three age groups, for example, 'Driving when I have been awake for 15 or more hours would mean I would be driving when I...find it difficult to concentrate/focus' (young adults)/ '...am unable to concentrate' (middle-aged adults).

For ease of completion, items assessing behavioural, normative and control beliefs (i.e., as identified in section 3.1) and their respective evaluations were each presented together, as in Ajzen's (2002b) sample questionnaire, with the negative endpoints displayed on the left. Behavioural beliefs were presented first, followed by outcome evaluations, normative beliefs, motivation to comply items, control belief strength items and finally control belief power items. The sections were separated by headings, for example, 'Section B', to emphasise the different item formats and scale endpoints in the assessment of the different types of beliefs. In most cases, the order of the beliefs within these sections was based on the frequency of elicitation, i.e., the most accessible belief appeared first and the least accessible belief last, to prevent potentially non-accessible beliefs from affecting existing accessible beliefs (e.g., Sutton *et al.*, 2003). An exception to this rule occurred when 'other family members'/'family' was an accessible referent group; this belief was presented after any other referents who could be considered to be within the participants' family, e.g., parents, partner, to avoid double-counting errors. Also, the referent group, 'People who want me to give them a lift' was placed after all of the other normative beliefs in the questionnaires to prevent a possible reason as to why their referents may want them to drive, i.e., because they wanted a lift, from being made accessible and affecting beliefs presented later on (e.g., Eagly & Chaiken, 1993; Sutton *et al.*, 2003).

For refraining from driving after being awake for 15 or more hours, 10 behavioural, nine normative and eight control beliefs were piloted with the young adults, 11 behavioural, seven normative and eight control beliefs with the middle-aged adults, and seven behavioural, five normative and nine control beliefs with the elderly adults. Ten behavioural, eight normative and 10 control beliefs in relation to refraining from driving between midnight and 6am were presented to the young adults. Finally, six behavioural, five normative and 12 control beliefs were piloted with the elderly adults in the questionnaire assessing determinants of refraining from driving between 3pm and 6pm. Three of these latter normative beliefs were not identified as accessible for this behaviour but were added to increase the number of items. Ajzen and Driver (1991) reported that accessible referents tend to be the same across related behaviours. As the three referents, 'partner', 'other road-users', and 'police', were accessible to this age group for refraining from driving after being awake for 15 or more hours, it was deemed acceptable to include them in the normative belief set for refraining from driving between 3pm and 6pm too.

Where there were eight or more behavioural, normative or control beliefs in the modal set, prior to presentation of the items assessing the behavioural beliefs, normative beliefs or power of control beliefs respectively, participants were instructed to mark an asterisk (*) next to the beliefs they perceived as being most important in determining whether or not they performed the behaviour being assessed. (This question was placed after the power of control belief items to avoid confusion as participants were presented with the list of control beliefs twice, see below.) Although Ajzen and Fishbein (1980) stated that the expectancy-value underpinnings of the belief-based measures make belief importance ratings redundant when predicting the overall constructs (as important beliefs tend to be more polarised and held more strongly than less important beliefs), in the present research they were considered a useful way of reducing the number of accessible beliefs in the modal sets. Indeed, van der Pligt and his associates (van der Pligt & de Vries, 1998a, 1998b; van der Pligt & Eiser, 1984) argued that the addition of measures of belief importance improves insight into the decision-making process.

3.2.2.3.3 Final section of questionnaires

At the end of the questionnaires (or part of the questionnaires, i.e., after each behaviour), participants were asked two questions regarding the content and wording of the items. Specifically, they were asked if there were any questions that they found difficult to answer and why, and if they had any suggestions as to how the questions could be made easier for people to understand. They were then asked to provide details of their age, gender and occupation. In addition, participants were asked an open-ended question to measure their past behaviour, 'How many hours have you normally been awake for when you drive for the last time in a typical day?'. The number of years in which the participant had held their driving licence for and details of any vehicle accidents that they had been involved in during the last year were also elicited at the end of the questionnaires.

3.2.2.3.4 Item wording

Although the behaviours concerned *refraining from* driving after being awake for 15 or more hours/between midnight and 6am/between 3pm and 6pm, some of the questionnaire items were worded, 'driving...' rather than, 'refraining from driving...'. This was because wording the items as 'driving' appeared to have higher face validity and made the questions simpler and easier to understand. Further, driving, as opposed to refraining from driving, was to be measured in the main study. It was not taken for granted that driving was necessarily the exact opposite of refraining from driving and it is true that the two may have different rationales and underlying cognitions (East, 1997). However, Sheeran and Orbell (1999) viewed not playing the lottery as a different behaviour to playing the lottery, but reported that their results were not influenced by one of the measures (anticipated regret) assessing one and the TPB variables assessing the other. In addition, in the present research, participants in the elicitation study often stated beliefs associated with driving, as well as with refraining from driving, suggesting that both sets of beliefs contribute to the decision whether or not to refrain.

All of the direct measures were worded, 'driving', except for attitude and PBC, which were worded 'refraining from driving'. Attitudes towards refraining from driving were assessed because the item stem was relatively short and therefore appeared easier for participants to grasp, despite being worded in the negative, e.g., 'For me to refrain from driving after being awake for 15 or more hours is...'. Wording the PBC items as 'driving' may have erroneously tapped the *ability* to drive and the control over and ease/difficulty of *actually* driving under the specified circumstances (e.g., if participants believed that 15 hours of wakefulness would reduce their driving skills, they may report a decreased ability to drive then). These issues were distinct to those pertaining to whether or not they refrained from driving. Manstead and Parker (1995) outlined several methodological problems with PBC when applied to socially undesirable behaviours such as driving violations. They argued that, in contrast to other behavioural domains, high PBC scores are associated with not intending to perform the behaviour, and an individual who believes they truly have control over a behaviour would actually score 0 on the PBC scale. Wording PBC as 'refraining from driving' eliminates these problems.

Moreover, Parker *et al.* (1995) applied the TPB to predict intentions to commit three driving violations and worded all of their TPB measures as 'committing the violation' except for the direct measure of PBC, which was worded as 'refraining from committing the violation'. Their PBC measure had originally comprised three items, the remaining two worded as 'committing the violation', however, poor reliability and correlations with the other variables required the removal of these two items. The single item worded, 'refraining from committing the violation' was retained as it demonstrated the best relationship with the belief-based measure of PBC.

Depending on the particular belief, some behavioural beliefs were worded as 'driving' and others as 'not driving'. The latter phrasing seemed simpler for longer items than 'refraining from driving', while retaining the same connotation. Beliefs associated with the risk of driving while sleep impaired, for example, 'prevents me from driving when tired' were worded as 'driving' to avoid unnecessary double-negatives. For example, 'Driving when I have been awake for 15 or more hours would mean I would be driving when I am tired'. However, beliefs associated with being unable to perform certain activities caused by not being able to drive made more sense to remain as 'not driving'. For example, 'Not driving when I have been awake for 15 or more hours would mean I would be unable to go out socialising'. Behavioural beliefs of each type of wording were grouped together in the questionnaires for ease of completion, with the 'driving' items presented first.

Normative beliefs were worded as 'driving' for simplicity. The power of control belief items were particularly problematic. If worded 'driving', participants may have construed the extent to which the control factors would facilitate or inhibit driving as the extent to which they would affect their *ability* to drive, whilst the wording of 'not driving' for these items seemed difficult to understand in itself. Therefore, both types of wording were piloted, and participants were asked which they found the easiest to understand and answer and why. Items phrased, 'refrain from driving' and 'not driving', were emboldened and underlined throughout the questionnaires to emphasise the difference to participants.

3.2.2.4 Procedure

Participants were told that the questionnaires were part of a pilot study and the importance of answering the open-ended questions regarding the content and wording of the items was emphasised. Participants were asked to answer all questions as accurately and honestly as possible and told that their responses would remain confidential and anonymous.

3.2.2.5 Analyses

Checks on reliability and face validity of direct measures

Cronbach's alpha and item-total correlations were computed for all of the direct measures to test their internal reliabilities. To identify any nondiscriminating items, the extent to which participants gave neutral responses to each item and to which all participants answered in the same way were examined via scrutiny of the modes and variances, respectively. For refraining from driving after prolonged wakefulness, these procedures were conducted on the sample as a whole (N = 18) as sample sizes for the three separate age groups were deemed small for statistical procedures (N = 6; i.e., the direct measures were the same for all participants). Finally, comments that participants made regarding the content and wording of the questions, i.e., their face validity, were considered.

Scoring of belief-based measures

Before any analyses could be conducted on the belief-based measures, the appropriate scoring for each of the components (e.g., behavioural beliefs, outcome evaluations) was determined, based on theoretical and empirical considerations. Where possible, i.e., for refraining from driving after prolonged wakefulness (as this behaviour was addressed in all three age groups), statistical procedures to identify the best scoring combinations were conducted on the overall sample, due to small sample sizes for the separate age groups. All possible multiplicative combinations of unipolar and bipolar scoring for the two components of each belief-based measure were calculated, for example, behavioural beliefs scored in a unipolar fashion multiplied by outcome evaluations scored in a unipolar fashion; unipolar behavioural beliefs multiplied by bipolar outcome evaluations, etc. Differences were examined in the magnitude of the correlations between the variously-scored multiplicative composites and the corresponding direct measure and intention (East, 1997). Although the belief-based measures do not necessarily have to be internally consistent (as individuals may hold beliefs that are inconsistent with their overall attitude, subjective norm and PBC, Ajzen, 2002a, 2002b; Ajzen & Driver, 1991), Cronbach's alpha was also computed for each of the scoring combinations to assist in reaching a verdict. In addition, the belief-based measure of subjective norm was calculated with and without the motivation to comply component, based on previous findings (Budd, 1987; Grube *et al.*, 1986; van den Putte & Hoogstraten, 1997; see section 3.2.1.3), and the above investigations conducted on each.

Reducing the number of beliefs in the modal sets

A primary aim of the pilot study was to reduce the number of beliefs in each modal set for each age group and behaviour to nine or less (Ajzen & Fishbein, 1980; see section 3.1.1). Over nine accessible beliefs were identified in several of the modal sets determined from the elicitation study.

A number of strategies were employed to determine which items to remove. First, the accessibility of each belief in relation to the other beliefs (i.e., the frequency of elicitation) was examined. Second, belief importance ratings were considered by tallying the number of asterisks marked alongside each belief. Finally, a number of descriptive and inferential statistical procedures were conducted. Items were checked for predominantly neutral responses and/or limited variance. Cronbach's alpha for each measure with and without particular beliefs, as well as item-total correlations, correlations between individual beliefs with the corresponding overall construct and intention, and correlations between the belief-based measures minus particular beliefs with the global construct and intention were examined. Participants' comments were also taken into account. It was necessary for these procedures to be conducted on the separate age groups due to their different modal belief sets. Hence, due to the small sample sizes ($N = 6$), caution was taken in interpreting the findings.

To summarise, a form of triangulation was used in that beliefs were likely to be omitted from the modal sets if they were less accessible, less important and/or if they had low reliability and concurrent validity. Ambiguous and nondiscriminating beliefs were also identified via qualitative and descriptive methods, respectively.

Issues with item wording

The questionnaire items that were worded 'drive' were reverse-scored so that all items were scored in the same direction, which corresponded with the behaviour under investigation, i.e., refraining from driving. It was unclear, however, whether the behavioural beliefs phrased 'drive' and 'not drive' should be scored in the same way or whether the 'drive' items should be reverse-scored. In order to determine the appropriate scoring, two belief-based measures were computed, one with all of the beliefs scored in the same way and the other with the two differently-worded beliefs scored differently. For the whole sample, the correlation between the two measures was examined and comparisons made between the correlations between the two belief-based measures with direct attitude and intention. In addition, the two Cronbach's alpha computations were compared within the separate age groups.

The same procedures were used to determine the optimal phrasing of the control belief power items, i.e., 'drive' or 'not to drive'. Thus, two belief-based measures were computed, one using the control belief power items worded as 'drive' and the other using the same beliefs phrased as 'not to drive', followed by an examination of the correlation between the two belief-based measures, comparisons of the relationships between the two belief-based measures with directly-measured PBC and intention, and comparisons of internal reliabilities. In addition, the comments that participants made regarding the two types of wording were considered.

3.2.3 Results

3.2.3.1 Issues relevant to all questionnaires

At the end of the questionnaires (or part of the questionnaires), similar comments were made by participants with regards to items assessing all three refraining from driving behaviours. Several participants stated that the questionnaire was too long, an issue that was partly resolved in the main study, but which indicates that these pilot findings warrant caution as participants may have suffered from response fatigue. Six participants (three middle-aged and three elderly adults) stated that some of the questions were difficult to answer because of the way they were worded. In particular, a third of respondents mentioned that they found the power of control belief items difficult to understand and answer for at least one of the behaviours they answered questions about (four young, one middle-aged and one elderly adult). Four participants had a problem with answering questions designed to measure subjective norm, stating for example, 'I had to make assumptions about what other people think' and reporting that the items assessing motivation to comply were 'strange' and difficult to answer. Finally, idiosyncratic comments regarding the wording of specific questions were elicited.

It was clear from all three datasets that the behavioural beliefs worded as 'drive' should be reverse-scored, while the 'not drive' items should be scored normally. The statistical and qualitative evidence supported the decision to phrase the items assessing the power of control beliefs as 'not to drive' for all three behaviours. Taking all three refraining from driving behaviours together, twice as many participants stated that the control belief power items were easier to understand and answer when worded as 'not to drive', as opposed to 'drive' (eight versus four). It is noteworthy that for refraining from driving after prolonged wakefulness (N = 18), the correlation between the two belief-based measures of PBC, one using the items worded, 'drive' and the other, 'not to drive', was only moderate ($r = -.47$, $p < .05$). This indicates that participants were not using the types of items as exact opposites of each other, supporting the decision to phrase the direct measures of PBC as 'refrain from driving'.

3.2.3.2 Questionnaires concerning refraining from driving after prolonged wakefulness

The subjective amount of time in which participants had normally been awake for before they drove for the last time in a typical day was 10.38 hours (SD = 3.59) for the whole sample. Young adults stated they had usually been awake for 10.25 hours (SD = 4.86), middle-aged adults stated 11.33 hours (SD = 2.16) and elderly adults reported an average of 9.40 hours (SD = 3.71). Only two participants (one young and one middle-aged adult) admitted to driving after being awake for 15 hours in a typical day.

Direct measures: All of the direct measures were internally consistent ($\alpha s \geq .74$) and the descriptive statistics revealed no problems with the way in which participants responded.

Belief-based measures: Behavioural beliefs and outcome evaluations were scored in a bipolar fashion (i.e., from -3 to 3). The belief-based measure of subjective norm performed better empirically when motivation to comply was omitted. Therefore, the average of the normative belief scores was used in subsequent analyses of the pilot data. For the belief-based measure of PBC, the strength of control belief items were scored in a unipolar way (i.e., from 1 to 7) and bipolar scoring was applied to the power of control belief items.

There were initially more than nine accessible behavioural beliefs for the young adults, of which two were subsequently removed using the procedures outlined above. In addition, the modal normative belief set comprised a relatively large number of beliefs (albeit not over the threshold of nine), compared to the other age groups and behaviours (nine). The referent group, 'People who want you to give them a lift/pick them up', was omitted to eliminate possible double-counting errors due to the likelihood that everyone who could be included in this group were already mentioned in the modal set (e.g., friends, partner).

Three behavioural beliefs were omitted from the modal set compiled for the middle-aged adults due to over nine beliefs being present initially. The referent group, 'People who want you to give them a lift/pick them up', was retained for the middle-aged adults as there was no need to omit any beliefs based on the total number (seven) and because people who could easily have belonged to this group were not already in the belief set (e.g., partner, friends).

One of the behavioural beliefs identified as accessible for the elderly adults, 'Not driving when I have been awake for 15 or more hours would be inconvenient', was removed from the modal set. Although this set originally comprised only seven beliefs, this same belief was omitted from the behavioural belief sets of both the young and middle-aged adults because, in each case, despite its high accessibility, it was not an important belief based on participant ratings and the item had low correlations with the belief-based total measure, direct attitude and intention. It was likely that these findings were due to the limited variance of the outcome evaluation of this item, i.e., 'Inconveniences are very bad-very good'. Additionally, several other behavioural beliefs were consequences of or specific instances of inconvenience, e.g., 'I would be unable to get somewhere if there was an emergency'. In keeping with the TPB's underpinnings, the overall assessment of inconvenience was tapped using the direct measure of attitude only (using the adjective pair, 'inconvenient-convenient'), whereas the behavioural beliefs captured specific consequences.

3.2.3.3 Questionnaires concerning refraining from driving between midnight and 6am

Direct measures: Cronbach's alpha values computed for all of the direct measures were high (αs $\geq$ .78), despite the small sample size (N = 6). There appeared to be no problems with the way in which participants responded.

Belief-based measures: The scoring procedures applied to the components of the belief-based measures of the TPB variables were identical to those used to score the data regarding refraining from driving after being awake for 15 or more hours. The behavioural belief, 'Not driving between midnight and 6am would be inconvenient and would limit what I can do between those times' and the normative belief, 'People who want you to give them a lift/pick them up' were removed due to problems mentioned previously. In addition, one control belief was omitted to reduce the number of beliefs to nine.

3.2.3.4 Questionnaires concerning refraining from driving between 3pm and 6pm

Direct measures: The direct measures of the TPB variables were highly reliable (αs $\geq$ .88). The measure of habit caused concern, however, as it resulted in a negative Cronbach's alpha (α = -6.61) demonstrating that it violated the assumptions of reliability. Examination of the item-total statistics revealed that deleting the second item ('Do you drive between 3pm and 6pm to give someone a lift?') resulted in a much improved value of α = .72. This made little sense, especially due to this belief being the most accessible control factor for this behaviour. Internal consistencies of the measures of past behaviour and anticipated regret were also low (α = .38 and α = .53, respectively), the latter finding possibly being due to the counterbalancing of the positive and negative endpoints of the four items (which were presented together) causing confusion among the small sample of elderly adults. Although consideration was given to why these results were obtained, it was likely that they were primarily due to the small sample size.

Belief-based measures: The elderly adults seemed to use the scales in a somewhat different manner for refraining from driving between 3pm and 6pm compared with the other age groups and refraining from driving behaviours. Whilst bipolar scoring was applied to the behavioural beliefs, outcome evaluations, normative beliefs, control belief strength items and control belief power items, motivation to comply (which was retained) was scored in a unipolar fashion. The behavioural belief, 'Not driving between 3pm and 6pm would be inconvenient and would mean I would be unable to do the things that I usually do' was kept in this belief set due to it providing more information than simply '...would be inconvenient'. Also, this belief was related to the belief-based total, the direct measure of attitude and intention, and there were only six accessible behavioural beliefs to begin with. Three of the control beliefs originally identified as accessible to the elderly adults were omitted from the modal set, resulting in nine control beliefs being retained.

3.2.4 Development of the questionnaires for the main study

The descriptive statistics regarding the subjective amount of time in which participants had normally been awake for before they drove for the last time in a typical day suggested that driving after 15 hours of wakefulness was not a particularly frequent behaviour, at least in this sample of 18 adults. Alternatively, the results may have been affected by social desirability concerns, rendering them invalid. The option of modifying the behaviour under investigation to refraining from driving after being awake for 12 or more hours (which eight out of 17 participants stated that they regularly did) was considered. The decision was reached, however, to leave the behaviour as it was initially defined due to its evidence-based rationale (see section 1.1.1) and to ensure that the accessible beliefs identified in the elicitation study were valid.

General amendments were made to the items for all three behaviours. In particular, the front page of the questionnaires was altered to clarify the instructions, for example, the adverbs which the points on the rating scales represented, e.g., 'very', 'quite', were emboldened, an example question was included to aid understanding of how to use the scale and a sentence directing participants' attention to the scale endpoints for each item was added. Also, the questionnaire was made more user-friendly with the use of spacing and emboldening the item numbers to clarify where items began and ended. Minor amendments were made to the wording of items in all of the questionnaires to rectify the problems elicited from participants, whilst maintaining the TPB format. Measures of motivation to comply were retained in the main questionnaires as the current findings suggesting its removal from the belief-based measure of subjective norm were based on just 18 participants.

For ease of completion, the order in which the belief-based measures were presented was changed so that all of the items worded 'driving' appeared first, followed by the items phrased, 'refraining from driving'/'not driving'. Therefore, after the direct measures (predominantly worded 'driving'), the belief-based components of subjective norm were displayed, then the components of attitude (the 'driving' items placed before the 'not driving' items) and finally the components of belief-based PBC. In some cases, this resulted in altering the order in which the beliefs were presented within their modal belief set to prevent two similarly-based beliefs of different types (i.e., behavioural, normative, control) appearing adjacent to each other in the questionnaire, for example, the outcome evaluation 'Being unable to get somewhere if there was an emergency is very bad-very good' and 'How often does an emergency occur in your life?'.

Owing to the relatively complex nature of refraining from driving while sleep impaired, the format of the normative belief items was simplified in that an item stem was employed. For example, the question, 'Do the following individuals/groups think you should drive when you have been awake for 15 or more hours?' preceded the list of normative referents.

The procedures previously outlined indicated that items designed to assess the power of control beliefs displayed higher face validity and performed better statistically when they were worded 'not to drive'. These items were therefore retained in the main questionnaires and the items phrased 'driving' were omitted. Judging by the comments that participants made, however, it was clear that they found the power of control belief items difficult to grasp. Therefore, in an attempt to enhance understanding in the main questionnaires, the phrasing was changed to 'refrain from driving', rather than 'not to drive', and an example of how to answer these items was added.

For refraining from driving after being awake for 15 or more hours and between midnight and 6am, the methods employed to determine the appropriate scoring procedure for the belief-based measures suggested that participants used the control belief strength scale in a unipolar manner. Although these findings were based on small sample sizes, they warranted a change in the endpoints of the control belief strength scale from 'very rarely-very frequently' to 'never-very frequently' (signifying unipolar scoring, Conner & Sparks, 1996; Conner *et al.*, 2001) for the main study. As bipolar scoring was applied to the control belief strength component of the belief-based measure of PBC for driving between 3pm and 6pm, the scale endpoints were left unaltered.

4.0 USING AN EXTENDED TPB TO PREDICT AND UNDERSTAND SLEEP IMPAIRED DRIVING

4.1 INTRODUCTION

Over the last 20 years, the success of high profile policing and the implementation of the drink driving limit has coincided with a marked change in social beliefs and attitudes towards drink driving (Martin, 2002). Public attitudes towards driving while sleep impaired are very different to those of drink driving, despite the fact that both are largely voluntary and self-imposed conditions that are equally impairing (Dement, 1997). It is important for society to recognise the consequences of sleepiness with the same vigour with which they acknowledge the impairments caused by alcohol (Bonnet & Arand, 1995; Dement & Vaughan, 1999).

The majority of research has indicated that the impairment caused by sleep loss is worse than is perceived by the driver (e.g., Horne & Reyner, 1995a, 2001). This is reflected in their tendency to drive regardless of impairment (Smith *et al.*, 2005), their failure to appreciate that extreme sleepiness leads to falling asleep (Reyner & Horne, 1998) and in the lack of correspondence between subjective and objective measures of sleepiness (Kamdar *et al.*, 2004; Moller *et al.*, 2006) and performance (Arnedt *et al.*, 2000; Philip *et al.*, 2003). Indeed, many reviews have emphasised the importance of educating drivers about the dangers of driving while sleep impaired (Horne & Reyner, 1995a, 1999; Reyner & Horne, 1998; Smith *et al.*, 2005). However, drivers have also been found to be aware of their sleepiness (Horne & Reyner, 1995a, 1996, 1999, 2001; Reyner & Horne, 1998; Smith *et al.*, 2005) and its negative effects upon performance (Dorrian *et al.*, 2000; Jones *et al.*, 2006), warranting the question of why adults drive while in a vulnerable state of sleepiness.

Taking a nap and/or drinking coffee leads to short term improvements in alertness and performance (Biggs *et al.*, 2007; Campbell *et al.*, 2005; De Valck & Cluydts, 2001; De Valck *et al.*, 2003; Dhand & Sohal, 2006; Horne & Reyner, 1996; Reyner & Horne, 1997) and so these are the key suggestions for temporarily counteracting driver sleepiness found in the literature (e.g., Horne & Reyner, 1995a, 1999; Johns, 2000).

Although these may be useful to drivers who have already decided to drive while sleep impaired, they fail to address the crucial cognitions underlying this decision. The present study explored these factors for the first time.

In general, young males are at increased risk of crashing their vehicle as a result of sleepiness (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003). Although the relationship between age and vehicle accident frequency is well-established, its connection with psychological factors, which may be acting alone or together, has not been clarified (Briem *et al.*, 2000). There is little in the literature, other than age and gender, to explain why individuals drive while sleep impaired (see section 1.1). Although knowledge of these demographic characteristics is important, it provides only descriptive information (Elliott *et al.*, 2003). As age and gender cannot be modified, the need to identify the underlying modifiable beliefs regarding this potentially fatal behaviour is crucial to produce behavioural change (Armitage *et al.*, 2002).

The following study applied the TPB to three behaviours that have been identified to increase the risk of being involved in a sleep-related vehicle accident. The model is useful for organising and understanding the large number of influences identified as being important within the area of traffic safety (Gordon & Hunt, 1998). Factors predictive of and underlying sleep impaired driving were identified in different age groups at varying degrees of risk, with the ultimate view to reducing the incidence of this behaviour in the general population.

4.1.1 The behaviours under investigation

Three driving behaviours were investigated in the present study. These were identified from the literature reviewed in section 1.1 as risk factors for being involved in a sleep-related vehicle accident.

(1) The determinants of refraining from driving after 15 or more hours of continuous wakefulness in the following week were explored in young, middle-aged and elderly adults. Whether or not the young adults drove after 15 or more hours of wakefulness over the week was also established.

(2) The determinants of refraining from driving between midnight and 6am in the following week were identified among young adults and a measure of behaviour obtained.

(3) The determinants of refraining from driving between 3pm and 6pm in the following week were examined in a sample of elderly adults.

Several researchers have successfully explored the determinants of avoidance behaviours, such as not smoking (Conner *et al.*, 2006), refraining from/avoiding speeding (Conner *et al.*, 2007; Elliott *et al.*, 2007), avoiding eating high-calorie snacks (Churchill *et al.*, 2008) and refraining from sexual intercourse (Richard *et al.*, 1995). In each of these studies, where a measure of behaviour was obtained, the behaviour of actually performing the act (as opposed to not performing it) was measured, as in the present research. For this reason, from hereon in, the terms 'driving' and 'refraining from driving' are used interchangeably when referring to the behaviours currently under investigation (see sections 3.2.2.3.4 and 5.2.1).

4.1.2 Measures of behaviour

Background

As previously mentioned, the validity of self-reported behaviour is questionable, but the results obtained via these measures should be viewed with particular caution when the behaviour is socially undesirable (Ajzen & Fishbein, 1977). It is explained elsewhere that although the behaviours in the present research regarded *refraining from driving* under certain circumstances, some of the measures were worded in relation to *driving* under these circumstances (see sections 3.2.2.3.4 and 4.2.3.1). The driving behaviours may be viewed by some individuals as socially undesirable to the extent that they associate the behaviour with an increased risk of causing a vehicle accident. It is reasonable to argue that driving after being awake for 15 or more hours may carry the most socially undesirable connotations due to the fact that the term alone implies driving whilst tired. Indeed, Stutts *et al.* (2003) suggested that the drivers in their study may have been less likely to report driving after prolonged wakefulness if they viewed this behaviour as incriminating. On the other hand, Elliott *et al.* (2003) applied the TPB to drivers' compliance with speed limits and obtained a self-reported measure of behaviour three months after the administration of the TPB measures. They argued that although the measure of behaviour was subjective, their findings were valid since previous research has documented significant correlations between self-reported and objective indices of driver speed. In addition, Elliott *et al.* (2003) pointed out that self-report is widely recognised as a valuable methodological tool in social research.

A valid and reliable alternative to a single administrative retrospective self-reported measure of driving behaviour is to ask participants to record their driving behaviour on a daily basis by means of a driving diary (Verplanken *et al.*, 1998). Furthermore, an assessment of behaviour based on objective measures is the most valid and reliable option (Armitage & Conner, 2001a; see section 1.3.2.5). However, there are obvious practical difficulties with obtaining a completely objective measure of sleep impaired driving. It would undoubtedly be very costly and sample sizes would be small (Elliott *et al.*, 2003). A purely objective measure of sleep impaired driving was therefore not obtained in the present study.

Research that has tested the ability of the TPB to predict prospective measures of actual observed driving behaviour is scarce. Gordon and Hunt (1998) measured the speed of passing vehicles on the roadside, before stopping the motorists and asking them to complete a TPB questionnaire in relation to speeding. They did not report the relationship between PBC and observed speeding behaviour, but the correlation between intention and behaviour was not significant. Elliott *et al.* (2007) also assessed the ability of the TPB to predict actual speeding. One week after administration of the TPB measures, they obtained a subjective measure of behaviour from participants and observed their driving speed on four different types of roads (e.g., village through roads, motorways) via a driving simulator. Intention and PBC accounted for 67% of the variance in subjective behaviour and both variables were significant predictors. The explained variance in observed behaviour was much lower, ranging from 31% to 39%. In contrast to the findings of Gordon and Hunt (1998), intention was the sole predictor of observed behaviour in all four cases. Conner *et al.* (2007) corroborated Elliott *et al.*'s (2007) findings; they obtained an objective measure of speeding using an on-road speed camera taken without driver awareness and found that intention, but not PBC, significantly predicted behaviour even after past behaviour was taken into account. It is worth noting that there were problems with the order in which the TPB variables were measured in this study (behaviour was assessed before the underlying cognitions), which warrants caution in interpreting the direction of the findings.

The present study

Driving after being awake for 15 or more hours: It was beyond the scope of the research to measure driving after prolonged wakefulness in the samples of middle-aged and elderly adults. Only the behaviour of the young adults was investigated since this age group are at an increased risk of crashing their vehicle as a result of sleepiness (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003), and therefore the findings have more important implications for road safety intervention attempts.

The young adults were required to wear an actiwatch and complete a sleep and driving diary for eight days. Three measures of behaviour were obtained. A subjective retrospective measure of driving behaviour was administered at the end of the week for completeness and comparative purposes. A diary-based measure of driving was obtained via the data recorded on a daily basis over the week in the driving diary. Finally, a calculated measure of driving behaviour was determined using the data from the actiwatch to determine periods of sleep, in conjunction with the data from the driving diary. The study described in Chapter 2 provided support for the use of actigraphy to differentiate periods of sleep and wake. This behavioural measure was the most objective and is argued to be the most valid and reliable.

Driving between midnight and 6am: Two measures of behaviour were obtained from the young adults; a subjective and a diary-based measure, both in a similar manner to those described for driving after 15 or more hours.

Driving between 3pm and 6pm: Behaviour was not measured due to time constraints; only the determinants of intention were explored. Predicting and understanding intention was worthwhile since research has indicated that intention predicts behaviour in general (e.g., Armitage & Conner, 2001a) and specifically driving behaviour (e.g., Elliott *et al.*, 2007). Further, Abraham and Sheeran (2004) emphasised the importance of examining the determinants of intention, drawing on Sheeran's (2002) finding that when an intention is not present, there is a 93% chance that the individual will not perform the behaviour.

4.1.3 Main aims and hypotheses

The determinants of (refraining from) driving while sleep impaired in young, middle-aged and elderly adults were investigated. Questionnaires were administered to participants at Time 1 assessing the TPB variables, past behaviour, habit, anticipated regret and ISS in relation to the behaviour(s) relevant to their age group (see section 4.1.1). Behaviour was measured one week later (Time 2) in the young adults only.

Based on the TPB and past research, the following hypotheses were devised:

H_1 Intention and, to the extent that the behaviour is perceived to be volitionally uncontrollable, PBC, would account for a significant proportion of variance in driving after 15 or more hours of wakefulness and driving between midnight and 6am.

H_2 Attitude towards the behaviour, subjective norm and PBC (or their subcomponents) would account for a significant amount of variance in intention to drive after 15 or more hours of wakefulness, intention to drive between midnight and 6am and intention to drive between 3pm and 6pm.

H_3 If intention significantly predicts behaviour (where it was measured) and at least one of the TPB variables predicts intention, there would be differences in the underlying beliefs of those who performed/intended to perform the behaviour compared to those who did not.

H_4 Anticipated regret would independently predict intention to perform all three behaviours, over and above the TPB constructs, and after controlling for past behaviour (as this constitutes a more robust test of the effects of additional variables, Abraham & Sheeran, 2004). Specifically, the more an individual anticipated that they would feel regret after driving under the particular circumstance, the weaker would be their intention to do so.

H_5 ISS would significantly predict the extent to which the young adults actually drove after being awake for 15 or more hours and between midnight and 6am, over and above the TPB constructs and past behaviour. High impulsive sensation seekers would be more likely to drive after 15 or more hours and between midnight and 6am.

H_6 It was expected that gender would independently predict intention to drive between midnight and 6am, over and above the TPB variables and past behaviour.

The predictive effects of past behaviour were also explored to test the sufficiency of the models (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). For exploratory purposes, the ability of ISS to independently predict intention to drive after 15 or more hours of wakefulness in all three age groups and intention to drive between midnight and 6am in the young adults was also investigated. Finally, the extent to which the TPB was able to mediate the effect of gender on whether or not the young adults actually drove between midnight and 6am was established.

4.2 METHOD

4.2.1 Design

The design of the study was prospective for the young adults. They completed a TPB questionnaire at Time 1 in relation to driving after being awake for 15 or more hours and between midnight and 6am, in the next week, before wearing an actiwatch (Actiwatch®, Cambridge Neurotechnology, Cambridge, UK) and completing a sleep and driving diary for eight days. They then returned to the laboratory (Time 2) to respond to another questionnaire regarding their driving over the previous week.

The middle-aged and elderly adults provided cross-sectional data, in the form of a TPB questionnaire. Both age groups answered questions in relation to driving after being awake for 15 or more hours in the next week, and the elderly adults also responded to items assessing the determinants of driving between 3pm and 6pm in the next week.

4.2.2 Participants

Young adults: To ensure that only healthy young adults who had fairly regular and natural sleep patterns were recruited and that the data obtained from the actiwatches were accurate, potential participants were screened to exclude people who worked night-shifts, people with a diagnosed sleep disorder, people taking sleeping pills, people who were chronically or acutely seriously ill or who had a psychiatric illness, pregnant women and people with a new born baby in the house. In addition, only individuals who held a current driving licence and who had access to a car were recruited. Young adults were recruited through word of mouth and emails were sent to the students and staff of a north-west university specifying the inclusion criteria and asking for their participation. This correspondence informed potential participants that they would receive a £10 gift-card for a local supermarket at the end of their role in the study. This was to increase participation rates, compliance with the study requirements and to cover any expenses. One young adult began the study but did not complete it, resulting in a completion rate of 98.6%. This individual's Time 1 data were not utilised due to their withdrawal from the study.

Middle-aged and elderly adults: Participants were recruited providing they held a current driving licence, had access to a car, did not work night-shifts and did not have a diagnosed sleep disorder. Owing to difficulties in the recruitment of adults in the older age groups, adults who participated in the study described in Chapter 2 were asked if they would consent to their details being retained so that they could be contacted about a second smaller-scale study (there was an eight-month time delay between studies). Other individuals were enlisted through word of mouth, snowballing and advertising at a number of clubs arranged for older adults. Potential participants were told they would receive a £5 supermarket gift-card after completing (and sending off) the questionnaire to encourage participation. Response rates were not recorded due to the different ways in which participants were recruited, for example, in some cases, trustworthy individuals were given several questionnaires to distribute to friends and those who wished to participate were asked to contact the researcher (in order to check they met the eligibility criteria and to arrange collection of the completed questionnaire, etc). The exact number of people who were asked but who declined to participate was therefore unknown.

Two hundred and ten healthy volunteers were recruited via quota sampling, comprising 70 young (35 female; mean age = 23.6 years, SD = 3.3), 70 middle-aged (35 female; mean age = 49.3 years, SD = 5.0) and 70 elderly (35 female; mean age = 72.9 years, SD = 4.9) adults (overall mean age = 48.5 years, SD = 20.6).

4.2.3 Measures

4.2.3.1 Time 1 questionnaires

For the young and elderly adults, this questionnaire consisted of two counterbalanced sections, one assessing the determinants of driving after 15 or more hours of wakefulness and the other measuring the variables in relation to driving at a particular time of day. The questionnaire designed for the middle-aged adults only contained items regarding driving after prolonged wakefulness.

The front page of the questionnaire booklets (or section) provided participants with a full description of the behaviour. The time frame of 'in the next week' was emboldened and underlined as it was not included in the individual questionnaire items in order to shorten and simplify them for ease of completion. A seven-point scale was presented together with details of what each point represented (i.e., 'very', 'quite' and 'slightly' at each side of the centre of the scale, the latter signifying 'neither', Osgood *et al.*, 1957), followed by an example item. The instructions also asked participants to answer as accurately and honestly as possible and informed them that the questions had no right or wrong answers. The instruction, 'Please answer all questions in relation to yourself at the present time' was underlined and emboldened to ensure that the older age groups did not consider times when they were younger, as this would have a bearing on the validity of the results, particularly on the ISS measure.

Direct measures of the constructs were presented before the belief-based measures to prevent the possible contamination of any beliefs which were not personally accessible affecting the corresponding direct measure (Sutton *et al.*, 2003; see section 3.2.2.3). All of the items, except for one item assessing past behaviour regarding driving after prolonged wakefulness, were assessed using seven-point scales with the ends representing opposing viewpoints.

Some questionnaire items were worded in relation to 'driving' (e.g., '...when you have been awake for 15 or more hours') whereas others were worded 'refraining from driving' or 'not driving' (e.g., '...when you have been awake for 15 or more hours'; see section 3.2.2.3.4). Where items were phrased, 'refraining from driving' or 'not driving', these terms were emboldened and underlined to ensure that the difference in wording was emphasised to participants.

With the exceptions of the direct measures of attitude and both measures of PBC (of which all of the items were worded in relation to refraining from driving), a higher score indicated a position more supportive of driving after being awake for 15 or more hours/between midnight and 6am/between 3pm and 6pm. That is, although this research explored *refraining from driving* under these circumstances, the measures were scored in relation to *driving* under these circumstances (which was in contrast to the pilot study, see section 3.2.2.5). This was because these were the behaviours that were actually measured in the young adults, i.e., driving after prolonged wakefulness and between midnight and 6am. The measures were scored in the same way for driving between 3pm and 6pm to maintain consistency.

For the direct measures of attitude and both measures of PBC, a higher score represented a position more supportive of refraining from driving after being awake for 15 or more hours/between midnight and 6am/between 3pm and 6pm. As these measures were not re-scored, negative relationships were expected between these and the remaining variables.

4.2.3.1.1 Direct measures

Items assessing the variables directly were presented under the heading of 'Section A'. With the exception of items employing stems, i.e., attitude, anticipated regret and some items assessing past behaviour, items were separated and interspersed with items measuring other constructs (Ajzen, 2002b). The positive and negative endpoints of the scales were counterbalanced to prevent possible response sets (Ajzen, 2002b). All of the items that used seven-point scales were scored from -3 to 3.

An aim of the study was to examine differences in the determinants of intention to drive after prolonged wakefulness between three age groups of adults. Thus, it was necessary to conduct the main regressions for the three groups separately and then to compare the results. Time and practical limitations, however, allowed an overall sample of only 210 adults, which comprised 70 adults in each age group. Comrey and Lee (1992) argued that, for analyses involving correlations and factor analysis, a sample size of 50 is very poor, 100 is poor and 200 is fair. Although the expected effect size also needs to be taken into account (Cohen, 1992; Miles & Shevlin, 2001; see section 4.3.1.4), these issues with sample size led to the decision to conduct some analyses on the sample as a whole in order to obtain more reliable and valid results. Thus, to determine the convergent and discriminant validity of the direct measures when applied to driving after prolonged wakefulness, principal components analyses (PCA) were conducted on the whole sample, as opposed to the separate age groups.

Presumably because the investigation of driving at a particular time of day only involved one age group (N = 70), some of the results were ambiguous in that the ensuing factor structure did not make theoretical sense. When this occurred, the direct measures were based on the results obtained for driving after prolonged wakefulness due to this being more reliable on account of a larger sample size and because all of the behaviours were similar, i.e., driving under particular circumstances. Estimates of internal reliability were also checked to ensure they were acceptable.

As PCA were primarily conducted to obtain empirical evidence on which to base the measures rather than testing the main hypotheses, the results are presented here. Components with eigenvalues greater than 1 were extracted and where there were more than one, direct oblimin rotation was used when the factors were correlated (r > .32) and varimax rotation when they were not (Tabachnick & Fidell, 2007).

Table 4.1 shows the items that assessed the TPB variables directly and anticipated regret for all three behaviours.

Table 4.1: Items used to assess the direct measures

Behaviours applied to	Variables	Items	Scale endpoints
All 3	Intention	I intend to drive...	Strongly disagree-Strongly agree
		How likely are you to drive...	Very unlikely-Very likely
		I plan to drive...	Very unlikely-Very likely
All 3	Attitude	For me to refrain from driving... is	Very bad-Very good
All 3			Very unpleasant-Very pleasant
All 3			Very unenjoyable-Very enjoyable
All 3			Very unsafe-Very safe
All 3			Very inconvenient-Very convenient
1, 2*			Very foolish-Very wise
3*			Very unnecessary-Very necessary
All 3	Social norm**	Most people who are important to me think that I should not-should drive...	
		Of the people you know, how many would want you to drive...	None of them-All of them
		The people in my life whose opinions I value would disapprove-approve of my driving...	
		The people in my life whose opinions I value do not drive-drive...	
		Most people who are important to me drive...	Definitely false-Definitely true
		Of the people you know, how many drive...	None of them-All of them
All 3	PBC	How much control do you believe you have over refraining from driving...	No control-Complete control
		It is completely up to me whether or not I refrain from driving...	Strongly disagree-Strongly agree
		I am confident that I could refrain from driving...	Strongly disagree-Strongly agree
		I feel that I am capable of refraining from driving...	Strongly disagree-Strongly agree
		If I wanted to I could easily refrain from driving...	Definitely false-Definitely true
		For me to refrain driving... is	Very difficult-Very easy
All 3	Antic. regret	Having driven... I would feel	Very bad-Very good
			Very regretful-Not at all regretful
			Very tense-Very relaxed
			Very guilty-Not at all guilty

* One set of adjective pairs used to assess attitude was different for driving between 3pm and 6pm (see section 3.2.2.3.1).

** For driving between midnight and 6am, the first three social norm items were used to assess injunctive norm and the final three captured descriptive norm (see below).

Driving after 15 or more hours of wakefulness

Intention: PCA extracted one component that explained 74.16% of the variance. The three items were therefore averaged (overall: α = .83; young adults: α = .85; middle-aged adults: α = .82; elderly adults: α = .79).

Attitude: PCA revealed one component accounting for 56.98% of the variance and the mean of the six items was used as the direct measure of attitude (overall: α = .85; young: α = .83; middle-aged: α = .86; elderly: α = .85).

Social norm[5]*:* PCA extracted one component that accounted for 52.65% of the variance. Therefore, the six items (i.e., those initially designed to tap injunctive and descriptive norm) were averaged to form an overall measure of social norm (overall: α = .81; young: α = .85; middle-aged: α = .80; elderly: α = .81).

PBC: One component was extracted that accounted for 54.13% of the variance and therefore the items were averaged (overall: α = .82; young: α = .78; middle-aged: α = .84; elderly: α = .83).

Anticipated regret: PCA was used to examine whether anticipated regret was distinguishable from attitude. Two components emerged from the data. After varimax rotation, the first component represented the attitude items, explaining 33.87% of the variance, and the second component reflected the anticipated regret items, accounting for 29.70% of the variance. This supported the discriminant validity of anticipated regret and it was treated as a separate construct in the main analyses. Responses to the four items were averaged to form this measure (overall α = .87; young: α = .84; middle-aged: α = .83; elderly: α = .91).

[5] The term, 'subjective norm', has been used interchangeably with injunctive norm in the literature, and as the current measure included items assessing both injunctive and descriptive norm, it was labelled 'social norm' here.

Past behaviour: One of the items designed to assess habit among the young and middle-aged adults differed from those presented to the elderly adults (see section 3.2.2.3.1). Therefore, two PCAs were performed. Both revealed that items initially anticipated to tap past behaviour and habit loaded onto the same component. In the data provided by the young and middle-aged adults, 50.41% of the variance was accounted for by this component, while in the elderly adults' data, 68.11% of variance was explained. These results led to the decision to combine all of the items.

Six of the items were assessed using seven-point scales. These items were: 'I normally drive when I have been awake for 15 or more hours' (*strongly disagree-strongly agree*), 'In a typical period of one month, how often do you drive when you have been awake for 15 or more hours?' (*never-very frequently*) and the item stem, 'Do you drive when you have been awake for 15 or more hours...' preceded the following four items, 'if you need to?', 'when you go out socialising?', 'to give someone a lift or pick them up?' and 'for work purposes' (presented to the young and middle-aged adults) / 'to take part in recreational activities?' (presented to the elderly adults) all with endpoints, *definitely do not-definitely do*. A sentence instructed participants to answer the latter four items 'quickly without thinking too much about them'. The final item, which was open-ended was, 'How many hours have you normally been awake for when you drive for the last time in a typical day?'. The seven items were standardised and then averaged to produce the measure of past behaviour (young: $\alpha = .83$; middle-aged: $\alpha = .82$; elderly: $\alpha = .92$).

<u>Driving between midnight and 6am</u>

Intention: The three items were averaged to form the measure of intention ($\alpha = .81$).

Attitude: The mean of the six items assessed attitude directly ($\alpha = .83$).

Social norm: PCA with direct oblimin rotation extracted two components; the first represented the injunctive norm items and accounted for 47.98% of the variance and the second involved the descriptive norm items, explaining 17.93% of the variance. Based on these empirical results, injunctive and descriptive norm were treated as distinct variables in the main analyses ($r = .46, p < .001$).

Injunctive norm: The average of three items was used to measure injunctive norm directly (α = .80; see Table 4.2).

Descriptive norm: The mean of three items formed this measure (α = .63; see Table 4.2).

PBC: The six items were averaged to create the direct measure of PBC (α = .85).

Anticipated regret: Responses to the four items were averaged to produce a measure of anticipated regret (α = .81).

Past behaviour: Six items assessed past behaviour, all of which employed seven-point scales. These items were: 'I normally drive between midnight and 6am' (*strongly disagree-strongly agree*), 'In a typical period of one month, how often do you drive between midnight and 6am?' (*never-very frequently*) and the item stem, 'Do you drive between midnight and 6am...' preceded the four items, 'if you need to?', 'for work purposes?', 'after socialising' and 'to give someone a lift or pick them up?', all with endpoints, *definitely do not-definitely do.* A sentence instructed participants to answer the latter four items 'quickly without thinking too much about them'. The mean of the six items formed the measure of past behaviour (α = .71).

<u>Driving between 3pm and 6pm</u>

Intention: The three items were averaged to form the measure of intention (α = .85).

Attitude: The mean of the six items assessed attitude directly (α = .76).

Social norm: The average of the six items represented the measure of social norm (α = .75).

PBC: The mean of six items formed the direct measure of PBC (α = .85).

Anticipated regret: Responses to the four items were averaged (α = .88).

Past behaviour: Six items assessed past behaviour, all of which employed seven-point scales. These items were: 'I normally drive between 3pm and 6pm' (*strongly disagree-strongly agree*), 'In a typical period of one month, how often do you drive between 3pm and 6pm?' (*never-very frequently*) and the item stem, 'Do you drive between 3pm and 6pm...' preceded the following four items, 'if you need to?', 'to give someone a lift or pick them up?', 'to socialise or visit family or friends' and 'to go shopping', all with endpoints, *definitely do not-definitely do.* A sentence instructed participants to answer the latter four items 'quickly without thinking too much about them'. The mean of the six items represented the measure of past behaviour ($\alpha = .81$).

4.2.3.1.2 Belief-based measures

Behavioural, normative and control beliefs and their respective evaluations were each presented together (Ajzen, 2002b), with the negative endpoints always being displayed on the left, for ease of completion. Items measuring the components of subjective norm were presented first, followed by those assessing attitude and finally those which tapped PBC (see section 3.2.4). The sections were separated by headings, for example, 'Section B'.

To determine the most appropriate scoring of the belief-based measures, all possible combinations of unipolar and bipolar scoring for each of the two components of each belief-based measure were multiplied together and differences examined in the magnitude of the correlations between the variously-scored multiplicative composites and the corresponding direct measure and intention (East, 1997). The internal consistencies of the multiplicative composites were also taken into account. These procedures were carried out for the belief-based measure of subjective norm with and without motivation to comply (see section 3.2.1.3). Theoretical considerations were also taken into account. For demonstration purposes, the example items below are worded in relation to driving after 15 or more hours of wakefulness only; the format was identical for all three behaviours.

Belief-based attitude: Behavioural beliefs, worded as 'Driving when I have been awake for 15 or more hours...' were presented before those worded 'Not driving when I have been awake...', with the latter items being reverse-scored. Behavioural beliefs, for example, 'Driving when I have been awake for 15 or more hours would mean I would be driving when I am too tired', were rated on a scale with endpoints, *very unlikely* (-3) and *very likely* (3). Outcome evaluations, for example, 'Driving when I am too tired', were assessed from *very bad* (-3) to *very good* (3). Responses to each behavioural belief item were multiplied by the corresponding outcome evaluation and the mean of all multiplicative composites represented the belief-based measure of attitude (range = -9 to 9).

Belief-based injunctive norm[6]*:* In line with previous studies (e.g., Budd, 1987), it was deemed necessary to omit the motivation to comply component from the belief-based measure of injunctive norm. Normative beliefs were assessed using the item stem, 'Do the following individuals/groups think you should drive when you have been awake for 15 or more hours?', followed by the accessible referents, for example, 'The police', and a scale ranging from *very unlikely* (-3) to *very likely* (3). The items were averaged to form the belief-based measure of injunctive norm (range = -3 to 3).

Belief-based PBC: Items measuring control belief strength, for example, 'How often do you socialise?' were rated from *never* (1) to *very frequently* (7) for driving after prolonged wakefulness and between midnight and 6am, and from *very rarely* (1) to *very frequently* (7) for driving between 3pm and 6pm (see section 3.2.4). To assess the power of control beliefs, the stem, 'Please indicate the extent to which the following circumstances would make it more difficult or easier for you to refrain from driving when you have been awake for 15 or more hours', preceded the control beliefs, for example, 'Socialising' and a scale from *much more difficult* (-3) to *much easier* (3). An example of how to respond to the power of control belief items was also provided (see section 3.2.4). Responses to each control belief strength item were multiplied by the corresponding control belief power item and the average of the multiple composites represented the belief-based measure of PBC (range = -21 to 21).

<u>Driving after 15 or more hours of wakefulness</u>

Table 4.2 shows the behavioural, normative and control beliefs held by young, middle-aged and elderly adults regarding driving after 15 or more hours of wakefulness, on which the belief-based measures were based.

[6] As the belief-based measure of subjective norm essentially assessed only one type of norm, injunctive norm, it was labelled as such for clarity.

Table 4.2: The belief-based items in relation to driving after being awake for 15 or more hours for the three age groups

YOUNG ADULTS	MIDDLE-AGED ADULTS	ELDERLY ADULTS
	BEHAVIOURAL BELIEFS	
Increase risk of vehicle accident [a]	Increase risk of vehicle accident [a]	Driving when tired [a]
Driving when too tired [a]	Driving when tired [a]	Increase risk of vehicle accident [a]
Driving when difficult to concentrate/focus [a]	Driving when unable to concentrate [a]	Driving at night [a]
Unable to go out socialising [b]	Driving when reactions slow [a]	Driving when unable to concentrate [a]
Unable to get somewhere in an emergency [b]	Driving when unable to function properly [a]	Driving when incapable [a]
Unable to drive for work purposes [b]	Unable to go out socialising [b]	Unable to get somewhere in an emergency [b]
Unable to give people lifts [b]	Unable to give people lifts [b]	
Have to arrange other transport [b]	Unable to drive for work purposes [b]	
	NORMATIVE BELIEFS [a]	
Police	Police	Partner
Parents	Family	Family
Partner	Other road-users	Friends
Other family members	Pedestrians	Police
People at work	Boss	Other road-users
Passengers	Road safety groups	
Other road-users	People who want a lift	
Friends		
	CONTROL BELIEFS [b]	
An emergency	An emergency	Someone else able to drive
Someone else able to drive	Socialising	Feeling tired
Socialising	Driving for work purposes	Feeling unwell
Getting a taxi	Feeling too tired to drive	An emergency
Driving for work purposes	Giving someone a lift	Considering accident risk and possibility that unfit to drive
Giving someone a lift	Someone else able to drive	Considering age effects on driving ability
Drinking alcohol	Drinking alcohol	Drinking alcohol
Working hours	Getting a taxi or bus	Socialising
		Getting a taxi

[a] Worded in relation to driving after being awake for 15 or more hours; [b] Worded in relation to not driving/refraining from driving after being awake for 15 or more hours.

The young adults were presented with eight behavioural beliefs (α = .63), eight normative beliefs (α = .92) and eight control beliefs (α = .37). The middle-aged adults responded to items regarding eight behavioural beliefs (α = .69), seven normative beliefs (α = .88) and eight control beliefs (α = .48). Finally, the questionnaire administered to the elderly adults contained six behavioural beliefs (α = .75), five normative beliefs (α = .93) and nine control beliefs (α = .71). Although the reliabilities of the belief-based measures of PBC were less than optimal for the young and middle-aged adults, Ajzen (2002a) argued that it is unnecessary for the belief composites to be internally consistent, as people may hold, for example, control beliefs that are perceived to facilitate as well as control beliefs perceived to inhibit, the behaviour[7].

Driving between midnight and 6am

Table 4.3 shows the behavioural, normative and control beliefs held by young adults regarding driving between midnight and 6am, on which the belief-based measures were based.

Table 4.3: The belief-based items in relation to driving between midnight and 6am

BEHAVIOURAL BELIEFS	NORMATIVE BELIEFS [a]	CONTROL BELIEFS [b]
Increase risk of vehicle accident [a]	Police	Driving for work purposes
Driving when tired [a]	People at work	Getting home after socialising
Driving when not as focused/concentrating [a]	Parents	An emergency
Driving when it is dark [a]	Partner	Giving someone a lift
Driving when less traffic [a]	Other family members	Someone else able to drive
Unable to drive for work purposes [b]	Friends	Getting a taxi or public transport
Unable to drive home after socialising [b]	Road safety groups	Driving for holiday purposes
Unable to give people lifts [b]		Drinking alcohol
More likely to be asleep then [b]		Getting home at night safely

[a] Worded in relation to driving between midnight and 6am; [b] Worded in relation to not driving/refraining from driving between midnight and 6am.

[7] This finding that the belief-based measures of PBC exhibited low internal consistency suggests that the excellent internal consistencies displayed by the belief-based measures of injunctive norm in all groups were not due to consistency bias caused by all of the items assessing each component appearing together in the questionnaires. If this was the case, the belief-based measures of PBC would also have been highly reliable as both of its components were presented together in the questionnaires.

The questionnaire contained nine behavioural beliefs (α = .65), seven normative beliefs (α = .83) and nine control beliefs (α = .49).

Driving between 3pm and 6pm

The elderly adults were presented with six behavioural beliefs (α = .71), five normative beliefs (α = .93) and nine control beliefs (α = .75). Three of the referents (partner, other road-users and police) were not strictly accessible for this behaviour but were accessible to this age group in relation to driving after prolonged wakefulness. They were added to increase the number of normative beliefs to five and were retained due to the high internal consistency displayed by this measure. See Table 4.27 in section 4.3.4.5 for the behavioural, normative and control beliefs held by the elderly adults regarding driving between 3pm and 6pm, on which the belief-based measures were based.

Missing data

For all of the variables described above, over 50% of the items which comprised a given measure must have been answered for it be classed as a valid response. This criterion ensured that none of the measures were based on a single item and that participants were not excluded if a particular belief did not apply to them, for example, because they did not have a partner or any children, as their normative belief score would simply be based on less beliefs.

4.2.3.1.3 Final section of questionnaires

The final section of the questionnaires included a number of demographic questions including age, gender, occupation, usual hours of work and marital status. Participants were also asked about their driving to obtain information on the number of years they had held their driving licence for, any vehicle accident involvement in the previous 12 months, the average number of journeys they made per week overall and when limited to driving on a single/dual carriageway or motorway, annual mileage and the extent to which they were expected to drive for their job.

ISS: A cross-cultural shortened form of the ZKPQ (the ZKPQ-50-CC) was developed by Aluja *et al.* (2006), whereby the original 19 items designed to assess ISS were reduced to 10 using factor analysis. The new ISS scale included only two items from the impulsivity facet, however the remaining eight SS items tapped a kind of impulsivity that reflects spontaneous SS which does not involve consideration of risks or consequences (Aluja *et al.*, 2006). Internal reliability of the revised scale was found to be high and comparable to the original scale (α > .72) and the two ISS scales correlated very strongly (*r* = .87; Aluja *et al.*, 2006). Therefore, this 10-item scale was used in the present research.

The 10 items of the ISS scale of the ZKPQ-50-CC (Aluja *et al.*, 2006) were separated within the demographic and driving questions described above to reduce the potential for participants to develop a response set based on the similarity of the items. Each item consisted of a statement, for example, 'I often do things on impulse' and participants were required to indicate whether the statement was true or false of them by ticking the appropriate box. Responses marked 'True' and 'False' were scored 1 and 0 respectively and responses from all 10 items were summed to form a total score ranging from 0 to 10 where a higher score represented higher ISS (young adults: α = .77; middle-aged adults: α = .81; elderly adults: α = .69). Participants must have answered all 10 items for their total score to be classed as a valid indicator of ISS.

To obtain information regarding the general level of daytime sleepiness in the three age groups, the Epworth Sleepiness Scale (Johns, 1991) was included at the end of the questionnaires. This scale overcomes the problem that individuals may be unaware of their sleepiness as it specifies periods of actually falling asleep which are clearly indicative of sleepiness (Anderson & Horne, 2008). It consists of eight items, each asking participants to indicate the likelihood that they would fall asleep in a particular everyday situation, for example, 'sitting and reading'. Participants were asked to write a number from 0 to 3 for each item where 0 represented that they would never doze in that situation and 1, 2 and 3 corresponded to a slight, moderate and high chance of dozing, respectively. Scores for each item were summed to create a total score that ranged from 0 to 24 with a higher score indicating a higher level of daytime sleepiness (young adults: α = .71; middle-aged adults: α = .78; elderly adults: α = .57).

The prospective design of the study required that participants' responses from the Time 1 and Time 2 questionnaires and their data from the sleep and driving diary and actiwatch be matched for analyses. Therefore, on the final page of the questionnaire, participants were asked to write their name but for ethical reasons, were assured that as soon as their data were matched, the pages containing their names would be destroyed. Although this may appear to be a threat to anonymity, it is noteworthy that Beck and Ajzen (1991) reported no effects of asking participants to write their name, address and phone number prior to completing a TPB questionnaire enquiring about several dishonest behaviours. See Appendices 4.1-4.3 for the three Time 1 questionnaires (only one questionnaire per counterbalanced pair is presented in the Appendices).

4.2.3.2 Time 2 questionnaire

The first page of this questionnaire contained similar information to the Time 1 questionnaire and instructions on how to respond to the scales. The young adults answered counterbalanced questions regarding their retrospective accounts of any occurrences of driving after 15 or more hours of wakefulness and of driving between midnight and 6am in the previous week. For demonstration purposes, the example items below are worded in relation to driving after prolonged wakefulness only.

Subjective behaviour: Four items assessed subjective behaviour for each behaviour. Three of these items were measured on a seven-point scale, scored from -3 to 3. These were: 'I have driven when I have been awake for 15 or more hours in the last week' (*strongly disagree – strongly agree*), 'In the course of the past week, did you drive when you had been awake for 15 or more hours?' (*definitely did not – definitely did*) and 'How often did you drive when you had been awake for 15 or more hours in the last week?' (*never – very frequently*). The final item was open-ended, 'On how many occasions in the last week did you drive when you had been awake for 15 or more hours?'. These four items were standardised and then averaged (driving after prolonged wakefulness: $\alpha = .94$; driving between midnight and 6am: $\alpha = .90$).

Week typicality: To assess the extent to which the week under investigation was a usual week, the item, 'How typical was the last week in terms of sleeping patterns and driving behaviour for you?' was presented and participants were asked to choose from four options, 'Not typical at all', 'Fairly untypical', 'Fairly typical' and 'Completely typical'. This item was scored from 1 to 4 with a higher score representing a more typical week.

On the final page of the questionnaire, participants were asked to provide their name as described above. The Time 2 questionnaire is presented in Appendix 4.4 (i.e., showing one of the two orders in which the behaviours appeared).

4.2.3.3 Sleep and driving diary

The diary included full instructions on how to complete the items. There were three pages for each day; the first was the sleep diary that contained three items to be completed each morning, 'Time you fell asleep last night', 'Final time you woke up this morning' and 'Total amount of time awake during night' and three open-ended questions to be answered throughout or at the end of each day, 'Number of naps taken during day', 'Times of naps (fell asleep and woke up)' and 'Time(s) you took the actiwatch off, for how long and the reason for removing it'. The last two pages corresponded to the 24-hour driving diary and participants were asked to record full details of every journey they took in which they drove, including, 'Purpose and destination', 'Time started journey', 'Time reached destination', 'Approximate number of miles driven' and 'Did journey involve driving on a single/dual carriageway or motorway?'[8]. There were spaces for the details of up to 20 journeys per day; participants were instructed to use a separate piece of paper if the number of journeys exceeded this amount. The first five pages of the sleep and driving diary which include the instructions and questions to be answered on the first day, are presented in Appendix 4.5 (the remaining pages contained the same questions to be answered each day).

Driving after 15 or more hours of wakefulness

Diary-based behaviour: The week under investigation was analysed from the participant waking up after the first night up until they went to sleep on the seventh night. This allowed for all seven days to be examined for occurrences of driving after 15 or more hours of wakefulness. The period of time elapsing between the participant waking up in the morning, as recorded in the sleep and driving diary, to the times at which they began each driving journey undertaken that day were calculated for the seven days[9]. In addition, daytime naps of at least 10 minutes were taken into account in

[8] It was emphasised to participants that the term, 'single carriageway', referred to a road with a speed limit of 60 miles per hour (the UK National Speed Limit for single carriageways), as opposed to more urban roads.

[9] Where journeys reported by participants involved only a very short stay at the destination, for example, dropping someone off, no inferences were made as to whether they constituted one or two journeys.

that they restarted the wake time to the time that they finished napping. The longest time period between waking up and starting driving over the week, along with the number of times they had driven after being awake for 15 or more hours, as identified by this method, were recorded. These two items were standardised and averaged to form the diary-based measure of behaviour ($\alpha = .85$). It is re-iterated that participants were not informed of exactly how the data obtained from the driving diary would be used (until the end of the study) in order to reduce social desirability demands and the obtrusiveness of the measure (Verplanken *et al.*, 1998).

<u>*Driving between midnight and 6am*</u>

Diary-based behaviour: Each day of the sleep and driving diary was assessed from the first until the seventh night to identify any incidences of driving between the hours of midnight and 6am. The number of times that the participant performed this behaviour during the week constituted the diary-based measure of behaviour. Recorded journeys with incomplete times were excluded and for a participant's data to be included in the analyses, they had to have valid data for all seven days.

4.2.3.4 Actiwatches and scoring software

See section 2.2.3.1 for full details regarding the actiwatches (Actiwatch®, Cambridge Neurotechnology, Cambridge, UK) and scoring software (Actiwatch Activity & Sleep Analysis 5, Version 5.36, Cambridge Neurotechnology Ltd).

<u>*Driving after 15 or more hours of wakefulness*</u>

Calculated behaviour: As for the diary-based measure, the period of time from the participant waking up after the first night up until they went to sleep on the seventh night was analysed to allow all seven days to be examined for occurrences of driving after 15 or more hours of wakefulness. Nocturnal sleep durations and daytime naps of at least 10 minutes were determined from the actiwatch data using the same procedure described in section 2.2.3.1. Objectively-determined wake times in the morning and from any daytime sleep, together with the journeys recorded in the sleep and driving

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Participants were instructed in the diaries that driving to and from their destination should be classed as two journeys, and therefore data analysis was kept systematic by entering the data as the participants reported it.

diaries, were used to identify the longest time that participants had been awake for when they began a journey during the week and the frequency with which they drove after they had been awake for 15 or more hours. These two items were standardised and the average represented the calculated measure of behaviour ($\alpha = .81$).

4.2.4 Procedure

Prior to participation in the study, all adults were given information about what their role would involve (see Appendix 4.6) and were made aware that their data would remain confidential and anonymous, and that they could withdraw at any time. They then signed a consent form. Further details are provided in the following sections.

4.2.4.1 Middle-aged and elderly adults

It was not necessary to meet with all of the middle-aged and elderly adults since their participation only involved completing a questionnaire, therefore, some questionnaires were mailed to participants with prepaid return envelopes. When this was the case, an additional page was attached to the front of the questionnaire explicitly stating the inclusion criteria and age range of the relevant sample to double-check they understood it was important for them to complete it (and not someone else) as discussed in the initial telephone call.

Middle-aged and elderly adults completed the Time 1 questionnaire in relation to driving after being awake for 15 or more hours, and the elderly adults also completed items regarding driving between 3pm and 6pm. All participants were then thanked, debriefed (over the telephone or in a letter if they had mailed their questionnaire) and given (or sent) a supermarket gift-card for their participation.

4.2.4.2 Young adults

It was ensured that the week under investigation was anticipated by the participant to be fairly normal in terms of sleeping and driving patterns. The young adults completed the Time 1 questionnaire in relation to driving after being awake for 15 or more hours and between midnight and 6am. Without being told the full purpose of the study, participants then wore an actiwatch (which had been set up to record in 30-second epochs) around their nondominant wrist and completed a sleep and driving diary every day for the next eight days.

Participants were made aware of what the actiwatch measured and were told that it was crucial that they wore it continuously for the full week and to record any periods of actiwatch removal, i.e., for bathing, in the sleep and driving diary. The date after the participants had completed the Time 1 questionnaire was written on Day 1 of the diary, followed by the consecutive dates to aid their understanding. Finally, participants were reminded to maintain their usual activities over the week.

Participants returned at the end of the week and completed the Time 2 questionnaire. They were then thanked and given a supermarket gift-card for their participation. When each participant had completed the Time 2 questionnaire, their data were matched and stored together under their unique participant number and the last pages of both questionnaires containing their names were destroyed. After the data collection period had ended, all young participants were sent an email intended to debrief them fully on the purpose of the study and how their data were to be used (see Appendix 4.7). They were also told that if they requested, they could be informed of their average nocturnal sleep duration as calculated by the actiwatch.

4.3 RESULTS

4.3.1 General information

4.3.1.1 Driving and sleepiness characteristics of samples

Table 4.4 shows the driving and sleepiness characteristics of the samples of young, middle-aged and elderly adults.

Table 4.4: Characteristics of samples (mean and SD, where appropriate)

	Young	Middle-aged	Elderly
Years held driving licence	5.42 (3.34)	28.57 (6.57)	42.96 (8.53)
Annual mileage	9636 (6449)	9629 (6443)	6335 (4987)
Number of journeys per week	21-30	21-30	11-20
Number of journeys on carriageway/motorway per week	11-20	11-20	11-20
Had a vehicle accident in last year	15.7%	4.3%	8.7%
Required to drive for job	Sometimes	Occasionally	Occasionally
Epworth Sleepiness Scale (0 - 24)	7.56 (3.87)	6.12 (3.89)	5.34 (2.78)

As expected, the number of years in which the participants had held their driving licence was greatest for the elderly adults and lowest for the young adults (F (2, 205) = 589.44, $p < .001$, $\eta^2 = .85$). On average, young and middle-aged adults drove more than elderly adults per year (H (2) = 20.14, $p < .001$). Table 4.4 suggests that this was due to them making more local journeys, as opposed to driving on roads with faster speed limits. Chi-square tests with Bonferroni corrections revealed that young adults were more likely to have been involved in a vehicle accident in the previous 12 months than middle-aged adults (x^2 (1) = 5.08, p (one-tailed) < .025) but not more than elderly adults (x^2 (1) = 1.60, $p > .05$). Accident involvement was not compared for middle-aged and elderly adults due to failure of the data to meet the assumptions of a Chi-square test. There were no age differences in terms of being required to drive for work purposes (H (2) = 2.84, $p > .05$; N = 15 for the elderly adults).

Age significantly affected scores on the Epworth Sleepiness Scale (F (2, 203) = 6.93, $p < .01$, $\eta^2 = .06$). Post hoc Tukey tests revealed that young adults were more sleepy than middle-aged ($p < .05$) and elderly ($p < .001$) adults, but the difference between the latter groups was not significant ($p > .05$). A score of 16 or greater indicates a very high level of sleepiness (Johns, 1991) and has been found to be a risk factor for having a sleep-related vehicle accident (Stutts *et al.*, 2003). Only one young and one middle-aged participant scored higher than 16 in the present research.

4.3.1.2 Order effects in the questionnaires

To assess if there were any effects of the order in which the behaviours were presented in the questionnaires administered to the young and elderly adults, MANOVAs and follow-up *t*-tests were performed.

For the young adults, a significant order effect was found on the variables assessed at Time 1 in relation to driving after 15 or more hours of wakefulness (F (9, 59) = 4.33, p < .001; V = .40). Follow-up *t*-tests with Bonferroni corrections revealed that responding to items regarding driving after prolonged wakefulness after answering the items in relation to driving between midnight and 6am resulted in a more positive direct attitude towards refraining (t (68) = -4.21, p < .001), greater general PBC over refraining (t (68) = -2.91, p < .006), weaker perceptions of generalised social pressure to drive after prolonged wakefulness (t (68) = 4.29, p < .001) and a weaker intention to drive after being awake for 15 or more hours (t (68) = 3.15, p < .006). Therefore, answering the questions in relation to driving after 15 or more hours of wakefulness last resulted in regarding this behaviour more negatively.

Conversely, the order in which the behaviours were presented to the young adults in the Time 1 questionnaire did not affect scores on the variables assessed in relation to driving between midnight and 6am (F (10, 58) = 1.43, p > .05; V = .20). The order that the behaviours were presented in the Time 2 questionnaire did not influence the subjective measure of driving after prolonged wakefulness (t (68) = 1.63, p > .05) or between midnight and 6am (t (68) = 0.29, p > .05). The order in which the two behaviours were presented to the elderly adults in the Time 1 questionnaire did not affect the variables when assessed in relation to driving after 15 or more hours of wakefulness (F (9, 55) = 1.63, p > .05; V = .21) or between 3pm and 6pm (F (9, 53) = 1.28, p > .05; V = .18).

Therefore, the only order effect was found for the young adults at Time 1 regarding driving after 15 or more hours of wakefulness. The participants who were presented with this behaviour after they had completed the measures applied to driving between midnight and 6am viewed driving after prolonged wakefulness more negatively compared with those who attended to this behaviour first.

4.3.1.3 Effects of missing data

In each of the five datasets that included data for all of the variables, there was less than 3% missing data, which suggests few problems (Tabachnik & Fidell, 2007). On the other hand, 13 young adults had missing data for the calculated measure of driving after 15 or more hours of wakefulness (18.6%), so to ensure there was no pattern to the missing data that related to any of the other variables, MANOVA was conducted. Specifically, this examined whether having a missing or valid score on the calculated behaviour measure significantly affected the remaining variables in the dataset (Tabachnik & Fidell, 2007). The result was not significant (F (12, 52) = 1.08, $p > .05$; V = .20), so it was concluded that the missing data in this dataset was random and would not pose any threats to the generalisability of the results (Tabachnik & Fidell, 2007). In addition, quite a high proportion of elderly adults had missing data for ISS (eight, 11.4%; individual items had not been completed resulting in missing data for the total score). MANOVA showed that having a valid or missing score on this variable did not significantly influence any of the other variables in this dataset (F (9, 55) = 0.91, $p > .05$; V = .13).

4.3.1.4 Checks on diagnostics and assumptions of regression

Sample size was determined on the basis of power analysis (Cohen, 1992; Miles & Shevlin, 2001). It involves first determining the expected effect size, which can be based on previous research. Armitage and Conner's (2001a) meta-analysis revealed effect sizes (R^2) of .39 and .27 for the prediction of intention and behaviour from the TPB variables, respectively. These values represent large effect sizes (Cohen, 1992). It was therefore anticipated that the regressions would produce comparable effect sizes. This assumption, together with an alpha value of .05 and a level of power of .80 was used to calculate the number of participants required using power analysis calculations (Cohen, 1992; Miles & Shevlin, 2001). The fewest participants required for a regression with seven predictors (the highest number of predictors used in the present research) was 48. Therefore, 70 participants (i.e., in each age group) was an acceptable sample size for the regressions.

Prior to conducting the regressions, checks were made to detect any outliers, defined as standardised residuals greater than 3 or -3. Influential cases were also identified, using the criterion of a Cook's distance greater than 1, a leverage value of more than three times the calculated average leverage value (3 (number of predictors + 1) / *N*) and/or a Mahalanobis distance of greater than the critical value, based on the number of predictors and an alpha level of .001 (Field, 2005). It is stated where cases were removed based on these criteria.

The assumption of independent errors was assessed via the Durbin-Watson test. In all of the regressions reported here, the value was close to 2, and in no cases was it less than 1 or greater than 3, which indicates no serious problems (Field, 2005). Graphs with the standardised residuals plotted against the standardised predictors were visually inspected to check the assumptions of linearity and homoscedasticity, and histograms and normal probability plots were inspected to check that the standardised residuals were normally distributed. Unless stated, these assumptions were met. Finally, in most cases, tolerance statistics were above .2 indicating that there were no serious issues with multicollinearity (Field, 2005). It is stated where this criterion was not met.

4.3.1.5 Rationale for emphases placed on particular analyses

In the analyses that follow, intention was regressed onto the belief-based and direct measures of the TPB variables separately. In order to explain intention, rather than just predict it, the belief-based measures should be used (Ajzen, 1991, 2002b). Therefore, regressions utilising the belief-based measures are the preferred method for demonstrating the relative importance of the TPB variables in the explanation of intention (Parker *et al.*, 1995). Since the additional variables were all assessed directly, the direct TPB measures were also used to predict intention. Maintaining consistency in the measurement of all of the variables used in these regressions allowed a fairer comparison by removing method effects.

It is re-iterated that, in contrast to the majority of measures which were scored in relation to driving under the particular circumstance, the direct measure of attitude and both measures of PBC were scored in relation to refraining from driving. Consequently, negative relationships were expected between these latter measures and the remaining variables.

4.3.2 Driving after 15 or more hours of wakefulness

4.3.2.1 Descriptive statistics (excluding behavioural measures)

The means, SDs, ranges and possible ranges of all of the variables for the young, middle-aged and elderly adults are presented in Table 4.5.

Table 4.5: Descriptive statistics for all measures[a]

	Young adults			Middle-aged adults			Elderly adults			
	Mean	SD	Range	Mean	SD	Range	Mean	SD	Range	Poss. Range
Bb Att.	-0.90	2.14	-4.88 to 4.25	-1.44	2.28	-6.38 to 4.50	-0.90	3.58	-7.00 to 7.00	-9.00 to 9.00
Bb Inj. norm	-1.06	1.20	-3.00 to 2.00	-0.85	1.38	-3.00 to 3.00	-1.21	1.74	-3.00 to 3.00	-3.00 to 3.00
Bb PBC	0.40	3.48	-12.00 to 8.62	1.46	3.64	-7.88 to 10.88	3.83	3.89	-6.89 to 11.67	-21.00 to 21.00
Attitude	0.71	1.21	-2.50 to 3.00	0.90	1.34	-2.67 to 3.00	0.98	1.45	-3.00 to 3.00	-3.00 to 3.00
Social norm	-0.77	1.10	-3.00 to 1.67	-0.67	1.23	-2.83 to 2.50	-0.79	1.38	-3.00 to 2.67	-3.00 to 3.00
PBC	1.06	1.15	-1.33 to 2.83	1.39	1.29	-2.33 to 3.00	1.74	1.18	-3.00 to 3.00	-3.00 to 3.00
Anticip. regret	-0.21	1.20	-3.00 to 2.00	-0.21	1.21	-3.00 to 2.75	-0.71	1.52	-3.00 to 2.50	-3.00 to 3.00
ISS	5.11	2.80	0.00 to 10.00	2.27	2.45	0.00 to 9.00	1.45	1.72	0.00 to 7.00	0.00 to 10.00
Past beh.	0.00	0.70	-2.21 to 1.21	0.00	0.70	-1.54 to 1.67	-0.01	0.83	-1.16 to 1.66	Standa-rdised
Intention	-0.65	1.48	-3.00 to 2.67	-1.20	1.52	-3.00 to 3.00	-1.32	1.61	-3.00 to 3.00	-3.00 to 3.00

[a]All measures related to driving after being awake for 15 or more hours, except for the direct measure of attitude and both measures of PBC, which were assessed regarding refraining from driving after being awake for 15 or more hours.

In general, comparisons between the mean scores and the scale midpoints indicated that perceptions of driving after 15 or more hours of wakefulness were generally unfavourable. Participants held negative attitudes towards driving after being awake for 15 hours (the belief-based measure) and positive attitudes towards refraining from driving after this length of wakefulness (the direct measure). The adults did not perceive social pressure to drive after prolonged wakefulness and believed that they had a degree of control over refraining from performing this behaviour. They also anticipated feeling an element of regret having driven after being awake for 15 or more hours and generally did not intend to do so.

After the removal of one multivariate outlier, MANOVA revealed that age had a significant effect on the TPB and additional variables (F (18, 350) = 6.94, $p < .001$; V = .53). Follow-up ANOVAs with a Bonferroni correction applied for the number of tests (nine, past behaviour was not tested due to it consisting of standardised scores; Field, 2005) showed that age significantly influenced the belief-based measure of PBC (F (2, 182) = 17.60, $p < .001$, $\eta^2 = .16$) and the ISS scores (F (2, 182) = 43.07, $p < .001$, $\eta^2 = .32$). Post hoc Tukey tests revealed that when based on the underlying beliefs, elderly adults perceived they had more control over refraining from driving after prolonged wakefulness than young ($p < .001$) and middle-aged ($p < .01$) adults. There was no significant difference between the belief-based scores of young and middle-aged adults ($p = .07$). Regarding ISS scores, as expected, young adults scored higher than both middle-aged ($p < .001$) and elderly ($p < .001$) adults, but the difference between the latter groups was not significant ($p > .05$).

4.3.2.2 Correlations (excluding behavioural measures)

Pearson's correlations between all of the variables for the young, middle-aged and elderly adults are presented in Tables 4.6, 4.7 and 4.8, respectively.

Table 4.6: Pearson's correlations between all variables: Young adults

	1	2	3	4	5	6	7	8	9
1 Bb Attitude	-								
2 Bb Inj. norm	.45***	-							
3 Bb PBC	-.39**	-.18	-						
4 Attitude	-.32**	-.37**	-.04	-					
5 Social norm	.54***	.65***	-.26*	-.32**	-				
6 PBC	-.35**	-.40**	.30**	.25*	-.50***	-			
7 Anticip. regret	.49***	.69***	-.12	-.30*	.52***	-.40**	-		
8 ISS	.08	.04	-.12	-.11	.14	-.09	-.02	-	
9 Past behaviour	.57***	.46***	-.22	-.27*	.56***	-.44***	.51***	.09	-
10 Intention	.57***	.58***	-.41***	-.15	.69***	-.58***	.55***	.25*	.75***

Table 4.7: Pearson's correlations between all variables: Middle-aged adults

	1	2	3	4	5	6	7	8	9
1 Bb Attitude	-								
2 Bb Inj. norm	.43***	-							
3 Bb PBC	-.13	.02	-						
4 Attitude	-.46***	-.29*	.12	-					
5 Social norm	.47***	.70***	-.09	-.28*	-				
6 PBC	-.10	.04	.41***	.19	-.18	-			
7 Anticip. regret	.33**	.45***	-.07	-.28*	.37**	.01	-		
8 ISS	.00	-.03	-.21	.11	.01	-.08	.10	-	
9 Past behaviour	.35**	.47***	-.26*	-.26*	.62***	-.27*	.60***	.13	-
10 Intention	.30**	.37***	-.31**	-.23*	.61***	-.43***	.41***	.05	.62***

Table 4.8: Pearson's correlations between all variables: Elderly adults

	1	2	3	4	5	6	7	8	9
1 Bb Attitude	-								
2 Bb Inj. norm	.57***	-							
3 Bb PBC	-.13	-.16	-						
4 Attitude	-.36**	-.34**	.12	-					
5 Social norm	.71***	.56***	-.29*	-.36**	-				
6 PBC	-.49***	-.39**	.18	.43***	-.54***	-			
7 Anticip. regret	.73***	.55***	-.27*	-.28*	.70***	-.45***	-		
8 ISS	.10	.08	-.16	.17	.17	.02	.27*	-	
9 Past behaviour	.75***	.55***	-.25*	-.33**	.74***	-.67***	.76***	.16	-
10 Intention	.60***	.60***	-.17	-.35**	.67***	-.54***	.67***	.12	.75***

*$p < .05$; **$p < .01$; ***$p < .001$. Probability values were adjusted for one- or two-tailed tests as appropriate (i.e., one-tailed tests included the correlations between (i) the belief-based and direct measures of the same variable and (ii) all belief-based, direct and additional measures with intention; the remainder reflected two-tailed probabilities).

4.3.2.2.1 TPB relationships

Correlations between the two measures of attitude were significant in all cases, showing that attitude towards driving after being awake for 15 or more hours based on underlying beliefs was negatively related to attitude towards refraining from driving after this length of wakefulness, assessed directly. The two measures of social pressure were strongly related in all three age groups, perhaps reflecting the fact that injunctive norm was the only belief-based measure that was not a multiplicative composite. Relationships between the two measures of PBC were weaker, especially among the elderly adults, where the correlation did not reach significance. The finding that most of the relationships between the two measures of the TPB variables were significant establishes their concurrent validity.

The patterns of correlations between the TPB variables and intention to drive after being awake for 15 or more hours were very similar in all three datasets. The direct measure of social norm was most strongly related to intention and the direct measure of attitude and the belief-based measure of PBC displayed the weakest associations with intention. All of the TPB measures were significantly correlated with intention among the middle-aged adults, yet the magnitude of the coefficients was relatively weaker compared with the other groups. The young adults did not relate their attitude, when assessed directly, to intention, while the beliefs underlying PBC were not significantly associated with intention among the elderly adults.

4.3.2.2.2 Relationships of additional variables

Anticipated regret was only weakly to moderately related to the direct measure of attitude in all three datasets, supporting its discriminant validity. This variable displayed robust correlations with the belief-based measure of injunctive norm in the young adults, and with the belief-based measure of attitude and the direct measure of social norm in the elderly adults. None of the TPB variables were strongly associated with anticipated regret among the middle-aged adults.

The relationship between anticipated regret and intention was moderate among the middle-aged adults and strong among the young and elderly adults. In all cases, stronger intentions to drive after prolonged wakefulness was related to anticipating less regret over having performed this behaviour.

ISS was unrelated to most of the variables in all three datasets. It was significantly associated with intention among the young adults; a higher score on ISS was weakly related to an intention to drive after being awake for 15 or more hours. It was also significantly related to anticipated regret in the elderly adults; a higher ISS was weakly associated with anticipating less regret having driven after being awake for 15 or more hours.

Overall, past behaviour was significantly related to the majority of TPB variables and fairly to very strongly related to anticipated regret. As expected, in all three datasets, past behaviour displayed the most robust correlation with intention. Past behaviour was strongly related to several variables assessed in the elderly adults, suggesting a potential problem with multicollinearity in the subsequent regression performed on this data (see below).

4.3.2.3 Predicting intention from belief-based TPB measures

Multiple regressions were performed in which the belief-based measures of attitude, injunctive norm and PBC were regressed onto intention to drive after 15 or more hours of wakefulness for the young, middle-aged and elderly adults. The results are shown in Table 4.9.

Table 4.9: Predicting intention to drive after prolonged wakefulness from belief-based TPB measures

Young adults	R^2	β	*B* (SE)
	.48***		
Attitude		.33**	.22 (.07)
Injunctive norm		.42***	.49 (.12)
PBC		-.16*	-.07 (.04)
Middle-aged adults	R^2	β	*B* (SE)
	.26***		
Attitude		.12	.08 (.08)
Injunctive norm		.34**	.38 (.13)
PBC		-.30**	-.13 (.05)
Elderly adults	R^2	β	*B* (SE)
	.53***		
Attitude		.31**	.13 (.05)
Injunctive norm		.46***	.43 (.11)
PBC		-.09	-.04 (.04)

*$p < .05$; **$p < .01$; ***$p < .001$. Probability values of betas were adjusted for one-tailed tests.

Young adults: One case was removed based on a high leverage value. A total of 48% of the variance in intention was explained (F (3, 64) = 19.59, $p < .001$) and all three variables exerted a significant influence. The belief-based measure of injunctive norm was the dominant predictor, followed by attitude and to a lesser extent, PBC.

Middle-aged adults: The belief-based measures of injunctive norm and PBC emerged as significant predictors, accounting for 26% of the variance (F (3, 65) = 7.50, $p < .001$). Attitude did not predict intention.

Elderly adults: Data screening led to the removal of three cases; two due to high leverage values and one outlier. The belief-based measures explained 53% of the variance in intention (F (3, 63) = 23.84, p < .001). Injunctive norm was the strongest predictor, followed by attitude, however PBC was not significant.

Summary: The belief-based measure of injunctive norm was the dominant predictor in all three regressions, suggesting that people's perceptions of whether specific referents want them to drive after they have been awake for 15 or more hours is an important determinant of whether or not they intend to perform this behaviour. Attitude towards driving after prolonged wakefulness significantly predicted intention among the young and elderly adults, whereas this variable did not influence intention among the middle-aged adults. Perceived control over refraining from driving after 15 or more hours of wakefulness also predicted whether or not the young and middle-aged adults intended to drive after this period of wakefulness.

4.3.2.4 Predicting intention from direct TPB and additional variables

Hierarchical regressions were conducted to examine the ability of the TPB to predict intention to drive after 15 or more hours of wakefulness, along with the influence of the additional variables. The direct measures of the TPB variables were entered first, followed by anticipated regret and ISS on Step 2 and past behaviour on Step 3. The results for the young, middle-aged and elderly adults are presented in Table 4.10.

Table 4.10: Predicting intention to drive after prolonged wakefulness from direct TPB measures and additional variables

Variables	Step 1			Step 2			Step 3		
Young	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.56***			.63***			.76***		
Attitude		.10	.13 (.11)		.16	.19 (.10)		.18*	.22 (.08)
Soc. norm		.56***	.76 (.13)		.44***	.60 (.13)		.29***	.40 (.11)
PBC		-.32***	-.42 (.12)		-.27**	-.35 (.12)		-.21**	-.27 (.10)
Ant regret					.26**	.32 (.11)		.14*	.17 (.10)
ISS					.19**	.10 (.04)		.17**	.09 (.03)
Past beh.								.46***	.97 (.17)
Middle	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.48***			.51***			.53***		
Attitude		-.06	-.06 (.11)		.01	.01 (.11)		.01	.01 (.11)
Soc. norm		.57***	.71 (.12)		.50***	.63 (.13)		.43***	.53 (.15)
PBC		-.27**	-.32 (.12)		-.31**	-.37 (.12)		-.25*	-.30 (.13)
Ant regret					.21*	.27 (.14)		.12	.16 (.17)
ISS					-.06	-.04 (.06)		-.08	-.05 (.06)
Past beh.								.19	.43 (.34)
Elderly	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.50***			.58***			.62***		
Attitude		-.13	-.15 (.13)		-.09	-.10 (.13)		-.16	-.18 (.13)
Soc. norm		.48***	.56 (.14)		.25*	.28 (.16)		.08	.09 (.17)
PBC		-.22*	-.28 (.16)		-.18	-.23 (.16)		.01	.01 (.18)
Ant regret					.40**	.44 (.15)		.18	.20 (.18)
ISS					-.02	-.02 (.09)		-.01	-.01 (.09)
Past beh.								.50**	.98 (.41)

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Probability values of betas were adjusted for one-tailed tests.

Young adults: On Step 1, the TPB variables explained 56% of the variance in intention to drive after being awake for 15 or more hours (F (3, 66) = 27.97, $p < .001$). Social norm was the strongest predictor, followed by PBC. Attitude did not influence intention. Anticipated regret and ISS explained a further 7% of the variance in intention (ΔF (2, 64) = 6.33, $p < .01$), and both contributed significantly. Social norm remained the dominant predictor, followed by PBC and anticipated regret, and then ISS. Finally, past behaviour accounted for a further 13% of the variance in intention (ΔF (1, 63) = 33.13, $p < .001$), resulting in a total of 76% explained variance (F (6, 63) = 33.09, $p < .001$). In the final model, past behaviour was the strongest predictor, however the four previous predictors did not lose their significant impact. Attitude also significantly predicted intention on the final step, however, the effect was in the opposite direction to expectations. As the Pearson's correlation between intention and attitude was negative, as predicted (r = -.15; see Table 4.6), it is likely that the significant beta for attitude reflects a suppressor effect (Tabachnik & Fidell, 2007).

Middle-aged adults: One influential case was removed and visual inspection of the standardised residuals plotted against the standardised predictors indicated slight heteroscedasticity. On Step 1, the TPB variables explained 48% of the variance in intention (F (3, 56) = 16.95, p < .001). The strongest predictor was social norm, then PBC. Attitude was not associated with intention. Taken together, anticipated regret and ISS did not increase the variance significantly (ΔF (2, 54) = 2.05, p > .05), though anticipated regret did significantly influence intention but to a lesser extent than social norm and PBC. Past behaviour did not significantly improve the model (ΔF (1, 53) = 1.60, p > .05). Social norm remained the dominant predictor of intention, followed by PBC. A total of 53% of the variance in intention was explained in the final model (F (6, 53) = 9.84, p < .001).

Elderly adults: One influential case was omitted. The standardised residuals appeared to deviate from normality and the tolerance value with the addition of past behaviour fell to below .2, indicating a potential problem with multicollinearity on the final step (Field, 2005). The direct measures of the TPB variables accounted for 50% of the variance in intention to drive after being awake for 15 or more hours (F (3, 52) = 17.52, p < .001); social norm was the strongest predictor, followed by PBC. Anticipated regret and ISS added 8% to the explained variance (ΔF (2, 50) = 4.36, p < .05), however, only anticipated regret had a significant independent influence. It became the dominant predictor on this step. The effect of PBC was reduced to non-significance whereas social norm remained a significant predictor. Past behaviour contributed an additional 4% to the variance in intention (ΔF (1, 49) = 5.86, p < .05) and became the only significant predictor in the final model, which accounted for a total of 62% of the variance in intention (F (6, 49) = 13.42, p < .001).

Summary: The pattern of results was identical for young, middle-aged and elderly adults on the first step of the regression. Similar to the results obtained with the belief-based measures, social norm was the dominant predictor of intention on the first step. PBC over refraining from driving after 15 or more hours of wakefulness also exerted a significant influence over intention to drive after this length of time awake. In contrast, attitude towards refraining from driving after prolonged wakefulness did not predict intention.

Anticipated regret significantly predicted intention in all three regressions. In the regression performed for the elderly adults, it superseded the dominant position of social norm and reduced PBC to non-significance. The more regret the adults perceived they would experience having driven after 15 or more hours, the weaker their intention to do so. ISS significantly predicted the young adults' intentions, yet its impact was weaker than social norm, PBC and anticipated regret. The higher the young adults scored on ISS, the stronger were their intentions to drive after prolonged wakefulness. ISS was not a significant predictor of intention for the middle-aged and elderly adults.

The results of the third step of the regressions were remarkably different for the three age groups. Past behaviour significantly increased the explained variance in intention for the young and elderly adults. In the young adults' regression, past behaviour was the dominant predictor but the other variables remained significant; for the elderly adults, past behaviour became the only significant predictor of intention in the final model, although the generalisability of this latter finding should be interpreted with caution due to the presence of multicollinearity between the predictors. Conversely, past behaviour did not account for additional variance in intention to drive after prolonged wakefulness among the middle-aged adults. Social norm remained the dominant predictor, followed by PBC, while the effect of anticipated regret was reduced to non-significance on the final step.

4.3.2.5 Additional analyses conducted on behavioural data from young adults

4.3.2.5.1 Descriptive statistics for behavioural measures

Whole sample of young adults

On average, the young adults drove on almost six (M = 5.86, SD = 1.42) days out of seven and made 3.14 (SD = 1.26) journeys per day and a total of 22.31 (SD = 8.84) journeys during the week under investigation.

Out of the whole sample, the maximum amount of time a young adult had been awake when they started driving was 22 hours and 53 minutes according to the diary-based measure and 24 hours and 1 minute according to the calculated measure. A total of 57 and 43 occurrences of driving after 15 or more hours of wakefulness were identified by the diary-based and calculated methods, respectively. These journeys averaged approximately nine miles, with the longest journey covering 95 miles, which began after the individual had been awake for 19 hours and 10 minutes (identified by both methods). Slightly more of these journeys involved driving on a carriageway or motorway, compared to more built-up roads (31 versus 25 of journeys identified by the diaries; 22 versus 21 identified by the calculated measure). Table 4.11 shows the purposes, as recorded in the diaries, of the journeys that were undertaken after participants had been awake for 15 or more hours.

Table 4.11: Reasons for journeys being undertaken by young adults after 15 or more hours of wakefulness

Reasons	Frequency as identified by diary-based method	Frequency as identified by calculated method
Going home after socialising	22	15
Giving lifts/returning home from giving lifts	11	9
Going home after work	10	6
Going out socialising	3	2
Going home after a hobby, e.g., sports	2	3
Going home from visiting family	2	2
Going home from work and giving lifts	2	2
Going to work	1	1
Going home for an emergency	1	1
Going home after hair cut	1	1
To get food	1	0
Going home after getting food	1	0
Going home after working on new property	0	1

The most common reason for driving after being awake for 15 or more hours was as a means of getting home after socialising, followed by giving people lifts and then getting home after work.

Sample without missing data

Diary-based behaviour: Days were omitted from the analyses if the data in the diaries were incomplete or inaccurate, for example, journeys recorded at the same time as the participant had written in the diary that they were napping.

Calculated behaviour: Days were omitted from the analyses if the actiwatch was not worn for the nocturnal sleep period or for over two hours and 24 minutes of the day (see section 2.2.3.1) or if the subjective data from the diaries were incomplete or inaccurate.

For a participant's diary-based and calculated data to be included in the analyses, they must have had valid data for all seven days. After deleting missing cases, the longest time that participants had been awake for when they began a journey averaged at 14 hours and 20 minutes (SD = 2 hours and 43 minutes) according to the diary-based measure and 13 hours and 44 minutes (SD = 2 hours and 40 minutes) according to the calculated measure. Table 4.12 shows the frequency with which the young adults drove after being awake for 15 or more hours, according to each of the behavioural measures. The data for the subjective behavioural measure was based on the question presented in the Time 2 questionnaire which asked participants, 'On how many occasions in the last week did you drive when you had been awake for 15 or more hours?'

Table 4.12: Number of young adults who drove after prolonged wakefulness

<table>
<tr><th>Frequency</th><th>Subjective measure</th><th>Diary-based measure</th><th>Calculated measure</th></tr>
<tr><td>Once</td><td>17 (24.3%)</td><td>16 (24.2)</td><td>10 (17.5%)</td></tr>
<tr><td>Twice</td><td rowspan="2">14 (20.0%)</td><td>8 (12.1%)</td><td>8 (14.0%)</td></tr>
<tr><td>Three times</td><td>4 (6.1%)</td><td>4 (7.0%)</td></tr>
<tr><td>Four times</td><td rowspan="2">6 (8.6%)</td><td>3 (4.5%)</td><td>0 (0%)</td></tr>
<tr><td>Five times</td><td>0 (0%)</td><td>0 (0%)</td></tr>
<tr><td>Seven times</td><td>1 (1.4%)</td><td>0 (0%)</td><td>0 (0%)</td></tr>
<tr><td>Total</td><td>38 / 70 (54.3%)</td><td>31 / 66 (46.9%)</td><td>22 / 57 (38.5%)</td></tr>
</table>

Table 4.12 indicates that more young adults subjectively reported driving after 15 or more hours of wakefulness than was estimated by the calculated measure.

4.3.2.5.2 Correlations with behavioural measures

The correlations between the behavioural measures and the other variables for the young adults are presented in Table 4.13.

Table 4.13: Pearson's correlations between behavioural measures and all other variables

	Subjective behaviour	Diary-based behaviour	Calculated behaviour
Bb Attitude	.13	-.01	-.08
Bb Injunctive norm	.09	.02	.02
Bb PBC	-.09	-.11	-.00
Attitude	.14	.18	.21
Social norm	.04	.01	-.04
PBC	-.22*	-.06	.02
Anticipated regret	.08	-.08	-.08
ISS	.06	.18	.11
Past behaviour	.30**	.14	-.03
Intention	.32**	.20	.04
Subjective behaviour	-	.55***	.56***
Diary-based behaviour	-	-	.89***

**p* < .05; ***p* < .01; ****p* < .001.

Table 4.13 shows that neither the diary-based nor the calculated measures of behaviour were significantly related to any of the variables assessed at Time 1. The subjective measure of behaviour was moderately correlated with intention and past behaviour and weakly related to the direct measure of PBC. Inter-correlations between the measures of behaviour were strong, with the most robust being between the diary-based and calculated measures. This establishes the convergent validity of the behavioural measures.

4.3.2.5.3 Predicting behaviour

Table 4.14 displays the results of hierarchical regressions on the subjective, diary-based and calculated measures of behaviour, in which intention and the direct measure of PBC were regressed on behaviour on Step 1, ISS was added on Step 2 and past behaviour on Step 3.

Table 4.14: Predicting the behaviour of young adults

Variables	Step 1			Step 2			Step 3		
Subjective	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.11*			.11			.11		
Intention		.29*	.18 (.09)		.30*	.19 (.09)		.21	.13 (.13)
PBC		-.05	-.04 (.11)		-.05	-.04 (.12)		-.05	-.04 (.12)
ISS					-.02	-.01 (.04)		-.01	-.00 (.04)
Past beh.								.12	.16 (.24)
Diary	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.04			.06			.06		
Intention		.23	.15 (.10)		.19	.12 (.10)		.16	.10 (.14)
PBC		.06	.05 (.12)		.05	.04 (.12)		.05	.04 (.12)
ISS					.13	.04 (.04)		.14	.05 (.04)
Past beh.								.04	.05 (.26)
Calculated	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.00			.01			.02		
Intention		.07	.05 (.11)		.04	.03 (11)		.14	.09 (.16)
PBC		.06	.05 (.13)		.05	.04 (.13)		.05	.04 (.13)
ISS					.10	.03 (.05)		.09	.03 (.05)
Past beh.								-.12	-.15 (.29)

*$p < .05$.

Inspection of histograms and normal probability plots indicated that the standardised residuals deviated from normality in all three regressions. The deviation was most noticeable in the regression conducted on the calculated measure of behaviour, followed by that of the diary-based measure. Therefore, conclusions regarding the generalisability of the results of these regressions should be interpreted with caution.

Subjective behaviour: The TPB variables explained 11% of the variance in the subjective measure of behaviour (F (2, 67) = 4.01, p < .05). Only intention had a significant impact. ISS did not significantly add to the model (ΔF (1, 66) = 0.04, p > .05) and intention remained a significant predictor on this step. Past behaviour also failed to explain any additional variance in subjective behaviour on the third step (ΔF (1, 65) = 0.44, $p > .05$) but its addition added to the error of the model and reduced the influence of intention to non-significance. Consequently, the final equation was not significant (F (4, 65) = 2.08, $p > .05$).

Diary-based behaviour: Only 4% percent of the variance in the diary-based measure of behaviour could be explained by intention and PBC. The beta for intention was marginally significant (β = .23, p (one-tailed) = .06), and the model did not offer a significantly greater than chance prediction (F (2, 63) = 1.33, $p > .05$). Neither ISS on the second step (ΔF (1, 62) = 1.07, $p > .05$) nor past behaviour on the third step (ΔF (1, 61) = 0.03, $p > .05$) significantly increased the variance explained in the diary-based measure of behaviour. A total of 6% of variance was explained (F (4, 61) = 0.93, $p > .05$).

Calculated behaviour: Again, the TPB model did not provide a significantly greater than chance prediction (F (2, 54) = 0.11, $p > .05$) and neither ISS (ΔF (1, 53) = 0.49, $p > .05$) nor past behaviour (ΔF (1, 52) = 0.29, $p > .05$) accounted for additional variance in the calculated measure of behaviour. In the final model, only 2% of the variance was accounted for (F (4, 52) = 0.25, $p > .05$).

Summary: Intention significantly predicted the subjective measure of behaviour. This indicates that the young adults retrospectively perceived that they had driven after being awake for 15 or more hours in the previous week to the extent that they had intended to do so at the beginning of that week. Intention was also a marginally significant predictor of driving after prolonged wakefulness, when assessed on a day-to-day subjective basis. On the other hand, neither the TPB variables, ISS nor past behaviour were capable of predicting the more objective measure of behaviour, although the generalisability of the results is questionable. In sum, the findings suggest that driving after 15 or more hours of wakefulness is not an intentional behaviour.

4.3.2.5.4 Explaining behaviour

Intention was not related to the calculated measure of behaviour, which was the more objective indicator obtained in the present study. Therefore, further analyses exploring the beliefs underlying intention are of limited value since these beliefs are not necessarily linked to whether or not the young adults actually drove after 15 or more hours of wakefulness. Although this finding was restricted to young adults as behaviour was not assessed in the other age groups, further examination of the beliefs underlying the intentions of middle-aged and elderly adults was not undertaken to avoid tedium (due to similar analyses reported elsewhere) and the likelihood that intention would not be related to behaviour in these age groups either.

4.3.2.5.5 Week typicality

The screening process made participants aware that it was important that the week under investigation was a fairly normal week for them in terms of sleep and driving behaviours. The week typicality variable measured at Time 2 provided information about the occurrence of any unusual events which the participant had not anticipated when they completed the Time 1 questionnaire. These events may have reduced the extent to which the variables assessed at Time 1 were able to predict behaviour.

Week typicality was dichotomised by grouping together those who indicated that they had encountered a 'completely typical' or 'fairly typical' week (given a score of 1, representing a normal week), and combining those whose response implied that the week had been 'not typical at all' or 'fairly untypical' (scored 0). It was found that only 5 out of the 70 young adults had encountered an atypical week (7%). Tabachnik and Fidell (2007) reported that if over 90% of responses to a dichotomous variable fall into one category, correlations between this variable and other continuous variables will be seriously deflated even if they are strongly related in the population. Therefore, this variable was not included in any further analyses.

4.3.2.6 Summary

Perceived social pressure, when assessed via beliefs regarding the expectations of specific normative referents and when measured directly taking account of both the prescriptions and behaviour of important others, was the dominant predictor of intention to drive after 15 or more hours of wakefulness in all three age groups. This suggests that this variable is important in the decision whether or not to drive while sleep impaired throughout adulthood. However, intention, as well as the other measured cognitions, was not significantly related to actual behaviour among the young adults. The inference is that intervention attempts targeting the perceived social pressure to drive after 15 or more hours of wakefulness may indeed impact on intention, but this would not necessarily result in behavioural change.

4.3.3 Driving between the hours of midnight and 6am

4.3.3.1 Descriptive statistics

Table 4.15 shows the frequency with which the young adults drove between midnight and 6am, according to the two behavioural measures. The data for the subjective behavioural measure was based on the question presented in the Time 2 questionnaire which asked participants, 'On how many occasions in the last week did you drive between midnight and 6am?'

Table 4.15: Number of young adults who drove between midnight and 6am

<table>
<tr><th>Frequency</th><th>Subjective measure</th><th>Diary-based measure</th></tr>
<tr><td>Once</td><td>16 (22.9%)</td><td>11 (16.4%)</td></tr>
<tr><td>Twice</td><td rowspan="2">8 (11.5%)</td><td>6 (9.0%)</td></tr>
<tr><td>Three times</td><td>2 (3.0%)</td></tr>
<tr><td>Four times</td><td>3 (4.3%)</td><td>1 (1.5%)</td></tr>
<tr><td>Five times</td><td>1 (1.4%)</td><td>1 (1.5%)</td></tr>
<tr><td>Total</td><td>28 / 70 (40.0%)</td><td>21 / 67 (31.4%)</td></tr>
</table>

A total of 38 occurrences of driving between midnight and 6am were identified by the diary-based measure of behaviour. These journeys averaged 9.25 miles and 55% involved driving on a carriageway or motorway. Table 4.16 shows the frequency of the reasons, as recorded in the diaries, for the journeys which were undertaken between midnight and 6am. It is clear that the most common reason for driving between midnight and 6am was as a means of getting home after socialising, followed by both going to and getting home from work.

Table 4.16: Reasons for journeys being undertaken between midnight and 6am

Reasons	Frequency
Going home after socialising	11
Going to work	8
Going home after work	8
Going home from work and giving lifts	2
Going to sports training	2
Giving lifts/returning home from giving lifts	2
Going out socialising	1
Going home for an emergency	1
Going home from visiting family	1
To get food	1
Going home after getting food	1

The means, SDs, ranges and possible ranges of all of the measures obtained in relation to driving between midnight and 6am are presented in Table 4.17.

Table 4.17: Descriptive statistics for all measures[a]

	Mean	SD	Range	Possible range
Bb Attitude	-0.28	1.88	-4.78 to 4.56	-9.00 to 9.00
Bb Injunctive norm	-0.73	1.11	-3.00 to 2.29	-3.00 to 3.00
Bb PBC	0.13	3.27	-7.56 to 8.00	-21.00 to 21.00
Attitude	0.76	1.11	-2.17 to 3.00	-3.00 to 3.00
Injunctive norm	-0.79	1.08	-2.67 to 2.00	-3.00 to 3.00
PBC	1.53	1.18	-1.33 to 3.00	-3.00 to 3.00
Descriptive norm	-0.61	1.17	-3.00 to 1.67	-3.00 to 3.00
Anticipated regret	0.46	1.09	-2.50 to 3.00	-3.00 to 3.00
ISS	5.11	2.80	0.00 to 10.00	0.00 to 10.00
Past behaviour	0.11	1.19	-2.00 to 2.67	-3.00 to 3.00
Intention	-0.77	1.59	-3.00 to 2.33	-3.00 to 3.00
Subjective beh.	0.00	0.88	-0.72 to 2.13	Standardised
Diary-based beh.	0.57	1.05	0 to 5	≥ 0

[a]All measures were assessed in relation to driving between midnight and 6am, except for the direct measure of attitude and both measures of PBC, which were assessed regarding refraining from driving between midnight and 6am.

Comparisons of mean scores with the scale midpoints indicated that in terms of attitude, the young adults viewed driving between midnight and 6am as slightly negative (i.e., the belief-based measure) and refraining from driving between these times as positive (i.e., the direct measure). They did not perceive social pressure in the form of injunctive or descriptive norms to perform this behaviour, or in other words, they believed their normative referents approved of them refraining from driving/refrained from driving themselves between midnight and 6am. The descriptives also suggested that the young adults believed that refraining from driving between midnight and 6am was under their control, that they would feel an element of regret having driven between these times, and that they did not generally intend to drive between midnight and 6am.

4.3.3.2 Correlations

Pearson's correlations between all of the variables are presented in Table 4.18.

Table 4.18: Pearson's correlations between all variables

	1 BB Att.	2 BB Inj. norm	3 BB PBC	4 Att.	5 Inj. norm	6 PBC	7 Des. norm	8 Ant. reg.	9 ISS	10 Past beh	11 Int.	12 Sub. beh..
1	-											
2	.55***	-										
3	-.18	-.13	-									
4	-.45***	-.41***	.31*	-								
5	.53***	.62***	-.15	-.36**	-							
6	-.41***	-.44***	.27*	.57***	-.45***	-						
7	.29*	.44***	-.03	-.29*	.46***	-.31**	-					
8	.48***	.54***	-.14	-.33**	.45***	-.17	.21	-				
9	.26*	.17	-.00	-.20	.18	-.10	.31**	.08	-			
10	.51***	.33**	-.17	-.42***	.53***	-.52***	.38**	.26*	.20	-		
11	.47***	.41***	-.15	-.58***	.49***	-.69***	.42***	.37**	.22*	.69***	-	
12	.09	.22*	.12	-.13	.24*	-.21*	.24*	.03	.27*	.37***	.31**	-
13[a]	.16	.25*	.01	-.16	.32**	-.24*	.31**	-.01	.29**	.39***	.33**	.81***

*$p < .05$; **$p < .01$; ***$p < .001$; [a]13 = Diary-based behaviour. Probability values were adjusted for one-tailed tests.

4.3.3.2.1 TPB relationships

All correlations between the belief-based and direct measures of the TPB variables were significant, as proposed by the model, indicating concurrent validity. The magnitudes of the correlation coefficients were strong, moderate and somewhat weak for injunctive norm, attitude and PBC respectively.

All three direct measures were more strongly related to intention than the belief-based measures, perhaps due to shared method variance. The direct measure of PBC displayed the strongest correlation, indicating that the less control the young adults perceived they had over refraining from driving between midnight and 6am, the stronger their intention to drive between these times. Conversely, the belief-based measure of PBC was not significantly related to intention, suggesting that the relevant accessible control beliefs were not adequately captured by this measure. There was also a strong correlation between the direct measure of attitude and intention, which shows that a negative attitude towards refraining from driving between midnight and 6am was associated with a stronger intention to drive then.

Correlations between the two variables that the TPB proposes to predict behaviour (i.e., intention and PBC) and the two measures of behaviour were significant and weak to moderate. The magnitude of these coefficients revealed that firstly, intention was more strongly related to the two measures of behaviour than PBC, and secondly, relationships involving the diary-based measure were slightly stronger than those involving the subjective measure of behaviour. The inter-correlation between the two behavioural measures was highly reliable, which demonstrated their strong convergent validity, particularly taking into account the different ways in which the measures were obtained.

4.3.3.2.2 Relationships of additional variables

Descriptive norm was only moderately related to the direct measure of injunctive norm, providing further support for their discriminant validity. It was also significantly correlated with intention, but to a lesser extent than injunctive norm. The relationship between anticipated regret and the direct measure of attitude was also moderate, which supports the distinctiveness of anticipated regret. This variable was significantly associated with intention.

ISS was weakly, but significantly, correlated with intention and both the subjective and diary-based measures of behaviour. The relationship between past behaviour and intention was of the same magnitude as that between PBC and intention, i.e., past behaviour and PBC were the most strongly associated with intention. On the other hand, correlations between past behaviour and both the subjective and diary-based measures of behaviour were of only moderate magnitude.

4.3.3.3 Effects of gender

Males were assigned a value of 0 (50% of the sample) and females a value of 1. Only four of the relationships between gender and the measured variables emerged as significant at the one-tailed level. Young males were more likely to perceive that important others approved of them driving between midnight and 6am ($r = -.25$, $p < .05$) and that these referents drove between these times themselves ($r = -.32$, $p < .01$). Males were also more likely to actually perform this behaviour than females ($r = -.21$, $p < .05$ for both the subjective and diary-based measures of behaviour). Although weak and non-significant, the relationship between gender and intention was in the opposite direction to both expectations and the findings for behaviour ($r = .09$, $p > .05$). Two *t*-tests were performed to examine whether there were gender differences in the extent to which the young adults drove between midnight and 6am during the week under investigation (one for each measure of behaviour). Both revealed that males performed the behaviour more often than females ($t\,(65.51) = 1.76$, p (one-tailed) $< .05$ and $t\,(65) = 1.72$, p (one-tailed) $< .05$ for the subjective and diary-based measures respectively).

4.3.3.4 Predicting intention from belief-based TPB measures

A hierarchical regression was performed on intention whereby gender was entered on the first step (as in previous investigations of the TPB's ability to mediate demographic variables, Armitage *et al.*, 2002; Conner *et al.*, 2007), followed by the belief-based measures of attitude, injunctive norm and PBC. The results are shown in Table 4.19.

Table 4.19: Predicting intention to drive between midnight and 6am from gender and belief-based TPB measures

	R^2	β	B (SE)	R^2	β	B (SE)
	.02			.26***		
Gender		.13	.39 (.37)		.21	.62 (.34)
Attitude					.28*	.24 (.12)
Inj. norm					.26*	.36 (.20)
PBC					-.06	-.03 (.06)

*$p < .05$; **$p < .01$; ***$p < .001$. Probability values of betas were adjusted for one-tailed tests if in the expected direction.

Two influential cases were removed from the analysis. Gender did not account for a significant proportion of the variance in intention (F (1, 65) = 1.07, $p > .05$). The addition of the TPB variables on the second step resulted in a significant and substantial increase of 24% to the explained variance (ΔF (3, 62) = 6.66, $p < .001$). Attitude was the dominant predictor, closely followed by injunctive norm. PBC had no effect. This shows that the young adults held strong intentions to drive between midnight and 6am to the extent that they evaluated this behaviour positively and that they believed that specific normative referents wanted them to do so. The influence of gender upon intention was somewhat increased (though in the opposite direction to what was expected) when the TPB variables were added to the equation, suggesting that gender may have suppressed variance irrelevant to intention (Tabachnik & Fidell, 2007). The final model accounted for 26% of the variance in intention (F (4, 62) = 5.33, $p < .001$).

4.3.3.5 Predicting intention from direct TPB and additional variables

A hierarchical regression was conducted to examine the relative ability of the TPB measures to predict intention, together with the influence of the additional variables upon the model. As the previous regression revealed that gender did not significantly predict intention, it was not included in this analysis. The direct measures of the TPB variables were entered first, followed by descriptive norm, anticipated regret and ISS on Step 2 and past behaviour on Step 3. The results are presented in Table 4.20.

Table 4.20: Predicting intention to drive between midnight and 6am from direct TPB measures and additional variables

Variables	Step 1			Step 2			Step 3		
	R^2	β	B (SE)	R^2	β	B (SE)	R^2	β	B (SE)
	.55***			.60***			.68***		
Attitude		-.24*	-.34 (.15)		-.16	-.23 (.15)		-.12	-.17 (.13)
Inj. norm		.19*	.27 (.14)		.05	.07 (.16)		-.07	-.10 (.15)
PBC		-.47***	-.63 (.14)		-.49***	-.67 (.14)		-.39***	-.52 (.13)
Des. norm					.14	.20 (.13)		.11	.15 (.12)
Ant regret					.17*	.25 (.14)		.17*	.24 (.12)
ISS					.08	.04 (.05)		.05	.03 (.04)
Past beh.								.38***	.51 (.13)

*$p < .05$; **$p < .01$; ***$p < .001$. Probability values of betas were adjusted for one-tailed tests.

The direct measures of the TPB variables accounted for 55% of the variance in intention to drive between midnight and 6am (F (3, 66) = 26.76, $p < .001$). All variables exerted a significant influence, with PBC being the strongest predictor, followed by attitude and injunctive norm. Descriptive norm, anticipated regret and ISS explained a further 5% of the variance in intention (ΔF (3, 63) = 2.43, p = .07). PBC remained the dominant predictor, but attitude and injunctive norm became non-significant. Anticipated regret was the only other variable to significantly predict intention on this step. Past behaviour added a further 8% to the variance explained in intention (ΔF (1, 62) = 16.57, $p < .001$). PBC was the strongest predictor, closely followed by past behaviour and then anticipated regret. In the final model, 68% of the variance in intention was explained (F (7, 62) = 18.89, $p < .001$).

4.3.3.6 Predicting behaviour

Table 4.21 shows the results of hierarchical regressions on the subjective and diary-based measures of behaviour, in which gender was entered on Step 1, intention and the direct measure of PBC on Step 2, ISS on Step 3 and past behaviour on Step 4.

Table 4.21: Predicting subjective and diary-based behaviour

Measure	Step 1		Step 2		Step 3		Step 4	
Subjective	$R^2 = .04$		$R^2 = .15^*$		$R^2 = .18^*$		$R^2 = .22^{**}$	
	β	*B* (SE)	β	*B* (SE)	β	*B* (SE)	β	*B* (SE)
Gender	-.21*	-.36 (.21)	-.24*	-.41 (.20)	-.21*	-.36 (.20)	-.20*	-.34 (.20)
Intention			.33*	.18 (.09)	.28*	.15 (.09)	.11	.06 (.10)
PBC			.01	.01 (.12)	-.01	-.01 (.12)	.02	.01 (.11)
ISS					.17	.05 (.04)	.16	.05 (.04)
Past beh.							.28*	.21 (.11)
Diary	$R^2 = .04$		$R^2 = .16^*$		$R^2 = .20^{**}$		$R^2 = .24^{**}$	
	β	*B* (SE)	β	*B* (SE)	β	*B* (SE)	β	*B* (SE)
Gender	-.21*	-.44 (.25)	-.23*	-.47 (.24)	-.20*	-.41 (.24)	-.19	-.39 (.24)
Intention			.34*	.22 (.10)	.28*	.18 (.11)	.10	.07 (.12)
PBC			-.01	-.01 (.14)	-.03	-.02 (.14)	-.01	-.01 (.14)
ISS					.19	.07 (.05)	.18	.07 (.04)
Past beh.							.28*	.24 (.14)

$^*p < .05$; $^{**}p < .01$. Probability values of betas were adjusted for one-tailed tests.

Subjective behaviour: Four percent of the variance in the subjective measure of behaviour was accounted for by gender (F (1, 68) = 3.10, p = .08). The significant negative beta coefficient indicates that males were more likely to subjectively report that they had driven between midnight and 6am than females. The TPB variables increased the explained variance by 11% (ΔF (2, 66) = 4.09, p < .05), however only intention had a significant effect. Gender remained significant, indicating that the TPB variables did not mediate its effect on subjective behaviour, although intention was the dominant predictor on this step. ISS did not increase the explained variance (ΔF (1, 65) = 2.16, p > .05) and the predictors were the same as on the previous step. Past behaviour also failed to add significantly to the model though it emerged as the dominant predictor, followed only by gender (ΔF (1, 64) = 3.35, p = .07). Intention was not a significant predictor in the final model, which accounted for a total of 22% of the variance in subjective behaviour (F (5, 64) = 3.55, p < .01).

Diary-based behaviour: The standardised residuals deviated from normality[10]. Gender explained 4% of the variance in the diary-based measure of behaviour (F (1, 65) = 2.97, p = .09). Intention and PBC accounted for a further 12% of variance (ΔF (2, 63) = 4.43,

[10] Two cases had outlying standardised residuals but were not removed from the analyses because they were the two participants who performed the behaviour the most times during the week under investigation.

$p < .05$), whereas the additions of ISS (ΔF (1, 62) = 2.53, $p > .05$) and past behaviour (ΔF (1, 61) = 3.21, $p = .08$) did not contribute. Regarding the independent predictors of the diary-based measure of behaviour, the inferences on the first three steps of the regression were identical to those for subjective behaviour. However, it is noteworthy that the influence of ISS did approach significance ($\beta = .19$, p (one-tailed) = .06) and on the fourth step, the effect of gender was only marginally significant ($\beta = -.19$, p (one-tailed) = .06). Only past behaviour was a predictor in the final model, which accounted for 24% of the variance in the diary-based measure of behaviour (F (5, 61) = 3.74, $p < .01$).

<u>Summary:</u> Perhaps unsurprisingly due to their strong relationship ($r = .81$, $p < .001$), the results of both regressions were very similar. Males were significantly more likely to drive between midnight and 6am than females and this effect was not fully mediated by the TPB or past behaviour. On the other hand, significant proportions of the variance were only explained with the addition of the TPB variables. PBC had no effect but intention emerged as a more important predictor of both measures of behaviour than gender. This shows that the young adults generally drove between midnight and 6am to the extent that they had intended to do so at the beginning of the week. The influence of ISS did not reach significance in either regression. On the last step, past behaviour was the dominant predictor of behaviour and its addition reduced the effect of intention to non-significance, however, gender remained at least a marginally significant predictor.

4.3.3.7 Explaining behaviour: Differences in underlying beliefs of performers and non-performers

The next step was to uncover the underlying reasons why some young adults drove between midnight and 6am and others did not. Intention significantly predicted both measures of behaviour and so the variables that predicted intention should be traced back to their underlying beliefs to find differences between individuals who did and did not perform the behaviour (Ajzen & Fishbein, 1980; see section 1.3.2.4). For this, the results of the analysis in which the belief-based TPB variables were regressed onto intention were used (see section 4.3.1.5). Attitude and injunctive norm were significant predictors of intention to drive between midnight and 6am and so their components were examined to identify differences in the opinions of the young adults.

The diary-based measure of behaviour was the most reliable due to it being completed by the participants on a daily basis, whereas the retrospective, single administrative subjective measure may have been subject to consistency biases and/or distortions due to memory problems (though the measures were strongly related). Therefore, the diary-based measure was dichotomised in terms of those who drove between midnight and 6am ($N = 21$) and those who did not ($N = 46$). The mean scores (and SD) of the belief-based items calculated for those who did and who did not drive between midnight and 6am are presented in Table 4.22. The dichotomous behavioural measure served as the independent variable in a series of independent t-tests (with Bonferroni corrections and adjusted for one-tailed tests) on the relevant beliefs (Conner *et al.*, 2001; Sutton, 2002).

To recap, behavioural belief strength assessed the likelihood of specific consequences arising from driving between midnight and 6am and was scored from -3 (very unlikely) to 3 (very likely), and evaluations of these outcomes were rated from very bad (-3) to very good (3). Normative beliefs represented the perceived likelihood that referents think the individual should drive between midnight and 6am, scored from -3 (very unlikely) to 3 (very likely).

Table 4.22: Descriptive statistics for beliefs: Comparison between performers and non-performers

	Behavioural belief strength		Outcome evaluations	
Behavioural beliefs	Performers	Non-performers	Performers	Non-performers
Increase risk of vehicle accident [a]	-0.57 (1.36)	-0.02 (1.68)	-2.43 (1.12)	-2.33 (1.30)
Driving when tired [a]	0.48 (1.57)	1.20 (1.60)	-2.14 (0.79)	-2.20 (0.78)
Driving when not as focused/concentrating [a]	-0.05 (1.53)	.87 (1.38)	-2.29 (0.78)	-2.26 (0.71)
Driving when it is dark [a]	2.38 (0.97)	2.33 (1.19)	0.38 (0.97)	0.48 (1.19)
Driving when less traffic [a]	2.76 (0.54)	2.50 (1.03)	2.00 (1.30)	2.02 (0.93)
Unable to drive for work purposes [b]	0.76 (2.07)	2.17 (1.72)[c]*	-1.43 (1.36)	-1.96 (0.99)
Unable to drive home after socialising [b]	-0.33 (1.91)	-0.40 (2.12)[c]	-0.10 (1.64)	-0.30 (1.49)
Unable to give people lifts [b]	-0.81 (1.72)	-0.22 (1.73)[c]	-0.81 (1.33)	-0.78 (1.05)
More likely to be asleep then [b]	-1.62 (1.50)	-1.91 (1.43)[c]	1.76 (1.30)	2.04 (1.05)
Normative beliefs [a]	Performers		Non-performers	
Police	-0.67 (1.53)		-1.07 (1.57)	
People at work	0.14 (1.59)		0.02 (1.68)	
Parents	-0.62 (1.36)		-1.13 (1.66)	
Partner	-0.71 (1.49)		-0.75 (1.77)	
Other family members	-0.29 (1.31)		-1.02 (1.50)	
Friends	-0.19 (1.60)		-0.39 (1.69)	
Road safety groups	-0.62 (1.94)		-1.83 (1.37)	

[a] Worded in relation to driving between midnight and 6am; [b] Worded in relation to not driving/refraining from driving between midnight and 6am; [c] These beliefs were reverse-scored; * Beliefs significantly differentiated those who did versus those who did not intend to drive between midnight and 6am.

Young adults who drove between midnight and 6am were more likely to believe that refraining from driving during those hours would mean they would be unable to drive for work purposes, relative to those who did not (t (33.06) = 2.73, $p < .006$). Those who drove between midnight and 6am did not differ from those who did not in their evaluations of the consequences. Comparisons between the mean scores (Table 4.20) with the scale midpoints revealed that the young adults, regardless of whether or not they drove between midnight and 6am, believed that their referents, except for their colleagues, did not want them to perform this behaviour. In addition, the means suggested that those who did not drive during those hours believed more strongly that the referents did not want them to do this. However, there were no significant differences in the extent to which the young adults perceived approval/disapproval from their referents according to whether or not they drove between midnight and 6am.

Summary: Only one belief significantly differentiated the young adults who drove between midnight and 6am from those who did not. This was the extent to which they associated refraining from driving between those times with being unable to drive for work purposes, reflecting the information shown in Table 4.16, i.e., two of the most frequent reasons for driving between midnight and 6am as recorded in the diaries was getting to and from work.

4.3.4 Driving between the hours of 3pm and 6pm

4.3.4.1 Descriptive statistics

The means, SDs, ranges and possible ranges of all of the measures obtained in relation to driving between 3pm and 6pm are presented in Table 4.23.

Table 4.23: Descriptive statistics for all measures[a]

	Mean	SD	Range	Possible range
Bb Attitude	1.33	3.01	-7.67 to 9.00	-9.00 to 9.00
Bb Injunctive norm	0.71	1.74	-3.00 to 3.00	-3.00 to 3.00
Bb PBC	-2.42	4.79	-10.11 to 13.22	-21.00 to 21.00
Attitude	-0.37	1.17	-2.50 to 3.00	-3.00 to 3.00
Social norm	1.21	1.17	-2.50 to 3.00	-3.00 to 3.00
PBC	0.75	1.62	-2.83 to 3.00	-3.00 to 3.00
Anticipated regret	1.31	1.40	-2.00 to 3.00	-3.00 to 3.00
Past behaviour	1.51	1.24	-2.33 to 3.00	-3.00 to 3.00
Intention	1.12	1.72	-3.00 to 3.00	-3.00 to 3.00

[a]All measures were assessed in relation to driving between 3pm and 6pm, except for the direct measure of attitude and both measures of PBC, which were assessed regarding refraining from driving between 3pm and 6pm.

The mean scores suggest that the elderly adults generally viewed driving between 3pm and 6pm in a favourable light. They intended to perform this behaviour in the following week and had done so in the past. The elderly adults also believed that normative referents would approve of them driving between these times. Regarding refraining from driving between 3pm and 6pm, their attitude was negative and specific control beliefs were perceived to make refraining difficult. On the other hand, the adults believed they had generalised control over refraining from driving between 3pm and 6pm and anticipated an element of regret having driven then. The latter finding suggests that although the elderly adults viewed driving between 3pm and 6pm in a positive light, they did have some awareness of their vulnerability between these times.

4.3.4.2 Correlations

Pearson's correlations between all of the variables are presented in Table 4.24.

Table 4.24: Pearson's correlations between all variables

	1	2	3	4	5	6	7	8
1 Bb Attitude	-							
2 Bb Inj. norm	$.43^{***}$	-						
3 Bb PBC	$-.25^{*}$	$-.27^{*}$	-					
4 Attitude	$-.61^{***}$	$-.58^{***}$	$.34^{**}$	-				
5 Social norm	$.52^{***}$	$.57^{***}$	$-.32^{**}$	$-.62^{***}$	-			
6 PBC	$-.27^{*}$	-.15	$.31^{**}$	$.28^{*}$	$-.29^{*}$	-		
7 Antic. regret	$.42^{***}$	$.61^{***}$	-.21	$-.61^{***}$	$.57^{***}$	-.07	-	
8 Past beh.	$.58^{***}$	$.53^{***}$	$-.52^{***}$	$-.70^{***}$	$.66^{***}$	$-.43^{***}$	$.61^{***}$	-
9 Intention	$.61^{***}$	$.55^{***}$	$-.41^{***}$	$-.73^{***}$	$.61^{***}$	$-.35^{**}$	$.64^{***}$	$.83^{***}$

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Probability values were adjusted for one-tailed tests.

The direct and belief-based measures of attitude and social pressure were strongly related demonstrating that these measures have concurrent validity. The magnitude of the correlation between the two measures of PBC was somewhat weaker, though significant and moderate. The pattern of relationships which the belief-based and direct

TPB variables displayed with intention were identical; all correlations were significant with attitude being the most strongly related to intention, followed by injunctive/social norm and lastly PBC. Therefore, the more positive the attitude towards driving between 3pm and 6pm and the more negative the attitude towards refraining from driving between these times, the stronger was the intention to drive during these hours amongst elderly adults.

Anticipated regret was strongly related to several variables, but not too highly to suggest redundancy. Its association with intention was more robust than that of all of the TPB measures, except for the direct measure of attitude. Past behaviour showed significant relationships with all of the variables, and correlated strongest with intention.

4.3.4.3 Predicting intention from belief-based TPB measures

A multiple regression was performed in which the belief-based measures of attitude, injunctive norm and PBC were regressed onto intention to drive between 3pm and 6pm. The results are shown in Table 4.25.

Table 4.25: Predicting intention to drive between 3pm and 6pm from belief-based TPB measures

	R^2	β	*B* (SE)
	.53***		
Attitude		.29**	.17 (.06)
Injunctive norm		.39***	.39 (.10)
PBC		-.24**	-.10 (.04)

$^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$. Probability values of betas were adjusted for one-tailed tests.

Two influential cases were removed and visual inspection of the standardised residuals plotted against the standardised predictors indicated heteroscedasticity. A total of 53% of the variance in intention was explained (F (3, 62) = 23.65, $p < .001$) and all three variables were significant. The belief-based measure of injunctive norm was the dominant predictor, followed by attitude and then PBC. Therefore, the elderly adults were likely to hold strong intentions to drive between 3pm and 6pm to the extent that they firstly, believed that their specific referents wanted them to drive then, secondly, held a positive attitude towards driving during these hours and thirdly, perceived little control over refraining from driving between these times.

4.3.4.4 Predicting intention from direct TPB and additional variables

A hierarchical regression was conducted to examine the relative ability of the TPB measures to predict intention to drive between 3pm and 6pm, along with the influence of the additional variables upon the model. The direct measures of the TPB variables were entered first, followed by anticipated regret on Step 2 and past behaviour on Step 3. The results are presented in Table 4.26.

Table 4.26: Predicting intention to drive between 3pm and 6pm from direct TPB measures and additional variables

Variables	Step 1			Step 2			Step 3		
	R^2	β	*B* (SE)	R^2	β	*B* (SE)	R^2	β	*B* (SE)
	.62***			.65***			.76***		
Attitude		-.55***	-.82 (.15)		.44***	-.66 (.16)		.25**	-.38 (.15)
Soc. norm		.25**	.38 (.15)		.16	.23 (.16)		-.06	-.09 (.15)
PBC		-.14	-.14 (.09)		-.17*	-.18 (.09)		-.03	-.03 (.08)
Ant regret					.26**	.32 (.13)		.15*	.19 (.11)
Past beh.								.60***	.88 (.17)

*$p < .05$; **$p < .01$; ***$p < .001$. Probability values of betas were adjusted for one-tailed tests.

The direct TPB measures explained 62% of the variance in intention to drive between 3pm and 6pm (F (3, 60) = 32.17, $p < .001$). Attitude was the strongest predictor, followed by social norm, but PBC was not significant. Anticipated regret explained a further 3% of the variance in intention (ΔF (1, 59) = 6.07, $p < .05$) and became the second most important predictor. On this second step, attitude remained the dominant predictor, but the significant predictive effect of social norm was superseded by PBC. Past behaviour accounted for a further 11% of the variance in intention (ΔF (1, 58) = 25.57, $p < .001$), resulting in a total of 76% explained variance (F (5, 58) = 36.48, $p < .001$). In the final model, past behaviour was the strongest predictor, followed by attitude and then anticipated regret. Social norm and PBC did not predict intention.

4.3.4.5 Explaining intention: Differences in underlying beliefs of intenders and non-intenders

The belief-based measures that significantly predicted intention were examined to identify differences in the opinions of elderly adults who intended to drive between 3pm and 6pm from those who did not. All three TPB variables significantly predicted intention to drive between 3pm and 6pm and so the components of all belief-based measures were examined. Injunctive norm was the dominant predictor, followed by attitude and then PBC.

Intention was dichotomised whereby those with a score of 0 (indicating that they neither intended nor did not intend to drive between 3pm and 6pm) were excluded and those scoring higher and lower than 0 were classified as intenders (N = 50) and non-intenders (N = 16), respectively. It was then used as the independent variable in a series of independent t-tests (with Bonferroni corrections and adjusted for one-tailed tests) on the relevant beliefs. The mean scores (and SD) of the belief-based items are shown in Table 4.27.

To recap, normative beliefs represented the perceived likelihood that referents think the individual should drive between 3pm and 6pm, scored from -3 (very unlikely) to 3 (very likely). Behavioural belief strength assessed the likelihood of specific consequences arising from driving between 3pm and 6pm and was scored from -3 (very unlikely) to 3 (very likely), and evaluations of these outcomes were rated from very bad (-3) to very good (3). Control belief strength measured the frequency with which circumstances perceived to facilitate or impede refraining from driving between 3pm and 6pm were experienced, from very rarely (1) to very frequently (7), and control belief power tapped whether these factors made it much more difficult (-3) or much easier (3) to refrain from driving between these times.

Table 4.27: Descriptive statistics for beliefs: Comparison between intenders and non-intenders

Normative beliefs [a]	Intenders		Non-intenders	
Partner	1.98 (1.60)		-0.58 (2.07)*	
Family	1.84 (1.70)		-0.62 (1.78)*	
Friends	1.51 (1.85)		-0.81 (1.87)*	
Other road-users	0.57 (1.84)		0.12 (1.93)	
Police	0.43 (1.85)		-0.62 (2.31)	
	Behavioural belief strength		**Outcome evaluations**	
Behavioural beliefs	Intenders	Non-intenders	Intenders	Non-intenders
Driving when traffic is busy [a]	2.10 (1.23)	2.19 (1.68)	-0.47 (1.28)	-1.69 (1.08)*
Worry about volume of traffic [a]	-0.33 (1.78)	1.44 (1.97)*	-0.60 (1.55)	-0.81 (1.76)
Pointless [b]	-1.60 (1.81)	0.06 (2.21)[c]*	-1.96 (1.07)	-2.19 (0.83)
Inconvenient/unable to do usual things [b]	-1.62 (1.92)	0.44 (2.13)[c]*	-1.44 (1.28)	-1.31 (0.95)
Unable to socialise/visit family and friends [b]	-1.16 (2.02)	1.00 (1.86)[c]*	-2.14 (0.99)	-1.25 (1.44)
Unable to give people lifts [b]	-1.66 (1.62)	-0.12 (2.22)[c]	-1.68 (1.35)	-0.81 (1.56)
	Control belief strength		**Control belief power** [b]	
Control beliefs	Intenders	Non-intenders	Intenders	Non-intenders
Going shopping	5.06 (1.57)	5.12 (1.71)	-0.96 (1.61)	0.81 (1.97)*
Feeling ill	2.14 (1.40)	2.06 (1.34)	0.02 (2.05)	1.00 (2.22)
An emergency	1.86 (1.34)	2.00 (1.10)	-2.06 (1.35)	-0.88 (2.06)*
Feeling tired	2.98 (1.42)	3.00 (1.67)	0.12 (1.73)	1.00 (1.90)
Socialising/visiting family or friends	5.30 (1.40)	4.50 (1.67)	-1.31 (1.57)	0.31 (1.96)*
Giving someone a lift	5.00 (1.54)	4.19 (1.94)	-1.39 (1.50)	-0.44 (2.03)
Taking part in recreation	4.82 (1.91)	4.12 (1.93)	-1.29 (1.46)	0.00 (1.90)*
Being busy	5.44 (1.43)	5.25 (1.81)	-0.57 (1.65)	0.31 (2.02)
Drinking alcohol	3.08 (1.77)	3.06 (1.84)	1.41 (1.92)	1.81 (2.01)

[a] Worded in relation to driving between 3pm and 6pm; [b] Worded in relation to not driving/refraining from driving between 3pm and 6pm; [c] These beliefs were reverse-scored; * Beliefs significantly differentiated those who did versus those who did not intend to drive between 3pm and 6pm.

Table 4.27 shows that those who intended to drive between 3pm and 6pm believed that all of the normative referents would encourage performance of this behaviour, whereas those who did not intend perceived that four out of the five referents would disapprove of them undertaking this behaviour. Three out of the six normative beliefs significantly differentiated those who intended from those who did not. The elderly adults who intended to drive between 3pm and 6pm more strongly believed that their partner (t (51) = -4.55) , $p < .001$), family (t (63) = -4.97, $p < .001$) and friends (t (63) = -4.35, $p < .001$) wanted them to do so.

Those who intended to drive between 3pm and 6pm were less likely to believe that this behaviour would cause them to worry about the volume of traffic on the road (t (63) = 3.35, $p < .001$) and were more likely to believe that refraining from driving between these times would be pointless (t (62) = 3.02, $p < .008$), inconvenient (t (64) = 3.64, $p < .001$), and would prevent them from socialising and visiting family and friends (t (64) = 3.78, $p < .001$), compared to those who did not hold this intention. In addition, those who intended to drive between 3pm and 6pm viewed driving when the traffic was busy more positively (t (63) = -3.43, $p < .001$) than did those who did not intend.

There were no differences between the elderly adults who did and who did not intend to drive between 3pm and 6pm in terms of how often they perceived encountering circumstances which may affect their PBC. Those who intended to drive between these times did, however, believe that going shopping (t (63) = 3.62, $p < .001$), the occurrence of an emergency (t (63) = 2.67, $p < .006$), socialising or visiting family and friends (t (63) = 3.37, $p < .001$) and taking part in recreational activities (t (63) = 2.84, $p < .006$) would make it significantly more difficult to refrain from driving between 3pm and 6pm than those who did not intend.

Summary: The extent to which the adults believed that (i) their partner, family and friends approved of them driving between 3pm and 6pm, (ii) driving between these times would cause worry relating to the volume of traffic on the roads, (iii) refraining from driving between 3pm and 6pm would be pointless, inconvenient and would prevent socialising, (iv) driving when the traffic was busy was good or bad, and (v) going shopping, an emergency, socialising and taking part in recreational activities would make it more difficult to refrain from driving between these times, all significantly differentiated the elderly adults who intended to drive between 3pm and 6pm from those who did not.

4.4 DISCUSSION

This section begins with a discussion of the main findings of the study. It then goes on to examine the results obtained for the three specific driving behaviours in turn, i.e., driving after prolonged wakefulness, driving between midnight and 6am and driving between 3pm and 6pm. Limitations and directions for future research relating to the investigation of each of the specific behaviours are also considered in these sections.

4.4.1 Main findings

This study applied the TPB to driving while sleep impaired in three age groups of adults for the first time known to date. The first hypothesis (H_1) was partially supported by the results of the research. Intention and PBC significantly predicted driving between midnight and 6am, but failed to capture a significant proportion of variance in driving after prolonged wakefulness among the young adults, which was the only group in which an estimate of prospective behaviour was obtained. The second hypothesis (H_2) was fully supported. The TPB explained a significant amount of variance in intention to drive after 15 or more hours of wakefulness in young, middle-aged and elderly adults, and in intention to drive between midnight and 6am and between 3pm and 6pm in the young and elderly adults, respectively. The third hypothesis (H_3) was tested for driving between midnight and 6am and between 3pm and 6pm only, as intention did not predict driving after prolonged wakefulness. One belief that discriminated the young adults who drove between midnight and 6am from those who did not was identified and several differences in the underlying beliefs of elderly adults who intended versus did not intend to drive between 3pm and 6pm were found. Therefore, H_3 was supported.

According to Cohen's (1992) guidelines, large effect sizes were obtained in all five regressions conducted on intention (i.e., for all three age groups regarding driving after prolonged wakefulness and for the young and elderly adults in relation to driving at a particular time of day). In terms of predicting the young adults' driving after 15 or more hours of wakefulness from the TPB, effect sizes decreased as the measure of behaviour became more objective. Effects sizes for the subjective, diary-based and calculated measures were medium, small-medium and trivial, respectively. The prediction of driving between midnight and 6am in the young adults represented a medium effect size. Although the results of this study support the TPB in its ability to understand intention to drive while sleep impaired, findings were mixed with regards to behaviour.

Some findings from the TPB appeared to be robust across all three of the sleep impaired driving behaviours. The belief-based measure of injunctive norm significantly predicted intention in all five regressions, which demonstrates its importance in this behavioural domain. The belief-based measure of attitude was also a significant predictor of intentions to drive under all three circumstances, however it did not predict intention to drive after prolonged wakefulness among the middle-aged adults. Finally, the belief-based measure of PBC predicted intention for two out of the three behaviours; it was not important in the decision whether or not to drive between midnight and 6am, or in the decision regarding driving after prolonged wakefulness among the elderly adults.

Driving after 15 or more hours and between midnight and 6am was measured in the young adults only. In each case where the TPB significantly predicted behaviour, it was due to intention; PBC never had any effect. This supports previous research that has revealed that intention is the most important TPB determinant of objective behaviour (Armitage, 2008; Christian *et al.*, 2007; Conner *et al.*, 2007; Elliott *et al.*, 2007). The finding was unlikely due to methodological problems in the operationalisation of the direct measure of PBC as it was reliable ($\alpha \geq .78$) and able to significantly predict intention. Instead, refraining from driving while sleep impaired may be a behaviour that is perceived to be under volitional control by young adults (Ajzen, 1991). The descriptive statistics support this inference (scores were above the scale midpoints, see Table 4.5). Alternatively, PBC may have failed to predict prospective behaviour because these perceptions were inaccurate (Ajzen, 1991; Sheeran *et al.*, 2003).

The fourth hypothesis (H_4) that anticipated regret would independently predict intention to drive while sleep impaired over and above the TPB constructs and past behaviour was partially supported. Anticipated regret displayed discriminant validity with attitude, which supports past research (Abraham & Sheeran, 2003, 2004; Rapaport & Orbell, 2000; Richard *et al.*, 1995, 1998; Sandberg & Conner, 2008; Sheeran & Orbell, 1999) and extends it to a new behaviour. Although anticipated regret significantly predicted intention to drive after 15 or more hours of wakefulness in all three age groups and intention to drive between midnight and 6am and between 3pm and 6pm for the young and elderly adults, respectively, in some cases its influence was reduced to non-significance when past behaviour was included in the model. After past behaviour was controlled, anticipated regret remained an important predictor of intention to drive after extended wakefulness in the young adults only, but also of the intentions of young and elderly adults to drive at the specified time of day.

The fifth hypothesis (H_5) was not supported. ISS did not significantly predict driving after 15 or more hours of wakefulness or driving between midnight and 6am in the young adults. The only significant effect of ISS on intention was found for the young adults in relation to driving after 15 or more hours of wakefulness. ISS remained an important predictor of this intention even after past behaviour was added to the regression model. ISS did not significantly predict intention to perform this behaviour in the middle-aged or elderly adults, nor did it predict the intentions of young adults to drive between midnight and 6am. Gender did not significantly predict intention to drive between midnight and 6am and so the final hypothesis (H_6) was not supported. However, males were more likely to drive during these hours than females and this effect was not mediated by the TPB.

4.4.2 Driving after 15 or more hours of wakefulness

4.4.2.1 Predicting intention

Injunctive norm was the dominant predictor of intention to drive after being awake for 15 or more hours in all three groups. This suggests that social pressure exerts an influence on the decision whether to drive while sleep impaired throughout adulthood. This contradicts past research that found that injunctive norm was the weakest predictor of intention (Ajzen, 1991; Armitage & Conner, 2001a; Godin & Kok, 1996), indicating its importance in this behavioural domain. Attitude and PBC also significantly predicted intention among the young adults, whereas only PBC and only attitude had additional predictive effects for the middle-aged and elderly adults, respectively. Therefore, all individuals intended to drive after prolonged wakefulness to the extent that they believed that their specific referents approved of them doing so. This intention was also based on an evaluation of the behaviour for the young and elderly adults and on perceptions of volitional control for the young and middle-aged adults. It is noteworthy that elderly adults perceived the most control over refraining from driving after 15 or more hours of wakefulness, perhaps reflecting their more relaxed lifestyle and increased leisure time due to retirement.

Although anticipated regret significantly influenced intention to drive after 15 or more hours of wakefulness in all three age groups, its effect was reduced to non-significance with the addition of past behaviour among the middle-aged and elderly adults. These results oppose previous research that also controlled for past behaviour (Abraham & Sheeran, 2004; Conner *et al.*, 2007; Cooke *et al.*, 2007; Sandberg & Conner, 2008), however, the result for the young adults support it. Anticipated regret may have acted as a proxy for past behaviour for the two older groups (Abraham & Sheeran, 2004) but was a genuine consideration in the decision-making process of young adults, although its effect was less important than that of several other constructs. The more regret the young adults anticipated feeling, the weaker their intention to drive after being awake for 15 or more hours.

The lack of a more robust effect of anticipated regret may have been due to the way that the construct was operationalised. Although the majority of previous studies have assessed anticipated regret directly, it has been proposed that it would be better tapped using an approach similar to the belief-based measure of attitude, i.e., by assessing anticipated affective reactions, for example, regret and guilt, in the same manner as behavioural beliefs (Conner & Armitage, 1998; Richard *et al.*, 1998; van der Pligt *et al.*, 1998). The justification was that this would take into account both likelihood and evaluation ratings and it would establish the independence of anticipated affective responses versus more instrumental beliefs. Conner *et al.* (2003) obtained their measure of anticipated affective reactions using this procedure, albeit using only two emotions (one negative, regret and one positive, feeling exhilarated), and reported that the construct did not independently predict intention. More research is required to establish the optimal operationalisation of this variable.

The finding that the young adults scored significantly higher than the other groups on ISS supports past research (Zuckerman, 1994). This may explain why the only significant effect of ISS was found for the young adults as this group contained more individuals who were likely to act on impulse and without consideration of the risks, rather than basing their decisions on rational thinking, supporting Churchill *et al.* (2008). However, ISS predicted intention but not behaviour. This is inconsistent with the findings from Churchill *et al.*'s (2008) study which used a subscale of impulsivity, urgency. The significant influence of ISS on intention was present even after past behaviour was controlled. Therefore, the TPB may not adequately capture ISS tendencies in a group in which they are prominent. These propensities appear to impact on the decision-making process, rather than directly upon behaviour, which goes against previous theorising (e.g., Eagly & Chaiken, 1993).

On the final step of the regressions, past behaviour became the dominant predictor of intention for the young and elderly adults. This supports the literature (e.g., Bagozzi & Kimmel, 1995; Beck & Ajzen, 1991; Conner & Armitage, 1998; Elliott *et al.*, 2003; Forward, 2009; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998) and indicates that these adults intended to drive after prolonged wakefulness to the extent that they had done so in the past. All of the variables that were significant on the previous step remained so for the young adults, however, past behaviour was the sole significant predictor in the final model for the elderly adults. Past behaviour did not impact on intention for the middle-aged adults; social norm and PBC were the final significant predictors, suggesting that the TPB provides a more sufficient account of the processes underlying intention to drive after 15 or more hours of wakefulness in this age group. Overall, the model was least sufficient for the young adults as all of the additional variables, i.e., anticipated regret, ISS and past behaviour, significantly predicted intention over and above the TPB constructs. However, social norm and PBC exerted stronger influences on intention than anticipated regret or ISS.

4.4.2.2 Predicting behaviour

Driving after 15 or more hours of wakefulness was assessed in the young adults only. Over a third of these individuals drove after being awake for 15 or more hours, which differs from the results of the pilot study (see section 3.2.3.2) and supports the investigation of this behaviour (see section 3.2.4). Also, the finding that over 50% of the young adults subjectively reported driving after this length of wakefulness indicates that the results were not affected by social desirability concerns. The most common reasons for driving after 15 or more hours were to get home after socialising, give lifts to people and to get home from work.

Intention was the only significant predictor of subjective behaviour and it also approached significance when predicting the diary-based measure. The young adults reported, both retrospectively and on a daily basis, that they had driven after being awake for 15 or more hours to the extent that they had intended to do so at the beginning of the week. Conversely, the TPB variables, ISS and past behaviour each failed to account for a significant proportion of variance in the more objective (the calculated) measure of driving after being awake for 15 or more hours. The finding that the TPB was a superior predictor of self-reported behaviour, relative to a more objective estimate was in line with Armitage and Conner's (2001a) meta-analysis. Past behaviour did not significantly predict any of the measures of future behaviour, which contradicts previous research (Bagozzi & Kimmel, 1995; Conner & Armitage, 1998; Cooke *et al.*, 2007; Elliott *et al.*, 2003; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998). Overall, the findings for the self-report measures provide modest support for the TPB, however, this was not the case for the calculated measure.

It may initially appear promising for the TPB that ISS did not independently predict driving after prolonged wakefulness among the young adults, however, ISS was not significantly related to any of the measures of behaviour. Thus, the TPB did not mediate the effects of ISS upon behaviour as there were no effects to begin with.

For the young adults, responses to the measures included in the Time 1 questionnaire were biased when completed after measures regarding driving between midnight and 6am. The adults who were presented with the measures applied to driving between these times first viewed driving after prolonged wakefulness more negatively compared with those who attended to the latter behaviour first. Specifically, the four direct measures of the TPB constructs, i.e., attitude, social norm, PBC and intention, were affected. This may partly account for the poor/non-existent relationships that PBC and intention held with the diary-based and calculated measures of behaviour. Where possible, future studies should assess one behaviour at a time to avoid these issues with order of presentation, although it is noteworthy that the Time 2 questionnaire and responses of the elderly adults in relation to two behaviours did not suffer from this problem.

The poor performance of the TPB in predicting the more objective measure of driving after 15 or more hours of wakefulness may have been due to the complexity of this behaviour. A mental summing of 15 hours on to the usual time of waking up in the morning/after a daytime nap would have been required to complete the Time 1 questionnaire accurately. It may have been difficult for young individuals, who have more irregular sleep-wake patterns (as found in Chapter 2), for example, on weekdays versus weekends (Dement & Vaughan, 1999; Hawkins & Shaw, 1992), to have reached an overall accurate time on which to focus on when completing the questionnaire.

The guidelines set by Ajzen (2002b) were followed for constructing the items used to assess intention and the subjective measure of behaviour. However, these procedures have been criticised in that they lead to violations of scale correspondence, which attenuate intention-behaviour relationships (Courneya, 1994; Sutton, 1998), although this problem is inherent in all TPB research (Courneya, 1994). In addition, two estimates were standardised and averaged to form the diary-based and calculated measures of driving after prolonged wakefulness (see section 4.2.3) in order to obtain more reliable multi-item measures of behaviour. This may have violated the principle of compatibility (Ajzen, 1988; see section 1.3.2.1), which also leads to attenuated relationships between constructs (Ajzen, 1988; Ajzen & Fishbein, 1977; Kraus, 1995).

Shared method variance, consistency bias and/or inaccurate perceptions of behaviour may explain the greater proportion of variance explained in the subjective measure of behaviour than the diary-based and calculated measures. As the latter measure was more resistant to these biases, more confidence can be placed in its results, suggesting that intention and PBC actually do not predict driving after 15 or more hours of wakefulness. In order to understand which type of individuals were responsible for the inconsistency between intention and behaviour, Sheeran (2002) suggested decomposing the two variables into a 2 (intenders versus non-intenders) x 2 (performed versus did not perform the behaviour) matrix. Therefore, intention was dichotomised whereby those with a score of 0 (indicating that they neither intended nor did not intend to drive after 15 hours of wakefulness) were excluded and those scoring higher and lower than 0 were classified as intenders (N = 15) and non-intenders (N = 36), respectively. The calculated measure of behaviour was dichotomised by grouping together those who did (N = 19) and those who did not (N = 32) drive after 15 hours of wakefulness during the week under investigation. The results are shown in Table 4.28.

Table 4.28: Decomposing the intention-behaviour relationship (adapted from Sheeran, 2002)

Subsequent behaviour	Intention	
	Did not intend	Intended
Did not perform	22 (43.1%)	10 (19.6%)
Performed	14 (27.5%)	5 (9.8%)

Although intention and behaviour were not significantly associated (x^2 (1) = 0.14, $p >$ .05), Table 4.28 suggests that the lack of consistency between these variables was mainly due to those who did not intend to drive after being awake for 15 or more hours but did so regardless. This contrasts with Sheeran's (2002) meta-analysis; he found that it was the individuals who intended and then did not perform who were responsible for the intention-behaviour gap. However, only studies of healthy/safe behaviours, for example, exercising and using a condom, were included in these analyses. The present behaviour can be classed as a safety risk behaviour and thus it is reasonable to expect opposite results. It may be the nature of the behaviour which made those who originally did not intend to drive after prolonged wakefulness to subsequently do so.

The application of the prototype willingness model (e.g., Gerrard *et al.*, 2008) to this behaviour in young adults may prove a productive avenue for future research. This model is based on a dual-process assumption, in which one path to behavioural action is reasoned (as postulated by the TPB) and the other is via social reaction, which was 'hypothesised in an attempt to explain adolescents' unintended behavior, specifically their unplanned decisions to start, continue, or stop behaviors that can put their health at risk' (Gerrard *et al.*, 2008, p. 35). The latter path acknowledges that young individuals can often find themselves in situations that facilitate risky behaviours, and proposes that once in these social situations, these behaviours are guided by willingness, rather than deliberative processes (Gerrard *et al.*, 2008). It is reasonable to speculate that the young adults in the present study were willing to drive after prolonged wakefulness if the opportunity arose.

PCA determined the convergent and discriminant validity of the variables that were assessed directly. As stated in section 4.2.3.1.1, these analyses were conducted on the three age groups together, rather than separately, due to limited sample sizes. Although this ensured more valid results for the sample as a whole, it is possible that they may not have accurately represented the data from a particular age group. For example, Rhodes and Courneya (2003) reported that an overall attitude factor comprising both affective and cognitive items was the optimal concepualisation in the prediction of intention to exercise for undergraduate students, while only affective attitude influenced intention to exercise among cancer survivors. The mean ages of the undergraduate students and cancer survivors were 20 (SD = 3.7) and 61 (SD = 11.2) years, respectively. It is unclear whether the inconsistent results were due to age differences and/or the cancer experience. Therefore, different conceptualisations of variables may be optimal for different populations. On the other hand, all of the measures displayed acceptable internal consistencies, suggesting that this did not have a substantial effect on the resulting measures. Future research should aim to obtain large sample sizes for each set of analyses to ensure that the results on which measures are based are accurate for the given population.

On a final note, although the preliminary study described in Chapter 2 established the validity of actigraphy to reliably identify periods of sleep and wake, there are limitations of actigraphy which should also be acknowledged (see section 2.4).

4.4.3 Driving between the hours of midnight and 6am

Just under a third of the young adults drove between midnight and 6am, most commonly to get home after socialising and to go to and get home from work. The finding that 40% of these individuals subjectively reported driving between midnight and 6am suggests that the results were not influenced by social desirability responding. As young males are the most likely group to have a sleep-related vehicle accident (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003), the additional role of gender was explored. Males were more likely to perceive social pressure to drive between midnight and 6am than females. They also drove between these times significantly more frequently than females.

Gender did not significantly influence intention to drive between midnight and 6am. The TPB provided a useful account of the determinants of intention; the young adults intended to drive between these hours if they valued this behaviour positively and if they believed that specific normative referents wanted them to do so. Descriptive norm was not a significant predictor of intention, which contradicts past studies (Conner & McMillan, 1999; Conner *et al.*, 1996; Forward, 2009; Grube *et al.*, 1986; Lemmens *et al.*, 2009; Rise *et al.*, 2008; Rivis & Sheeran, 2003; Sheeran & Orbell, 1999; White *et al.*, 2009). The relatively low internal reliability ($\alpha < .63$) of the measure of descriptive norm may have accounted for its poor predictive validity. Also, the measure of descriptive norm may have been inadequate to capture the views of all relevant referents, for example, by the use of the term 'most people', resulting in an underestimation of social influence (Donald & Cooper, 2001). However, the direct measure of injunctive norm included the same terms yet emerged as a significant predictor of intention rendering this explanation unlikely.

Anticipated regret independently predicted intention, even after past behaviour was controlled, supporting previous research (Abraham & Sheeran, 2004; Conner *et al.*, 2007; Cooke *et al.*, 2007; Sandberg & Conner, 2008) and extending it to a new behavioural domain. ISS had no effect on intention after the TPB variables had been taken into account, which corroborates the findings of studies using similar measures (Beadnell *et al.*, 2007; Churchill *et al.*, 2008; Fishbein *et al.*, 2002). Finally, past behaviour exerted a significant influence on intention, again supporting the literature (e.g., Bagozzi & Kimmel, 1995; Beck & Ajzen, 1991; Conner & Armitage, 1998; Elliott *et al.*, 2003; Forward, 2009; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998).

The subjective and diary-based measures of behaviour were very strongly related which supports their robustness in light of the different ways in which they were obtained by making it less likely that violations of scale correspondence (Courneya, 1994; Sutton, 1998), shared method variance, consistency bias and/or inaccurate perceptions of behaviour (see section 1.3.2.5) exerted a huge influence. Consequently, findings for these two behavioural measures were almost identical. Young males were significantly more likely to report driving between midnight and 6am than young females. The TPB failed to mediate the effect of gender upon behaviour. This supports research by Armitage *et al.* (2002) that revealed that gender predicted attending a health screening appointment over and above the TPB variables, but it contradicts Elliott *et al.*'s (2003) finding that the TPB mediated the influence of gender on self-reported compliance with speed limits. Nevertheless, intention was a stronger predictor than gender. ISS did not significantly predict behaviour, which goes against Churchill *et al.*'s (2008) findings using a subscale of impulsivity, urgency. The addition of past behaviour reduced the influence of intention to non-significance. It was the dominant predictor in the final models, supporting previous research (Bagozzi & Kimmel, 1995; Conner & Armitage, 1998; Cooke *et al.*, 2007; Elliott *et al.*, 2003; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998). This finding suggests that driving between midnight and 6am was stable from Time 1 to Time 2 and an unmeasured variable may have caused the residual effect of past upon future behaviour (Ajzen, 1991, 2002c; Beck & Ajzen, 1991).

Therefore, although the TPB was useful in identifying the determinants of driving between midnight and 6am, it does not provide a sufficient account of its antecedents. Anticipated regret and past behaviour exerted independent influences upon intention, and the initial significant predictive effect of intention on behaviour was superseded by past behaviour. Further, the model failed to mediate the impact of gender on driving between midnight and 6am. This may have been due to the nature of the behaviour. On the other hand and although this was not directly tested, it is possible that the TPB mediated the effect of ISS on behaviour, as the zero-order correlations between ISS and both measures of behaviour were significant (see Table 4.18). This is important as ISS is an external variable which has frequently been found to exert an influence over risk-taking behaviours (Zuckerman, 1994). Alternatively, gender may have been the mediating or moderating variable. Future research using a larger sample is required to specifically investigate the relationships between the TPB variables, ISS and gender for risk-taking behaviours, such as sleep impaired driving.

As intention significantly predicted behaviour, beliefs that discriminated those who drove between midnight and 6am from those who did not were identified in order to understand the processes underlying this behavioural decision. Behavioural and normative beliefs were examined, however, a significant difference was detected for only one behavioural belief. Young adults who more strongly believed that refraining from driving between midnight and 6am would prevent them from driving for work purposes were more likely to drive during those hours. This belief should be targeted in behavioural change interventions (see section 5.3.2.1).

Males drove between midnight and 6am significantly more than females. This is important as young males are the most likely group to crash their vehicle due to sleepiness (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003). Males also perceived more social pressure to drive between midnight and 6am than females. This supports Conner *et al.*'s (2003) finding that males report greater normative pressure to speed, which suggests that this influence may be stable across different driving behaviours. In the present study, gender was not related to intention and the effect of gender on behaviour was not mediated by the TPB. This indicates that young males are more likely to engage in risky behaviours without prior deliberation. Future research should replicate this study with a larger sample and conduct the analyses on separate groups of males and females. If this conclusion is confirmed, it may prove useful to apply the prototype willingness model (e.g., Gerrard *et al.*, 2008) to driving between midnight and 6am in a sample of young males to more fully understand the underlying processes.

The present study was conducted over the months of February through to May, making it possible that the frequency of driving between midnight and 6am was underestimated, relative to the summer months. One of the accessible control beliefs perceived to make it difficult to refrain from driving during these hours was driving for holiday purposes and it is reasonable to suggest that the majority of people go on holiday during the summer. Seasonal issues would have to be built in to the design of further studies exploring reasons why young adults drive between midnight and 6am.

4.4.4 Driving between the hours of 3pm and 6pm

All three TPB constructs predicted intention to drive between 3pm and 6pm among the elderly adults. Stronger intentions were associated with perceiving more social pressure to drive between 3pm and 6pm, a more positive evaluation of this behaviour, and perceiving control over refraining from driving during these hours. Anticipated regret exerted an independent influence upon intention, even after past behaviour was controlled, which supports prior research (Abraham & Sheeran, 2004; Conner *et al.*, 2007; Cooke *et al.*, 2007; Sandberg & Conner, 2008). Past behaviour was the dominant predictor of intention, again corroborating previous studies (e.g., Bagozzi & Kimmel, 1995; Beck & Ajzen, 1991; Conner & Armitage, 1998; Elliott *et al.*, 2003; Forward, 2009; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998) and extending them to a new behavioural domain. The impact of these variables external to the TPB question the sufficiency of the model.

Beliefs that discriminated those who intended to drive between 3pm and 6pm from those who did not were identified in order to delve deeper into the decision-making process. Elderly adults who more strongly believed that their partner, family and friends wanted them to drive between 3pm and 6pm were more likely to intend to do so. Those who intended were also less likely to believe that driving between those times would cause them to worry about the volume of traffic and were more likely to think that refraining from driving would be pointless, inconvenient and would prevent them from socialising. These individuals also evaluated driving when the traffic was busy more positively than those who did not intend to drive between 3pm and 6pm. Finally, the adults who believed that going shopping, the occurrence of an emergency, socialising or visiting family or friends and taking part in recreational activities would make it more difficult to refrain from driving at this time were more likely to intend to drive then. If intention predicts actually driving between 3pm and 6pm (see section 5.2.1), it is these beliefs that should be modified in order to produce behavioural change (see section 5.3.2.1).

The adjective pair, 'necessary-unnecessary', was included in the set of scales used to directly assess attitude towards driving between 3pm and 6pm. This scale has previously been included in the items used to directly assess attitude (e.g., Young *et al.*, 1991), but has also been used to measure a variable external to the TPB, perceived need. This variable has been shown to independently predict intention in the healthy eating/dietary literature (Paisley & Sparks, 1998; Payne *et al.*, 2004; Povey *et al.*, 2000), but has rarely been employed in alternative behavioural domains. No attempt was made to assess the influence of perceived need in the present research due an already extensive list of additional variables and so other items designed to assess perceived need were not included. However, over half of the elderly adults who took part in the elicitation study stated that refraining from driving between 3pm and 6pm was pointless (see section 3.2.2.3.1), a belief that was represented by being included as a behavioural belief, rather than as an independent construct. Thus, explicitly measuring the influence of perceived need may be fruitful for understanding the determinants of driving between 3pm and 6pm. Further, if elderly adults do not perceive a need for refraining from driving between 3pm and 6pm, interventions which focus on changing TPB variables may be unsuccessful as these individuals would be unlikely to be contemplating behavioural change (Paisley & Sparks, 1998).

4.4.5 Summary

Predictors of intention to drive while sleep impaired varied as a function of age and specific behaviour, however, perceived social pressure to engage in such activities was reliably predictive throughout. Young adults prospectively self-reported driving while sleep impaired to the extent that they had intended to do so at the beginning of the week. However, intention was unrelated to a more objective measure of driving after 15 or more hours of wakefulness, which suggests that this is not a planned behaviour. The effect of gender on driving between midnight and 6am was not mediated by the TPB.

5.0 GENERAL DISCUSSION

The primary aim of this thesis was to explore the determinants of sleep impaired driving across adulthood using the framework of the TPB. Such research has not previously been conducted. In a preliminary study (Chapter 2), the sleep duration and quality of young, middle-aged and elderly adults were measured over one week in order to compare the results of actigraphy with those of subjective measures and to establish the extent to which actigraphy was able to differentiate the sleep duration and quality of the three age groups. This supported the use of actigraphy to provide a partly objective measure of driving after prolonged wakefulness in the main study. An elicitation study was then conducted in which accessible beliefs regarding the specific behaviours were extracted from the target populations (section 3.1), from which questionnaire items were formulated for use in the main study. This was important as the identification and inclusion of these underlying beliefs permitted a detailed understanding of why individuals decided to drive while sleep impaired. Extensive pilot work strengthened the reliability and validity of the questionnaires prior to the main study (section 3.2), in which the TPB was applied to refraining from driving after 15 or more hours of wakefulness, and at particular times of the day (Chapter 4).

This final chapter provides a general discussion of the research and is divided into four sections. The first part draws together results obtained for all three specific behaviours and focuses on the key findings across the research. The second section focuses on general methodological issues that may have influenced the findings, along with directions for future research. Thirdly, the key implication of using the present results to inform behavioural change interventions is discussed, followed by a section detailing the main conclusions that can be derived from the research. Specific findings, limitations and suggestions for future research which were discussed in section 4.4 are not re-iterated in this chapter to avoid repetition. It is also noteworthy that some sections include brief literature reviews of recent advances in TPB research and/or issues that have not been previously mentioned due to them not being a focus of the present research, but which are important in the domain of the TPB.

5.1 OVERALL KEY FINDINGS

5.1.1 Overview

5.1.1.1 Sleep duration and quality

Sleep duration per 24 hours was less than the recommended quota of eight hours in all age groups, suggesting that all three age groups are vulnerable to psychological and physiological health and safety risks. The middle-aged adults slept for the least time during the night and per 24 hours. Although the elderly adults slept for the longest during the day, the proportion of sleep taken in the daytime was equivalent in the middle-aged and elderly adults. Young adults had the poorest sleep quality. Overall, individuals accurately reported their sleep duration when assessed each day but underestimated how much they slept when asked to provide a retrospective account of the previous week.

5.1.1.2 Sleep impaired driving

In general, all age groups regarded driving after 15 or more hours of wakefulness negatively. Injunctive/social norm, attitude, PBC, past behaviour, ISS and anticipated regret predicted intention to drive after being awake for 15 or more hours among the young adults. Only injunctive norm and PBC influenced intention among the middle-aged adults, while injunctive norm, attitude and past behaviour exerted effects on the intentions of elderly adults. Over a third of young adults drove after being awake for 15 or more hours, most commonly to get home after socialising, give people lifts and to get home from work. Although a subjective behavioural measure could be predicted, neither the TPB variables, ISS nor past behaviour were able to reliably predict the most objective measure of driving after 15 or more hours of wakefulness in the young adults. Significant findings for the subjective, but not partly objective behavioural measure may have reflected shared method variance, consistency bias and/or inaccurate perceptions of behaviour. Previous meta-analytical findings have also found that the TPB is a better predictor of self-reported, than objective behaviour (Armitage & Conner, 2001a). In conclusion, driving after prolonged wakefulness may not be a planned behaviour.

Just under a third of young adults drove between midnight and 6am, most frequently to get home after socialising and to go to and get home from work. The young adults held generally negative opinions of driving between midnight and 6am. Attitude, injunctive norm, PBC, past behaviour and anticipated regret predicted intention to drive between these times. The additional role of gender was explored for this behaviour as young males are the most likely group to have a sleep-related vehicle accident (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003). Males were found to be significantly more likely to drive between midnight and 6am than females. This effect was not mediated by the TPB and even after past behaviour was added to the model, gender remained a marginally significant predictor of behaviour. On the other hand, intention was a stronger predictor of driving between midnight and 6am than gender, though its effect was diminished when past behaviour was controlled. PBC and ISS did not predict behaviour. Young adults who drove during these hours were more likely to believe that refraining from driving then would mean they would be unable to drive for work purposes, relative to those who did not.

The elderly adults generally regarded driving between 3pm and 6pm positively. The significant predictors of intention to drive during these hours were injunctive norm, attitude, PBC, past behaviour and anticipated regret. A number of normative, behavioural and control beliefs significantly differentiated those who intended to drive between 3pm and 6pm from those who did not.

<u>5.1.2 Dimensionality of TPB constructs</u>

Both attitude and PBC were empirically found to be unidimensional. This contradicts most of the literature reviewed in section 1.2.3.2 regarding the optimal operationalisation of attitude (Ajzen & Driver, 1992; Bagozzi *et al.*, 2001; French *et al.*, 2005; Hagger & Chatzisarantis, 2005; Lemmens *et al.*, 2009; Payne *et al.*, 2004; Rhodes & Courneya, 2003; Rhodes *et al.*, 2006; Rise *et al.*, 2008) and PBC (Armitage & Conner, 1999a, 1999c, 2001b, Armitage *et al.*, 1999; Hagger & Chatzisarantis, 2005; Jackson *et al.*, 2003; Povey *et al.*, 2000; Rhodes & Courneya, 2003; Terry & O'Leary, 1995; Trafimow *et al.*, 2002), but it supports Rise *et al.*'s (2008) finding that PBC was unidimensional. On the other hand, these findings were in line with Ajzen and Fishbein's recommendations (Ajzen, 2002a; Ajzen & Driver, 1992; Fishbein, 1993), as well as the results from structural equation modelling (Bagozzi *et al.*, 2001; Hagger & Chatzisarantis, 2005). Both traditional intention and expectation items were administered in the assessment of intention (see section 1.3.2.6.1) and this construct was reliably found to be unidimensional.

On the other hand, different results were found for the factor structure of social norm depending on the specific behaviour under investigation. Injunctive and descriptive norm were empirically distinct for driving between midnight and 6am, whereas social norm was unidimensional for driving after 15 or more hours of wakefulness and driving between 3pm and 6pm. Therefore, past studies that found a distinction between injunctive and descriptive norm were partially corroborated (Cialdini *et al.*, 1990; Grube *et al.*, 1986; Hagger & Chatzisarantis, 2005; Lemmens *et al.*, 2009; Rhodes & Courneya, 2003; Rhodes *et al.*, 2006; Rise *et al.*, 2008; Sheeran & Orbell, 1999), although the results for driving between midnight and 6am which supported a distinction may have been less reliable than those for driving after prolonged wakefulness due to them being based on a smaller sample size ($N = 70$ versus $N = 210$).

5.1.3 The importance of injunctive norm

Injunctive norm was found to be a significant predictor of intention for all samples and specific behaviours investigated in the present research. In fact, it was the dominant predictor in four out of five cases. This contradicts past research that has found injunctive norm to be a weaker predictor of intention than attitude and PBC (Ajzen, 1991; Armitage & Conner, 2001a; Godin & Kok, 1996). Individuals have been found to experience systematic difficulties in answering items designed to assess injunctive norm both in the pilot study (see section 3.2.3.1) and in a recent investigation (French *et al.*, 2007), and so the strong influence of injunctive norm demonstrated here provides support for its operationalisation in the present research.

Injunctive norm was the only belief-based measure that was not assessed via a multiplication of two components. Empirical work led to the decision to omit the motivation to comply component from the injunctive norm measure, as in several past studies (Budd, 1987; Grube *et al.*, 1986; van den Putte & Hoogstraten, 1997; see section 3.2.1.3), and instead, the measure was based on the mean of responses to the normative belief items. The fact that this measure did not suffer from the problems associated with multiplicative composites (Evans, 1991; van den Putte & Hoogstraten, 1997; see section 1.2.1) may partly explain its superior predictive power over the remaining TPB constructs. If problems due to the use of multiplicative composites consistently appear in the literature, a potential approach to overcoming them is to elicit personally accessible beliefs rather than using a modal set (see section 3.1.1), as this would eliminate the need for an expectancy component to each belief-based measure (Eagly & Chaiken, 1993).

On the other hand, Armitage and Conner's (2001a) meta-analysis showed that direct measures of subjective norm and belief-based measures of injunctive norm, based on the summed products of normative beliefs and motivation to comply, had equivalent correlations with intention. Moreover, studies that have explicitly tested the validity of the multiplicative underpinning of the TPB variables have revealed that the product of normative beliefs and motivation to comply has actually improved the prediction of overall injunctive norm and intention over and above their additive effects (Armitage *et al.*, 1999; Elliott *et al.*, 2005). Theoretical knowledge would be extended if further research examined the predictive utility of this product term when the motivation to comply component is assessed at the level of the behavioural domain, as it was in the present research. This was not investigated here due to limited sample sizes (Elliott *et al.*, 2005; Rise *et al.*, 2008), but has not been extensively explored.

In conclusion, perceived pressure from social referents is an important and consistent determinant of intention to drive while sleep impaired.

5.1.4 Past behaviour

An attempt was made to assess past behaviour and habit separately, despite the problems associated with capturing habit independently (e.g., Ajzen, 2002c; Ouellette & Wood, 1998; Verplanken & Orbell, 2003). Although past behaviour and habit are conceptually distinct (Ajzen, 1991, 2002c, Conner & Armitage, 1998), in the analyses reported here, they were found to be empirically synonymous. The position could be taken that these results support Ouellette and Wood's (1998) contention that frequency of past behaviour is a good indicator of habit for behaviours conducive to habit formation, as driving is usually performed on a daily basis in a stable context (Aarts *et al.*, 1997, 1998; Ouellette & Wood, 1998). This would imply that the measure captured habitual tendencies, rather than past behaviour.

However, it is more likely that the operationalisation of habit in the present research was inadequate. The measure administered was based on the work of Aarts *et al.* (1997) and Verplanken *et al.* (1998) and was considered the optimal short-form measure at the time of questionnaire construction (Conner & McMillan, 1999; Sheeran, 2002). The imposed time pressure distinguished this measure from being a generalised assessment of intention or past behaviour (Ajzen, 2002c), however, this time pressure was not explicitly enforced; participants were left to complete the questionnaire in their own time and only the written instruction presented before the habit items in the questionnaire instructed them to answer the items 'quickly without thinking too much about them'. It is an empirical question as to whether or not participants did respond quickly, and even if they did, it is unknown whether time pressure has any effect on responses or whether the measure obtained under time pressure actually taps habit strength (Bamberg *et al.*, 2003). In addition, Norman and Conner (2005) argued that this measure of habit taps behavioural choices in a range of different contexts and that this goes against the importance attributed to context stability in the formation of habit.

Therefore, the measure that was utilised in the present research can best be described as an indicator of past behaviour (and was labelled as such). Future research may successfully capture habit independently of past behaviour using the 12-item measure of habit strength developed by Verplanken and Orbell (2003). This index demonstrated high reliability and validity and so should be considered if the length of the existing questionnaire permits.

Past behaviour significantly predicted intention, over and above the TPB and additional variables, in all but one case (it did not significantly predict intention to drive after 15 or more hours of wakefulness among the middle-aged adults), supporting past research (Bagozzi & Kimmel, 1995; Beck & Ajzen, 1991; Conner & Armitage, 1998; Elliott *et al.*, 2003; Forward, 2009; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998). The fact that this was an almost consistent finding across samples and specific behaviours suggests that the TPB does not provide a sufficient account of the influences underlying intention. Past behaviour does not offer any explanatory power as to why individuals intend or do not intend to perform a behaviour and so the residual effect of past behaviour on intention may be due to the influence of a different external variable to the ones assessed in the present research (Ajzen, 1991, 2002c; Beck & Ajzen, 1991), for example, moral norm (see section 5.2.3).

Despite the large body of research showing that past behaviour is the best predictor of future behaviour (Bagozzi & Kimmel, 1995; Conner & Armitage, 1998; Cooke *et al.*, 2007; Elliott *et al.*, 2003; Jackson *et al.*, 2003; Norman & Conner, 2006; Ouellette & Wood, 1998), it did not significantly predict any of the measures of driving after prolonged wakefulness among the young adults. On the other hand, the influence of past behaviour superseded that of intention and it became the strongest predictor of the diary-based measure of driving between midnight and 6am. As it has been argued that this measure did not tap habit, this finding indicates that driving between midnight and 6am was stable from Time 1 to Time 2 and that although past behaviour produced only a small increase in the explained variance (4%), it is possible that the residual effect was due to an unmeasured variable (Ajzen, 1991, 2002c; Beck & Ajzen, 1991). Overall, the finding that past behaviour exerted only a weak influence on sleep impaired driving points to the potential utility of intervention attempts designed to reduce the incidence of this behaviour (Conner *et al.*, 2007; see section 5.3.2).

5.2 GENERAL METHODOLOGICAL ISSUES AND DIRECTIONS FOR FUTURE RESEARCH

The design of the main study was commendable in that it incorporated belief-based measures of the TPB constructs and assessed the prospective behaviour of young adults using thorough measures ranging from subjective to partly objective. Nevertheless, some limitations of the design and analyses should be acknowledged.

5.2.1 Limitations of the design

Regarding sample size, Rashidian *et al.* (2006) argued that 'most of the published studies of the TPB have ignored the issue of sample size' (p. 591). Power analysis (Cohen, 1992; Miles & Shevlin, 2001) determined the sample sizes in the present research (see section 4.3.1.4). However, the recent findings of Rashidian *et al.* (2006) suggest that they may have been inadequate. They used the variance inflation factor method to estimate sample size and concluded that 114 and 148 participants were required to predict intention and behaviour respectively, in TPB research. More studies are needed to determine the best method of estimating sample size in TPB research.

Sampling bias may also have been a problem. In the absence of literature in this area, Sheeran and Orbell (1999) speculated that individuals who volunteer to take part in research studies may differ from those who do not. For example, it is possible that those who are willing to take part in a study about sleep impaired driving may be in the process of trying to avoid driving when they are tired and those who take part in a study about sleep may disproportionately suffer from insufficient or poor sleep compared to those who do not. This would prevent generalisation to the population. The incentives of learning their average sleep duration and quality at the end of the study may have increased this influence in the present research, however, the prospect of gaining a supermarket gift-card may have reduced it (see sections 2.2.2 and 4.2.2).

A clear limitation of the present research was that driving after prolonged wakefulness was not measured in the middle-aged and elderly adults, and driving between 3pm and 6pm was not measured in the elderly adults. Due to limited time and resources, behaviour was assessed for the young adults only due to this group being at the most risk of having a sleep-related vehicle accident (Akerstedt & Kecklund, 2001; Horne & Reyner, 1995b; Stutts *et al.*, 2003). Exploring the determinants of intention among the middle-aged and elderly adults was deemed worthwhile as intention has been found to predict behaviour in past research (e.g., Armitage & Conner, 2001a; Elliott *et al.*, 2007), and if an individual has not formed an intention, there is a 93% chance that they will not perform the behaviour (Sheeran, 2002). Nonetheless, the precise extent to which intention predicts these driving behaviours among middle-aged and elderly adults remains unknown. Future research should address these limitations.

For practical reasons, fully objective measures of behaviour were not obtained from the young adults. It would be impossible to objectively assess driving after prolonged wakefulness and between midnight and 6am while participants continued with their usual lives and activities without an enormous level of intrusion. Participants would have to be observed 24 hours a day for the full week in order to obtain a thorough objective measure of driving after prolonged wakefulness, while they would have to be under observation every night from midnight to 6am to objectively assess driving between these times. Therefore, the estimates of behaviour obtained are argued to represent the most accurate accounts without intrusion to the participants' lifestyles.

The interchanging use of the terms 'driving' and 'refraining from driving' in the questionnaires could provoke criticism. Strong justifications were given for wording some items as 'driving' and some as 'refraining' (see section 3.2.2.3.4). Moreover, a recent study confirmed the argument for phrasing the direct measure of PBC as refraining from driving. French *et al.* (2007) found that respondents misconstrued 'control' as control over their behaviour having been drinking rather than control over whether or not they engaged in a binge drinking session. There have also been several recent investigations into the determinants of avoidance behaviours (e.g., refraining from speeding), many of which similarly measured performing the behaviour, rather than not performing it (e.g., speeding; Churchill *et al.*, 2008; Conner *et al.*, 2006, 2007; Elliott *et al.*, 2007; Richard *et al.*, 1995), as in the present research.

However, East (1997) argued that the propensity to perform a behaviour is measured on a bipolar scale with acting on one side and not acting on the other. Therefore, both performing the behaviour and not performing the behaviour may be viewed as actions each with their own rationale and underlying cognitions. East (1997) suggested that the investigation of some behaviours, particularly ones of an avoidant nature, should include the identification and inclusion in the main questionnaire of accessible beliefs underlying both. Ajzen and Fishbein (1980) also reported that the TRA is better at predicting the difference between behavioural alternatives than it is at predicting either behaviour alone. This was not implemented in the present research because the questionnaires were already extensive due to applying the TPB to two behaviours for two of the age groups. Future research investigating avoidance behaviours may find it constructive to elicit beliefs relevant to both behavioural alternatives to obtain a more complete picture of the underlying influences.

On a related note, participants may have had difficulty understanding the items worded as 'refraining from driving...' due to their cognitive complexity. French *et al.* (2007)

found that respondents had specific problems with negatively-phrased questions. These researchers suggested that this may be a particular problem for members of the general population, as opposed to undergraduate students. It is reasonable to speculate that the elderly adults in the present research may have suffered with this the most. On the other hand, the extensive pilot work identified many difficulties with the wording of questionnaire items and amendments were made for the main study. Future investigations involving older members of the general population may benefit from interviewing their participants, as in Conn *et al.*'s (2003) study, or at least being available to assist with the understanding of questionnaire items.

The only significant effect of ISS in this research was for intention to drive after 15 or more hours of wakefulness among the young adults. ISS did not predict intention to drive between midnight and 6am nor did it predict actually driving after prolonged wakefulness or between midnight and 6am. It may be that individuals are not able to reason about their ISS in a questionnaire due to the nature of this personality trait. Research in this area should work on developing alternative measures of ISS, where possible with the use of more objective methods.

Driving between 3pm and 6pm may have been confounded with the volume of traffic as this time is busy with people returning home after school and work. On the other hand, weekends are different as most people are typically not in school/work and the items in the questionnaire specified the time frame, 'in the next week'. Two of the behavioural beliefs took into account evaluations of traffic volume (both of which were found to significantly differentiate between those who intended to drive between 3pm and 6pm from those who did not). Likewise, responses to the items regarding driving between midnight and 6am may have been influenced by the roads being quiet then. One behavioural belief addressed this. However, the extent to which the adults may have focused on the issue of traffic volume when completing the questionnaire, rather than the risk of having a sleep-related vehicle accident, is unimportant: the risk of having a sleep-related vehicle accident is elevated for these individuals between these times regardless of their underlying motivations for driving then. This research set out to identify the determinants of sleep impaired driving, and following the procedures outlined by the TPB, traffic volume was tapped via the belief-based measure of attitude, which was all that was necessary.

In a similar vein, some of the outcome evaluation items may have been confounded with issues unconnected to the behaviour under investigation. For example, 'Being unable to drive home after I have been out socialising... is bad-good', was assessed in relation to driving between midnight and 6am, and may have evoked responses due to the consideration of drinking alcohol. This may have led some individuals to view this as a positive consequence as it would prevent them from driving after they had consumed alcohol, rather than between midnight and 6am. If they had not considered alcohol, they may have perceived it to be a negative outcome, as did participants in the elicitation study. Again, knowledge of the extent to which the adults considered these issues was unnecessary; outcome evaluations are assessed independently of the behaviour under investigation and so the overall response to the item is sufficient.

5.2.2 Limitations of the analyses

The TPB posits a causal sequence of events linking beliefs to behaviour (Ajzen, 1988; Ajzen & Fishbein, 1980, 2005; Fishbein & Ajzen, 1975). As the measures of intention and the other TPB and additional variables were obtained simultaneously, caution is warranted in inferring the direction of the findings. It is possible that the relationships between constructs were due to the influence of intention on the other variables, rather than vice versa. In addition, the measures of behaviour were obtained over a relatively short period of time, i.e., one week, which precludes strong conclusions regarding the direction of effects (Norman *et al.*, 2007). Moreover, the present studies, as well as most of the research which has used the TPB, whether cross-sectional or prospective, relied on correlational data, which prevents causal inferences from being made (Ajzen & Fishbein, 2005; Conner & Armitage, 1998; Webb & Sheeran, 2006; Weinstein, 2006). The ultimate test of the assumption of causality lies with behavioural change interventions grounded in the TPB; the success of the latter provides evidence for the former (Ajzen & Fishbein, 2005; Conner & Armitage, 1998; Conner & Sparks, 2005; Fishbein, 1993). This topic is discussed in more depth in section 5.3.1.

In several cases, different results were obtained depending on whether the direct or belief-based TPB measures were regressed onto intention. This disputes the framework of the TPB as it assumes that beliefs determine the overall constructs and that either type of measure can be used to assess attitude, injunctive norm and PBC (Ajzen, 1991, 2002b). Correlations between the two measures of the same construct were significant in most cases, with the weaker and stronger relationships generally being found among the PBC (which has been found elsewhere; Conner & Armitage, 1998; Manstead & Parker, 1995) and injunctive/social norm measures, respectively. Despite these significant correlations, the discrepancies in the results of the two types of measure cast uncertainty on their validity as they suggest that the measures may have tapped different psychological constructs. In the present research, more value was placed on the belief-based measures due to them being able to explain the behaviours, as opposed to just predicting them (Ajzen, 1991, 2005; Ajzen & Fishbein, 1980; Symons Downs & Hausenblas, 2005; Terry *et al.*, 1993).

The research aimed to explain the behaviours by tracing their determinants back to the underlying beliefs on the one hand, and to explore the influence of additional variables upon intention after the TPB constructs had been taken into account on the other. The direct measures of the constructs were used for the latter purpose to maintain consistency as the additional variables were all assessed directly. An alternative strategy that would also address the previous point would be to include both belief-based and direct measures of the TPB constructs, as well as the additional variables in the same regression on intention. This would also provide a more stringent test of the power of the additional variables (Conner *et al.*, 2001). On the other hand, Trafimow (2004) argued that experimental manipulations are the only valid way of assessing the true contribution of an additional variable, although he acknowledged the difficulty in manipulating variables, relative to measuring them.

An additional variable that consistently shows correlational evidence that it would be a worthwhile addition to the TPB, if theoretically justified (Ajzen, 1991; Ajzen & Fishbein, 2005; Conner & Armitage, 1998; Conner & Sparks, 2005), should be manipulated and its effects on intention (or behaviour, if relevant) examined to confirm its causal influence. In the present research, anticipated regret independently predicted the intentions of young adults to drive after 15 or more hours of wakefulness and between midnight and 6am, and the intentions of elderly adults to drive between 3pm and 6pm, and theoretical grounds for its discriminant validity with attitude were discussed in section 1.2.3.1.2 (Richard *et al.*, 1996; van der Pligt & de Vries, 1998b). Therefore, future studies should attempt to replicate these findings in alternative behavioural domains, explore the conditions and processes by which anticipated regret influences intention (Conner & Armitage, 1998) and manipulate anticipated regret to observe its effects on intention (Trafimow, 2004).

Since PBC did not predict behaviour in the present research, it is possible that rather than exerting a main effect on behaviour, PBC moderated the effects of the other constructs upon behaviour. The TPB predicts an interaction between intention and PBC (Ajzen, 1991), however, most of the research that has tested this has failed to find a significant effect (e.g., Ajzen & Driver, 1992; Ajzen & Madden, 1986; Armitage & Conner, 2001a) and so the additive model has been used in most applications (Ajzen, 2002a). On the other hand, a significant moderating effect of PBC on the intention-behaviour relationship has been found for exercising (Terry & O'Leary, 1995), quitting smoking (Rise *et al.*, 2008) and using cannabis (Conner & McMillan, 1999). PBC has also been found to interact with past behaviour to affect behaviour (Elliott *et al.*, 2003), although other research has not found this to be the case (Bagozzi & Kimmel, 1995).

As Ajzen (1991) argued that linear models account well for psychological data even when multiplicative effects exist, and owing to the limited sample sizes used in the present research, interactions between constructs were not explored in the current datasets. The role of PBC in the decision underlying sleep impaired driving may be investigated further by looking at whether it does interact with intention and/or past behaviour to influence subsequent behaviour. If future research were to go down this path, however, large sample sizes must be used (Elliott *et al.*, 2005; Rise *et al.*, 2008) and the conceptualisation of PBC (Terry & O'Leary, 1995; see section 1.2.3.2.3) and its relationship with actual control (Armitage & Conner, 2001a) should be addressed.

It is also possible that anticipated regret may have moderated the relationship between intention and behaviour, as found in previous studies (Abraham & Sheeran, 2003; Conner *et al.*, 2006; Sandberg & Conner, 2009; Sheeran & Abraham, 2003; Sheeran & Orbell, 1999). Further, this moderation effect has been found to be mediated by intention stability, suggesting that anticipating regret promotes performance of the behaviour because it is associated with more stable intentions (Abraham & Sheeran, 2003; Sheeran & Abraham, 2003), although more recent work has not supported this finding (Conner *et al.*, 2006). The current research would be usefully extended if these issues were investigated in relation to sleep impaired driving, using an adequate measure of anticipated regret and large sample sizes (Elliott *et al.*, 2005; Rise *et al.*, 2008).

Regression analyses are typically used in TPB studies to test the model and the contribution of any additional variables (Conner & Sparks, 1996), as they were in the present research. However, the use of structural equation modelling has a number of advantages over regression analyses, such as allowing simultaneous testing of the pathways proposed by mediational models (e.g., the TPB), being able to explicitly test the assumption that error is random and uncorrelated, correcting for attenuation due to unreliability and correcting for measurement error using latent variables (Miles & Shevlin, 2001; Terry & O'Leary, 1995; Trafimow, 2004). In the present research, in an attempt to increase the reliability of the results, correlations were corrected for attenuation due to unreliability (Trafimow, 2004) but this led to coefficients exceeding 1.0 and therefore all analyses were conducted using the original correlations. Future correlational research in this area may achieve more reliable findings which may result in more variance being explained in the dependent variables, by employing structural equation modelling.

5.2.3 Alternative future directions

The influence of moral norm was not specifically measured in the present research due to an already extensive list of external variables being investigated, although the adjective pair, 'bad-good', in the direct measure of attitude may have partly captured moral considerations (Manstead, 2000). Manstead (2000) identified a number of studies that found moral norm to be a significant independent predictor of intention and also provided a conceptual rationale for assessing this variable alongside the TPB variables. Manstead (2000) argued that moral norm would be particularly expected to play a role in instances where individual and social rewards are at conflict with moral prescriptions. In the driving domain, Parker *et al.* (1995) reported that personal norm, which included a measure of moral norm and anticipated regret, significantly predicted intentions to cut across traffic, weave in and out of traffic and overtake on the inside, over and above the TPB constructs. Therefore, exploring the role of moral norm in the prediction of intention to drive while sleep impaired seems a worthwhile venture for future research.

Norman and Conner (2005) argued that the TPB focuses on factors that affect the initiation of behaviour, at the expense of those associated with behavioural maintenance. Refraining from driving while sleep impaired is a behaviour which needs to be maintained in order to avoid being at risk of a sleep-related vehicle accident. A focus for future research could be the application of stage models, such as the transtheoretical model (e.g., Prochaska & DiClemente, 1983; Prochaska & Norcross, 2001), to sleep impaired driving, as these theories acknowledge that different factors are important in the decisions to initiate and maintain performance of a behaviour (Norman & Conner, 2005).

People who worked shifts were excluded from the current research, however, shift-workers are an important population worth research attention. Their sleep has been found to be shorter (Bonnet, 1994; Bonnet & Arand, 1995; Chatzitheochari & Arber, 2009; Ursin *et al.*, 2009) and of poorer quality (Ohayon & Lemoine, 2004) compared to those with regular daytime working hours. This suggests that shift-workers are more susceptible to the adverse health effects reviewed in section 2.1.1. Working night shifts has also been found to significantly increase the risk of being involved in a sleep-related vehicle accident (Stutts *et al.*, 2003). Future research exploring the determinants of sleep impaired driving in a purely shift-working population is therefore urgently required. This would represent a first step to reducing the occurrence of driving after prolonged wakefulness and at risky times of the day in this particularly vulnerable population. Although work issues would most likely become apparent, other important factors may emerge, for example, specific problems with attempting to sleep during the day. A measure of behaviour taken over a longer period of one week may be required, however, in order to take account of the full spectrum of shift systems.

5.3 KEY IMPLICATION: BEHAVIOURAL CHANGE INTERVENTIONS

There would be both theoretical and practical implications if future research were to extend the findings from the present research by using them to develop behavioural change interventions aimed at reducing the incidence of sleep impaired driving.

5.3.1 Theoretical implications

Several investigators have raised concerns regarding the causal assumption of the model. Some studies have shown that the overall constructs of injunctive norm and PBC have not fully mediated the effects of their corresponding belief-based measures on intention (Conner *et al.*, 2001; Godin *et al.*, 2004; Miniard & Cohen, 1981[11])[12], while others have suggested the possibility of feedback effects of attitude on beliefs (Eagly & Chaiken, 1993), of intention and behaviour on subjective norm (Eiser *et al.*, 1989) and of behaviour on attitudes (Eagly & Chaiken, 1993) and beliefs (Weinstein, 2006). As stated in section 5.2.2, behavioural change interventions based on the TPB provide a test of the causal chain proposed by the model (Ajzen & Fishbein, 2005; Conner & Armitage, 1998; Conner & Sparks, 2005; Fishbein, 1993). In TPB-based interventions, 'information relevant to one or more of the theory's predictors is provided, and its effect on behavior is traced through the theoretical antecedents' (Ajzen & Fishbein, 2005, p. 198).

Hardeman *et al.* (2002) conducted a review of behavioural change interventions based on the TPB and although the majority of studies identified did not adequately develop the intervention in line with the TPB, the results were nevertheless encouraging (Ajzen, 2005). Hardeman *et al.* (2002) identified 13 studies that found that the intervention successfully changed intention or behaviour in the desired direction: half reported a change in intention and two-thirds a change in behaviour. The effect sizes were, however, of a small to moderate magnitude (Hardeman *et al.*, 2002).

Recent studies that have carefully developed interventions grounded in the TPB have proved successful (Elliott & Armitage, 2009; Parker *et al.*, 1996; Quine *et al.*, 2002), although there are exceptions (Armitage & Conner, 2002). Further, experiments have provided support for the causal directions specified in the model; manipulation of the key beliefs has generated changes in the corresponding overall constructs (Elliott & Armitage, 2009; Parker *et al.*, 1996; Quine *et al.*, 2002), changes in TPB variables have produced or mediated changes in intention (Armitage & Reidy, 2008; Quine *et al.*,

[11] Miniard and Cohen (1981) found this effect for injunctive norm, but the direct measure fully mediated the influence of the belief-based measure once the motivation to comply component was removed (as it was in the present research).
[12] These findings also support the decision in the present research to place more value on the results obtained using the belief-based, as opposed to the direct, measures of the TPB constructs.

2002), overall PBC change has produced behavioural change (Elliott & Armitage, 2009) and manipulation of intention has led to changes in behaviour (Webb & Sheeran, 2006).

Therefore, if future research used the present results to inform behavioural change interventions, it would add to this limited body of literature (Armitage & Conner, 2001b, 2002; Armitage & Reidy, 2008; Elliott & Armitage, 2009), which is crucial to establish the validity of the causal sequence at the core of the TPB.

5.3.2 Practical implications

From an applied perspective, it is desirable to promote safety in the general population by reducing the incidence of sleep impaired driving. The investigation has the potential to contribute to road safety campaigns designed to deter the sleep impaired individual from driving. Indeed, the consensus is that more emphasis should be directed toward primary prevention efforts, such as educating drivers about the dangers of driving while sleep impaired and at vulnerable times of the day (Horne & Reyner, 1999; MacLean *et al.*, 2003). The need to tailor behavioural change interventions aimed at preventing vehicle accidents to specific age groups is crucial (Zhang *et al.*, 1998). In particular, more research and intervention attempts need to focus on young adults. It was revealed in Chapter 2 that young adults had the poorest sleep quality compared to the other age groups and in Chapter 4 that this group report more daytime sleepiness. Importantly, Stutts *et al.* (2003) found that both of these factors increase the risk of being in a sleep-related vehicle accident. Young adults are therefore already vulnerable even before the risks of driving under the dangerous circumstances explored here are taken into account. It is crucial to develop behavioural change interventions using theory (Quine *et al.*, 2002; Rutter & Quine, 2002) to ensure that the most appropriate psychological constructs are targeted (Elliott *et al.*, 2007). This is an aspect that past research (Hardeman *et al.*, 2002) and real-life behavioural change campaigns (Parker, 2002) have failed on.

Parker *et al.* (1996) noted that while campaigns that attempted to encourage individuals to wear their seatbelt in the car were unsuccessful in changing behaviour, they prepared the public for when it became a legal requirement. People immediately changed their behaviour when this new law was enforced; an effect which Parker *et al.* (1996)

attributed to the prior extensive publicity given to the benefits of wearing a seatbelt. A similar effect was observed for drink-driving; the legal consequences were made possible by education campaigns that changed public opinion (Ajzen & Manstead, 2007). If the statistics continue to show a high prevalence of sleep-related vehicle accidents, a new law may be introduced preventing individuals from driving while sleep impaired, e.g., when they have been awake for 15 or more hours. Therefore, now is the time to educate the public about the dangers of driving while sleep impaired and to develop behavioural change interventions based on the TPB and/or using the alternative strategies discussed below.

5.3.2.1 TPB interventions based on the current findings

According to the TPB, in order to change behaviour, either changes must be made to the key accessible behavioural, normative or control beliefs to produce a change in attitude, injunctive norm or PBC respectively, which then influences intention and ultimately behaviour (assuming these constructs are significantly related) or new beliefs must be introduced and made accessible (Ajzen, 2002b, 2005; Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975; Fishbein *et al.*, 1980; see section 1.3.2.4). The TPB provides only general guidelines about how to design and implement effective interventions (Ajzen, 2005), and the fact that it does not specify how to go about changing beliefs has been seen as a serious limitation of the model (Sutton, 2002).

Sutton (2002) specified five steps which are necessary to develop a behavioural change intervention based on the TPB. These are (i) defining the target behaviour and population, (ii) identifying the modal accessible beliefs by means of an elicitation study, (iii) conducting the main study and using the results to test the relationships specified by the model, (iv) identifying the beliefs which discriminate those who intended to perform the behaviour (or performed) from those who did not (perform) and (v) developing an intervention designed to change these key beliefs and evaluating it with a separate sample of the target population. As the present research was concerned with the prediction and explanation of the behaviours under investigation, only the first four steps were followed.

Although the young adults generally did not intend to drive between midnight and 6am (i.e., they intended to refrain), mean scores were close to the midpoints (see Table 4.17). This suggests that an intervention should focus on strengthening these intentions and/or encouraging more people to hold them. Therefore, it would be beneficial to design an intervention following Sutton's (2002) steps for this behaviour and population. The elderly adults did intend to drive between 3pm and 6pm (see Table 4.23) and so the only approach should be to change the underlying cognitions in order to influence intention and ultimately reduce the incidence of this behaviour. Again, Sutton's (2002) final step would provide a means of doing this. However, it is cautioned that the relationship between intention and behaviour in the latter case remains unknown. As intention failed to predict driving after 15 or more hours of wakefulness, there would be no value to suggesting behavioural change interventions based on the TPB for this behaviour (unless beliefs directly influenced behaviour which was unlikely since it was those who did not intend to drive after prolonged wakefulness but did so anyway who were mainly responsible for the lack of correspondence between intention and behaviour, although this association was not significant; see section 4.4.2.2).

Reducing driving between midnight and 6am in young adults

Young adults who more strongly believed that refraining from driving between midnight and 6am would prevent them from driving for work purposes were more likely to drive during those hours. In order to reduce driving between these times, the risks of driving then should be emphasised to young adults and they could be persuaded to confront their boss about the times at which they are required to begin/finish work. This could be achieved by helping to develop their sense of individuality by promoting self-esteem (Sheeran & Orbell, 1999). Alternatively, the use of alternative modes of transport could be suggested.

Reducing driving between 3pm and 6pm in elderly adults

Several beliefs discriminated the elderly adults who intended to drive between 3pm and 6pm from those who did not. Elderly adults should be presented with empirical evidence showing the elevated risk for a sleep-related vehicle accident between 3pm and 6pm amongst this age group. Indeed, the attempt to permanently change beliefs should be more successful if the argument made is credible (Ajzen, 2002b; Petty & Cacioppo, 1986). This information may influence whether they perceive refraining from driving between 3pm and 6pm as pointless. An intervention aimed at elderly adults might also concentrate on convincing them to ignore pressures to drive from specific referents. Further, the adults should be asked to consider whether their partner, family and/or friends would want them to be in an accident (Elliott & Armitage, 2009). Elderly adults could also be presented with messages designed to persuade and help them to plan their activities in advance to ensure they were not driving to or from somewhere between 3pm and 6pm. This may weaken the beliefs that refraining from driving then would be inconvenient and would prevent them from socialising. Encouraging them to plan to go shopping, socialising and participating in recreational activities at different times (or via alternative means of transport) should also increase the control they feel over refraining from driving between these times. The association between driving between 3pm and 6pm and a greater volume of traffic needs to be strengthened to induce more worry which may then lead to refraining, perhaps, again, via an increase in forward planning. Further, elderly adults need to be made more aware of the dangers of driving when the traffic is busy *per se*, regardless of their tiredness.

It is important that in targeting these key beliefs, individuals are given the opportunity to carefully consider the new information they have been presented with, as this should lead to cognition changes that are sustained, resistant and predictive of behaviour (Petty & Cacioppo, 1986). A way in which this could be implemented may be via booklets which include tasks designed to stimulate information elaboration such as question and answer flowcharts and thought listing procedures. Quine *et al.* (2002) found this approach successful in bringing about enduring behavioural change (wearing a bicycle helmet). If this strategy showed promise in an evaluation study (i.e., the last of Sutton's, 2002, steps), distributing a booklet to the general population would be cost-effective and relatively simple (Elliott & Armitage, 2009), although the extent to which they would participate in the exercises is unknown.

In some of the cases above, only one belief from a list of several was identified as a key belief. It is possible that targeting this few beliefs would not produce a change in the summed products of the total set of beliefs which is substantial enough to affect the overall construct (i.e., attitude, injunctive norm or PBC), and therefore intention and behaviour (Ajzen, 2002b; Fishbein *et al.*, 1980; Sutton, 2002). Also, in targeting a particular key belief, the intervention may have an unanticipated impact on other beliefs or model constructs that may affect intention and behaviour (Ajzen, 2002b; Ajzen & Fishbein, 1980; Conner & Sparks, 2005; Fishbein *et al.*, 1980). These issues emphasise the importance of evaluating the intervention using an adequate sample of the target population before implementing it in the general population (Sutton, 2002).

5.3.2.2 Alternative interventions

5.3.2.2.1 Implementation intentions

Intention and PBC explained an additional 12% in driving between midnight and 6am, after gender was taken into account. This proportion may be too small for effects on intention to translate to behaviour, given that the impact of the intervention weakens as it moves down the causal chain (Armitage & Conner, 2002; Sutton, 2002). Future research testing the effectiveness of the suggested interventions therefore require large sample sizes (Sutton, 2002), and if the relationship between intention and behaviour is not strong enough, the use of implementation intentions (IIs) may prove useful (Ajzen, 2002b; Armitage & Conner, 2002). Indeed, Ajzen (2005) noted that changing the key beliefs to produce corresponding changes in the overall construct and intention is only one of two approaches which can be used to generate behavioural change. The other strategy can be used to ensure that intentions are carried out, i.e., to maximise the strength of the intention-behaviour relationship, and involves removing any obstacles which may inhibit actual control over the behaviour and the development of an II (Ajzen, 2005).

IIs (Gollwitzer, 1993, 1999) are conditional if-then plans which stipulate when, where and how an intention to perform a particular behaviour will be executed, for example, 'I intend to go to bed at 10pm, straight after watching 'Lost' on television.' Gollwitzer (1993, 1999) argued that IIs link the intended behaviour to an anticipated situation, which commits the individual to perform the behaviour via automatic processes. When an II is made, it is stored in memory until the specified situation occurs (e.g., the end of the television program, 'Lost'), at which point it disrupts focused attention, brings the behaviour to mind and promotes swift initiation (e.g., going straight to bed), without further conscious consideration. In other words, performance of the behaviour is transferred from under the control of the individual to environmental cues (Gollwitzer, 1993, 1999). Forming an II has been found to greatly increase the likelihood that intention will be translated into action (Ajzen & Fishbein, 2005; Orbell & Sheeran, 2002; Sheeran, 2002; Sheeran *et al.*, 2005).

A strategy which may help to prevent adults from driving after 15 or more hours of wakefulness could therefore be to encourage them to develop an II. Although intention did not predict this behaviour, IIs may still prove effective in reducing its incidence as the adults did not generally intend to drive after prolonged wakefulness (see Table 4.5; i.e., they were motivated to refrain which is in the desired direction, Ajzen & Manstead, 2007). However, forming an II to refrain from driving after 15 or more hours of wakefulness may be relatively complex as it would require a daily calculation of how many hours the individual had been awake for, depending on what time they woke up in the morning or after an afternoon nap.

IIs may also be effective in reducing driving between midnight and 6am among young adults as the descriptive statistics indicated that this group did not intend to drive then (see Table 4.17; i.e., they were motivated to refrain, Ajzen & Manstead, 2007). An II to refrain from driving between midnight and 6am may be tied to a particular event, such as getting home from work or from socialising, for example, 'If it gets later than 12am when I want to come home, I will leave my car and get a taxi.' IIs have been shown to be useful both for performing single acts and for establishing regular patterns of behaviour (Orbell & Sheeran, 2002). Further, they are effective even when the behaviour is performed as a function of past behaviour (Ajzen & Manstead, 2007; Jackson *et al.*, 2003; Sheeran, 2002). Thus, although past behaviour superseded the predictive effect of intention to drive between midnight and 6am, the formation of an II should still help to reduce this behaviour.

Conversely, the elderly adults did intend to drive between 3pm and 6pm (see Table 4.23) and so encouraging them to develop an II to refrain from this behaviour would make no sense (Ajzen & Manstead, 2007). For the latter behaviour, interventions should solely focus on changing the underlying key beliefs in order to produce changes in intention (as outlined above). The fact that several key beliefs were identified for driving between 3pm and 6pm among elderly adults is encouraging, as they each represent a potential approach to changing intention and ultimately behaviour (see section 5.3.2.1).

5.3.2.2.2 The mere measurement effect

Findings are currently emerging which suggest that merely completing a TPB questionnaire is sufficient to bring about changes in behaviour. Godin *et al.* (2008) reported that individuals who completed a questionnaire that assessed TPB and several additional variables in relation to giving blood were significantly more likely to donate blood (assessed objectively) than individuals who had not received the questionnaire. The effects were significant at both six and 12 months later. Similarly, Sandberg and Conner (2009) found that women who completed a TPB questionnaire in relation to attending cervical screening were significantly more likely to (objectively) perform this behaviour within four months of questionnaire completion. Both studies revealed that it was necessary to actually complete the questionnaire; receiving it in the post was not sufficient to affect behaviour. This may be because the former but not the latter condition increased attitude accessibility (Morwitz & Fitzsimons, 2004). Alternatively, the results may have been due to sampling bias in that those who completed the questionnaire were already contemplating giving blood or attending cervical screening. It is noteworthy that Sandberg and Conner (2009) reported that the inclusion of items assessing anticipated regret further increased attendance at cervical screening through moderation of the intention-behaviour relationship.

Therefore, a simple and cost-effective way of promoting the performance of a safe behaviour, e.g., refraining from driving while sleep impaired, in the general population may be to persuade people to complete a TPB questionnaire in relation to the given behaviour (Godin *et al.*, 2008; Sandberg & Conner, 2009). Although it has been demonstrated that completing items assessing intention (Morwitz & Fitzsimons, 2004; Sherman, 1980) and anticipated regret (Abraham & Sheeran, 2003; Sandberg & Conner, 2009) changes behaviour, future research may usefully identify whether the other TPB constructs produce the effect (Godin *et al.*, 2008).

It is possible that the mere measurement effect may have produced behavioural change in the present research. Completing a TPB questionnaire in relation to a novel or unfamiliar behaviour, of which the specific behaviours explored in the present research could be classed, may induce participants to create new cognitions (Ogden, 2003). For example, participants may have been initially unaware that driving under the particular circumstance was a risk factor for being involved in a sleep-related vehicle accident and so completing the Time 1 questionnaire may have changed their beliefs and/or affected their subsequent driving behaviour. Similarly, asking people to record when they drove on a daily basis may have given them a unique insight into their habits, which may have motivated them to change their behaviour. In particular, completing the sleep and driving diary may have had a therapeutic effect by allowing individuals to realise that they frequently drove at a risky time and subsequently they may have endeavoured to avoid driving at this time. While these are positive outcomes in terms of safety, if participants were influenced by completing the TPB questionnaire, the results would not generalise to the general population (i.e., who have not completed a TPB questionnaire in relation to these behaviours). Also, this may have reduced the predictive validity of the TPB in the present research and obscured the true determinants of behaviour. These represent limitations of all research using the TPB or any social cognition model and there is no straightforward solution.

5.3.2.2.3 Changing anticipated regret

In spite of possible methodological problems, anticipated regret was an important predictor of the intentions of young adults to drive after 15 or more hours of wakefulness and between midnight and 6am, and of the intentions of elderly adults to drive between 3pm and 6pm. This construct should therefore be a useful target for intervention in these groups (Armitage & Conner, 2001b). Experimental studies that have manipulated anticipated regret have demonstrated that the construct exerts a causal influence on intention and behaviour (Abraham & Sheeran, 2003, 2004; Sandberg & Conner, 2009; Sheeran & Orbell, 1999). Parker *et al.* (1996) also showed that a behavioural intervention based on increasing the regret anticipated after speeding was effective in changing beliefs about speeding. Therefore, a strategy that may help to reduce the incidence of sleep impaired driving might be to increase the salience of possible negative short-term consequences of performing this behaviour (Abraham & Sheeran, 2003, 2004; Parker *et al.*, 1996; Richard *et al.*, 1995, 1996, 1998; Sheeran & Orbell, 1999; van der Pligt & de Vries, 1998b; van der Pligt *et al.*, 1998).

Richard *et al.* (1995, 1996) argued that people should stop performing risky behaviours if they become aware that they could lead to negative feelings afterwards, especially if it is also made explicit that these feelings would be avoided if preventative measures were taken, i.e., avoiding driving under risky sleep-related circumstances. One way of achieving this in the general population could involve a campaign which includes television advertisements and posters, similar to the British 'THINK' campaign, but specifically applied to the decision to drive after prolonged wakefulness or at a vulnerable time of the day and encompassing the post-behavioural emotions resulting from having a sleep-related vehicle accident. Alternatively, asking people to imagine how they would feel having driven while tired (Richard *et al.*, 1996) or attempting to persuade them that they should feel bad about driving when tired due to the risk involved (Parker *et al.*, 1996), perhaps via radio advertisements, may also prove successful. Repeatedly subjecting an individual to a persuasive message increases its effectiveness (Petty & Cacioppo, 1986).

Anticipated regret has been shown to be a relatively easy construct to manipulate. Merely asking people the extent to which they would regret performing/not performing a behaviour, on a questionnaire, has been found to influence intention (Abraham & Sheeran, 2004; Sheeran & Orbell, 1999) and the intention-behaviour relationship (Abraham & Sheeran, 2003; Sandberg & Conner, 2009) in the desired direction. Therefore, a simple, cost-effective intervention designed to deter young and elderly adults from driving while at risk of having a sleep-related vehicle accident may be to ask them to complete a questionnaire in relation to sleep impaired driving which includes items assessing anticipated regret (Sandberg & Conner, 2009; also see section 5.3.2.2.2).

5.4 MAIN CONCLUSIONS

The TPB provided useful, but not sufficient, accounts of the determinants of intention to drive after 15 or more hours of wakefulness, between midnight and 6am and between 3pm and 6pm. The model was able to predict subjective measures of sleep impaired driving but was unable to predict a partly objective measure of driving after prolonged wakefulness.

The present research has revealed an important role for injunctive norm in the prediction of intention across adulthood and sleep impaired driving behaviours. The extent to which individuals perceived that their normative referents approved or disapproved of them driving after 15 or more hours of wakefulness, between midnight and 6am and between 3pm and 6pm significantly predicted intentions to perform these behaviours in all of the samples in which they were measured. This contradicts past research which has found injunctive norm to be the weakest predictor of intention across a range of behaviours (Ajzen, 1991; Armitage & Conner, 2001a; Godin & Kok, 1996).

Several beliefs that discriminated adults who did and who did not perform/intend to perform the behaviours were identified. This research can be used to inform interventions attempting to reduce the incidence of sleep impaired driving in the general population. A number of possible behavioural change strategies were proposed based on the empirical, theory-based results obtained here.

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7.0 APPENDICES

Appendix 2.1

Sleep Diary

Instructions

Please complete your Sleep Diary as accurately as possible and remember to fill it in every day for the next week. You should begin filling in the diary today (the day you began the study, i.e., Day 1). Please note: you only need to answer questions regarding naps and removing the watch today. The questions about night-time sleep only begin tomorrow morning.

For Days 2-8, please answer the first seven questions about your night-time sleep in the morning upon awakening, and the last three questions regarding naps and watch removal throughout the day for optimal accuracy, or at the end of each day. Please make sure you answer all of the questions every day.

When asked to state a time, use the 24-hour clock, and do not approximate but indicate the exact time if you can, for example, 23.35. Similarly, when asked to estimate a length of time, state hours and minutes.

All responses to the Sleep Diary will remain completely confidential and anonymous.

Explanation of questions

Time you went to bed last night with the intention to go to sleep: This means the time that you turned the light off to go to sleep. If you read, watched TV or did anything else after going to bed, please make sure that the time you write down reflects the time that you actually attempted to go to sleep.

Time you fell asleep: This will be an estimation, but please try to be as accurate as possible.

Final time you woke up this morning: This question refers to the last time that you woke up before getting out of bed. For example, if you woke up a few times in the morning but then went back to sleep, please state the final time that you woke up and did not go back to sleep.

Number of times awakened during night: This involves a simple count of any times that you can remember waking up during the night or in the morning, in between being asleep. This can include both brief awakenings and actually getting out of bed.

Total amount of time awake during night: This is an estimation of how many minutes (or hours and minutes) in total that you were awake for during the night. Again, this means in between sleeping.

How would you assess the quality of your sleep? This question makes use of a rating scale with 7 places and opposing viewpoints at each end. Please circle the number that best describes your opinion. The numbers on the scale represent the following:

good :	1	2	3	4	5	6	7	: bad
	extremely good	quite good	slightly good	neither good nor bad	slightly bad	quite bad	extremely bad	

How did you feel when you woke up this morning? Again, please answer this question by circling the appropriate number on the rating scale. In this case, the numbers on the scale represent the following:

tired :	1	2	3	4	5	6	7	: refreshed
	extremely tired	quite tired	slightly tired	neither tired nor refreshed	slightly refreshed	quite refreshed	extremely refreshed	

Number of naps taken during day: This is a count of how many times you fell asleep during the day. If you did not sleep at all during the day, please write "0" and ignore the next question.

Times of naps: This includes spaces for entering the details of up to three naps. Please complete the times that you fell asleep and woke up for any naps that you had during the day.

Time(s) you took the actiwatch off, for how long and the reason for removing it: Please specify any times that you removed the actiwatch from your wrist. Remember that you should only remove the actiwatch when you have a shower, bath or do anything else which would cause the actiwatch to get wet and you should put the actiwatch back on straight after. Please note how long you were not wearing the actiwatch for and the reason why you took it off. There are spaces for entering the details of up to three occasions when you may have removed the actiwatch, but remember that you should take the actiwatch off as little as possible.

Please remember to always wear the actiwatch on the non-dominant wrist.

<u>DAY 1</u> <u>Date (day you began the study):</u>

<u>Complete throughout/at the end of the day:</u>

Number of naps taken during day since put actiwatch on: _____

Times of naps: Fell asleep: _________ Woke up: _________

Fell asleep: _________ Woke up: _________

Fell asleep: _________ Woke up: _________

Time(s) you took the actiwatch off, for how long and the reason for removing it:

Time: _________ Duration: _____________

Reason: ______________________________________

Time: _________ Duration: _____________

Reason: ______________________________________

Time: _________ Duration: _____________

Reason: ______________________________________

DAY 2 **Date:**

Complete in the morning upon awakening:

Time you went to bed last night with the intention to go to sleep: _________

Time you fell asleep: _________

Final time you woke up this morning: _________

Number of times awakened during night: _____

Total amount of time awake during night: _________

How would you assess the quality of your sleep?

good :__1__:__2__:__3__:__4__:__5__:__6__:__7__: bad

How did you feel when you woke up this morning?

tired :__1__:__2__:__3__:__4__:__5__:__6__:__7__: refreshed

Complete throughout/at the end of the day:

Number of naps taken during day: _____

Times of naps: Fell asleep: _________ Woke up: _________

Fell asleep: _________ Woke up: _________

Fell asleep: _________ Woke up: _________

Time(s) you took the actiwatch off, for how long and the reason for removing it:

Time: _________ Duration: _____________

Reason: ______________________________________

Time: _________ Duration: _____________

Reason: ______________________________________

Time: _________ Duration: _____________

Reason: ______________________________________

[Days 3-8 contained the same questions as Day 2]

Appendix 2.2

Short questionnaire

Questionnaire about Sleep Length over the Past Week

The aim of this brief questionnaire is to obtain your views on your sleep length over the past week and to obtain some descriptive information about you. Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

1. On average, how many hours of sleep did you get per 24 hours in the last week?

____

2. Did anything out of the ordinary happen in the last week which significantly affected your sleeping patterns and if so, what happened?

____

____

____

Please complete your details in the appropriate sections below.

Age: ______

Gender: ______________

Occupation: ____

Usual hours of work (i.e., times from and until): ____________________________

Marital status: ___________________

Do you live with any children (under the age of 18)? ________

Do you normally sleep in bed alone or with someone else (please specify, e.g., partner, baby)?

____

Thank you for completing this questionnaire.

Appendix 2.3

Participant information sheet

Name of experimenter: Laura Nicholson
Address: Room 451, School of Psychology, Henry Cotton Campus, LJMU,
15-21 Webster Street, Liverpool, L3 2ET
Tel: 0151 231 4057
Email address: L.J.Nicholson@2003.ljmu.ac.uk
Supervisor: Dr Yvonne Harrison

Title of study/project: Using actigraphy to measure sleep duration

Purpose of study: The aim of the study is to measure sleep duration and sleep quality using sleep diaries and activity monitors.

Procedures and participants' role: Healthy adults from three different age groups will be asked to wear an activity monitor around their wrist and to keep a 24-hour sleep diary for a period of one week. The activity monitor continuously records information regarding whether the participant is awake or asleep. The participants will return a week later with their activity monitor and sleep diary to complete a short questionnaire, enquiring about their actual sleeping behaviour over the previous seven days. When participants have completed the study, a debriefing session will take place, including guidelines about how much sleep is necessary for healthy adults and the possible consequences of not getting enough sleep. Further sources of information will be made available along with an opportunity to ask questions. Participants will receive a £10 gift-card for Tesco supermarket to cover any expenses and if requested, will be informed of their average nightly sleep duration and sleep quality as estimated by the activity monitor. Participants will be assured of confidentiality and anonymity in the storage, analysis and reporting of information relating to the outcome of this project.

Please Note:
All participants have the right to withdraw from the project/study at any time without prejudice to access of services which are already being provided or may subsequently be provided to the participant.

Appendix 3.1

Elicitation study interview script

At the beginning of each interview: *I am going to ask you a series of questions regarding driving. Please respond as honestly as possible. All answers will remain confidential and you can withdraw from the interview at any time. There will be an opportunity at the end of the interview for you to ask questions.*

All age groups: Refraining from driving after 15 or more hours of wakefulness

Firt, I am going to ask you some questions about refraining from driving when you have been awake for 15 or more hours. I will give you a moment to think of your own experiences of driving when you have been awake for 15 or more hours.

What do you believe are the advantages of your refraining from driving after being awake for 15 or more hours in the forthcoming week?

What do you believe are the disadvantages of your refraining from driving after being awake for 15 or more hours in the forthcoming week?

Is there anything else you associate with your refraining from driving after being awake for 15 or more hours in the forthcoming week?

Are there any individuals or groups who would approve of your refraining from driving after being awake for 15 or more hours in the forthcoming week?

Are there any individuals or groups who would disapprove of your refraining from driving after being awake for 15 or more hours in the forthcoming week?

Are there any other individuals or groups who come to mind when you think about refraining from driving after being awake for 15 or more hours in the forthcoming week?

What factors or circumstances would enable you to refrain from driving after being awake for 15 or more hours in the forthcoming week?

What factors or circumstances would make it difficult or impossible for you to refrain from driving after being awake for 15 or more hours in the forthcoming week?

Are there any other issues that come to mind when you think about the difficulty of refraining from driving after being awake for 15 or more hours in the forthcoming week?

Young adults only: Refraining from driving between midnight and 6am

Next, I am going to ask you about refraining from driving between the hours of midnight and 6am.

What do you believe are the advantages of your refraining from driving between the hours of midnight and 6am in the forthcoming week?

What do you believe are the disadvantages of your refraining from driving between the hours of midnight and 6am in the forthcoming week?

Is there anything else you associate with your refraining from driving between the hours of midnight and 6am in the forthcoming week?

Are there any individuals or groups who would approve of your refraining from driving between the hours of midnight and 6am in the forthcoming week?

Are there any individuals or groups who would disapprove of your refraining from driving between the hours of midnight and 6am in the forthcoming week?

Are there any other individuals or groups who come to mind when you think about refraining from driving between the hours of midnight and 6am in the forthcoming week?

What factors or circumstances would enable you to refrain from driving between the hours of midnight and 6am in the forthcoming week?

What factors or circumstances would make it difficult or impossible for you to refrain from driving between the hours of midnight and 6am in the forthcoming week?

Are there any other issues that come to mind when you think about the difficulty of refraining from driving between the hours of midnight and 6am in the forthcoming week?

Elderly adults only: Refraining from driving between 3pm and 6pm

Next, I am going to ask you about refraining from driving between the hours of 3pm and 6pm.

What do you believe are the advantages of your refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

What do you believe are the disadvantages of your refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

Is there anything else you associate with your refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

Are there any individuals or groups who would approve of your refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

Are there any individuals or groups who would disapprove of your refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

Are there any other individuals or groups who come to mind when you think about refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

What factors or circumstances would enable you to refrain from driving between the hours of 3pm and 6pm in the forthcoming week?

What factors or circumstances would make it difficult or impossible for you to refrain from driving between the hours of 3pm and 6pm in the forthcoming week?

Are there any other issues that come to mind when you think about the difficulty of refraining from driving between the hours of 3pm and 6pm in the forthcoming week?

At the end of each interview: *Thank you for your time. Are there any questions that you would like to ask regarding any of the behaviours discussed?*

Appendix 3.2

Example of interview transcript

Refraining from driving after 15 or more hours of wakefulness

Participant: 33 (Young, Female)

What do you believe are the advantages of your refraining from driving after being awake for fifteen hours or more in the forthcoming week?

The advantages are that you're more alert and you've got less likelihood of not just yourself causing an accident, but you're more alert to anybody else who may cause an accident to you.

What do you believe are the disadvantages of your refraining from driving after being awake for fifteen hours or more in the forthcoming week?

For me personally, it is difficult in that I'm up very early in the morning and I do socialise at night so, say if I'm up at quarter to seven in the morning, technically I shouldn't be driving on that basis after fifteen hours- anytime after about quarter to ten at night which I obviously do because if for example, I'm going just to visit my boyfriend or a friend, I'm going to be coming home about eleven- even going to pictures and that's over the time limit- and then I'd have to try and arrange lifts and it just becomes quite inconvenient really.

Is there anything else you associate with your refraining from driving after being awake for fifteen hours or more in the forthcoming week?

No.

Are there any individuals or groups who would approve of your refraining from driving after being awake for fifteen hours or more in the forthcoming week?

Obviously the people closest to you would like you to have the best chance of not causing any kind of accident. My parents especially would approve of that as they're always saying, be careful, whenever I'm leaving the house. I, myself personally, would like to be at my optimal levels for driving but as I say, sometimes it's just not feasible. So, my parents and my boyfriend and my friends would approve of my not driving because of the likelihood of causing a crash. And also I instantly thought of my brother- who I will mention is in the police. I associate him with the police and the police are very much on the campaign trail for people not driving while they're tired- you see the big campaigns that have been up at the moment. So yes I think the police would very much approve of that.

Are there any individuals or groups who would disapprove of your refraining from driving after being awake for fifteen hours or more in the forthcoming week?

The same people that I've just mentioned- people that are closest to you. If I wasn't to drive after ten o clock at night I would need them to give me lifts and that would obviously inconvenience them. So my parents and I do tend to rely on my boyfriend quite a lot aswell.

Are there any other individuals or groups who come to mind when you think about refraining from driving after being awake for fifteen hours or more in the forthcoming week?

No.

What factors or circumstances would enable you to refrain from driving after being awake for fifteen hours or more in the forthcoming week?

It's all about your lifestyle and your career and your job really. With my job, being up so early and having to commute- that is a factor in that I can't do it. So if I worked close to home then it'd be later at night and obviously I'm not going to drive after twelve at night because I'm more than likely going to be in bed. So if I was up at nine, then everything would be fine really. So different job and different working hours- that's the main one during the week. Also, with only getting in at quarter to seven at night, I've got to then try and find an exercise regime that falls in after seven o clock at night so the earlier that I would be able to exercise, then the earlier that I would be able to finish driving for the day. So different exercise class times aswell. Weekends are different in that I don't have to be up as early but then on the same side of the coin, you've got the fact that you're probably going to be more likely to socialise so you'd have to think about your socialising hours with what time you've got up in the morning. You'd have to try and get lifts.

What factors or circumstances would make it difficult or impossible for you to refrain from driving after being awake for fifteen hours or more in the forthcoming week?

Exactly the same things. My job makes it very difficult during the week. At weekends, obviously, you don't want to be in bed by eleven o clock so you'd have to think about it and try and get lifts. Otherwise it'd be impossible.

Are there any other issues that come to mind when you think about the difficulty of refraining from driving after being awake for fifteen hours or more in the forthcoming week?

No.

Appendix 3.3

Modal accessible beliefs for age groups and behaviours that are not presented in Chapter 2.1

Accessible beliefs of young adults regarding refraining from driving after 15 or more hours of wakefulness (number of participants who mentioned belief)

Behavioural beliefs	*Normative referents*	*Control beliefs*
Reduces risk of having vehicle accident (18)	People who want a lift (9)	An emergency (8)
Inconvenient (9)	Police (9)	Someone else being able to give me a lift or drive instead of me (7)
Prevents me from driving when too tired (8)	Parents (7)	Socialising (7)
Prevents me from driving when difficult to concentrate/focus (4)	Other family members (7)	Getting a taxi (5)
Prevents me from driving when not aware (4)	People at work (5)	Driving for work purposes (4)
Unable to go out socialising (4)	Passengers in car (5)	Giving someone a lift (4)
Unable to get somewhere if there was an emergency (4)	Other road-users (4)	Drinking alcohol (3)
Unable to drive for work purposes (3)	Friends (4)	The hours that I work (3)
Unable to give people lifts (2)	Partner (2)	
Would have to try to arrange getting other forms of transport (2)		

Accessible beliefs of elderly adults regarding refraining from driving after 15 or more hours of wakefulness (number of participants who mentioned belief)

Behavioural beliefs	*Normative referents*	*Control beliefs*
Prevents me from driving when tired (18)	Family (10)	An emergency (10)
Reduces risk of having vehicle accident (11)	Friends (6)	Feeling tired (7)
Unable to get somewhere if there was an emergency (6)	Partner (3)	Feeling unwell (4)
Prevents me from driving at night (5)	Police (3)	Someone else being able to give me a lift or drive instead of me (4)
Prevents me from driving when unable to concentrate (4)	Other road-users (2)	Considering risk of accidents and possibility that not fit to be on road (4)
Prevents me from driving when incapable and not fit to drive (3)		Considering effects that age may have on driving ability (3)
Inconvenient (3)		Drinking alcohol (3)
		Socialising (2)
		Getting a taxi (2)

Appendix 3.4

Questionnaire concerning sleep impaired driving that was designed for and piloted on elderly adults

Attitudes towards Driving Questionnaire

Part 1

The aim of the first part of this questionnaire is to obtain your views on **driving/refraining from driving after being awake for 15 or more hours in the next week.** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

Instructions

Each question consists of either a straightforward question or statement, along with a rating scale with 7 places and opposing viewpoints at each end. Please **circle the number** that best describes the extent of your opinion. The numbers on the scales represent the following:

very bad :	1	2	3	4	5	6	7	: very good
	very bad	quite bad	slightly bad	neither bad nor good	slightly good	quite good	very good	

The bad-good pair is given as an example.

Please make sure that you answer all questions and do not circle more than one number on a single scale or put a circle in between two numbers. Some of the questions may appear to be similar, but they do address different issues. Please read each question carefully and note that some questions are about driving after being awake for 15 or more hours and some are about refraining from driving after being awake for that length of time.

Please answer all questions in relation to yourself at the present time. There are no right or wrong answers. I am interested in what you actually think.

To help you to complete the first part of the questionnaire, before you begin, it may help you to think of your own experiences of driving when you have been awake for 15 or more hours.

Section A

1. For me to **refrain from driving** when I have been awake for 15 or more hours is

very bad	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very good
very pleasant	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very unpleasant
very inconvenient	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very convenient
very safe	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very unsafe
very unenjoyable	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very enjoyable
very wise	: 1 : 2 : 3 : 4 : 5 : 6 : 7 :	very foolish

2. I am confident that I could **refrain from driving** when I have been awake for 15 or more hours.

strongly agree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly disagree

3. The people in my life whose opinions I value

drive : 1 : 2 : 3 : 4 : 5 : 6 : 7 : do not drive

when they have been awake for 15 or more hours.

4. I intend to drive when I have been awake for 15 or more hours.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

5. How much control do you believe you have over **refraining from driving** when you have been awake for 15 or more hours?

no control : 1 : 2 : 3 : 4 : 5 : 6 : 7 : complete control

6. Most people who are important to me think that

I should : 1 : 2 : 3 : 4 : 5 : 6 : 7 : I should not

drive when I have been awake for 15 or more hours.

7. I normally drive when I have been awake for 15 or more hours.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

8. If I wanted to I could easily **refrain from driving** when I have been awake for 15 or more hours.

definitely true : 1 : 2 : 3 : 4 : 5 : 6 : 7 : definitely false

9. Of all the people you know, how many would want you to drive when you have been awake for 15 or more hours?

none of them : 1 : 2 : 3 : 4 : 5 : 6 : 7 : all of them

10. How likely are you to drive when you have been awake for 15 or more hours?

very likely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very unlikely

11. I feel that I am capable of **refraining from driving** when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

12. **Please answer the following four questions quickly without thinking too much about them.**

Do you drive when you have been awake for 15 or more hours...

- if you need to?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- when you go out socialising?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- to give someone a lift?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- to take part in recreational activities?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

13. Most people who are important to me drive when they have been awake for 15 hours or more.

definitely false :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely true

14. For me to **refrain from driving** when I have been awake for 15 or more hours is

very easy :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very difficult

15. I plan to drive when I have been awake for 15 or more hours.

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

16. The people in my life whose opinions I value would

disapprove :_1_:_2_:_3_:_4_:_5_:_6_:_7_: approve

of my driving when I have been awake for 15 or more hours.

17. In a typical period of one month, over the last year, how many times have you driven when you have been awake for 15 or more hours?

frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

18. It is completely up to me whether or not I **refrain from driving** when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

19. Of all the people you know, how many drive when they have been awake for 15 hours or more?

all of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: none of them

20. Having driven when I have been awake for 15 or more hours I would feel

very good :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very bad
very regretful :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all regretful
very relaxed :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very tense
very guilty :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all guilty

Section B

21. Driving when I have been awake for 15 or more hours would mean I would be driving when I am tired.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Driving when I have been awake for 15 or more hours would increase my risk of having a vehicle accident.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. Driving when I have been awake for 15 or more hours would mean I would be driving at night.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. Driving when I have been awake for 15 or more hours would mean I would be driving when I am unable to concentrate.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. Driving when I have been awake for 15 or more hours would mean I would be driving when I am incapable and not fit to drive.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

26. **Not driving** when I have been awake for 15 or more hours would mean I would be unable to get somewhere if there was an emergency.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

27. **Not driving** when I have been awake for 15 or more hours would be inconvenient.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

28. Driving when I am tired is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

29. Increasing my risk of having a vehicle accident is

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

30. Driving at night is

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

31. Driving when I am unable to concentrate is

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

32. Driving when I am incapable and not fit to drive is

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

33. Being unable to get somewhere if there was an emergency is

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

34. Inconveniences are

very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

Section D

35. My partner thinks that I should drive when I have been awake for 15 or more hours.

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

36. My family think that I should drive when I have been awake for 15 or more hours.

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

37. My friends think that I should drive when I have been awake for 15 or more hours.

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

38. The police think that I should drive when I have been awake for 15 or more hours.

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

39. Other road-users think that I should drive when I have been awake for 15 or more hours.

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

Section E

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

40. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

41. Your family

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

42. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

43. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

44. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section F

45. How often does an emergency occur in your life?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

46. How often do you feel tired?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

47. How often do you feel unwell?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

48. How often is someone else able to give you a lift or drive instead of you?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

49. How often do you consider the risk of accidents and the possibility that you are not fit to be on the road?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

50. How often do you consider the effects that your age may have on your ability to drive?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

51. How often do you drink alcohol?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

52. How often do you socialise?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

53. How often do you get a taxi?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

<u>Section G</u>

A) Please indicate the extent to which the following factors/circumstances would make it easier or more difficult for you <u>NOT TO DRIVE</u> when you have been awake for 15 or more hours.

54. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

55. Feeling tired

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

56. Feeling unwell

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

57. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

58. Considering the risk of accidents and the possibility that you are not fit to be on the road

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

59. Considering the effects that your age may have on your ability to drive

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

60. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

61. Socialising

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

62. Getting a taxi

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

B) Please indicate the extent to which the following factors/circumstances would make it easier or more difficult for you to <u>DRIVE</u> when you have been awake for 15 or more hours.

63. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

64. Feeling tired

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

65. Feeling unwell

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

66. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

67. Considering the risk of accidents and the possibility that you are not fit to be on the road

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

68. Considering the effects that your age may have on your ability to drive

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

69. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

70. Socialising

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

71. Getting a taxi

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

72. Which of the previous two types of questions - **A** or **B** - did you find the easiest to understand and answer, and why?

____

____

73. **Please go back and mark an asterisk (*) next to the above facilitating/difficulty factors which you believe are the most important in determining whether or not you drive when you have been awake for 15 or more hours.**

Please answer the following two questions regarding the content and wording of the first part of the questionnaire.

1. Were there any questions which you found difficult to understand, and if so, why?

2. Do you have any suggestions as to how the questions can be made easier for people to understand?

Thank you for completing the first part of this questionnaire.

Part 2
The aim of the second part of this questionnaire is to obtain your views on **driving/refraining from driving between the hours of 3pm and 6pm <u>in the next week.</u>** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be completely confidential.

The instructions are the same as those of the first part of the questionnaire.

Please read each question carefully and note that some questions are about driving between 3pm and 6pm and some are about **<u>refraining from driving</u>** between those hours.

To help you to complete the second part of the questionnaire, before you begin, it may help you to think of your own experiences of driving between the hours of 3pm and 6pm.

<u>Section A</u>

1. For me to **<u>refrain from driving</u>** between 3pm and 6pm is

very bad	1	2	3	4	5	6	7	very good
very pleasant	1	2	3	4	5	6	7	very unpleasant
very inconvenient	1	2	3	4	5	6	7	very convenient
very safe	1	2	3	4	5	6	7	very unsafe
very unenjoyable	1	2	3	4	5	6	7	very enjoyable
very necessary	1	2	3	4	5	6	7	very unnecessary

2. I am confident that I could **<u>refrain from driving</u>** between 3pm and 6pm.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

3. The people in my life whose opinions I value

drive :_1_:_2_:_3_:_4_:_5_:_6_:_7_: do not drive

between 3pm and 6pm.

4. I intend to drive between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

5. How much control do you believe you have over **<u>refraining from driving</u>** between 3pm and 6pm?

no control :_1_:_2_:_3_:_4_:_5_:_6_:_7_: complete control

6. Most people who are important to me think that

I should :_1_:_2_:_3_:_4_:_5_:_6_:_7_: I should not

drive between 3pm and 6pm.

7. I normally drive between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

8. If I wanted to I could easily **refrain from driving** between 3pm and 6pm.

definitely true :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely false

9. Of all the people you know, how many would want you to drive between 3pm and 6pm?

none of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: all of them

10. How likely are you to drive between 3pm and 6pm?

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

11. I feel that I am capable of **refraining from driving** between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

12. **Please answer the following four questions quickly without thinking too much about them.**

Do you drive between 3pm and 6pm...

- if you need to?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- to give someone a lift?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- to socialise or visit family or friends?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

- to go shopping?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

13. Most people who are important to me drive between 3pm and 6pm.

definitely false :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely true

14. For me to **refrain from driving** between 3pm and 6pm is

very easy :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very difficult

15. I plan to drive between 3pm and 6pm.

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

16. The people in my life whose opinions I value would

disapprove :_1_:_2_:_3_:_4_:_5_:_6_:_7_: approve

of my driving between 3pm and 6pm.

17. In a typical period of one month, over the last year, how many times have you driven between 3pm and 6pm?

frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

18. It is completely up to me whether or not I **refrain from driving** between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

19. Of all the people you know, how many drive between 3pm and 6pm?

all of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: none of them

20. Having driven between 3pm and 6pm I would feel

very good	1	2	3	4	5	6	7	very bad
very regretful	1	2	3	4	5	6	7	not at all regretful
very relaxed	1	2	3	4	5	6	7	very tense
very guilty	1	2	3	4	5	6	7	not at all guilty

Section B

21. Driving between 3pm and 6pm would mean I would be driving when the traffic is busy.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Driving between 3pm and 6pm would mean I would worry about the volume of traffic.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. **Not driving** between 3pm and 6pm would be pointless because I don't feel tired between those times and I feel capable of driving then.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. **Not driving** between 3pm and 6pm would be inconvenient and would mean I would be unable to do the things that I usually do.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. **Not driving** between 3pm and 6pm would mean I would be unable to socialise or visit family and friends.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

26. **Not driving** between 3pm and 6pm would mean I would be unable to give people lifts.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

27. Driving when the traffic is busy is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

28. Worrying about the volume of traffic is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

29. Doing something that is pointless is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

30. Inconveniences and being unable to do the things that I usually do are

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

31. Being unable to socialise or visit family and friends is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

32. Being unable to give people lifts is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section D

33. My partner thinks that I should drive between 3pm and 6pm.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

34. My family think that I should drive between 3pm and 6pm.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

35. My friends think that I should drive between 3pm and 6pm.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

36. Other road-users think that I should drive between 3pm and 6pm.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

37. The police think that I should drive between 3pm and 6pm.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section E

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

38. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

39. Your family

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

40. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

41. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

42. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section F

43. How often do you give someone a lift?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

44. How often do you feel ill?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

45. How often does an emergency occur in your life?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

46. How often do you feel tired?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

47. How often do you socialise or visit family or friends?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

48. How often do you go shopping?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

49. How often do you take part in recreational activities?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

50. How often are you busy?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

51. How often do you drink alcohol?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

52. How often do you not feel like driving?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

53. How often do you have to go somewhere or have an appointment to keep?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

54. How often do you have jobs or activities to do which don't involve driving?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

A) Please indicate the extent to which the following factors/circumstances would make it easier or more difficult for you NOT TO DRIVE between 3pm and 6pm.

55. Giving someone a lift

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

56. Feeling ill

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

57. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

58. Feeling tired

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

59. Socialising or visiting family or friends

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

60. Going shopping

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

61. Taking part in recreational activities

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

62. Being busy

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

63. Drinking alcohol

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

64. Not feeling like driving

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

65. Having to go somewhere or having an appointment to keep

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

66. Having jobs or activities to do which don't involve driving

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

B) Please indicate the extent to which the following factors/circumstances would make it easier or more difficult for you to <u>DRIVE</u> between 3pm and 6pm.

67. Giving someone a lift

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

68. Feeling ill

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

69. An emergency

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

70. Feeling tired

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

71. Socialising or visiting family or friends

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

72. Going shopping

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

73. Taking part in recreational activities

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

74. Being busy

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

75. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

76. Not feeling like driving

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

77. Having to go somewhere or having an appointment to keep

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

78. Having jobs or activities to do which don't involve driving

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

79. Which of the previous two types of questions - A or B - did you find the easiest to understand and answer, and why?

____

____

____

____

____

____

80. Please go back and mark an asterisk (*) next to the above facilitating/difficulty factors which you believe are the most important in determining whether or not you drive between 3pm and 6pm.

Finally, please answer the following two questions regarding the content and wording of the second part of the questionnaire and then complete your details on the following page.

1. Were there any questions which you found difficult to understand, and if so, why?

____

2. Do you have any suggestions as to how the questions can be made easier for people to understand?

Please complete your details in the appropriate sections below.

Age: _____

Gender: ___________

Occupation (including any additional part-time work):

Number of years held driving licence for: ______________

How many hours have you normally been awake for when you drive for the last time in a typical day? ___________

Have you been involved in a vehicle accident in the previous 12 months? _______

If so, please state brief circumstances:

Thank you for completing this questionnaire.

Appendix 4.1

Time 1 questionnaire administered to young adults

Attitudes towards Driving Questionnaire

Part 1

The aim of the first part of this questionnaire is to obtain your views on **driving/refraining from driving after being awake for 15 or more hours in the next week.** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

Instructions

Each question consists of either a straightforward question or statement, along with a rating scale with 7 places and opposing viewpoints at each end. Please circle the number that best describes the extent of your opinion. The numbers on the scales represent the following (in bold):

very (bad) :	1 :	2 :	3 :	4 :	5 :	6 :	7 :	very (good)
	very (bad)	**quite** (bad)	**slightly** (bad)	**neither** (bad nor good)	**slightly** (good)	**quite** (good)	**very** (good)	

The bad-good pair above is given as an example. **Please pay particular attention to the endpoints of the scales (e.g., bad-good), as the positive and negative sides vary with each question.**

An example question:

I would like to refrain from driving when I have been awake for 15 or more hours.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

For this example question, you would be required to indicate the extent to which you agree or disagree with the statement, "I would like to refrain from driving when I have been awake for 15 or more hours". If you slightly agree with it, you would circle number 3, as in the example. If you disagree with the statement quite a bit, you would circle number 6. If you very strongly agree with it, number 1. If you neither agree nor disagree with the statement, you would circle number 4.

Please make sure that you answer all questions and do not circle more than one number on a single scale or put a circle in between two numbers. Some of the questions may appear to be similar, but they do address different issues. Please read each question carefully and note that some questions are about driving after being awake for 15 or more hours and some are about **refraining from driving** after being awake for that length of time.

Please answer all questions in relation to yourself at the present time. There are no right or wrong answers. I am interested in what you actually think.

To help you to complete the first part of the questionnaire, before you begin, it may help you to think of your own experiences of driving when you have been awake for 15 or more hours.

Section A

1. For me to **refrain from driving** when I have been awake for 15 or more hours is

a)	very bad	1	2	3	4	5	6	7	very good
b)	very pleasant	1	2	3	4	5	6	7	very unpleasant
c)	very inconvenient	1	2	3	4	5	6	7	very convenient
d)	very safe	1	2	3	4	5	6	7	very unsafe
e)	very unenjoyable	1	2	3	4	5	6	7	very enjoyable
f)	very wise	1	2	3	4	5	6	7	very foolish

2. I am confident that I could **refrain from driving** when I have been awake for 15 or more hours.

strongly agree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly disagree

3. The people in my life whose opinions I value

drive : 1 : 2 : 3 : 4 : 5 : 6 : 7 : do not drive

when they have been awake for 15 or more hours.

4. I intend to drive when I have been awake for 15 or more hours.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

5. How much control do you believe you have over **refraining from driving** when you have been awake for 15 or more hours?

no control : 1 : 2 : 3 : 4 : 5 : 6 : 7 : complete control

6. Most people who are important to me think that I

should : 1 : 2 : 3 : 4 : 5 : 6 : 7 : should not

drive when I have been awake for 15 or more hours.

7. I normally drive when I have been awake for 15 or more hours.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

8. If I wanted to I could easily **refrain from driving** when I have been awake for 15 or more hours.

definitely true : 1 : 2 : 3 : 4 : 5 : 6 : 7 : definitely false

9. Of the people you know, how many would want you to drive when you have been awake for 15 or more hours?

none of them :__1__:__2__:__3__:__4__:__5__:__6__:__7__: all of them

10. How likely are you to drive when you have been awake for 15 or more hours?

very likely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very unlikely

11. I feel that I am capable of **<u>refraining from driving</u>** when I have been awake for 15 or more hours.

strongly disagree :__1__:__2__:__3__:__4__:__5__:__6__:__7__: strongly agree

12. Please answer the following four questions quickly without thinking too much about them.

<u>Do you drive when you have been awake for 15 or more hours...</u>

a) if you need to?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

b) when you go out socialising?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

c) for work purposes?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

d) to give someone a lift or pick them up?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

13. Most people who are important to me drive when they have been awake for 15 or more hours.

definitely false :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely true

14. For me to **<u>refrain from driving</u>** when I have been awake for 15 or more hours is

very easy :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very difficult

15. I plan to drive when I have been awake for 15 or more hours.

very likely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very unlikely

16. The people in my life whose opinions I value would

disapprove :__1__:__2__:__3__:__4__:__5__:__6__:__7__: approve

of my driving when I have been awake for 15 or more hours.

17. In a typical period of one month, how often do you drive when you have been awake for 15 or more hours?

very frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

18. It is completely up to me whether or not I **refrain from driving** when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

19. Of the people you know, how many drive when they have been awake for 15 or more hours?

all of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: none of them

20. Having driven when I have been awake for 15 or more hours I would feel

a) very good :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very bad

b) very regretful :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all regretful

c) very relaxed :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very tense

d) very guilty :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all guilty

Section B

Do the following individuals/groups think you should drive when you have been awake for 15 or more hours?

21. The police

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Your parents

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. Your partner

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. Other family members

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. People at work

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

26. Passengers in your car

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

27. Other road-users

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

28. Your friends

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

29. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

30. Your parents

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

31. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

32. Other family members

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

33. People at work

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

34. Passengers in your car

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

35. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

36. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section D

37. Driving when I have been awake for 15 or more hours would increase my risk of having a vehicle accident.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

38. Driving when I have been awake for 15 or more hours would mean I would be driving when I am too tired.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

39. Driving when I have been awake for 15 or more hours would mean I would be driving when I find it difficult to concentrate/focus.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

40. <u>**Not driving**</u> when I have been awake for 15 or more hours would mean I would be unable to go out socialising.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

41. <u>**Not driving**</u> when I have been awake for 15 or more hours would mean I would be unable to get somewhere if there was an emergency.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

42. <u>**Not driving**</u> when I have been awake for 15 or more hours would mean I would be unable to drive for work purposes.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

43. <u>**Not driving**</u> when I have been awake for 15 or more hours would mean I would be unable to give people lifts or pick them up.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

44. <u>**Not driving**</u> when I have been awake for 15 or more hours would mean I would have to try to arrange getting other forms of transport.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

<u>*Section E*</u>

45. Increasing my risk of having a vehicle accident is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

46. Driving when I am too tired is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

47. Driving when I find it difficult to concentrate/focus is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

48. Being unable to go out socialising is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

49. Being unable to get somewhere if there was an emergency is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

50. Being unable to drive for work purposes is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

51. Being unable to give people lifts or pick them up is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

52. Having to try to arrange getting other forms of transport is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section F

53. How often does an emergency occur in your life?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

54. How often is someone else able to give you a lift or drive instead of you?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

55. How often do you socialise?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

56. How often do you get a taxi?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

57. How often do you drive for work purposes?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

58. How often do you give someone a lift or pick them up?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

59. How often do you drink alcohol?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

60. How often do you work?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

Please indicate the extent to which the following circumstances would make it more difficult or easier for you to REFRAIN FROM DRIVING when you have been awake for 15 or more hours.

[For example, if the circumstance was "Going on holiday", you would decide whether going on holiday would make it more difficult or easier for you to refrain from driving when you have been awake for 15 or more hours. If you thought that going on holiday would make it quite difficult for you to refrain (perhaps because you sometimes drive there on an evening), you would circle number 2. If you thought that going on holiday would make it much easier for you to refrain (perhaps because you don't take your car away with you), you would circle number 7.]

61. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

62. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

63. Socialising

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

64. Getting a taxi

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

65. Driving for work purposes

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

66. Giving someone a lift or picking them up

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

67. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

68. The hours that you work

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

Part 2

The aim of the second part of this questionnaire is to obtain your views on **driving/refraining from driving between the hours of midnight and 6am <u>in the next week.</u>** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be completely confidential.

The instructions are the same as those of the first part of the questionnaire.

Please read each question carefully and note that some questions are about driving between midnight and 6am and some are about **<u>refraining from driving</u>** between those hours.

To help you to complete the second part of the questionnaire, before you begin, it may help you to think of your own experiences of driving between the hours of midnight and 6am.

<u>Section A</u>

1. For me to **<u>refrain from driving</u>** between midnight and 6am is

a)	very bad	1	2	3	4	5	6	7	very good
b)	very pleasant	1	2	3	4	5	6	7	very unpleasant
c)	very inconvenient	1	2	3	4	5	6	7	very convenient
d)	very safe	1	2	3	4	5	6	7	very unsafe
e)	very unenjoyable	1	2	3	4	5	6	7	very enjoyable
f)	very wise	1	2	3	4	5	6	7	very foolish

2. I am confident that I could **<u>refrain from driving</u>** between midnight and 6am.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

3. The people in my life whose opinions I value

drive :_1_:_2_:_3_:_4_:_5_:_6_:_7_: do not drive

between midnight and 6am.

4. I intend to drive between midnight and 6am.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

5. How much control do you believe you have over **<u>refraining from driving</u>** between midnight and 6am?

no control :_1_:_2_:_3_:_4_:_5_:_6_:_7_: complete control

6. Most people who are important to me think that I

should :_1_:_2_:_3_:_4_:_5_:_6_:_7_: should not

drive between midnight and 6am.

7. I normally drive between midnight and 6am.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

8. If I wanted to I could easily **<u>refrain from driving</u>** between midnight and 6am.

definitely true :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely false

9. Of the people you know, how many would want you to drive between midnight and 6am?

none of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: all of them

10. How likely are you to drive between midnight and 6am?

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

11. I feel that I am capable of **<u>refraining from driving</u>** between midnight and 6am.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

12. Please answer the following four questions quickly without thinking too much about them.

<u>Do you drive between midnight and 6am...</u>

a) if you need to?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

b) for work purposes?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

c) after socialising?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

d) to give someone a lift or pick them up?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

13. Most people who are important to me drive between midnight and 6am.

definitely false :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely true

14. For me to **refrain from driving** between midnight and 6am is

very easy : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very difficult

15. I plan to drive between midnight and 6am.

very likely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very unlikely

16. The people in my life whose opinions I value would

disapprove : 1 : 2 : 3 : 4 : 5 : 6 : 7 : approve

of my driving between midnight and 6am.

17. In a typical period of one month, how often do you drive between midnight and 6am?

very frequently : 1 : 2 : 3 : 4 : 5 : 6 : 7 : never

18. It is completely up to me whether or not I **refrain from driving** between midnight and 6am.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

19. Of the people you know, how many drive between midnight and 6am?

all of them : 1 : 2 : 3 : 4 : 5 : 6 : 7 : none of them

20. Having driven between midnight and 6am I would feel

a) very good : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very bad

b) very regretful : 1 : 2 : 3 : 4 : 5 : 6 : 7 : not at all regretful

c) very relaxed : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very tense

d) very guilty : 1 : 2 : 3 : 4 : 5 : 6 : 7 : not at all guilty

Section B

Do the following individuals/groups think you should drive between midnight and 6am?

21. The police

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

22. People at work

very unlikely : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very likely

23. Your parents

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. Your partner

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. Other family members

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

26. Your friends

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

27. Road safety groups

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

28. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

29. People at work

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

30. Your parents

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

31. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

32. Other family members

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

33. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

34. Road safety groups

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section D

35. Driving between midnight and 6am would increase my risk of having a vehicle accident.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

36. Driving between midnight and 6am would mean I would be driving when I am tired.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

37. Driving between midnight and 6am would mean I would be driving when I am not as focused/concentrating.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

38. Driving between midnight and 6am would mean I would be driving when it is dark.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

39. Driving between midnight and 6am would mean I would be driving when there is less traffic on the roads.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

40. **Not driving** between midnight and 6am would mean I would be unable drive for work purposes.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

41. **Not driving** between midnight and 6am would mean I would be unable to drive home after I have been out socialising.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

42. **Not driving** between midnight and 6am would mean I would be unable to give people lifts or pick them up.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

43. **Not driving** between midnight and 6am would mean I would be more likely to be asleep between those times.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section E

44. Increasing my risk of having a vehicle accident is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

45. Driving when I am tired is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

46. Driving when I am not as focused/concentrating is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

47. Driving when it is dark is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

48. Driving when there is less traffic on the roads is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

49. Being unable to drive for work purposes is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

50. Being unable to drive home after I have been out socialising is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

51. Being unable to give people lifts or pick them up is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

52. Being more likely to be asleep between midnight and 6am is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section F

53. How often do you drive for work purposes?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

54. How often do you drive home after socialising?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

55. How often does an emergency occur in your life?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

56. How often do you give someone a lift or pick them up?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

57. How often is someone else able to give you a lift or drive instead of you?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

58. How often do you get a taxi or another form of public transport?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

59. How often do you drive for holiday purposes?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

60. How often do you drink alcohol?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

61. How often do you drive home at night because it is the safest way of getting home?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

Please indicate the extent to which the following circumstances would make it more difficult or easier for you to REFRAIN FROM DRIVING between midnight and 6am.

[For example, if the circumstance was "Feeling tired", you would decide whether feeling tired would make it more difficult or easier for you to refrain from driving between midnight and 6am. If you thought that feeling tired would make it much easier for you to refrain (perhaps because you can choose not to drive if you feel tired), you would circle number 7. If you thought that feeling tired would neither make it more difficult nor easier for you to refrain (perhaps because you would have to drive anyway, e.g., for work), you would circle number 4.]

62. Driving for work purposes

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

63. Getting home after socialising

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

64. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

65. Giving someone a lift or picking them up

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

66. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

67. Getting a taxi or another form of public transport

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

68. Driving for holiday purposes

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

69. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

70. Getting home at night safely

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

Finally, please complete your details in the sections below and respond to the true-false statements based on a decision of whether or not the statement describes you.

Where there is a choice of boxes, please tick the box that corresponds to your answer.

1. I often do things on impulse.

True ☐ False ☐

2. Age: ______

3. Gender: ____________

4. I would like to take off on a trip with no preplanned or definite routes or timetables.

True ☐ False ☐

5. Occupation (including any additional part-time work):

____

6. Usual hours of work (i.e., times from and until):

____

7. I enjoy getting into new situations where you can't predict how things will turn out.

True ☐ False ☐

8. Marital status: ________________

9. I sometimes like to do things that are a little frightening.

True ☐ False ☐

10. Number of years held driving licence for: ___________

11. I'll try anything once.

True ☐ False ☐

12. Have you been involved in a vehicle accident in the previous 12 months?

____

13. If so, please state brief circumstances:

____

14. I would like the kind of life where one is on the move and travelling a lot, with lots of change and excitement.

True ☐ False ☐

15. How many hours have you normally been awake for when you drive for the last

time in a typical day? ____________

16. I sometimes do "crazy" things just for fun.

True ☐ False ☐

17. How many journeys do you make by car in an average week (e.g., driving there = 1 journey; driving back = 1 journey)?

0-10	11-20	21-30	31-40	41-50	51+
☐	☐	☐	☐	☐	☐

18. How many times do you drive on a single/dual carriageway or motorway in an average week?

0-10	11-20	21-30	31-40	41-50	51+
☐	☐	☐	☐	☐	☐

19. I prefer friends who are excitingly unpredictable.

True ☐ False ☐

20. What is your annual mileage? ________________

21. I often get so carried away by new and exciting things and ideas that I never think of possible complications.

True ☐ False ☐

22. Are you required to drive for your job (not including driving to/from work)?

All the time	Often	Sometimes	Occasionally	Never	N/A
☐	☐	☐	☐	☐	☐

23. I like "wild" uninhibited parties.

True ☐ False ☐

24. How likely are you to doze off or fall asleep in the situations described below, in contrast to feeling just tired?

This refers to **your usual way of life in recent times.**

Even if you have not done some of these things recently try to work out how they would have affected you.

Use the following scale to choose the most appropriate number for each situation:

0 = would never doze
1 = slight chance of dozing
2 = moderate chance of dozing
3 = high chance of dozing

Situation	**Chance of dozing**
Sitting and reading	☐
Watching TV	☐
Sitting, inactive in a public place (e.g., a theatre or a meeting)	☐
As a passenger in a car for an hour without a break	☐
Lying down to rest in the afternoon when circumstances permit	☐
Sitting and talking to someone	☐
Sitting quietly after a lunch without alcohol	☐
In a car, while stopped for a few minutes in the traffic	☐

Please turn over the page.

Your name is needed for the sole purpose of matching this questionnaire with the follow-up questionnaire. Once you have completed this second questionnaire, this page will be destroyed. All responses to the questionnaire will remain completely confidential and anonymous.

Name: ________________________________

Thank you for completing this questionnaire.

Appendix 4.2

Time 1 questionnaire administered to middle-aged adults

Attitudes towards Driving Questionnaire

The aim of this questionnaire is to obtain your views on **driving/refraining from driving after being awake for 15 or more hours** **in the next week.** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

Instructions

Each question consists of either a straightforward question or statement, along with a rating scale with 7 places and opposing viewpoints at each end. Please **circle the number** that best describes the extent of your opinion. The numbers on the scales represent the following (in bold):

very (bad) :	1 :	2 :	3 :	4 :	5 :	6 :	7 :	very (good)
	very (bad)	**quite** (bad)	**slightly** (bad)	**neither** (bad nor good)	**slightly** (good)	**quite** (good)	**very** (good)	

The bad-good pair above is given as an example. **Please pay particular attention to the endpoints of the scales (e.g., bad-good), as the positive and negative sides vary with each question.**

An example question:

I would like to refrain from driving when I have been awake for 15 or more hours.

strongly agree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly disagree

For this example question, you would be required to indicate the extent to which you agree or disagree with the statement, "I would like to refrain from driving when I have been awake for 15 or more hours". If you slightly agree with it, you would circle number 3, as in the example. If you disagree with the statement quite a bit, you would circle number 6. If you very strongly agree with it, number 1. If you neither agree nor disagree with the statement, you would circle number 4.

Please make sure that you answer all questions and do not circle more than one number on a single scale or put a circle in between two numbers. Some of the questions may appear to be similar, but they do address different issues. Please read each question carefully and note that some questions are about driving after being awake for 15 or more hours and some are about **refraining from driving** after being awake for that length of time.

Please answer all questions in relation to yourself at the present time. There are no right or wrong answers. I am interested in what you actually think.

To help you to complete the questionnaire, before you begin, it may help you to think of your own experiences of driving when you have been awake for 15 or more hours.

Section A

1. For me to **refrain from driving** when I have been awake for 15 or more hours is

a)	very bad	1	2	3	4	5	6	7	very good
b)	very pleasant	1	2	3	4	5	6	7	very unpleasant
c)	very inconvenient	1	2	3	4	5	6	7	very convenient
d)	very safe	1	2	3	4	5	6	7	very unsafe
e)	very unenjoyable	1	2	3	4	5	6	7	very enjoyable
f)	very wise	1	2	3	4	5	6	7	very foolish

2. I am confident that I could **refrain from driving** when I have been awake for 15 or more hours.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

3. The people in my life whose opinions I value

drive :_1_:_2_:_3_:_4_:_5_:_6_:_7_: do not drive

when they have been awake for 15 or more hours.

4. I intend to drive when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

5. How much control do you believe you have over **refraining from driving** when you have been awake for 15 or more hours?

no control :_1_:_2_:_3_:_4_:_5_:_6_:_7_: complete control

6. Most people who are important to me think that I

should :_1_:_2_:_3_:_4_:_5_:_6_:_7_: should not

drive when I have been awake for 15 or more hours.

7. I normally drive when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

8. If I wanted to I could easily **refrain from driving** when I have been awake for 15 or more hours.

definitely true :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely false

9. Of the people you know, how many would want you to drive when you have been awake for 15 or more hours?

none of them :__1__:__2__:__3__:__4__:__5__:__6__:__7__: all of them

10. How likely are you to drive when you have been awake for 15 or more hours?

very likely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very unlikely

11. I feel that I am capable of **refraining from driving** when I have been awake for 15 or more hours.

strongly disagree :__1__:__2__:__3__:__4__:__5__:__6__:__7__: strongly agree

12. Please answer the following four questions quickly without thinking too much about them.

Do you drive when you have been awake for 15 or more hours...

a) if you need to?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

b) when you go out socialising?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

c) for work purposes?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

d) to give someone a lift or pick them up?

definitely do :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely do not

13. Most people who are important to me drive when they have been awake for 15 or more hours.

definitely false :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely true

14. For me to **refrain from driving** when I have been awake for 15 or more hours is

very easy :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very difficult

15. I plan to drive when I have been awake for 15 or more hours.

very likely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very unlikely

16. The people in my life whose opinions I value would

disapprove :__1__:__2__:__3__:__4__:__5__:__6__:__7__: approve

of my driving when I have been awake for 15 or more hours.

17. In a typical period of one month, how often do you drive when you have been awake for 15 or more hours?

very frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

18. It is completely up to me whether or not I <u>refrain from driving</u> when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

19. Of the people you know, how many drive when they have been awake for 15 or more hours?

all of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: none of them

20. Having driven when I have been awake for 15 or more hours I would feel

a) very good :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very bad

b) very regretful :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all regretful

c) very relaxed :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very tense

d) very guilty :_1_:_2_:_3_:_4_:_5_:_6_:_7_: not at all guilty

<u>*Section B*</u>

<u>**Do the following individuals/groups think you should drive when you have been awake for 15 or more hours?**</u>

21. The police

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Your family

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. Other road-users

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. Pedestrians

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. Your boss

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

26. Road safety groups

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

27. People who want you to give them a lift/pick them up

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

28. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

29. Your family

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

30. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

31. Pedestrians

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

32. Your boss

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

33. Road safety groups

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

34. People who want you to give them a lift/pick them up

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section D

35. Driving when I have been awake for 15 or more hours would increase my risk of having a vehicle accident.

Very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

36. Driving when I have been awake for 15 or more hours would mean I would be driving when I am tired.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

37. Driving when I have been awake for 15 or more hours would mean I would be driving when I am unable to concentrate.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

38. Driving when I have been awake for 15 or more hours would mean I would be driving when my reactions are slow.

very unlikely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very likely

39. Driving when I have been awake for 15 or more hours would mean I would be driving when I am unable to function properly.

very unlikely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very likely

40. **Not driving** when I have been awake for 15 or more hours would mean I would be unable to go out socialising.

very unlikely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very likely

41. **Not driving** when I have been awake for 15 or more hours would mean I would be unable to give lifts to people who are relying on me.

very unlikely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very likely

42. **Not driving** when I have been awake for 15 or more hours would mean I would be unable to drive for work purposes.

very unlikely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very likely

Section E

43. Increasing my risk of having a vehicle accident is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

44. Driving when I am tired is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

45. Driving when I am unable to concentrate is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

46. Driving when my reactions are slow is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

47. Driving when I am unable to function properly is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

48. Being unable to go out socialising is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

49. Being unable to give lifts to people who are relying on me is

very bad :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very good

50. Being unable to drive for work purposes is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section F

51. How often does an emergency occur in your life?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

52. How often do you socialise?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

53. How often do you drive for work purposes?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

54. How often do you feel too tired to drive?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

55. How often do you give someone a lift or pick them up?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

56. How often is someone else able to give you a lift or drive instead of you?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

57. How often do you drink alcohol?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

58. How often do you get a taxi or a bus?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

Please indicate the extent to which the following circumstances would make it more difficult or easier for you to REFRAIN FROM DRIVING when you have been awake for 15 or more hours.

[For example, if the circumstance was "Going on holiday", you would decide whether going on holiday would make it more difficult or easier for you to refrain from driving when you have been awake for 15 or more hours. If you thought that going on holiday would make it quite difficult for you to refrain (perhaps because you sometimes drive there on an evening), you would circle number 2. If you thought that going on holiday would make it much easier for you to refrain (perhaps because you don't take your car away with you), you would circle number 7.]

59. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

60. Socialising

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

61. Driving for work purposes

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

62. Feeling too tired to drive

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

63. Giving someone a lift or picking them up

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

64. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

65. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

66. Getting a taxi or a bus

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

[The final three pages were identical to the penultimate three pages of Appendix 4.1; middle-aged adults were not asked to provide their name so they were not presented with the final page of Appendix 4.1]

Appendix 4.3

Time 1 questionnaire administered to elderly adults

Attitudes towards Driving Questionnaire

Part 1

The aim of the first part of this questionnaire is to obtain your views on **driving/refraining from driving between the hours of 3pm and 6pm in the next week.** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

Instructions

Each question consists of either a straightforward question or statement, along with a rating scale with 7 places and opposing viewpoints at each end. Please **circle the number** that best describes the extent of your opinion. The numbers on the scales represent the following (in bold):

very (bad) :	1	2	3	4	5	6	7	: very (good)
	very (bad)	**quite** (bad)	**slightly** (bad)	**neither** (bad nor good)	**slightly** (good)	**quite** (good)	**very** (good)	

The bad-good pair above is given as an example. **Please pay particular attention to the endpoints of the scales (e.g., bad-good), as the positive and negative sides vary with each question.**

An example question:

I would like to refrain from driving between 3pm and 6pm.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

For this example question, you would be required to indicate the extent to which you agree or disagree with the statement, "I would like to refrain from driving between 3pm and 6pm". If you slightly agree with it, you would circle number 3, as in the example. If you disagree with the statement quite a bit, you would circle number 6. If you very strongly agree with it, number 1. If you neither agree nor disagree with the statement, you would circle number 4.

Please make sure that you answer all questions and do not circle more than one number on a single scale or put a circle in between two numbers. Some of the questions may appear to be similar, but they do address different issues. Please read each question carefully and note that some questions are about driving between 3pm and 6pm and some are about **refraining from driving** between those hours.

Please answer all questions in relation to yourself at the present time. There are no right or wrong answers. I am interested in what you actually think.

To help you to complete the first part of the questionnaire, before you begin, it may help you to think of your own experiences of driving between the hours of 3pm and 6pm.

Section A

1. For me to **refrain from driving** between 3pm and 6pm is

a) very bad : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very good

b) very pleasant : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very unpleasant

c) very inconvenient : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very convenient

d) very safe : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very unsafe

e) very unenjoyable : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very enjoyable

f) very necessary : 1 : 2 : 3 : 4 : 5 : 6 : 7 : very unnecessary

2. I am confident that I could **refrain from driving** between 3pm and 6pm.

strongly agree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly disagree

3. The people in my life whose opinions I value

drive : 1 : 2 : 3 : 4 : 5 : 6 : 7 : do not drive

between 3pm and 6pm.

4. I intend to drive between 3pm and 6pm.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

5. How much control do you believe you have over **refraining from driving** between 3pm and 6pm?

no control : 1 : 2 : 3 : 4 : 5 : 6 : 7 : complete control

6. Most people who are important to me think that I

should : 1 : 2 : 3 : 4 : 5 : 6 : 7 : should not

drive between 3pm and 6pm.

7. I normally drive between 3pm and 6pm.

strongly disagree : 1 : 2 : 3 : 4 : 5 : 6 : 7 : strongly agree

8. If I wanted to I could easily **refrain from driving** between 3pm and 6pm.

definitely true : 1 : 2 : 3 : 4 : 5 : 6 : 7 : definitely false

9. Of the people you know, how many would want you to drive between 3pm and 6pm?

none of them : 1 : 2 : 3 : 4 : 5 : 6 : 7 : all of them

10. How likely are you to drive between 3pm and 6pm?

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

11. I feel that I am capable of **refraining from driving** between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

12. Please answer the following four questions quickly without thinking too much about them.

Do you drive between 3pm and 6pm...

a) if you need to?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

b) to give someone a lift or pick them up?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

c) to socialise or visit family or friends?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

d) to go shopping?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

13. Most people who are important to me drive between 3pm and 6pm.

definitely false :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely true

14. For me to **refrain from driving** between 3pm and 6pm is

very easy :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very difficult

15. I plan to drive between 3pm and 6pm.

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

16. The people in my life whose opinions I value would

disapprove :_1_:_2_:_3_:_4_:_5_:_6_:_7_: approve

of my driving between 3pm and 6pm.

17. In a typical period of one month, how often do you drive between 3pm and 6pm?

very frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

18. It is completely up to me whether or not I **refrain from driving** between 3pm and 6pm.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

19. Of the people you know, how many drive between 3pm and 6pm?

all of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: none of them

20. Having driven between 3pm and 6pm I would feel

a)	very good	:_1_:_2_:_3_:_4_:_5_:_6_:_7_:	very bad
b)	very regretful	:_1_:_2_:_3_:_4_:_5_:_6_:_7_:	not at all regretful
c)	very relaxed	:_1_:_2_:_3_:_4_:_5_:_6_:_7_:	very tense
d)	very guilty	:_1_:_2_:_3_:_4_:_5_:_6_:_7_:	not at all guilty

Section B

Do the following individuals/groups think you should drive between 3pm and 6pm?

21. Your partner

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Your family

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. Your friends

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. Other road-users

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. The police

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

26. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

27. Your family

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

28. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

29. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

30. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section D

31. Driving between 3pm and 6pm would mean I would be driving when the traffic is busy.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

32. Driving between 3pm and 6pm would mean I would worry about the volume of traffic.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

33. Not driving between 3pm and 6pm would be pointless because I don't feel tired between those times and I feel capable of driving then.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

34. Not driving between 3pm and 6pm would be inconvenient and would mean I would be unable to do the things that I usually do.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

35. Not driving between 3pm and 6pm would mean I would be unable to socialise or visit family and friends.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

36. Not driving between 3pm and 6pm would mean I would be unable to give people lifts or pick them up.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section E

37. Driving when the traffic is busy is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

38. Worrying about the volume of traffic is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

39. Doing something that is pointless is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

40. Inconveniences and being unable to do the things that I usually do are

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

41. Being unable to socialise or visit family and friends is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

42. Being unable to give people lifts or pick them up is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section F

43. How often do you go shopping?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

44. How often do you feel ill?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

45. How often does an emergency occur in your life?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

46. How often do you feel tired?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

47. How often do you socialise or visit family or friends?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

48. How often do you give someone a lift or pick them up?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

49. How often do you take part in recreational activities?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

50. How often are you busy?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

51. How often do you drink alcohol?

very rarely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

Please indicate the extent to which the following circumstances would make it more difficult or easier for you to REFRAIN FROM DRIVING between 3pm and 6pm.

[For example, if the circumstance was "Having an appointment", you would decide whether having an appointment would make it more difficult or easier for you to refrain from driving between 3pm and 6pm. If you thought that having an appointment would make it much more difficult for you to refrain (perhaps because your appointments are normally at about 4pm), you would circle number 1. If you thought that having an appointment would neither make it more difficult nor easier for you to refrain (perhaps because your appointments are always in the morning anyway), you would circle number 4.]

52. Going shopping

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

53. Feeling ill

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

54. An emergency

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

55. Feeling tired

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

56. Socialising or visiting family or friends

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

57. Giving someone a lift or picking them up

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

58. Taking part in recreational activities

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

59. Being busy

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

60. Drinking alcohol

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

Part 2

The aim of the second part of this questionnaire is to obtain your views on **driving/refraining from driving after being awake for 15 or more hours <u>in the next week.</u>** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be completely confidential.

The instructions are the same as those of the first part of the questionnaire.

Please read each question carefully and note that some questions are about driving after being awake for 15 or more hours and some are about **<u>refraining from driving</u>** after being awake for that length of time.

To help you to complete the second part of the questionnaire, before you begin, it may help you to think of your own experiences of driving when you have been awake for 15 or more hours.

<u>Section A</u>

1. For me to **<u>refrain from driving</u>** when I have been awake for 15 or more hours is

a) very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

b) very pleasant :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unpleasant

c) very inconvenient :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very convenient

d) very safe :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unsafe

e) very unenjoyable :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very enjoyable

f) very wise :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very foolish

2. I am confident that I could **<u>refrain from driving</u>** when I have been awake for 15 or more hours.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

3. The people in my life whose opinions I value

drive :_1_:_2_:_3_:_4_:_5_:_6_:_7_: do not drive

when they have been awake for 15 or more hours.

4. I intend to drive when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

5. How much control do you believe you have over **refraining from driving** when you have been awake for 15 or more hours?

no control :_1_:_2_:_3_:_4_:_5_:_6_:_7_: complete control

6. Most people who are important to me think that I

should :_1_:_2_:_3_:_4_:_5_:_6_:_7_: should not

drive when I have been awake for 15 or more hours.

7. I normally drive when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

8. If I wanted to I could easily **refrain from driving** when I have been awake for 15 or more hours.

definitely true :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely false

9. Of the people you know, how many would want you to drive when you have been awake for 15 or more hours?

none of them :_1_:_2_:_3_:_4_:_5_:_6_:_7_: all of them

10. How likely are you to drive when you have been awake for 15 or more hours?

very likely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very unlikely

11. I feel that I am capable of **refraining from driving** when I have been awake for 15 or more hours.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

12. Please answer the following four questions quickly without thinking too much about them.

Do you drive when you have been awake for 15 or more hours...

a) if you need to?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

b) when you go out socialising?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

c) to give someone a lift or pick them up?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

d) to take part in recreational activities?

definitely do :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely do not

13. Most people who are important to me drive when they have been awake for 15 or more hours.

definitely false :__1__:__2__:__3__:__4__:__5__:__6__:__7__: definitely true

14. For me to **refrain from driving** when I have been awake for 15 or more hours is

very easy :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very difficult

15. I plan to drive when I have been awake for 15 or more hours.

very likely :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very unlikely

16. The people in my life whose opinions I value would

disapprove :__1__:__2__:__3__:__4__:__5__:__6__:__7__: approve

of my driving when I have been awake for 15 or more hours.

17. In a typical period of one month, how often do you drive when you have been awake for 15 or more hours?

very frequently :__1__:__2__:__3__:__4__:__5__:__6__:__7__: never

18. It is completely up to me whether or not I **refrain from driving** when I have been awake for 15 or more hours.

strongly disagree :__1__:__2__:__3__:__4__:__5__:__6__:__7__: strongly agree

19. Of the people you know, how many drive when they have been awake for 15 or more hours?

all of them :__1__:__2__:__3__:__4__:__5__:__6__:__7__: none of them

20. Having driven when I have been awake for 15 or more hours I would feel

a) very good :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very bad

b) very regretful :__1__:__2__:__3__:__4__:__5__:__6__:__7__: not at all regretful

c) very relaxed :__1__:__2__:__3__:__4__:__5__:__6__:__7__: very tense

d) very guilty :__1__:__2__:__3__:__4__:__5__:__6__:__7__: not at all guilty

Section B

Do the following individuals/groups think you should drive when you have been awake for 15 or more hours?

21. Your partner

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

22. Your family

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

23. Your friends

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

24. The police

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

25. Other road-users

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section C

When it comes to driving, how much do you want to do what the following individuals/groups think you should do?

26. Your partner

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

27. Your family

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

28. Your friends

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

29. The police

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

30. Other road-users

not at all :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very much

Section D

31. Driving when I have been awake for 15 or more hours would mean I would be driving when I am tired.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

32. Driving when I have been awake for 15 or more hours would increase my risk of having a vehicle accident.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

33. Driving when I have been awake for 15 or more hours would mean I would be driving at night.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

34. Driving when I have been awake for 15 or more hours would mean I would be driving when I am unable to concentrate.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

35. Driving when I have been awake for 15 or more hours would mean I would be driving when I am incapable and not fit to drive.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

36. Not driving when I have been awake for 15 or more hours would mean I would be unable to get somewhere if there was an emergency.

very unlikely :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very likely

Section E

37. Driving when I am tired is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

38. Increasing my risk of having a vehicle accident is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

39. Driving at night is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

40. Driving when I am unable to concentrate is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

41. Driving when I am incapable and not fit to drive is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

42. Being unable to get somewhere if there was an emergency is

very bad :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very good

Section F

43. How often is someone else able to give you a lift or drive instead of you?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

44. How often do you feel tired?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

45. How often do you feel unwell?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

46. How often does an emergency occur in your life?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

47. How often do you consider the risk of accidents and the possibility that you are not fit to be on the road?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

48. How often do you consider the effects that your age may have on your ability to drive?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

49. How often do you drink alcohol?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

50. How often do you socialise?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

51. How often do you get a taxi?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

Section G

Please indicate the extent to which the following circumstances would make it more difficult or easier for you to REFRAIN FROM DRIVING when you have been awake for 15 or more hours.

[For example, if the circumstance was "Going on holiday", you would decide whether going on holiday would make it more difficult or easier for you to refrain from driving when you have been awake for 15 or more hours. If you thought that going on holiday would make it quite difficult for you to refrain (perhaps because you sometimes drive there on an evening), you would circle number 2. If you thought that going on holiday would make it much easier for you to refrain (perhaps because you don't take your car away with you), you would circle number 7.]

52. Someone else being able to give you a lift or drive instead of you

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

53. Feeling tired

much more difficult :_1_:_2_:_3_:_4_:_5_:_6_:_7_: much easier

54. Feeling unwell

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

55. An emergency

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

56. Considering the risk of accidents and the possibility that you are not fit to be on the road

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

57. Considering the effects that your age may have on your ability to drive

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

58. Drinking alcohol

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

59. Socialising

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

60. Getting a taxi

much more difficult :__1__:__2__:__3__:__4__:__5__:__6__:__7__: much easier

[The final three pages were identical to the penultimate three pages of Appendix 4.1; elderly adults were not asked to provide their name so they were not presented with the final page of Appendix 4.1]

Appendix 4.4

Time 2 questionnaire

Questionnaire about Driving over the Past Week

The aim of this brief questionnaire is to obtain your views on **your driving behaviour over the past week.** Please answer all questions as accurately and honestly as possible. All responses to the questionnaire will be kept completely confidential and anonymous.

The questions are referring to the seven days beginning on the day after you completed the first questionnaire. Therefore, when answering the questions, please do not include any driving behaviour that you may have undertaken today (unless it was before 9am).

Instructions

The first six questions make use of the same rating scale as did the initial questionnaire that you completed last week. The scale has 7 places and opposing viewpoints at each end. Please circle the number that best describes the extent of your opinion. The numbers on the scale represent the following (in bold):

very (good) :	1	2	3	4	5	6	7	: very (bad)
	very (good)	**quite** (good)	**slightly** (good)	**neither** (good nor bad)	**slightly** (bad)	**quite** (bad)	**very** (bad)	

The good-bad pair above is given as an example. **Please pay particular attention to the endpoints of the scales (e.g., good-bad), as the positive and negative sides vary with each question.**

An example question:

I have driven at least once a day in the last week.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

For this example question, you would be required to indicate the extent to which you disagree or agree with the statement, "I have driven at least once a day in the last week". If you slightly agree with it, you would circle number 5, as in the example. If you disagree with the statement quite a bit, you would circle number 2. If you very strongly agree with it, number 7. If you neither disagree nor agree with the statement, you would circle number 4.

Please do not circle more than one number on a single scale or put a circle in between two numbers.

The final three questions do not involve the scale and are straightforward.

Please make sure that you answer all of the questions.

1. I have driven when I have been awake for 15 or more hours in the last week.

strongly disagree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly agree

2. In the course of the past week, did you drive when you had been awake for 15 or more hours?

definitely did :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely did not

3. How often did you drive when you had been awake for 15 or more hours in the last week?

never :_1_:_2_:_3_:_4_:_5_:_6_:_7_: very frequently

4. I have driven between midnight and 6am in the last week.

strongly agree :_1_:_2_:_3_:_4_:_5_:_6_:_7_: strongly disagree

5. In the course of the past week, did you drive between midnight and 6am?

definitely did not :_1_:_2_:_3_:_4_:_5_:_6_:_7_: definitely did

6. How often did you drive between midnight and 6am in the last week?

very frequently :_1_:_2_:_3_:_4_:_5_:_6_:_7_: never

7. On how many occasions in the last week did you drive when you had been awake for 15 or more hours?

____

8. On how many occasions in the last week did you drive between midnight and 6am?

____

9. How typical was the last week in terms of sleeping patterns and driving behaviour for you? *(Please tick the appropriate box.)*

Not typical at all	Fairly untypical	Fairly typical	Completely typical
☐	☐	☐	☐

Please turn over the page.

Your name is needed for the sole purpose of matching this questionnaire with the previous questionnaire from last week. Once they have been matched, this page will be destroyed. All responses to the questionnaire will remain completely confidential and anonymous.

Name: ______________________________

Thank you for completing this questionnaire.

Appendix 4.5

Sleep and Driving Diary

Instructions

Please complete your Sleep and Driving Diary as accurately as possible and remember to fill it in every day for the following eight days. You should begin filling in the diary tomorrow morning (the day after completing the questionnaire) upon awakening (Day 1).

The first three questions should be answered each morning when you wake up. The remaining questions, regarding naps, watch removal and the driving log should be answered throughout the day for optimal accuracy, or at the end of each day. Please make sure you answer all of the questions every day.

When asked to state a time, please use the 24-hour clock, and do not approximate but indicate the exact time if you can, for example, 23.35. Similarly, when asked to estimate a length of time, state hours and minutes.

All responses to the Sleep and Driving Diary will remain completely confidential and anonymous.

Explanation of questions

Time you fell asleep last night: This will be an estimation, but please try to be as accurate as possible. (Looking at the time each night when you go to bed and thinking about how long you think it took to go to sleep will give you an idea.)

Final time you woke up this morning: This question refers to the last time that you woke up before getting out of bed. For example, if you woke up a few times in the morning but then went back to sleep, please state the final time that you woke up and did not go back to sleep.

Total amount of time awake during night: This is an estimation of how many minutes (or hours and minutes) in total that you can remember being awake for during the night, i.e., in between sleeping.

Number of naps taken during day: This is a count of how many times you fell asleep during the day. If you did not sleep at all during the day, please write "0" and ignore the next question.

Times of naps: This includes spaces for entering the details of up to three naps. Please complete the times that you fell asleep and woke up for any naps that you had during the day.

Time(s) you took the actiwatch off, for how long and the reason for removing it: Please specify any times that you removed the actiwatch from your wrist. Remember that you should only remove the actiwatch when you have a shower, bath or do anything else which would cause the actiwatch to get wet and you should put the actiwatch back on straight after. Please note how long you were not wearing the actiwatch for and the reason why you took it off. There are spaces for entering the details of up to three occasions when you may have removed the actiwatch, but remember that you should take the actiwatch off as little as possible.

Please remember to always wear the actiwatch on the non-dominant wrist.

Driving Log

It is important that you log the details of every occurrence of your driving, i.e., every journey, no matter how short. If when driving to your destination, you stop off somewhere in between for longer than five minutes, this is classed as two journeys, so needs to be logged as such. (Driving to and from your destination is classed as two journeys, also.)

Each day, please complete the details of all journeys you have made by car (i.e., with you driving) from when you got up in the morning, until you go to bed at night.

The five questions you are required to answer for each journey are self-explanatory. Please remember to answer all questions for each journey and be as accurate as possible with the times.

There are spaces for writing the details of up to 20 journeys for each day (except the last day in which there are only 10). Where spaces are not needed, leave them blank. If you make more than 20 journeys on a particular day, please record the appropriate details on a separate sheet of paper (remembering to write the date on) and attach it to the diary.

DAY 1 Date:

Complete in the morning upon awakening:

Time you fell asleep last night: __________

Final time you woke up this morning: __________

Total amount of time awake during night: __________

Complete throughout/at the end of the day:

Number of naps taken during day: ______

Times of naps: Fell asleep: __________ Woke up: __________

Fell asleep: __________ Woke up: __________

Fell asleep: __________ Woke up: __________

Time(s) you took the actiwatch off, for how long and the reason for removing it:

Time: __________ Duration: ______________

Reason: ____

Time: __________ Duration: ______________

Reason: ____

Time: __________ Duration: ______________

Reason: ____

Driving Log (Day 1)

Journey	**1**	**2**	**3**	**4**	**5**
Purpose and destination					
Time started journey (24-hour clock)					
Time reached destination (24-hour clock)					
Approximate number of miles driven					
Did journey involve driving on single/dual carriageway or motorway? (Yes/No)					

Journey	**6**	**7**	**8**	**9**	**10**
Purpose and destination					
Time started journey (24-hour clock)					
Time reached destination (24-hour clock)					
Approximate number of miles driven					
Did journey involve driving on single/dual carriageway or motorway? (Yes/No)					

Driving Log (Day 1 cont.)

Journey	**11**	**12**	**13**	**14**	**15**
Purpose and destination					
Time started journey (24-hour clock)					
Time reached destination (24-hour clock)					
Approximate number of miles driven					
Did journey involve driving on single/dual carriageway or motorway? (Yes/No)					

Journey	**16**	**17**	**18**	**19**	**20**
Purpose and destination					
Time started journey (24-hour clock)					
Time reached destination (24-hour clock)					
Approximate number of miles driven					
Did journey involve driving on single/dual carriageway or motorway? (Yes/No)					

Appendix 4.6

Participant information sheet

Name of experimenter: Laura Nicholson
Address: Room 313, School of Psychology, Henry Cotton Campus, LJMU,
15-21 Webster Street, Liverpool, L3 2ET
Tel: 0151 231 4488
Email address: L.J.Nicholson@2003.ljmu.ac.uk
Supervisor: Dr Yvonne Harrison

Title of study/project: Using an extended theory of planned behaviour to understand sleep impaired driving

Purpose of study: The aim of the study is to investigate the factors underlying driving while sleepy.

Procedures and participants' role: Adults from three different age groups will be asked to take part in the study. Volunteers in the middle (aged 40-55 years) and older (aged 65-90 years) age groups will respond to a questionnaire about their attitudes towards driving while sleepy.

Adults in the young (aged 18-30 years) age group will complete a questionnaire about their attitudes towards driving while sleepy, but will additionally be asked to wear an activity monitor around their wrist and to keep a sleep diary and 24-hour driving diary for a period of one week. The activity monitor continuously records information regarding whether the participant is awake or asleep. The young adults will be required to return at the end of the week with their activity monitor and diaries and will complete a final questionnaire, enquiring about their driving behaviour over the previous seven days. At the end of their role in the study, the young adults will be informed of their average nightly sleep duration as estimated by the activity monitor, if requested.

When participants have completed the study, a debriefing session will take place, including guidelines about when it is not safe to drive due to sleepiness. Further sources of information will be made available along with an opportunity to ask questions. Participants will receive a supermarket gift-card to cover any expenses. They will be assured of confidentiality and anonymity in the storage, analysis and reporting of information relating to the outcome of this project.

Please Note:
All participants have the right to withdraw from the project/study at any time without prejudice to access of services which are already being provided or may subsequently be provided to the participant.

Appendix 4.7

Debriefing email for young adults

Hello participants,

This email is intended to debrief you on the study you took part in about sleep and driving activities, and to tell you what I will actually be doing with the data I obtained from you.

Sleepiness is the cause of 16-20% of all road accidents in the UK and young adults are the most vulnerable group for having a sleep-related vehicle accident (Horne & Reyner, 1995). I am therefore looking at reasons why young people drive when they are sleepy, with the view to assisting interventions directed at reducing sleep-related vehicle accidents. In particular, I am looking at two behaviours: driving after being awake for 15 or more hours and driving between midnight and 6am. I chose these behaviours as driving after being awake for 15 or more hours has been found to be a risk factor for being involved in a sleep-related vehicle accident (Stutts *et al.*, 2003) and driving between midnight and 6am is the peak time for the occurrence of a sleep-related vehicle accident in young adults (Summala & Mikkola, 1994).

As you know, the actiwatch identified and recorded when you were asleep and awake, with the use of an activity sensor. I will be using the data from the actiwatches in conjunction with the driving diary to identify if and how frequently young people (i) drove after being awake for 15 or more hours, and (ii) drove between midnight and 6am. Questionnaire responses of people who did and did not perform each of the behaviours will be compared, so that the psychological processes underlying why individuals drive when they are sleepy can be identified. I will also be comparing questionnaire responses between young, middle-aged and elderly adults.

Please remember that all of the data you supplied will be kept confidential and is being stored anonymously. Each participant has been given a unique participant number so that all of the responses from the same participant can be matched. There is one hard copy displaying the names and corresponding participant numbers (stored in a different place) and this will be destroyed in one month from the date of this email. This is to ensure that all data are analysed and reported anonymously.

If you would like to know your average nightly sleep length for the week in which you wore the watch, please email me back within a month (even if you have already verbally stated that you do) so that I can look up your individual participant number. After a month's time, I will be unable to do this so will not be able to tell you your sleep length. Please note that it will be a few weeks until I get back to you with your sleep length, as I need to analyse the data first.

If you have any questions or want more information about the study, please don't hesitate to contact me.

Thanks again for taking part and best wishes,
Laura Nicholson
Liverpool John Moores University